CREATING LEXICAL MODELS: DO FOREIGN LANGUAGE LEARNING TECHNIQUES AFFECT LEXICAL ORGANIZATION IN FLUENT BILINGUALS?

by

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B.A., University of Texas at Brownsville, 2005

M.S., Kansas State University, 2008

AN ABSTRACT OF A DISSERTATION

submitted in partial fulfillment of the requirements for the degree

DOCTOR OF PHILOSOPHY

Department of Psychology

College of Arts and Sciences

KANSAS STATE UNIVERSITY
Manhattan, Kansas

2012

Abstract

The use of different language learning methods for the purposes of acquiring foreign language vocabulary has long been explored but studies have often failed to take into account the potential effects on lexical processing. The current study examined the effectiveness of the Keyword, Context and Paired-Associate learning methods in acquiring foreign language vocabulary, but primarily focusing on the lexical and conceptual organization effects that each method may have on a foreign language learner. Three main theories/models (i.e., Word Association, Concept Mediated and Revised Asymmetrical Hierarchical) have been used to explain the organization of bilingual lexical, conceptual stores and connections between each store, but studies have not examined the addition of a third language (i.e., L3) and the potential connections created between new L3 and the two existing language stores. It was predicted that since low-proficiency bilinguals would create lexical models which heavily rely on translation equivalents, thus, the use of non-elaborative learning methods would assist in creating only lexical translation links, while more sophisticated elaborative methods would be successful in creating direct access to the conceptual meaning. The current study further explored the potential effects of language learning methods on comprehension ability, requiring the creation of situation models for comprehension. Finally, the present study explored the immediate and delayed effects of language learning methods on both vocabulary acquisition and comprehension ability. Results from the current study indicated that all learning methods were successful in creating and conceptual connections between the languages and the conceptual store, while Keyword learners had significantly better scores on certain trial types. Differences in terms in lexical and conceptual strength are suggested since differences in RTs and scores were found between some of the learning methods.

Furthermore, in terms of comparisons across time, repeated testing learners attained better scores on all trial types in comparison to learners who were only tested at Time 2. Lastly, when assessing if lexical links could be created to a non-associated highly fluent second language known by the bilingual, results indicated that each language learning method successfully created such lexical connections, but these links were weaker in strength than those of the base language that was used during learning. Based on the current results, new models of lexical access are proposed which vary based on the use of language learning methods. The current findings also have strong implications and applications to the field of foreign language acquisition, primarily for bilingual language learners acquiring an L3.

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Acknowledgements

Many people needed to be thanked for their help and guidance throughout the completion of this project. First, I would like to thank Dr. Richard J. Harris, my major advisor and research guide, for all the guidance and patients you have had with me throughout all these years. Without your guidance and help I would have never reached this great milestone and would have never thought to be the researcher that I am today. I would also like to thank Dr. Donald A. Saucier. Without your guidance and motivation I would never have thought to be able to become a researcher and an academic. Research methods (and Stats.) will always have a special place in my heart thanks to you. Also, I would like to thank Dr. Lester Loschky, Dr. Bradley Shaw and Dr. Socorro Herrera, for their helpful comments and suggestions in the completion of this project. Lastly, I would like to thank all of my friends who have given me their support throughout the completion of this project, especially Adam M. Larson and Christopher J. Waples. Without your supportive comments and suggestions this project would have not been achieved.

Quiero agradecer a mi familia, especialmente a mi esposa Iris Barrera de de la Garza, por todo el apoyo que me han dado durante mi carrera educativa. Les doy gracias especialmente a mis padres, Dr. Abel de la Garza Fernandez y Esther Alicia Vela de de la Garza, por todo su cariño, y amor que me han dado durante este proceso tan importante en mi vida. Gracias a mis hermanos Abel de la Garza Vela y Diana Alicia Ortiz por el apoyo y amor que me han dado toda mi vida. Gracias por su apoyo y amor y sin ustedes nunca hubiera podido obtener mi sueño.

Dedication

Iris, this work is dedicated to you. You have given me the greatest moments and memories in my life and helped me more than you know to complete this work. Our family is my inspiration. If it wasn't for you, this work would be non-existent.

Chapter 1- Past Research

High school and college students know that at some point in their educational careers learning a new language is needed to complete their academic requirement for graduation, and every student discovers that it is not as easy as they thought to learn a new language. Foreign language learning methods (e.g., Keyword, Paired-Associated, and Context learning methods) have long been used to assist students in the acquisition of vocabulary (i.e., in the growth of their vocabulary knowledge) and grammatical rules associated with the language of interest. Although extensive research has focused on the success of each of these methods, numerous questions remain to be addressed. For example, do foreign language learning methods affect the lexical organization of lexical memory models (i.e., mental dictionaries which encompass our word knowledge associated with a particular language)? Do foreign language learning methods facilitate the creation of situation models needed for comprehension? The purpose of the current study examined these particular issues since it is vital that any language learning program use the most effective foreign language learning method, not only for vocabulary learning but also for development of comprehension ability and to be able to assess learners' performance over different periods of time.

The current study focused on the creation of lexical memory models[1] associated with foreign language learning methods through the examination of foreign language vocabulary acquisition. This is to say, the primary goal of this study was to examine if there is a particular language learning method which would be the most effective in assisting language learners to identify foreign language word meaning. The purpose of foreign language learning methods, such as the Keyword, Paired-Associate and Context learning methods, is primarily to facilitate novel vocabulary acquisition in a formal study setting, but they tend to overlook the issue of

comprehensibility of the foreign language vocabulary when used in natural contexts, such as while reading or conversing with individuals. Foreign language learning methods focus on the semantic properties (i.e., word meaning) of vocabulary but fail to evaluate learners in their comprehension ability in meaningful discourse. Any language learning student would agree that learning the vocabulary of the language is only the first step in acquiring or familiarizing themselves with the new language, but that the ability to comprehend what is being said or read involves much more than merely knowing the definitions of specific vocabulary. However, the role of vocabulary knowledge in the foreign language (FL) is essential for FL reading comprehension and it has been shown to be a significant predictor of comprehension ability (Laufer, 1992, 1997; Nation, 1993). Having a considerable knowledge of FL vocabulary, which would suggest that the learner has a great ability to quickly and automatically access semantic meaning from memory, allows the learner to more fluently read and extract the meaning of the words, thus leading to greater comprehension ability (de Groot & van Hell, 2005).

An important issue which also needs to be addressed is the organization achieved by individuals who are acquiring or have acquired a second language. Various models of lexical access (e.g., Word Association, Concept Mediated and Revised Asymmetrical) propose that differences, in terms of lexical (i.e., translation) and conceptual knowledge (i.e., meaning), exist for individuals who are at various stages of language acquisition. Even though models of lexical access, such as the Word Association, Concept Mediated and Revised Asymmetrical Hierarchical models, all assume that bilingual mental representations are constructed, a language learner's end goal is to develop a mental lexical representation which is similar to that of a fluent speaker and create lexical and conceptual links/connections similar to those of fluent speakers. Since the benchmark of the language learner is typically the fluent speaker/reader, it is also

important, even critical, to examine bilingual individuals who are proficient in at least two languages. An important question which was addressed was if bilingual language learners would be able to associate the newly acquired vocabulary (L3) to their alternate lexical store (i.e., Spanish) even when only English translation equivalents were given during a learning phase of the novel vocabulary. This is to say, do bilingual language learners, when learning a third language, lexically and conceptually organize the new language (i.e., L3) in a way similar to novice learners (e.g., low-proficiency bilinguals), such as by creating simplistic memory organizations as proposed by previous research, or are they able to create an organization comparable to their L1 and L2?

Application and Rationale for Bilingual Sample

Since a new language, which was not Spanish or English, was taught to the language learners, it was key to assess if, during vocabulary learning, the novel language would solely be associated with the language used during the learning session in (i.e., English) or if the non-used language (e.g., Spanish), in which they were also fluent, would also be lexically linked to the newly formed lexical store (i.e., create lexical links between Finnish vocabulary and Spanish translations). For example, if a novel vocabulary word such as "lintu" in Finnish, which means "belt" in English, is presented in any of the three learning techniques, but learners are only given the English equivalent of "belt", and not explicitly given the Spanish translation equivalent of "cinturon," would learning methodologies allow for equivalent associations with both proficiently known languages? Since it is assumed that fluent bilinguals have already attained a sophisticated model of lexical and conceptual organization (i.e., lexical and conceptual links are present for their two known languages), it is key to assess if the newly acquired language is organized in a similar manner to the language which was used during the learning phase of the

experiment and as are the L1 and L2 to each other (as shown in Figure 1c); thus, it was necessary to use balanced Spanish-English bilingual participants. Bilinguals in this study were defined as individuals who had a high degree of proficiency, in writing, speaking, comprehending and reading, both Spanish and English; a self-report proficiency rating scale was used to assess language proficiency. The use of self-report fluency/proficiency measures has been shown to be a valid measure of proficiency by Grosjean (1992), who established the validity of using self-report assessments and also by de la Garza & Harris (in preparation), who identified a significant strong positive correlation between self-reported proficiency and self-categorization of bilingual status.

Since all participants in the present study were highly proficient bilinguals, it was assumed, based on the findings of Kroll & de Groot (1997) and Kroll & Stewart (1994), that all participants have achieved a Revised Asymmetrical Hierarchical organization which predicts that bilinguals are able to translate words and understand the meaning of vocabulary from the multiple languages. The above mentioned authors found supportive evidence for the asymmetrical design of their Revised Asymmetrical Hierarchical model (i.e., model includes both lexical and conceptual links for all languages). Since this assumption was critical to Kroll & Stewart's (1994) theory/model, all hypotheses, regarding lexical organization due to language learning method, assumed that the above mentioned learning methods would directly affect lexical and/or conceptual organization in conjunction with the Asymmetrical Hierarchical model (discussed below in subsequent section). This is to say, since all bilinguals were assumed to possess the asymmetrical lexical memory organization design (see Figure 1c), but with the strength of lexical and conceptual links being equal due to their high proficiency in both English and Spanish, language learning techniques would ultimately affect lexical and/or conceptual

organization through the creation of lexical and/or conceptual links as additions to the Asymmetrical Lexical model already possessed.

Even though there is virtually no research which suggests that bilinguals would be able to create associates (i.e., lexical links) between their non-used language and the novel L3 vocabulary, one theory in particular could be used as a model to predict/account for such results. The Bilingual Mode Theory (Grosjean, 1998) suggests that bilinguals constantly are living on a continuum which varies from a predominantly monolingual mode to a bilingual language mode in which lexical access to multiple lexicons may be achieved. When bilinguals are in a monolingual mode (i.e., only one language is being utilized for the monolingual speaker/listener), one language is more strongly activated and access to only one lexicon is generally available. It is important to note that the bilingual's other language (i.e., the language not being utilized) has a considerably lower activation and in a sense is inhibited from accessing items in the additional lexicon. However, this "deactivation" of the language not being used when in the "monolingual mode" may sometimes not be totally inhibited, as proposed by Green (1986); rather, the non-base language may be in a lower degree of activation, since interference produced by bilingual speakers is sometimes encountered during monolingual language mode production (Grosjean, 1998).

Models of Lexical Access

Much research has focused on the primary issues of lexical organization. For example, Altarriba & Mathis (1997), Ferré et al. (2006), Kroll & Stewart (1994), and Potter et al. (1984) specifically examined accessing times of lexical items by fluent bilingual speakers. Research in psycholinguistics has yet to examine how language acquisition methods may potentially affect the organization of lexical models. Within the literature, three models of lexical memory

organization have been proposed (see Figure 1). All three models assume similar representations of the mental lexicon and the conceptual store; additionally, each of the models assumes that there are separate lexicons for each language, lexicon being defined as a mental dictionary of vocabulary/lexical items associated with a particular language (Independent Storage Hypothesis[2] by Kroll & Stewart, 1994; Mitterer, 2011). It is further assumed that each individual has a language-independent conceptual storage unit which houses all semantic features associated with each known word (Altarriba & Mathis, 1997). The key difference between the three models exists at the lexical and conceptual link level which is assumed to exist between the mental lexicon(s) and the conceptual store; the conceptual store is generally defined as the knowledge structure which houses semantic (i.e., meaning) information associated with lexical items independent of the language being used and/or learned (Ferré et al., 2006; Schwieter & Sunderman, 2009).

Word Association Model

One of the first lexical models developed to discuss the lexical structure of bilingual memory was the Word Association Model of Lexical Access (Potter et al., 1984) (see Figure 1a); this model predicts a direct lexical connection between the bilingual's first language (L1) and their second language (L2), suggesting that lexical links exist which allow communication between both lexical stores, but only the L1 store is connected to the conceptual store (i.e., the L2 has no access to the conceptual meaning store except through the L1). Empirical evidence supporting the Word Association Model (Kroll & Curley, 1988) suggests that novice learners initially develop this simplistic model, since they are most likely to use simple association between words from their newly acquired second language and their first language, while truly having only conceptual (i.e., semantically meaningful) connections associated between the first

language words and their conceptual referents. Even though evidence suggests slower translations from L2 to L1 than from L1 to L2 for novice learners, proficient bilinguals' lexical processing has shown equal processing times for both types of translation trials (Curley, 1988). Rather than using a word association model of lexical access, fluent bilinguals can conceptually connect both their L1 and L2 languages to the conceptual store (Chen & Leung, 1989; Kroll & Sholl, 1992; Kroll & Stewart, 1994; Sholl, Sankaranarayanan, & Kroll, 1995) (i.e., a Conceptually Mediated Model of Lexical Access discussed below). Furthermore, the conceptual mediation found while testing bilinguals is strongly related to the level of fluency which the bilingual speaker possesses (Kroll & Curley, 1988; Chen & Leung, 1989; Chen, 1992; De Groot, 1993; Kroll, 1993; Kroll & De Groot, 1997; Kroll, Michael, & Sankaranarayanan, 1998; Kroll & Tokowicz, 2001). For example, if a language learner's ultimate goal is to develop a lexical access system equal to that of a bilingual speaker, when first acquiring the novel vocabulary, they will be at a novice state of fluency and will slowly increase their fluency to a more expert level as they continue to acquire more sophisticated elements of the language (e.g., phonology, morphology, syntax and semantics). Based on these findings, it could be argued that, by using higher order language learning methods (e.g., Context or Keyword learning - discussed below), conceptual associations should be created from the newly acquired foreign word and its translation, since deeper conceptual processing is occurring, i.e., the novice learner is gaining greater knowledge of the language, rather than only creating surface level associations as suggested by a Paired-Associate word learning method.

The Word Association model further predicts that, when a target word in the L2 is presented to the learner, it would first have to be translated into the L1, which then would access the conceptual store to identify the semantic properties (i.e., meaning) of the word. Additionally,

this model predicts that there is no mechanism for directly translating information from the L1 (i.e., native language) to the L2 (i.e., second language). According to this model, reaction times would be longer than reaction times for individuals who had already created lexical links between L1 and L2, since to access the meaning of a word in the conceptual store, the learner would first have to access the L1 in order to access the conceptual store, thus requiring a longer processing time to access the conceptual store and identify the correct meaning of the word.

Concept Mediated Model

Contrary to the Word Association Model, the Concept Mediated Model of Lexical Access predicts that each of the lexical stores of the bilingual speaker has direct access to the conceptual store (see Figure 1b) and that no direct communication is available between the lexicons themselves since it is unnecessary for the L2 words to be translated into the L1, due to having direct access to the conceptual store. In other words, no mediation would be needed from the L1 to access the semantic meaning of the concept(s) from L2 (Potter et al., 1984; Kroll & Tokowicz, 2001). This model further predicts that translation latency reaction times (RTs) would be equal for both forward (i.e., L2 to L1) and backward (i.e., L1 to L2) translations (de Groot, 1992), or picture naming, since the presentation of a lexical items in either language would have direct access to the conceptual store to identify the meaning of the translation equivalent or image (Potter et al., 1984; Kroll, Michael & Sankaranarayanan, 1998; de Groot, Dannenburg & van Hell, 1994; La Heij & Akerboom, 2007). The Concept Mediated model further predicts that, once a connection has been created between the lexical store and the conceptual store, there is no variation in strength of the conceptual link.

Kroll & Curley (1988) found patterns of reaction times which supported Concept-Mediation rather than a Word-Association organization for high-proficiency bilinguals.

According to Kroll & Curley's (1988) empirical results, the effects observed by Potter et al. (1984) suggested that, at low proficiency levels, bilinguals would use a word-association organization but with greater proficiency levels, conceptual link development would become evident, thus allowing bilinguals to directly access the conceptual/semantic store. Chen & Leung (1989) further supported the findings of Kroll & Curley by concluding that low-proficiency bilinguals were unable to attain conceptual mediation from their L2, but that as proficiency level increased, so did their ability to conceptually mediate, thus eliminating the need for direct translation, since conceptual links had now been created. This is to say, Chen & Leung (1989) supported the core assumptions of a Conceptual Mediation Lexical Model of Organization by identifying conceptual link creation through a picture-naming task for high proficiency bilinguals (i.e., picture naming existed in both L1 and L2), but not in low proficiency bilinguals.

Revised Asymmetrical Hierarchical Model

The final lexical memory organization model is the most sophisticated and recent model of lexical organization. According to Kroll & Stewart's (1994) Asymmetrical Hierarchical Model of Memory (see Figure 1c), there are two separate lexicons (e.g., L1 and L2) associated with the conceptual store. Within this model, links between the L1 and the semantic system (i.e., word meanings) are more strongly associated than the links which are associated with the conceptual store and the individual's L2. The associated links between the L1 and the conceptual store are stronger due to the greater proficiency in L1, thus creating a stronger association between a word and its meaning. When considering the use of word-word translation, the association between the L1 and the L2 lexical item is stronger than the connection between the conceptual system and the L2. This stronger association between the L1 and the L2 lexical items is due to the learning of items for the L2 through direct translation and association with word

items from the L1 (Kroll & de Groot, 1997). Findings indicate that word translation is slower for forward translation (i.e., translation from L1 to L2) than for backward translation (i.e., L2 to L1), thus indicating a stronger link between L2 to L1 than for L1 to L2 (Altarriba & Basnight-Brown, 2007; Basnight-Brown & Altarriba, 2007; Kroll & Stewart, 1994). These findings are not consistent with the Word Association or Conceptually Mediated models of lexical organization, since these models either presume that lexical links between the lexical stores exist in only a specific direction (Word Association) or that conceptual links are present with both lexicons and do not vary in strength (Concept Mediation). Rather, the lexical and conceptual links vary in strength as a function of the level of proficiency.

A plausible extension of the above findings for word translation is that, through the use of highly elaborate imagery techniques, such as the Keyword Learning strategy, the link between $L3^3$ and the conceptual store would be strengthened further than with more basic techniques (e.g., Paired-Association), and thus, the learner could access the appropriate conceptual information associated with the L3 words with greater ease. In considering the case of novice language learners, when encountering situations which may require translation of a somewhat familiar language (e.g., Spanish for a North American learner), the link between L2 to the conceptual store (i.e., semantic system) would be very low and close to having no association, but the link between L1 to L2 may have some strength in its association. The weak link from L1 to L2 and no association at all between L2 and the conceptual store may be due to their very basic level of knowledge of L2 vocabulary which is only based on the direct translation to L1. However, when attempting to integrate new vocabulary into the existing semantic system, the semantic associations may be absent due to their lack of proficiency/semantic knowledge (i.e., no knowledge of word meaning and uses). It may be possible that, with the use of contextual

information, the associated links between L1 and L2 and between L2 and the semantic system may become strengthened. With the use of language-mixed prose there may be an increased use of a Context Learning strategy or a Keyword strategy for translation and strengthening the associated conceptual store links.

Language Learning Methods

One of the primary issues in the language learning literature addressed in the current study was whether differences in vocabulary knowledge may exist based on the use of various techniques/methods used for vocabulary acquisition. Even though much research has evaluated the utility of the following techniques (see de Groot & van Hell, 2005 for a review of these techniques), it is important to examine each of these methods independently to understand the underlying theoretical components associated with each. The three primary learning techniques contrasted included Paired-Associate (Runquist, 1967), Keyword Method (Atkinson & Raugh, 1975; Gruneberg & Pascoe, 1996; Rodríguez & Sadoski, 2000; Raugh & Atkinson, 1975) and Context Learning (Moore & Surber, 1992; Prince, 1996).

One key question which remains unanswered within the language learning literature is if a learner's lexical and/or conceptual organization can potentially be affected by the use of different language learning methods. The vast majority of language learning studies directly examine the effectiveness of learning methods in terms of vocabulary acquisition, but interestingly, fail to extend their findings to the lexical memory organization models discussed above (i.e., Word Association, Conceptually Mediated or Asymmetrical Hierarchical). By determining whether learning methods directly affect the organization of lexical and/or conceptual links, we may be able to address the issue of the effectiveness of language learning methods. Thus far, within the literature, research has assumed that by strictly focusing on

Paivio's Dual Coding Theory (see below), the issue of learning method effectiveness would be "resolved," since any method using both the verbal and imagery codes would be predicted to have greater recall than any method using only one code. However, by also examining conceptual and/or lexical link formation, which was a focus of the current study, we may be able to identify why certain language learning methods produce greater or lesser vocabulary acquisition.

One of the recurring key assumptions, which is a primary debated issue between the three techniques, is the use of elaborative imagery during learning. Paivio (1971, 1991), who proposed the Dual-Coding Theory (DCT), suggests that the interaction of dual codes (verbal and imagery) will lead to greater recall than using a single code. Since various techniques, notably the Keyword and Context Learning methods, assume this interaction between the verbal and imagery codes as proposed by the DCT, vocabulary knowledge would be assumed to be greater when utilizing such methods in comparison to other methods such as Paired-Associate learning, due to their ability to create more interactive images. Additionally, since the DCT predicts that interactions between the codes are more explicit in these methods, potential lexical and conceptual link strengths would also be predicted to increase, leading to greater recall, independent of the lexical model being examined.

Paired-Associate Learning (i.e., Rote Rehearsal)

One of the most basic and traditionally used vocabulary acquisition techniques within the literature is Paired-Associate learning. Paired-Associate learning focuses on providing the learner with direct word translation equivalents of target words. In other words, learners are presented with a new word (i.e., target) in a FL and its word translation equivalent in the native language (Atkinson & Raugh, 1975). For example, a learner would be presented with the cue

word “school” and the target Spanish word “escuela” and asked to repeat the pair a specified number or amount of time(s). No additional instructions are given to the participants other than “Rehearse the new word with its translation equivalent for the specified amount or number of time(s).” No specific imagery instructions are given to the learner, rather only instructions to rehearse the pair of words by saying “escuela” and “school.”

Van Hell & Candia Mahn (1997) found that the use of rote rehearsal led to better vocabulary acquisition than did other methods, such as Keyword or Context Learning, in experienced foreign language learners, but rote rehearsal (i.e., Paired-Associate) training did not lead to better performance by non-experienced learners in words recalled. Interestingly, van Hell & Candia Mahn (1997) also found that retrieval times for Keyword method learners were longer than for rote rehearsal learners, presumably since much more elaborative imagery recall is needed in the later method. This finding ultimately suggests that, even using elaborative imagery techniques, such as those discussed below, does not necessarily lead to better vocabulary acquisition and may even produce longer response latencies due to the complex nature of the technique. Inconsistent with van Hell & Candia Mahn (1997), Fritz et al. (2007) found that elaborative methods, such as the Keyword method, produced better vocabulary recall in comparison to simplistic techniques as rote rehearsal.

Although the evidence of Fritz et al. (2007) did not support the superiority of the rote rehearsal method, Benjamin & Bjork (2000) found in a series of three studies that rote rehearsal for novice learners was vastly superior to any elaborative technique, due to the potential effects of time constraints needed to access lexical items. According to Benjamin & Bjork (2000), even though methods such as Keyword or Context learning focus on the interactive properties between the target vocabulary word and an additional imagery component, the effectiveness of

these techniques is limited by the time accessibility pressure (i.e., speed-accuracy tradeoff) when lexical information needs to be accessed. In conclusion, through this additional "pressure" component, Benjamin & Bjork (2000) suggest that rote rehearsal, which does not suffer from this time pressure of needing to access additional imagery or context information, would ultimately produce the best vocabulary acquisition.

Keyword Method (KW)

The KW technique, as developed by Atkinson (1975) and which is perhaps the most elaborative imagery method, uses visual imagery-based instruction for the learning of vocabulary. This technique is used in a two-step process, the first step having the individual learn to associate the novel word in the foreign language (e.g., escuela) with a Keyword (e.g., escalator) in the learner's native/base language (L1). The Keyword is a word which sounds or looks similar to the L2 target word being learned. The second step requires the individual to create a mental image in which the Keyword and the native language translation, in this instance "school," interact. In this example, one might create a mental image of a school with an escalator inside taking students from floor to floor (Rodriguez & Sadoski, 2000; Wyra, Lawson & Hungi, 2007). The creation of this mental image assists the individual to associate the mental image with the novel foreign word. It is assumed that at a later time the foreign word, when presented, will activate the Keyword which in turn will activate the mental image previously constructed and facilitate the accessing of the appropriate L1 translation.

The Keyword method, in comparison to other language learning methods such as Paired-Associate (i.e., rote rehearsal), has been shown to be superior due to the explicit creation of a mental image interaction (Godley, Fournet & Estes, 1987; Avila & Sadoski, 1996; Elhelou, 1994; Gruneberg & Pascoe, 1996; Paivio, 1991; Paivio & Madigan, 1968), as argued by Paivio

(1971, 1986, 1991). This positive effect reflects the interconnections between the learner's L2 verbal representation (i.e., novel word being learned) and their imagery system, which would clearly be related to the learner's L1 (i.e., native language). The imagery system itself, since it holds non-language-specific semantic information about the referent of interest, is closely tied to the conceptual store which holds the semantic information related to the vocabulary referent. Because of the activation of a mental image in congruence with the verbal referent, it was predicted that the use of the Keyword method would create direct access between the novel foreign vocabulary word and the learner's semantic conceptual store. The current study directly focused on this issue of the creation of lexical and conceptual links associated with this learning technique, but even more importantly, examined the long-term benefits associated with Keyword, rote rehearsal and Context learning methodologies.

Further evidence for the effectiveness of the Keyword technique was provided by Sagarra & Alba (2006), who suggested, that since relatively deep (i.e., elaborative) processing is occurring between the target word and the associated semantic meaning, greater retention is seen in comparison to other methods like rote rehearsal. Troutt-Ervin (1990) went as far to suggest that this technique is useful in learning novel vocabulary in one's own language. Troutt-Ervin (1990) concluded that medical terminology given in the learner's L1 in combination with the Keyword method produced significantly higher rates of word recall and vocabulary definitions in comparison to more traditional learning methods. Many other studies (e.g., Cohen, 1987; Hulstijn, 1997; Pressley, Levin & Delaney, 1982) have further supported the use of the Keyword method as a technique to facilitate foreign language vocabulary acquisition and ultimately produce better recall rates than rote rehearsal or other unstructured individual learning methods which learners independently choose to employ. However, Ellis & Beaton (1993), van Hell &

Candia Mahn (1997), and Wang et al. (1992), to mention only a few key studies, all found that simpler methods, such as rote rehearsal, seem to be as effective as or superior to the Keyword method in long-term retention of FL vocabulary. Although findings, such as those previously mentioned, have suggested that the Keyword method is in fact a beneficial language learning technique, most studies have solely focused on the short-term benefits rather than on the long-term benefits and/or effects on lexical development, which was a secondary focus of the current study.

Context Learning

The use of linguistic context information and/or contextual cues for the identification of unfamiliar words in one's native language has also been used as a method of learning novel vocabulary. Findings indicate that, in instances when unfamiliar vocabulary words appear, individuals are often able to accurately infer the meaning of the unknown word(s) based on the contextual cues from the surrounding linguistic/discourse context (de la Garza & Harris, in preparation; Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985). These findings indicate that, for learning unfamiliar words in the reader's L1 or foreign language vocabulary from written L1 context, individuals with a low degree of knowledge of the unfamiliar vocabulary are able to use linguistic information (i.e., contextual cues) from familiar L1 written text as a means to identify the meaning of unfamiliar words (Moore & Surber, 1992; Nagy, Anderson, & Herman, 1987; Nagy, Herman, & Anderson, 1985; Prince, 1996; Tabossi, 1988a; Tabossi, 1988b; Webb, 2007). Findings such as these suggest that linguistic context provides critical information which helps identify the meaning of novel vocabulary.

Because words in a foreign language are at best ambiguous, and often entirely opaque, to the non-speaker of the language, it is critical to examine the usefulness of context information in

allowing the reader to determine the meaning of the unfamiliar foreign words (i.e., correctly identify the novel vocabulary). The contextual information should also facilitate comprehension due to the critical information provided by the discourse, which should allow the reader to create the needed situation models. Situation models are mental representations of the text which represent the situation that is being described (Zwaan & Radvansky, 1998). For comprehension to take place, it is necessary for the reader to construct situation models to help understand the underlying message transmitted by the discourse, not solely a process of understanding individual words as predicted by the surface and textbase levels of representation (van Dijk & Kintsch, 1983; Kintsch, 1998).

Although the use of contextual linguistic information has been suggested to facilitate vocabulary learning, there is no guarantee that a foreign language learner utilizing a Context learning strategy will ultimately acquire vocabulary. The importance of using a Context learning strategy is to provide the learner with a "knowledge framework" since the acquisition of a foreign language begins with basic level knowledge such as acquiring vocabulary and then gradually progresses into higher level skills (e.g., construction of sentences). Any failure to acquire the vocabulary may be due to the insufficient amount of context in the L1, thus not providing enough information to allow construction of an appropriate situation model to use to infer the meaning of the unfamiliar vocabulary.

Methodological Concerns

Although the current study's overarching intent was to examine tentative lexical memory organizations which are initially created by each of the three previously mentioned language learning methods, it was also necessary to evaluate how each of these lexical memory representations change over extended periods of time. In other words, how does the use of these

language learning methods affect lexical memory organization when continuously used? As with any language learning program, short-term effects suggest the impact which the teaching method may be having on the learner; ultimately, however, long-term benefits/effects are of greatest interest because it is vital to assess 1) the continuing effects that a single learning session may have on a learner's vocabulary knowledge and 2) the effects that multiple testing sessions have on a learner's vocabulary knowledge. Rather than solely focusing on vocabulary knowledge, a secondary focus of the current study also examined comprehension abilities across time.

The debate over which language learning technique is most effective has been previously assessed but solely in terms of retention of vocabulary knowledge (see de Groot & van Hell, 2005 for a review of this issue); as of now, contradictory evidence has left this question unanswered. Furthermore, a fundamental unanswered question remains regarding which method may lead to the best discourse comprehension ability. Even though supporting evidence has suggested the effectiveness of each of the three methods at immediate testing in terms of vocabulary knowledge (see above review of these findings), evidence has also suggested significant differences between methodologies at delayed testing or, in rare instances, no significant differences between methodologies. Rodríguez & Sadoski (2000), Wang, Thomas and Ouellette (1992) and Thomas & Wang (1996) suggest that, in comparison to the Keyword Rote rehearsal, Context Learning and a combination of Keyword and Context Learning, the Keyword method retention rate for learners significantly decreased over time. Additionally, McDaniel & Pressley (1984) suggested that at long-term retention (i.e., repeated testing) learners did not show any significant advantage of using the Keyword method or Context learning strategies when assessed longitudinally, but interestingly at initial immediate testing, did demonstrate significant vocabulary knowledge gains for Keyword learners over Context learning learners. Lawson &

Hogben (1998), on the other hand, found that the Keyword method demonstrated a continued rise in performance following testing after Time 2 out of 4, but consistently found a decrease in performance at Time 2 from Time 1. Even though both Keyword and control learners demonstrated decreases at Time 2, the decline in performance for the Keyword method learners was more substantial than for the control learners at Time 2. One identified methodological concern is the time length between Time 1 and Time 2 testing. This within-groups variable has varied widely, in terms of length, from one day to one week to one month between testing sessions, thus making it difficult to compare these findings, when this factor has been varied to such a great degree. The present study used a moderate delay between Time 1 and Time 2 testing, namely one week, so as to not solely assess vocabulary and comprehension too quickly after Time 1 but also to not measure these variables at such a long interval that any effects would be gone.

Many of the inconsistent findings associated with the long-term benefits of using each of these methods can be attributed to various methodological issues, including but not limited to varying Time 1 and Time 2 testing intervals, type of target word, and word frequency of targets. The first issue identified refers to the methodological issue of words lists which are generally filtered by vividness of the content word (i.e., concrete vs. abstract words); for example, Lawson & Hogben (1998) used abstract content words as the primary stimuli used in the teaching of each of their language learning methods. This issue is of major concern since one of the key assumptions of the Keyword Method is that the learner is required to create a mental image of the Keyword and also target word; in instances where abstract words, which have a low vividness rating, are used, the Keyword method may be less successful at increasing vocabulary knowledge since the learner may have a greater difficulty creating the interaction between the

Keyword and the target word. Thus, it is crucial or at least clearer to limit word lists to concrete words, which have high vividness ratings, when implementing such learning methods as the Keyword Method, especially given that Paivio's (1971, 1991) Dual Coding Theory (DCT) is the major theoretical foundation for this learning method (Paivio & Clark, 1986). The importance of examining the issue of the DCT is founded on the primary assumptions of the theory which predicts that two separate systems are responsible for learning novel words. According to the DCT, the interaction between the verbal and nonverbal (i.e., imagery) system available for concrete items will ultimately produce greater knowledge acquisition (i.e., learning) in contrast to abstract items, which can only easily utilize the verbal code. Based on this core prediction of the DCT, it is plausible to predict that at prolonged exposure to a single language learning method, with concrete rather than abstract words, vocabulary knowledge should increase due to the interaction between the two codes. Thus, testing the Keyword method with abstract words is not a fair test of the method.

The second major issue within the language learning literature is the necessity to control word frequency usage for vocabulary stimuli. This is to say, it is general practice to use word stimuli that are controlled for their frequency of use in the native and/or foreign language, based on the findings of Kucera & Francis (1967). By controlling word frequency, the learner can be provided with the best possible word list of moderate level of difficulty, rather than too infrequently or too frequently occurring terms, either of which would create greater ease or difficulty for the learner. For example, Rodríguez & Sadoski (2000), while using obscure words provided by McDaniel and Pressley (1984) and words rated on imagery, concreteness, and meaningfulness by Paivio & Madigan (1968), but who failed to control for word frequency in the native language, found that at immediate testing, moderate differences between the language

learning methods but at delayed testing significantly lower vocabulary retention for all methods. Although it would be expected that decreases in performance should be seen across time, especially when no additional learning/training is taking place between sessions, the differences at repeated or delayed testing should demonstrate similar group differences (e.g., Keyword learners having greater recall scores than Paired-Associate learners) as those observed at early testing times. In other words, vocabulary scores may not be equal at Time 1 and Time 2, but it would be expected that a learning group which demonstrates greater scores at Time 1 over other methods would continue to demonstrate the same superiority at Time 2. One contributing factor which may have ultimately led to the differences at delayed testing may have been the difficulty associated with the word items based on their frequency of occurrence.

The third and final methodological issue which could be contributing to the contradictory results previously discussed is a design issue, the use of either a single or multiple tests, at immediate or delayed testing. Many studies, such as Wang et al. (1992) and Thomas & Wang (1996) used testing time as a between-groups variable rather than a within-groups variable. By using such a design, researchers naturally create greater error variability between testing times (i.e., using different participants at immediate and delayed testing) and also eliminate the possibility of using longitudinal comparisons for the purposes of examining performance differences, if any, between and within the learning methods. Using a within-groups research design will allow a more accurate measure of lexical and/or conceptual link formation over an extended period of time and will also be useful as predictors of overall reaction time performance in the recognition of novel vocabulary items. It does, however, have the problem of possible carryover or practice effects from testing at T1 and T2.

In summary, it is essential to control the above-mentioned methodological factors which have up to now not been adequately addressed. Once having controlled for these potential confounding variables, the potential vocabulary development potential of each of the three foreign language learning methods can more accurately be assessed. Additionally, it is not solely the purpose of the present study to evaluate the longer-term effects of vocabulary learning techniques on the development of lexical and/or conceptual links associated with vocabulary knowledge, but it also will evaluate the comprehension effects shown across each of the language learning methods across the multiple testing sessions.

Discourse Memory - Situation Models of Comprehension

Even though an important part of foreign language learning is the learning of vocabulary words from the new language, it is also essential for the learner to be able to comprehend information which is given in discourse. Ultimately, examination of memory for discourse content is needed for an adequate evaluation of comprehensibility. Discourse memory (Fletcher, 1994; Kintsch, 1998; van Dijk & Kintsch, 1983) exists in three dimensions or what are known as levels of representation: surface representations, propositional (textbase) representations and situation models. Surface level representations encompass recall of exact words which were encountered in discourse (Kintsch & Bates, 1977), while propositional level representations retains the semantic meaning of each idea unit, but not necessarily in the exact words used in the original discourse (Kintsch & Keenan, 1973). The most abstract level of processing involves the creation of situation models of discourse. All language learners understand that to be successful at acquiring a foreign language, comprehensibility of discourse, whether oral or written, is needed. Situation models are mental representations of discourse which represent the situation that is being discussed (Zwaan & Radvansky, 1998). For comprehension to take place, it is

necessary for the reader to form situation models to understand the underlying message which is attempting to be transmitted by the discourse, not solely understanding individual units (e.g., words) comprising the surface level of representation (Kintsch, 1998; van Dijk & Kintsch, 1983).

Examination of comprehension as a measure of performance would further test and assist in establishing the utility of foreign language learning methods (e.g., Keyword, Context and Paired-Associate methods) in helping to develop situation model understanding, rather than only documenting the utility of second language learning methods on the learning of second language vocabulary. Vocabulary knowledge is an essential component of comprehension since, without vocabulary knowledge, comprehension is not possible (Meara, 1996). As further suggested by La Heij & Akerboom (2007), one of the most significant predictors of comprehension is the proficiency level attained in a foreign language, thus suggesting that increasing a learner's proficiency through vocabulary acquisition presumes that, as vocabulary knowledge increases, so then must comprehension ability (Staehr, 2009). This point was central to the proposed studies, since examination of vocabulary knowledge, based on whatever method was used, would lead to later improvements in comprehension ability.

Purpose

Even though much research has demonstrated the effectiveness of each of the language learning techniques previously discussed, much is still unknown about the creation of lexical models of language knowledge when using each technique. The primary purpose of the current study was to identify if different types of lexical memory models (i.e., Word Association, Concept Mediation or Revised Asymmetrical Hierarchical Model) would be created through the use of different language learning methods and also to examine the strength of conceptual and/or lexical links when present. Additionally, the current study intended to go beyond solely

examining lexical memory models to also examine the effectiveness of each of the methods' ability to affect comprehension more broadly (i.e., situation model creation).

Furthermore, to properly evaluate if the lexical and/or conceptual links in the lexical memory models may shift in strength over time, examination of the three methodologies in a repeated measures (i.e., longitudinal) design with a one-week delay, rather than only at immediate testing, was conducted. Longitudinal examination would ultimately provide empirical evidence which would suggest either equal strengths in conceptual and/or lexical links as those at initial testing or potential changes in conceptual and/or lexical links over time as a product of repeated exposure to each of the language learning methods.

The current study also examined whether repeated use of language learning techniques would truly increase performance, as suggested by the findings of Lawson & Hogben (1998) and as predicted by Paivio's (1971, 1991) DCT, or whether repeated use of a language learning method would not be sufficiently effective to continue to increase overall vocabulary knowledge over an extended period of time, as suggested by the findings of McDaniel & Pressley (1984), Rodríguez & Sadoski (2000), and Thomas & Wang (1996) and Wang, et al. (1992). Additionally, as mentioned above, it was the intent of the current study to further examine if lexical memory models significantly change, in terms of lexical and conceptual links, due to the repeated use of the particular language learning methods. Furthermore, the current study continued to examine if comprehension ability changed with repeated exposure to each of the language learning techniques. This issue is of great importance, since as of yet no empirical research has examined this issue in terms of using language learning methods as the principal moderating variable over extended periods of time.

One final key question in the current study was the issue of between- vs. within-groups research designs associated with language learning. Thomas and Wang (1996) and Wang et al. (1992) suggested that the use of within-groups designs is inherently flawed for the purposes of testing vocabulary knowledge acquisition over time, since using multiple testing sessions (i.e., testing the same people at both Time 1 and Time 2) potentially provides learners with an opportunity to rehearse (i.e., practice) outside of the experimental testing setting, ultimately creating a confounding third variable. To deal with this concern, different groups will be tested with either a within-groups design tested at both Time 1 and Time 2 or a group tested only at Time 2.

From a pedagogical perspective, having a clearer understanding of which technique creates the most effective (i.e., quickest and most accurate) lexical memory model would assist foreign language teachers to implement the best practices needed to facilitate language learning. As previously mentioned, the goal of a language learner is to not only be able to translate single vocabulary words but ultimately to be able to use the gained vocabulary to correctly understand broader discourse in the novel language's speech or writings.

Primary Independent and Dependent Variables

The primary *independent variables* which were used as predictors were: 1) Language Learning Method (Paired-Associate, Keyword and Context Learning; 2) Direction of testing during translation recognition (forward: English to L3 and backward: L3 to English translation); 3) Language Congruence during translation recognition testing (congruent and non-congruent trials, which will be discussed in greater detail within the materials sub-section); and 4) Time of Testing for translation recognition and comprehension (repeated testing at Time 1 and Time 2 or testing at only Time 2).

The *dependent variables* included: 1) number of correct translations recognized; 2) Reaction time (RT) (i.e., response time) during forward and backward recognition translation ; 3)number of correct comprehension items ; 4) RT during comprehension assessment ; 5) number of items correctly named during picture-naming; and 6) RTs during picture-naming.

Hypotheses – Lexical Memory Model Formation

The following hypotheses are based on the assumption that all participants are fluently proficient bilinguals who have already attained an Asymmetrical Hierarchical Lexical Model, with both of their primary languages, and that the newly acquired foreign vocabulary would create a separate memory store in conjunction with the already established model. The following predictions solely relate to the creation of lexical memory models for learners; discussions of predictions associated with comprehension ability are discussed in the subsequent section.

H_1: Learners using Paired-Associate (i.e., rote rehearsal) learning would create a Word Association Lexical Memory Model (see Figure 1a) connection, since only direct word-for-word translation between the foreign vocabulary word (i.e., target word) and translation equivalent would be taking place at Time 1 and learners would continue to use this model of lexical access at Time 2.

H_{1a}: To assess if a Word Association model had been created for Paired-Associate learners, it is predicted that response latencies would be shorter (i.e., faster response times) for backward translation from the L3 (i.e., Finnish) → English that for forward translation from English → Finnish. This prediction was based on the findings from Kroll & Stewart (1994) who suggest that since concept mediation exists between English (L1) to the Conceptual store, during forward translation the English item would activate the conceptual store prior to translating the given item in the target language.

H_{1b}: In terms of number of correct words recognized during the word translation task, recognition would be poorer following Paired-Associate learning than for Context and Keyword learning methods. Since no elaborate semantic rehearsal should have taken place during Paired-Associate learning, recognition following the Context and Keyword learning methods would be significantly better.

H_{1c}: Additionally, when assessing if conceptual links have been created for the newly developed L3 lexical memory store during picture recognition, participants' scores would be close to zero in terms of accuracy and also result in high RTs. Since the Word Association model predicts that the newly acquired language, in this case L3, has no conceptual link to the conceptual store, it was thus predicted that during picture recognition, which solely uses conceptual information, recognition would be close to zero since no conceptual link has been made between the L3 and the conceptual store.

H_2: Learners using Context learning would create a Conceptual Mediation Lexical Memory Model (see Figure 1b), in which the learner is able to conceptually link each lexical store to the conceptual store, due to the high degree of semantic information contained within the contextual information of each novel vocabulary word.

H_{2a}: To assess if a Conceptual Mediation model has been created for Context learners, it was predicted that response latencies for picture recognition in L1 and L3 would not differ, since the Conceptual Mediation model assumes that direct connections between the conceptual store and lexical store exist for each language. It is also important to remember that the Conceptual Mediation model assumes that no lexical links exist between the lexical stores due to each lexical store having direct access to the conceptual store.

H_{2b}: To further establish that conceptual mediation was only being created for Context learners, forward and backward translation RTs and correct translation recognition scores would be examined. It was predicted that RTs for forward and backward translation would be significantly greater (i.e., longer) in contrast to forward and backward translation in the Paired-Associate learning method, while it was also predicted that recognition scores during forward or backward translation would be relatively poor, since lexical links should not be present.

H_3: Learners using the Keyword method would create a lexical memory model which should be very similar to that of an Asymmetrical Hierarchical Model (see Figure 1c). By learners creating this form of lexical model, lexical and conceptual links between lexical and conceptual stores would be created. Since Keyword learners have available both semantic information from the mental imagery construction and the translation equivalent given at the beginning of each learning trial, thus it would ultimately produce both conceptual and lexical links.

H_{3a}: To assess if an Asymmetrical Hierarchical model has been created in terms of lexical links, forward translation RTs should be faster (i.e., lower) than backward translation (i.e., greater RTs) trials. This is to say, that both translation types would exist but differ in the strength (i.e., RTs) associated with each link, which would be evident through the comparisons of RTs for forward and backward translation.

H_{3b}: If conceptual links have been created, it was predicted that picture-naming RTs for Keyword learners should be longer than RTs for Context learners, since the Asymmetrical Hierarchical model predicts that a newly acquired language should have weak connectivity strength for conceptual links, though should exist in weaker form. In other words, RTs for

conceptual links between the conceptual store and L3 would be longer than RTs for conceptual links between the conceptual store and L1.

H_{3c}: In terms of the number of correct translations recognized, it was predicted that Keyword learners' correct translation scores would be significantly greater than those of Context and Paired-Associate learners. Sagarra & Alba's (2006) recent work and Paivio's DCT suggests that, since the Keyword method continuously uses semantic elaboration between the phonetically similar Keyword and target word, ultimately creating both lexical and conceptual links, translation scores should be significantly greater than with the other learning strategies, due to the multiple connections being created.

H_4: The final prediction associated with lexical memory model creation was based on responses associated during incongruent forward and backward translation. For example, incongruent language trials present the target word in the L3 foreign language (Finnish) and asked if the translation equivalents, which would be in the language opposite to which was seen during the learning phase (i.e., Spanish), are equivalent. This procedure would be used for both forward and backward translation. Since all learning sessions took place in English, which was one of the languages known by the bilingual sample, it was predicted that during incongruent forward and backward translation in any of the language learning methods, RTs would be significantly longer than RTs in congruent forward and backward language trials.

H_{4a}: Additionally, the number of correct translation recognition scores was predicted to be significantly lower (and close to zero) for incongruent translation trials forward or backward), than for congruent trials. Since no explicit instruction was given to the language learners, in the additional language which they knew (i.e., Spanish), it was predicted that the lexical association would only be created between the novel vocabulary (i.e., Finnish) and the paired language (i.e.,

English) due to the explicit instruction provided. This is to say, lexical links only become available when explicit associations are made between the target novel vocabulary and their translation equivalents.

Hypotheses - Comprehension Scores

H_5: In terms of comprehension scores (i.e., scores on a sentence completion task), it was predicted that Keyword learners should attain significantly better scores than Context and Paired-Associate learners. This prediction was based on findings which suggest that, since Keyword learners are likely to be using highly elaborative methods of learning the novel vocabulary (McDaniel & Pressley, 1984; Rodriguez & Sadoski, 2000), and as predicted in H_{3b} and H_{3c}, and through the likely creation of lexical and conceptual links, thus scores would be highest in the Keyword condition.

H_6: It was further predicted that Context learners should have better comprehension scores than Paired-Associate learners due to the presence of semantic Context information during vocabulary acquisition. Although it was predicted that Context learners' scores on the comprehension task would be better than those of Paired-Associate learners, in comparison to Keyword learners, Context learners' scores would be lower.

Hypothesis – Within- vs. Between-Testing Groups

H_7: When examining comparisons across time, it was predicted that RTs for all types (e.g., congruent vs. non-congruent and forward vs. backward) would be shorter, and translation recognition, comprehension and picture-naming scores higher at Time 2 for repeated testing learners for all language learning methods. However, RTs for all translation recognition trial types, comprehension and picture-naming and all performance scores would be equal to repeated testing learners' Time 1 performance for Time 2 Only learners. It was also predicted that Time 2

Only learners' RTs for all types would be longer and scores lower at Time 2 in comparison to repeated learners' RTs and scores at Time 2 for all learning methods.

Chapter 2 - Method

Participants

Three hundred and fifty University of Texas at Brownsville students were recruited from Behavioral Sciences Courses. Since the current study required Spanish-English bilinguals, the total sample size decreased to 267 after having identified those participants who were eligible to participate. Eligibility consisted of participants responding, to a number of demographic language questions, as: 1) self-categorizing themselves as bilingual on a binary scale, and 2) providing a self-proficiency rating greater than 8 out of 9 in both English and Spanish when combining all four competency items (i.e., speaking, reading, writing and understanding)[4]. No participants were excluded from the study based on their self-reported knowledge of Finnish (i.e., No participants reported knowing any Finnish vocabulary). The 267 selected bilinguals had an overall mean English self-proficiency rating (i.e., English reading, writing, speaking and overall understanding/comprehension) of 8.75 out of 9 and a mean reading self-proficiency rating of 8.8 out of 9. The overall mean Spanish self-proficiency rating (i.e., Spanish reading, writing, speaking and overall understanding/comprehension) was 8.48 out of 9 and a meaning reading self-proficiency rating of 8.47 out of 9.

The mean age of participants was 21.43 years (range from 18 to 50 years). Seventy males (26.2%) and 195 females (73%) participated, while 2 (.8%) participants failed to provide their gender classification. In terms of order of language acquisition, 198 (74.2%) participants reported learning English as their second language, while 66 (24.7%) participants reported learning Spanish as their second languages. Although differences did arise in which language

was learned first or second, self-proficiency ratings confirmed adequate/acceptable (means of 8 or greater out of 9) participation eligibility.

Lastly, 150 (56.2%) participants were randomly assigned to participate at both Time 1 and Time 2 testing (i.e., completed all measurements tasks at Time 1 and Time 2), while 117 (43.8%) participants were randomly assigned to participate at only Time 2 testing (i.e., attended Time 1 but were not tested until Time 2). In terms of language learning methods, 92 (34.5%) participants were randomly assigned to Paired-Associate learning, 90 (33.7%) to Context learning and 85 (31.8%) to Keyword learning groups. When examining the number of participants per language learning method based at time of testing (i.e., either Time 1 and Time 2 or only Time 2 testing), at Time 1 and Time 2, 47 (31.3%) participants were randomly assigned to Paired-Associate learning, 58 (38.7%) participants were randomly assigned to Context learning and 45 (30%) participants were randomly assigned to Keyword learning groups. At only Time 2, 45 (38.5%) participants were randomly assigned to Paired-Associate learning, 32 (27.4%) participants were randomly assigned to Context learning and 40 (34.1%) participants were randomly assigned to Keyword learning groups.

Materials

Informed Consent. An informed consent form was given to all participants with a brief description of all procedures which would take place. They were informed that they would be attempting to learn foreign vocabulary through one of three techniques (see Appendix A).

Language Experience Questionnaire (LEQ). The LEQ collected self-reported demographic information (e.g., age, languages spoken, age at which languages were acquired) which was used to ensure that all participants were fluently bilingual in Spanish and English and that they had no familiarity or knowledge of the Finnish language (see Appendix B). Also, based

on the given responses on the LEQ, data from participants who were not fluent bilinguals in English and Spanish were excluded from the preceding tasks and analyses.

Foreign Language Target Words. Thirty (30) target vocabulary words were presented in Pseudo-Finnish (see Appendix C). From here on, the target language's vocabulary will be referred to as Finnish. Finnish words were selected since Finnish has a high degree of dissimilarity to both Spanish and English, which both are highly familiar languages for the sample tested. Although written in the familiar Latin alphabet, Finnish is a non-Indo-European (Finno-Ugric) language which is unknown to most individuals in the United States. It has very few cognates or common roots with English or Spanish. The term "pseudo" was applied since target words were translated using an online English-to-Finnish dictionary. All translations were obtained from Google Translate®. Even though online dictionaries may not provide the stylistically most accurate translations in the correct morphological form, the target words were used to represent the English translation equivalents. By using these pseudo-words, we can ensure that participants do not truly know any of the target words. By using a foreign language such as Finnish and using a bilingual sample of participants, the study was able to 1) assess how differing foreign language learning methods may create varying lexical memory models for novice learners, and 2) assess the associations which may or may not be created by integrating a third language into the bilingual's lexical memory for his/her two fluent languages.

All target Finnish words were selected based on Snodgrass & Vanderwart's (1980) 260 standardized set of pictures which have been normalized for word frequency based on Kučera & Francis' (1967) English norming guidelines for word frequency. All target words were concrete and were selected from Snodgrass & Vanderwart's image set which has been normalized for word frequency occurrence and vividness of image. The average word frequency for the selected

target words was 77.06 per million (range 11 to 312 in frequency of occurrence) with a standard deviation of 116.23.

Paired-Associate Sample List. Thirty (30) Finnish target words with only their English translation equivalents were shown to learners. For example, participants were shown "Lintu" which means "Belt" in English and told to continue to rehearse the foreign word with the English translation equivalent (see Appendix C). The instructions which were used included: "See that 'Belt' means 'Lintu'. Continue to examine this word pair."

Keyword Method Sample List. Thirty (30) Keyword sentences were given to participants. The lists included the target word in Finnish, the English translation equivalent, and the Keyword in English that is phonetically similar to the target word. For example, participants were shown the word "Lintu" which means "Belt". The participants were instructed to note that "Lintu" sounds similar to the word "Lint"; participants were then instructed to create a mental image of a belt that is covered in lint (see Appendix E). The instructions which were used included: "Picture a belt that is covered in lint. Focus that the word lintu sounds like "lint". This image will help you to remember that the Finnish word lintu means belt."

Context Method Sample Sentence List. Thirty (30) sentences, one sentence per target word, were used. For example, participants were shown a sentence such "The boy forgot to put the lintu around his waist." By using the surrounding contextual information from the discourse sentence, participants should have been able to accurately infer the meaning of the novel word (see Appendix F), although the translation was never given directly nor feedback was provided to indicate that correct or incorrect translations had been made. Lastly, all sentences were highly constrained so as to facilitate the identification of the novel word by using the surrounding

linguist context. The instructions which were used include: “Read the following sentence which uses ‘lintu’ within the sentence.”

Standardized Picture Set. A set of thirty (30) monochrome pictures, selected from Snodgrass & Vanderwart’s (1980) standardized set of 260 pictures normalized for word frequency based on Kučera & Francis’ (1967) English norming guidelines for word frequency normalization, were used (see Appendix G). These images, which are pictorial representations of the Finnish target words, were used for the picture-naming task in which a random subset of fifteen (15) images were used to assess conceptual link development/organization.

Measurement Tasks/Trials

Pre-Test. A pencil and paper pre-test was given to all participants, prior to the initiation of the learning phase. This test functioned as a baseline measure of translation performance. Participants received all thirty Finnish vocabulary words during this task (see Appendix D). The pre-translation task consisted of presenting participants with target words followed by a blank space in which they were asked to write the correct translation of the given word. Participants were given three (3) minutes to complete this pre-test.

Practice Trials. Five (5) practice trials were given to each participant, complete with instructions as to how to complete the practice trials. Participants were only given backward translation recognition trials (i.e., presentation of the first word in the word pairs was in Finnish followed by the English translation) to ensure that no additional learning could take place during the practice trial phase by attempting to create potential lexical and/or conceptual links which were not previously present (see Appendix H). For example, a participant received a cue (the cue used in this study was a fixation cross to focus attention) followed by a translation pair such as the word “lintu” and at the same time receive the English translation word “belt”; half of the

trials were correct and half were incorrect translations. It is important to note that no words used in the practice trials were used during the learning phase.

Congruent Forward (CF) Recognition Task. In the CF recognition trials participants were given the trial word pairs beginning with the English translation (e.g., belt) followed by a Finnish word (e.g., lintu); for example, during the learning phase participants always saw the Finnish word (e.g., lintu) followed by the English translation equivalent (e.g., belt) (see Appendix I). Sixteen (16) trials were given in random order, eight (8) correct trials in which the target word and translation equivalent were correct translations of each other, and eight (8) incorrect trials in which the target word and translation equivalent were not correct translations of each other. The issue of forward translation was addressed in the presentation of the English translation word first and having participants recognize if the target word translation is correct; forward translation involved access from L1 to L2, or in this case L3. The purpose of using this method was to measure response latencies to accurately access the native language translation equivalent of the foreign vocabulary and recognition scores.

Congruent Backward (CB) Recognition Task. In the CB recognition task participants were again given the word pairs as they were presented during the learning phase sessions. Backward translation trials presented participants with the Finnish target word first (e.g., lintu) followed by the English translation equivalent (e.g., belt). Sixteen (16) trials were given in random order, eight (8) correct trials in which the target word and translation equivalent were correct translations of each other, and eight (8) incorrect trials in which the target word and translation equivalent were not correct translations of each other. Participants were not informed that these types of trials would be taking take place so that at testing a true measure of lexical link development could be accurately assessed (see Appendix I). The purpose of using this

method was to identify the response latencies to accurately access the native word translation equivalent of the foreign vocabulary word and compare these times to those of forward translation recognition while also examining recognition scores.

Incongruent Forward (IF) Recognition Task. IF recognition presented learners with the word pairs at testing beginning with a Spanish word translation of the original English word (e.g., cinto) followed by Finnish translation (e.g., lintu) (see Appendix I). Sixteen (16) trials were given in random order, eight (8) correct trials in which the target word and translation equivalent were correct translations of each other, and eight (8) incorrect trials in which the target word and translation equivalent were not correct translations of each other. The purpose of using this method was to identify if learners were only making the connection between the English and L3 lexicons or if linking between the L3 to both the Spanish and English lexicons.

Incongruent Backward (IB) Recognition Task. IB recognition presented learners with the word pairs at testing beginning with a Finnish word translation (e.g., lintu) followed by Spanish translation (e.g., cinto) of the original English word (see Appendix I). Sixteen (16) trials were given in random order, eight (8) correct trials in which the target word and translation equivalent were correct translations of each other, and eight (8) incorrect trials in which the target word and translation equivalent were not correct translations of each other. By using this method examination of 1) if new language lexical entries are being linked to only the L1 or also to the L2 and 2) if by testing direction of production (i.e., forward vs. backward) produce differences in reaction times in recognition (i.e., weaker link development between the lexical stores or strong link development).

Picture-Naming Task. To measure if conceptual links were created by each language learning method, a picture-naming task was used in which participants were shown an image in

conjunction with the target word (e.g., Finnish) and asked if the image is equivalent to the target word (see Appendix J). There were three picture-naming sessions. One session consisted of fifteen (15) English translation trials in which eight (8) trials were correct trials in which the picture and English translation equivalent were correct translations of each other, while seven (7) trials in which the picture and English translation were not correct translations. The second session consisted of fifteen (15) Finnish trials in which eight (8) trials were correct trials in which the picture and Finnish translation equivalent were correct translations of each other, while seven (7) trials in which the picture and Finnish translations were not correct translations of each other. The third session consisted of fifteen (15) Spanish translation trials in which eight (8) trials were correct trials in which the picture and Spanish translation equivalent were correct translations of each other, while seven (7) trials in which the picture and Spanish translation were not correct translations. This method has been widely used within the literature for the measuring of conceptual links (de Groot, Dannenburg & van Hell, 1994; Potter et al., 1984). This procedure measures RTs and scores for conceptual links that already exist (i.e., from their English and Spanish lexicon to the conceptual store) so as to compare the L3 conceptual links for RTs and recognition scores for their new L3. The pictures used in the picture naming task were selected from Snodgrass & Vanderwart's (1980) 260 standardized set of pictures. All target words were selected from Snodgrass & Vanderwart's images which have been normed for word frequency and vividness of image.

Comprehension Assessment Measure. To measure comprehension ability, once having been trained to acquire novel vocabulary through various learning techniques, a sentence completion (i.e., cloze) task was given. This task has been adapted from Avila & Sadoski's (1996) study in which they also used a sentence completion task to evaluate comprehension

ability. By using a sentence completion (cloze) task, in which learners offered the most suitable content word to create a semantically meaningful sentence, examination of comprehension ability based on the language learning method could be assessed. It is important to note that all missing target words were Finnish nouns (i.e., content words). A series of fifteen (15) sentences were given to each participant in which each sentence were presented individually with a set of four (4) distracter items in which one of the four items was the correct response for that specific trial (see Appendix K). Each sentence trial was presented for ten (10) seconds to allow learners to completely read each sentence prior to being given the answer options. Once answer options had been given, learners were given five (5) seconds to select the best answer for the given sentence. A sample comprehension trial was: "The school children were happy to go home on the _____." Once having been given the sentence, learners were presented with a set of four (4) choices in which one of the four will be the correct response. For example, participants saw the choices: A. Hylsyc B. Tynnyri C. Vayla D. Putki.

The materials given during this task were not used during the practice trials session, which were given prior to commencing the sentence completion task and which consisted of five practice trials. Also, the trials in this task were different sentences than those used in the Context learning method, so as to ensure that semantic processing was being measured rather than strict memorization of the sentences used by Context learners. The sentences used in this task were written at an elementary reading level which all participants, being university students, should have been able to adequately and rapidly read. Additionally, distracter items were randomly selected while the correct answer was randomly placed within one of the four answer options.

Apparatus. For the word translation recognition and comprehension tasks, presentation of stimuli took place on a Dell 17" monitor using a Dell Optiplex 380 PC. E-Prime was used as

the software tool for the presentation of the stimuli since E-Prime 2.0 allows for collection of time sensitive data (i.e., RTs) when used with serial response boxes. Serial response boxes were also used since they provide an almost 0-millisecond debounce period (i.e., no lag time between when a key is pressed to when a response is recorded electronically through the PC), thus providing a more accurate/sensitive measure of processing time in contrast to traditional keyboard usage.

Design and Procedure

The research design for the current study was a 2 (Language Testing Direction) x 2 (Language Congruence at Testing) x 3 (Number of Measurements) x 3 (Language Learning Method) Mixed-Factorial design. The language testing direction predictor variable consisted of two levels: 1) Forward and 2) Backward translation trials. Language congruence at testing consisted of two levels: 1) Incongruent language testing trials and 2) Congruent language testing trials. This is to say, participants were only allowed to be in one of the language learning methods but received forward and backward translations and also congruent and incongruent testing trials in which half of the trials were correct translations of the foreign target word and half were incorrect translation of the target word. Number of Measurements consisted of two groups but three levels, with Repeated testing Time 1 learners were used as the comparison group against Only Time 2 learners: 1) Repeated testing at Time 1 and Time 2, 2) Measure at only Time 1 (this sample of participants were the same participants from Time 1 from the repeated measures level but only using measurements taken from their Time 1 performance) and 3) Measure at only Time 2. Lastly, Language learning method consisted of three levels: 1) Paired-Associate (i.e., rote rehearsal), 2) Keyword and 3) Context learning methods. This study is considered to be a Mixed-Factorial design since the language testing direction and language

congruence variables were within-groups variables, while the language learning method was a between-groups variable. Lastly, the number of measurements was between-groups when comparing Time 1 data from repeated tested learners against Time 2 data from only Time 2 tested learners.

Prior to the start of the learning sessions, participants were given an oral and written informed consent form (all in English), in which they were given a brief explanation as to the purpose and procedures of the study. The brief explanation of the purpose of the study informed participants that their task was to learn vocabulary from a foreign language. Even though participants were informed that their task was to learn novel vocabulary, they were not informed about the specific types of tasks. Consent was gathered by having participants read and sign the informed consent form, and participants completed the LEQ for the purposes of gathering key demographic and language proficiency data. Having completed the LEQ, participants were given the pre-test task to evaluate baseline performance; this task functioned as a manipulation check to further confirm no prior knowledge of Finnish at the start of testing.

Since three different language learning methods were used, each of the subsequent sections discusses the procedure for one language learning method learning session and the tasks which followed. For the Paired-Associate method, participants were given a list of Finnish words, which were presented on a computer monitor for 20 seconds individually[5], with the English translation equivalent (i.e., learning phase). This procedure was again given in a second learning round immediately after the first round of learning had been completed. This procedure was used to ensure that a onetime exposure effect could not be contributing to the overall effects later demonstrated. This is to say, by presenting the target words more than one time would avoid suggesting that possible low scores could be to due to a single presentation or due to a high

number of target which were given during learning. Once all words had been reviewed twice, participants were instructed that the upcoming trials would test their performance over the words previously reviewed.

Prior to commencing the testing phase, participants were given five (5) practice trials which depended on the measurement task which they would subsequently complete (e.g., Translation practice trials prior to completing the measured translation trials). Since multiple measurement tasks were given to participants, measurement task randomization was used so as to ensure that the observed effects could not be attributed to the order of task presentation (e.g., observing lower scores on the last task due to fatigue). The purpose of the practice trials was to familiarize participants with the upcoming testing task. Participants were instructed that each item would be presented for 5sec. (5000ms.), in the case of translation and picture-naming trials, or 10sec. (10,000ms.), in the case of comprehension trials, and they were to respond as quickly and accurately as possible to each trial. Each trial began with the presentation of a 1sec. fixation cross to focus the participant's attention followed by the presentation of the translation recognition item which required a response. Unlike during the testing phase, practice trials for translation tasks consisted solely of backward translation trials (i.e., trials from L3 to English). Once participants completed the practice trials for that given task, the testing phase began by presenting participants, in blocks of sixteen trials per translation type (i.e., CF, CB, IF, or IB) or fifteen trials per picture-naming and sentence-comprehension trials, one trial at a time using the same cued procedure as above (i.e., fixation cross presentation). It is important to note that during sentence-comprehension trials, presentation times of the sentences were for 10sec. (10000ms.), but learners were only given 5sec. (5000ms.) to select the best answer for the given

sentence. Once participants had completed the final assessment task, they were debriefed, thanked for their participation, and dismissed.

Participants randomly assigned to the Keyword learning method followed a similar procedure to that of our Paired-Associate learners. The key difference between these learning strategies took place during the learning phase in which Keyword learners received the foreign target word and the English translation equivalent, which here was an English word which was orthographically (i.e., written) and phonologically (i.e., sounds) similar to the target word, and was immediately followed by instructions underneath the translation pair which indicated to the participant how to form an interacting mental image of the target and foreign word. Each item, complete with the additional instructional information below, was presented for 20 seconds to allow for the formation of the mental image with the interaction of the Keyword and the Finnish word. As with Paired-Associate learners, KW learners received two rounds of learning to ensure once again that elaborate rehearsal/processing of presented stimuli would be taking place. Once participants had completed both rounds of learning, learners were given practice trials followed by the appropriate measurement task. Once participants completed all measurements, debriefing took place in which participants were thanked and dismissed.

The final language learning method procedure was the Context Learning method. Participants completed the informed consent and LEQ prior to being introduced into the language learning style. Once participants completed each of the above-mentioned tasks, participants were introduced to the Context Learning method by brief instructions on how to use this method. Participants were instructed that an English base sentence in which the target Finnish word would be systematically integrated into that sentence would be shown to them. Context learning sentences were highly semantically constrained, since it was important for the

learner to be able to accurately extract the correct meaning of the foreign word. Participants were not allowed to ask the experimenter what the translation of the foreign word was since the purpose of the technique was to allow the learner to independently extract the correct meaning. Participants were also instructed that their task was to learn the meaning of the word by reviewing the sentence and using contextual information to understand its meaning. Participants than began the learning phase in which all Context learning trials were shown individually for 20 seconds. Once all learning trials were presented, the second round of learning trials immediately began. After having completed both rounds of learning, participants completed the appropriate practice trials and testing measures. Once participants completed all tasks they were thanked, debriefed and dismissed.

Repeated Testing Sessions T1 & T2. Since some participants were tested at both Time 1 and Time 2 while others were only tested at Time 2, the following sections discuss the procedure taken by each language learning group, but based on time of testing. Participants from the Paired-Associate, Context and Keyword learning methods followed the procedures discussed above at Time 1. During Time 2 (one-week later), participants immediately began the testing session (i.e., Time 2) but did not complete a second Pre-Test or LEQ. They did, however, complete five (5) practice trials prior to beginning the measurement tasks. Once participants completed the second testing session, they were debriefed and thanked. Three learning groups with the same participants, one for each learning method, were tested during the repeated testing sessions at both Time 1 and Time 2 (see Figure 2a – c).

Testing at <u>Only</u> T2. Three additional learning groups, one for each method, were used to contrast learners' scores on all dependent variables by only assessing participants at Time 2 while contrasting the differing language learning scores from Repeated Testing learners at Time

2. Participants were not assessed at Time 1, but were given one of the three learning sessions and told to return for a second session in which they would be further evaluated. Thomas & Wang (1996) and Wang et al. (1992) argued that, by providing a testing session at Time 1, there may be practice effects (i.e., performing better at Time 2 because of earlier exposure to the previous testing session), thus raising scores during Time 2 testing. Once all participants completed the given tasks, including the translation recognition tasks, picture naming task and sentence completion comprehension task, participants were thanked, debriefed and dismissed (see Figure 2a - c).

Chapter 3 - Results

Overview of Analyses

Primary analyses are presented in terms of main effects and interactions examining effects of two primary independent variables. Hypotheses tested these two predictors as primary moderators of effects on translation trial types, picture-naming trials and sentence-completion trials. The two main independent variables were: 1) the learning method which participants were randomly assigned to (i.e., Paired-Associate, Context or Keyword Learning Methods) and 2) the time at which testing took place (i.e., Repeated Testing or Tested Only at Time 2). In terms of the measures of performance, only correct responses were used for all dependent measures. Additionally, RT performance data only includes times for correct responses. Thirty-seven percent of data was excluded for Congruent Backward, 33% for Congruent Forward, 36% for Incongruent Backward and 38% for Incongruent Forward translation trials due to incorrect responses or for failure to respond. Forty-nine percent and 50% of data was excluded for Sentence Comprehension and Finnish Picture-naming trials, respectively. The amount of data which was removed for the present study is consistent with that of previous research when the

primary purpose of the study was for acquisition of novel vocabulary (Francis & Gallard, 2005; de Groot & Keijzer (2000). The primary data analysis procedures which were used were Multivariate Analysis of Variance (MANOVA). To assess performance across time (i.e., Time 1 versus Time 2 scores) on the dependent variables of interest, repeated measures analyses were used. In instances where multiple comparisons were conducted with a Bonferroni correction Post-Hoc test, adjusted alpha (α) was equal to .017 when comparing the three learning methods. It is important to note that even though trial type scores (e.g., Congruent and Incongruent Forward and Backward trials) will be used as dependent variables in separate MANOVAs, they will be analyzed later in some regression and repeated measures analyses as predictors, for example, when testing which trial type was faster in terms of processing or showed better performance. These additional analyses were used (e.g., Regressions) as exploratory analyses since no specific predictions were made with regard to those specific data, but it is still important to examine all possible effects.

In terms of the reaction time (RT) dependent variables, data trimming was used in order to attain a more representative measure of performance. When responses were above 3750 ms (3.75 seconds), participants' RTs and responses, either correct or incorrect, were excluded from the analysis for that specific trial type. For example, if a participant's response was over 3750 ms., even though they may have responded to the trial correctly, their RT and response for that specific trial were excluded from the calculation of the average RT and score for that specific trial type. Of all trial types, 1.7% of Congruent Backward, 1.2% of Congruent Forward, 2.5% of Incongruent Backward, 3.1% of Incongruent Forward, 2.2% of Finnish Picture-Naming and 5.3% of Sentence Completion trials were excluded. Additionally, participants who were observed by the experimenters as being unengaged in the testing procedure (e.g., randomly

responding to the given trials) were excluded from all further dependent variable calculations (N = 8 for non-compliance). Participants were considered to be unengaged when consistently focusing on other items located in the laboratory rather than attempting to concentrate on the given tasks. All data so identified were excluded in the analyses of each of the dependent variables for these participants.

Selection of Participants

A critical issue which needs to be addressed is the issue of participants' comparability in fluency for English and Spanish. As discussed in the Participants subsection of the Method section, participants whose average self-rated proficiency assessment in both English and Spanish did not exceed 8 out of 9 and did not self-categorize themselves as bilingual ("Do you consider yourself bilingual or not?") were excluded from any further analyses. As a further check on bilingual balance, participants' RTs and accuracy on the Spanish and English Picture-naming trials were examined. The multivariate result was not significant, Wilks' Lambda = .972, F (1, 147) = 2.25, $p > .05$. Results from RTs and scores on the picture-naming trials demonstrated that no significant differences existed for participants on RTs between English and Spanish at Time 1 [t (149) = .117, $p > .05$] or at Time 2 [t (266) = 1.01 = $p > .05$]; additionally, scores between English (M = 14.40, $S.D.$ = 1.08) and Spanish (M = 14.38, $S.D.$ = 1.26) at Time 1 [t (149) = -1.21, $p > .05$] and Time 2 [t (266) = 1.19, $p > .05$] (see Figure 5 & 6). Based on these results from RTs and scores on English and Spanish Picture-naming trials, combined with the self ratings, it was concluded that the bilinguals used in this study were balanced bilinguals and have a high degree of knowledge of both languages. The final usable sample size of balanced bilinguals was 267.

Pre-Translation Task

Prior to the start of the experiment all participants were given a pre-test translation task so as to ensure no prior knowledge of Finnish words. The pre-test translation task included all target Finnish words which were later presented during the learning phase of the experiment. Results from this pre-translation task found that all participants' scores were virtually zero (0) (M = .08, $S.D.$ = .054). To calculate a pre-translation score, a strict (i.e., verbatim) measure was used since specific target words were being examined. Although the mean was not zero, it was very close to zero, with the very few correct responses observed most likely due to random guessing. As an observational note, the majority of participants quickly ended the task due to their high degree of perceived difficulty. Since all participants' pre-test translation scores were so close to zero, no participants were excluded from the analyses due their pre-test scores; in other words, all participants were used since they had virtually no previous knowledge of any of the target words in the Finnish language.

Hypothesis Testing – Lexical Memory Model Formation

The analyses of the data used only correct responses in the testing of the hypotheses. This use of only correct responses is standard practice in the examination of language learning performance measures and also for RT data in general. The first set of analyses examined translation performance (i.e., lexical link development), followed by picture naming performance (i.e., conceptual link development) and subsequently concluding with sentence completion performance scores (i.e., comprehension assessment).

When first assessing the effects of Paired-Associate learning on lexical and conceptual link development, Paired-Associate learners were predicted ($H_{1a)}$ to develop lexical links between the Finnish vocabulary and L1 (i.e., English) and provide shorter (i.e., faster) response

times for backward translations (i.e., from Finnish to English) than for forward translations (i.e., from English to Finnish). The multivariate result was significant for condition, Wilks' Lambda = .943, F (1, 146) = 8.85, $p < .001$. Repeated measures analyses indicated that a significant difference did exist between the trial types, F (1, 45) = 6.034, $p < .001$, but not in the direction supporting the hypothesis for Paired-Associate Learners, since backward translation trial RTs (M = 1595.70, *S.D.* = 473.53) were significantly longer (i.e., slower) processing than forward translation RTs (M = 1456.96, *S.D.* = 367.84). Thus, this result suggests that, in terms of lexical processing times, bilinguals were able to lexically process significantly more rapidly when a familiar language item (i.e., English) is presented first followed by the foreign item (i.e., Finnish) (see Figure 3).

Also, in terms of the number of correct translations given (H_{1b}), it was predicted that overall translation scores (i.e., combining backward, forward, congruent and incongruent translation trials) would be significantly lower in the Paired-Associate learning group due to no additional assistance provided by the learning technique. The multivariate result was significant for condition, Wilks' Lambda = .832, F (8, 286) = 3.45, $p < .001$ Results indicated that a significant main effect of learning technique was present, F (2, 146) = 8.30, $p < .001$, but a Bonferroni Post-Hoc test indicated that no significant differences existed between Paired-Associate learners (M = 11.55, *S.D.* = 1.61) and Context (M = 11.06, *S.D.* = 1.87) or Keyword (M = 12.51, *S.D.* = 1.91) learners. When trial types were examined between groups (e.g., Congruent Backward trials for Paired-Associate and other learning conditions), no significant differences were found for Congruent Backward ($p > .017$), Incongruent Backward ($p > .017$) and Incongruent Forward ($p > .017$) trial types, but significant differences were found between

Paired-Associate (*M* = 12.02, *S.D.* = 2.67) and Keyword (*M* = 13.4, *S.D.* = 2.52) conditions for Congruent Forward ($p < .017$) trials (see Figure 4).

Lastly, when examining if conceptual links had been created for Paired-Associate learners, it was predicted that Picture-naming scores for Finnish should be close to zero (see Figure 5) and RTs (see Figure 6) should be longer in comparison to RTs for Picture-naming in English (H_{1c}). The multivariate result was significant for Paired-Associate learners, Wilks' Lambda = .418, F (1, 46) = 64.01, $p < .001$. A One-Sample t-test was used since it was of interest to compare our obtained score to the predicted zero score; observed results indicate that Paired-Associate learners' scores (*M* = 7.96, *S.D.* = 2.65) were significantly different from zero, t (46) = 20.56, $p < .001$, thus suggesting that conceptual links are developed when using Paired-Associate learning, while RTs were significantly longer than for English Picture-naming trials, F (1, 46) = 64.01, $p < .001$.

When assessing the effect of Context learning on lexical and conceptual link development, it was first predicted (H_{2a}) that RTs for Picture-naming trials in English and in Finnish should be equal since the Conceptual Mediation Model assumes that direct connections between the lexical and conceptual stores should exist; this is to say, conceptual links should develop using Context learning and their strength should be equal to that of their native language. The multivariate result was significant Context learners, Wilks' Lambda = .642, F (1, 57) = 31.80, $p < .001$. Repeated measures results indicated, F(1, 46) = 31.08, $p < .001$, that a significant difference did exist between English and Finnish picture-naming trials, thus, not supporting the hypothesis. In terms of relative strength, Finnish conceptual links, although developed, were weaker in comparison to the established links of the known language of the learner (see Figure 6).

Additionally, when comparing Context and Paired-Associate learners' performance (H_{2b}), it was predicted that Context learners should have longer RTs for Congruent Forward and Backward trials and also significantly lower correct translation scores compared to Paired-Associate learners. The multivariate result was significant for condition, Wilks' Lambda = .839, F (8, 286) = 3.27, $p < .001$. Univariate results indicated that no significant differences existed between Paired-Associate (M = 1595.70, *S.D.* = 473.54) and Context learners' (M = 1585.49, *S.D.* = 342.44) RTs for Congruent Forward, F(2, 146) = 3.51, $p < .017$ (Bonferroni test indicated no difference), or Backward translation trials (Context - M = 1513.55, *S.D.* = 531.90; Paired-associate - M = 1580.45, *S.D.* = 421.50), F (2, 147) = 1.42, $p = .246$ (see Figure 3). In terms of translation scores, the multivariate result was significant for condition, Wilks' Lambda = .832, F (8, 286) = 3.45, $p < .001$. Univariate results indicated that Context learners did not significantly differ from Paired-Associate learners on Congruent Forward (Context - M = 11.40, *S.D.* = 2.20; Paired-associate - M = 12.00, *S.D.* = 2.77) or Congruent Backward translation scores (Context - M = 10.85, *S.D.* = 2.22; Paired-associate - M = 11.70, *S.D.* = 2.32), F (2, 146) = 8.726, $p < .001$ (Bonferroni test indicated no difference for Congruent Backward scores) trials and F (2, 147) = 9.079, $p < .001$ (Bonferroni test indicated no difference for Congruent Forward scores), thus not supporting the hypothesis (see Figure 4).

The final predictions based on language learning methods predicted that Congruent Forward translation RTs for Keyword learners should be faster (i.e., shorter) than RTs for Congruent Backward translations (H_{3a}). The multivariate result was significant for condition, Wilks' Lambda = .943, F (1, 146) = 8.85, $p < .001$. Repeated measures results indicated that RTs for Forward translations (M = 1672.23, *S.D.* = 402.19) were indeed faster than for Backward translations (M = 1765.89, *S.D.* = 434.75), thus supporting the hypothesis, F (1, 44) = 4.98, $p <$

.017. Additionally, it was predicted that Picture-naming RTs in Finnish trials would be significantly longer (i.e., slower) for Keyword learners than for Context learners. Results indicated that no significant differences existed between Keyword (M = 1616.75, $S.D.$ = 535.42) and Context (M = 1402.70, $S.D.$ = 454.33) learners on Picture-naming RTs for Finnish trials, F (2, 147) = 2.36, $p > .017$ (see Figure 3).

Lastly, it was predicted that Keyword learners' correct translation scores and picture-naming scores in Finnish would be significantly greater than those for Context and Paired-Associate learners. A One-Way ANOVA indicated no significant differences were observed between the three learning methods on Picture-naming scores, F (2, 147) = 3.12, $p > .017$, but significant differences were observed between Keyword and Context learners when translation type scores (e.g., Congruent Forward and Backward, Incongruent Forward and Backward) were combined and examined as one dependent variable, F (2, 147) = 8.30, $p < .001$. Additionally, the multivariate result was significant for condition, Wilks' Lambda = .832, F (8, 286) = 3.45, $p <$ .001, with univariate F tests indicating significant differences were also found for Congruent Backward, F (2, 147) = 8.73, $p < .001$ and Congruent Forward, F (2, 147) = 9.079, $p < .001$, trials when examined separately (see Figure 4). Also, significant differences were found between Keyword and Paired-Associate learners on Congruent Forward translation trials with Keyword learners having higher scores than Paired-Associate learners.

Hypothesis Testing - Incongruent Trials

Hypotheses 4 and 4a focused on the use of Incongruent language learning trials (i.e., testing bilingual participants using their second additional known language—Spanish-- rather than the language of the learning trials, since it is critical to assess if lexical and conceptual associations are created and if they differ from those associations made from the learned

language. It was first predicted that when testing participants with Spanish, rather than English, translations of the Finnish words, RTs (H_{4a}) would be significantly longer than RTs from Congruent Trial types within each language learning method. The multivariate result was significant for condition, Wilks' Lambda = .536, F (8, 286) = 42.19, $p < .001$. Results supported this prediction, [Paired-associate - F (3, 135) = 29.47, $p < .001$; Context - F (3, 171) = 10.65, $p < .001$; Keyword - F (3, 132) = 26.64, $p < .001$], showing that significant differences did exist between the trial types, with RTs for Incongruent trials being significantly greater than RTs for Congruent trials within each language learning method (see Table 1 – Time 1 columns per language learning group). It was further predicted (H_{4a}) that Incongruent translation scores would be significantly lower within each of the language learning methods. The multivariate result was significant for condition, Wilks' Lambda = .832, F (8, 286) = 3.45, $p < .001$. Results partially supported this prediction, [Paired-associate - F (3, 135) = 6.90, $p < .001$; Context - F (3, 171) = 2.72, $p > .017$; Keyword - F (3, 132) = 13.89, $p < .001$], with Incongruent trials beings lower than Congruent trials for Paired-Associate and Keyword learning groups, while no differences were found between the trial types for Context learners (see Table 2 - Time 1 columns per language learning group); as an additional note, no Incongruent trials were close to zero as predicted. This finding, although contrary to what was predicted, suggests that bilingual learners were able to associate the novel language with both of their known languages, but translation did take significantly longer when the novel language was associated with only one of the known languages. This is to say, bilinguals were able to create lexical and conceptual links between the Spanish and Finnish words even when no pairings were explicitly made for the learners in Spanish. These results are of great importance since previous research had excluded any examination of conceptual and lexical link formation with non-associated languages known by

the learners. In other words, bilinguals were able to successfully associate the novel language with their other lexical store they had available, but ultimately these associations were weaker than those provided by the associated language used during the learning phase.

Hypothesis Testing – Comprehension Scores

In terms of comprehension scores (i.e., sentence completion scores) it was predicted that elaborative learning techniques, Context and Keyword methods, would produce significantly better comprehension scores than the Paired-Associate learning method (H_5). Results did not support this hypothesis since Paired-Associate learners (M = 8.55, $S.D.$ = 3.19) (H_6) did not have significantly lower scores than Context (M = 8.56, $S.D.$ = 2.96) or Keyword learners (M = 9.66, $S.D.$ = 3.42) (H_5), F (2, 146) = 1.91, $p > .01$. All ps > .017 (see Figure 4).

Based on this finding, learners using any of the three language learning techniques were apparently able to develop these lexical and conceptual links; this result in particular could suggest that language learning techniques, although differentially effective in assisting learners to achieve vocabulary acquisition, provide similar results in terms of comprehension acquisition.

Hypothesis Testing - Time 1 vs. Time 2 Testing Groups

When assessing if performance on all trials, including accuracy scores and RTs, would significantly change for Repeated Testing learners, it was predicted that accuracy scores should be significantly better at Time 2 while RTs should be significantly faster (H_7). Repeated Measures analyses partially supported the prediction by revealing significant differences in RTs; RTs significantly decreased (see Figure 7) but scores also significantly decreased from Time 1 to Time 2 for learners (see Figure 8). In this particular case, learners were able to more rapidly respond to trials at Time 2, possibly due to practice effects, but accuracy scores also significantly decreased at Time 2, possibly suggesting that there is a decrease in retained knowledge due to

inconsistent use of the novel vocabulary (i.e., not continuously using the gained knowledge) or of forgetting.

Further examination of learning methods across time revealed that significant differences were not consistently observed from Time 1 to Time 2. Specifically, Paired-Associate learners' RT measures, except for that of Finnish Picture-naming and sentence completion trials, significantly decreased from Time 1 to Time 2, suggesting that processing time significantly decreased with repeated testing (all *p*s < .017). Although this result does suggest faster processing time for translation trials, picture-naming and comprehension trials actually took longer to complete at Time 2, although not significantly so. This result could further suggest that for conceptual processing, which picture-naming and comprehension trials would directly test, the learner may need additional time to assess the current state of knowledge while for translation, lexical decisions may be made more quickly (see Table 1). Interestingly, in terms of translation trial RTs for Context and Keyword learners, similar patterns arose from Time 1 processing time to Time 2 (i.e., RTs significantly decreased from Time 1 to Time 2). Moreover, contrary to the results from the Paired-Associate learners, that RTs for both Context (Time 1 - *M* = 1402.70, *S.D.* = 454.33; Time 2 - *M* = 1240.53, *S.D.* = 364.90) and Keyword (Time 1 - *M* = 1616.75, *S.D.* = 535.42; Time 2 - *M* = 1470.28, *S.D.* = 529.39) learners did significantly differ for picture-naming trials in Finnish from Time 1 to Time 2, with RTs decreasing at Time 2. This result could suggest that more interactive learning methods (i.e., Context and Keyword methods) may allow learners to not only more rapidly process lexical information but also more rapidly process conceptual information, but this does not guarantee that this knowledge is successfully retained.

Additional analyses examined language learning methods' effects across time on performance scores (i.e., accuracy). For Paired-Associate learners, Congruent Backward, Incongruent Backward, Finnish Picture-naming and Sentence comprehension scores significantly decreased from Time 1 to Time 2 (all *p*s < .01). For Context learners, Congruent Forward scores and Finnish Picture-naming scores significantly decreased from Time 1 to Time 2, while for Keyword learners all performance scores including translation, picture-naming and sentence comprehension scores decreased from Time 1 to Time 2 (all *p*s < .05). Based on these results it could be suggested, just as was seen with Time 1 and Time 2 RTs, that more interactive methods such as the Keyword method lose their advantage of their high degree of interactiveness/vividness without repeated use (i.e., lack of practice using the interactive image with the correct translation equivalent), thus leading to significantly lower scores at Time 2 (see Table 2). This is to say, since this technique is much more complex than rote rehearsal or identifying obscure words through linguistic context, the complexity of the method may hinder retrieval at Time 2, since it requires retaining both the Keyword and the translation equivalent.

For comparisons between Repeated Testing and Time 2 Only participants' performance scores and RTs, it was predicted (H_7) that Time 2 Only performance scores and RTs would not differ on scores and RTs for Repeated Testing participants' Time 1 performance. Results indicated partial support for this prediction, with RTs not significantly differing between testing groups, *p*s > .05, except when comparing Finnish Picture-naming and Sentence comprehension RTs (all *F*s > 6.45, *p*s < .01) (see Figure 9), while significant differences were found between the groups' scores on translation, picture-naming, and comprehension trials, all *p*s < .05 (see Figure 10). Even though translation processing times did not significantly differ across the strategy/learning methods at one-week delays, processing times did not significantly differ from

those during the first testing of the learned vocabulary, at least for translation processing. For conceptual processing, however, differences were found. Interestingly though, scores on translations (i.e., Congruent Backwards and Forwards and Incongruent Backwards and Forwards) did significantly differ based on when testing occurs. In other words, when learners were immediately tested after learning novel vocabulary, scores were significantly higher than at delayed testing, again possibly suggesting the importance of an immediate testing of the learned vocabulary to adequately evaluate the acquired knowledge.

Although no specific predictions were made in terms of the effects of language learning method for comparison between Repeated learners' Time 1 scores and Only Time 2 learners' Time 2 scores, main effects indicated that significant differences between the three groups did exist for Congruent Backward and Forward accuracy scores and RTs for Incongruent Forward and Finnish Picture-Naming trials (all Fs > 3.30, ps < .05). This result indicates that overall accuracy and RTs were not equal at the first time of testing, thus suggesting that the most influential moderating variable, which had the greatest effect on performance, was time of testing rather than the learning method. When further examining the effects of both of these moderating variables on performance, the interaction effect of Time of Testing and Learning Method was examined and a number of significant effects did emerge. Significant interactions were observed on three dependent variables, those being Congruent Backward and Forward accuracy scores and also on accuracy scores for Finnish Picture-Naming trials and Sentence Comprehension accuracy scores (Fs > 3.13, ps < .05).

To further examine these significant interactions, simple effects were used to determine where the significant differences did lie. Although a number of interaction effects were found to be non-significant, further probing using simple effects was used to confirm that no significant

differences had emerged for those specific dependent variables. When first comparing both testing groups who used Paired-Associate learning, significant differences emerged when assessing translation scores for Congruent and Incongruent Forward and Backward trials and also for comprehension scores (all *Fs > 6.46,* p < .05) (see Figure 13); significant differences were also observed for RTs on Finnish Picture-naming trials [F (1, 256) = 7.08, p < .01] (see Figure 12). The findings suggest that learners tested immediately after having received the learning procedures had significantly better scores on almost all trial types than those learners who were tested at the one-week delay. For Context learners, similar findings emerged, as well as a significant difference on Finnish Picture-naming trials (all Fs > 4.96, ps < .05) (see Figures 15 & 16). Lastly, when examining Keyword learners, the same significant differences were found, plus the additional effect on RT for sentence comprehension trials (all Fs > 12.07, ps < .01) (see Figures 17 & 18). Overall, these results suggest that the time of testing is vital and that to maximize performance, immediate implementation of the acquired knowledge (e.g., techniques and vocabulary) is very important.

To assess if group differences would be observed between Repeated Testing learners and Time 2 Only learners' scores at Time 2, it was predicted (H_7) that RTs for all translations trial types would be significantly longer for Only Time 2 testing learners and performance scores (i.e., translation, comprehension and picture-naming) would be lower. Results of a MANOVA comparing both groups' performance at Time 2 revealed significant differences between both groups, all ps < .01, except when comparing both groups Finnish Picture-naming scores at Time 2, p = .06 (see Figure 11 & 12). Further examination of interaction effects (i.e., Time of Testing by Language Learning Method) revealed significant differences between Repeated Testing and Only Time 2 tested learners based on their learning condition (see Additional Analyses).

Additional Analyses – Main Effects, Interactions and Regressions

Since all participants provided Time 2 data, but no specific predictions were made with regard to the effects of language learning methods on vocabulary acquisition at Time 2, main effects (e.g., the effect of language learning method) and interactions (i.e., comparisons of participants who were tested at Time 1 and Time 2 versus those tested at only Time 2 based on language learning method) were further explored at only Time 2. Previous analyses only examined if differences from Time 1 to Time 2 were observed for each language learning method. In these current analyses performance (e.g., RTs and accuracy scores) were examined at only Time 2. A Multivariate Analysis of Variance (MANOVA) was used to examine main effects and interactions. In the case where significant interactions were obtained, simple effects were used to further probe the interactions.

Main Effects for Language Learning Method for Time 2 Scores. When comparing the three language learning methods groups' performance at Time 2 only, the multivariate result was significant for condition, Wilks' Lambda = .880, F (16, 508) = 2.11, p = .007. Although the multivariate result was not significant, univariate tests were conducted and significant main effects were observed when comparing the three learning methods on the number of correct Congruent Forward translation trial scores, F (2, 256) = 3.86, $p < .05$, RTs on Incongruent Forward translation trials, F (2, 256) = 4.56, $p < .01$, and RTs for Picture-naming trials in Finnish, F (2, 256) = 5.23, $p < .01$. Post-hoc analyses, using a Bonferroni correction (adjusted $\alpha = .017$) revealed significant differences between Context learners and both other learning methods for each of the three main effects (see Figure 19 & 20). Although no specific predictions were made with regard to the effects of language learning strategies at only Time 2, the results are important since these results do suggest that an interactive strategy, such as

Context learning, ultimately produces significantly poorer performance at Time 2 than a simplistic method such as Paired-Associate learning. This is to say that the complexity associated with a Context learning method may not facilitate the retention of information for the second measuring time, thus producing lower scores at Time 2.

Interactions and Simple Effects between Time of Testing and Learning Method for Time 2 Scores. Two significant two-way interactions were obtained, the multivariate result was significant for condition and time of testing, Condition - Wilks' Lambda = .887, F (16, 504) = 1.93, $p < .01$; Time of Testing - Wilks' Lambda = .795, F (8, 251) = 8.07, $p < .001$. The interaction multivariate effect was not significant, Wilks' Lambda = .932, F (16, 502) = 1.12, p = .33. The first significant interaction occurred for the number of correct Finnish Picture-naming trials at Time 2, F (2, 256) = 5.80, $p < .01$. Further exploration using simple effects indicated that Repeated Testing learners had significantly higher scores at Time 2 than did Time 2 Only learners in the Keyword learning group, F (1, 83) = 11.99, $p < .05$. No significant differences existed between Repeated Testing and Only Time 2 learners at Time 2 for Paired-Associate or Context Learners (Fs = 1.79 or less, ps > .05) (see Table 3).

The second significant interaction obtained was on the number of correct comprehension items at Time 2, F (2, 256) = 3.66, $p < .05$. The observed interaction assessed the effect of time of testing and language learning method on the comprehension scores. Simple effects analyses showed a similar finding as that of the first interaction, in which Repeated Testing learners who used the Keyword learning method had significantly greater scores than Time 2 Only learners, F (1, 83) = 21.86, $p < .01$, at Time 2; additionally, no significant differences between the testing groups existed for Paired-Associate or Context learners (Fs = 2.09 or less, ps > .05) (see Table 3).

Although a number of interaction effects were non-significant, further probing using simple effects was used to determine if possible significant differences could emerge between the Repeated Testing and Only Time 2 tested learners when each language learning method was examined individually. Alpha (α) level was again adjusted to .017. Significant differences were found on a number of dependent variables for each of the learning methods. The first set of significant simple effects was found for Paired-associate learners when comparing when learners were tested; significant differences in RTs were observed between the testing groups for Congruent Backward [F (1, 256) = 11.05, $p < .05$], Congruent Forward [F (1, 256) = 6.88, $p < .05$] and Incongruent Forward [F (1, 256) = 10.86, $p < .05$]. Although Repeated Testing and Only Time 2 testing learners using Paired-associate learning did not significantly differ in terms of performance scores, they did significantly differ in time of processing (RT) for the majority of trial types with Only Time 2 learners taking significantly longer than did Repeated testing learners (see Table 3).

When assessing whether differences would emerge between Repeated testing and Only Time 2 tested for learners who used a Context learning strategy, simple effects indicated that significant differences did exist between the two testing groups on a number of measures. Significant differences emerged in RTs for Incongruent Backward, F (1, 256) = 5.01, $p < .01$, Incongruent Forward, F (1, 256) = 5.01, $p < .01$, and Finnish-Picture naming trials, F (1, 256) = 5.05, $p < .01$ (see Table 4). Additionally, differences for accuracy scores were found between the two testing groups when tested on Congruent Backward, F (1, 256) = 4.93, $p < .05$, Incongruent Backward, F (1, 256) = 11.02, $p < .01$, and Incongruent Forward translation trial scores, F (1, 256) = 4.71, $p < .05$ (see Table 3).

The last simple effect assessing differences between Repeated testing and Only Time 2 tested learners examined specifically those individuals who were randomly assigned to the Keyword learning method. Significant differences did emerge between the two time testing groups when assessing their Congruent Forward and Backward, Incongruent Forward and Backward accuracy scores (all Fs > 4.61, $p < .05$) (see Table 3), with Repeated Testing learners having significantly better scores than did Only Time 2 tested learners. Additionally, significant differences also emerged when examining Incongruent Forward RTs, Finnish RTs, Sentence Comprehension RTs and Finnish and Sentence Comprehension scores (all Fs > 9.42, $p < .05$) (see Table 4). In this instance, Repeated Testing learners had lower RTs than did Only Time 2 learners. This finding suggests that, without repeated use of the interactive image for testing purposes, as provided in the Keyword method, the images themselves may have lost their vividness and thus did not assist learners when they attempted to use the method one week later.

Although the above mentioned simple effects did test the effects of time of testing at Time 2 while examining each learning method separately, an additional exploratory analysis, in the form of simple effects, was conducted to examine differences between the three learning conditions while holding constant whether the learners were Repeated testing or solely Time 2 tested learners for Time 2 scores and RTs. In other words, this analysis was used as the second set of possible simple effects to examine the overall interaction effect by examining whether differences between the three learning conditions existed based on time of testing. Results from this exploratory analysis indicated that only one significant difference between the three learning methods existed when examining Congruent Forward translation scores, F (2, 256) = 5.47, $p < .05$, for Repeated Testing learners (all other Fs < 2.92, $p > .05$), with Context learners having poorer translation scores than Paired-associate or Keyword learners. When comparing the three

learning methods for Only Time 2 tested learners, results indicated that no significant differences existed between the methods at Time 2 testing (all other Fs < 2.72, p > .05). Ultimately, these results suggest that the method itself does not produce significant differences in performance (i.e., RTs or scores) when assessing performance only at a one-week interval, but rather, the significant moderating factor is the number of times that a participant was tested. This is to say, that if participants had been exposed to the tasks multiple times, higher scores were found for those participants at delayed testing (see Table 5 & 6).

Regression analyses. The final sets of analyses to be discussed used Hierarchical Regressions as the primary data analytical technique. Each analysis tested whether the predicted variables were significant predictors of the criterion variable(s). These analyses used translation, picture-naming and sentence comprehension RTs and accuracy scores as predictors of performance of the differing translation trial types, Finnish Picture-naming trials and Sentence comprehension scores. A number of the demographic questions given in the LEQ were used as predictors of performance in a number of separate regression analyses. The three main demographic variables used were the age of the participant, age at which their second language was acquired and the number of foreign language courses in which the participant had enrolled. Results from these regression analysis indicated that none of these three demographic measures were unique predictors of any of the dependent variables assessed (all βs = or < .12, ps > .05). Hierarchical Regression analyses were conducted with three steps; Step 1 used the learning condition as a predictor, Step 2 including all RTs from the all trial types, and Step 3 included all accuracy scores from all trial types. It is important to note that all analyses examined the effects of RT and score variables based on each individual language learning method in which learners were randomly placed.

Regression analyses For Time 1 scores for Paired-associate Learners. When examining the predicted effect on Congruent Forward translation trials, Sentence comprehension RTs (β = -.28, $p < .01$), Congruent Backward translation scores (β = .25, $p < .01$) and Sentence comprehension scores (β = .26, $p < .01$) were all found to be unique predictors of translation performance. For Congruent Backward translation trials, Incongruent Forward RTs, Sentence comprehension RTs (β = -.22, $p < .01$), and Incongruent Backward, Congruent Forward and Sentence comprehension accuracy scores (all βs > .19, $p < .05$) were all unique predictors. For Incongruent Backward trials, Incongruent Backward translation RTs (β = .25, $p < .01$), Sentence RTs (β = -.26, $p < .01$), Incongruent Forward scores (β = .20, $p = .01$), Congruent Backward scores (β = .34, $p < .001$), and Sentence comprehension scores (β = .25, $p < .01$) were all unique predictors of performance. Lastly, when assessing Incongruent Forward translation scores, Incongruent Forward RTs (β = .27, $p < .05$), Sentence comprehension RTs (β = -.30, $p < .001$), Sentence comprehension scores (β = .24, $p = .01$), and Incongruent Backward scores (β = .23, $p < .01$) were unique predictors. These results suggests that, as Congruent Forward translation scores increase, comprehension RTs decrease and accuracy scores increase, possibly suggesting that with greater conceptual knowledge and lexical knowledge, there are associated increases in translation performance.

When examining the conceptual link, through Finnish Picture-naming and Sentence comprehension scores, , for Finnish Picture-naming scores, Finnish picture-naming RTs were found to be unique predictors of performance (β = -.43, $p < .001$) while for Sentence comprehension scores, Congruent Forward (β = .20, $p < .01$), Congruent Backward (β = .19, $p < .05$), Incongruent Backward (β = .24, $p < .01$) and Incongruent Forward translation scores (β = .19, $p < .05$) were unique predictors. Additionally, Finnish Picture-naming RTs (β = .-.18, $p <$

.05) and Sentence comprehension RTs (β = -.31 $p < .01$) were also found to be unique predictors of comprehension scores. Ultimately, these results suggest that the strongest predictors of performance were comprehension scores; specifically, as Sentence comprehension scores increase, in terms of correct responses, there is an associated increase in translation ability. This finding is consistent with that of previous literature which suggests that comprehension is a unique predictor of vocabulary knowledge (Laufer, 1992, 1997; Nation, 1993).

Regression analyses for Time 1 scores for Context Learning. In the examination of the variables which were unique predictors of translation performance, Incongruent Backward RT (β = .26, $p < .01$), Sentence comprehension RTs (β = -.20, $p < .02$), Incongruent Forward (β = .17, $p < .05$), Incongruent Backward (β = .33, $p < .01$), and Sentence comprehension scores (β = .20, $p < .05$) were unique predictors of Congruent Backward translation scores. For Congruent Forward scores, Sentence comprehension RTs (β = -.27, $p < .01$) and scores (β = .27, $p < .01$) were unique predictors; for Incongruent Backward translation scores, Sentence comprehension RTs (β = -.25, $p < .01$), Congruent Backward (β = .35, $p < .001$), Incongruent Forward (β = .19, $p < .05$), and Sentence comprehension scores (β = .25, $p < .01$) were unique predictors. Lastly, for Incongruent Forward translation scores, Incongruent Forward (β = .26, $p < .05$) and Sentence comprehension RTs (β = -.30, $p < .001$), while Incongruent Backward (β = .23, $p < .05$), Congruent Backward (β = .22, $p < .05$) and Sentence comprehension scores (β = .23, $p < .05$) were unique predictors of performance.

When assessing the predictive effect of variables for conceptual scores, Finnish Picture-naming RT (β = -.43, $p < .001$) was a unique predictor of Finnish Picture-naming scores; as for Sentence comprehension scores, Incongruent Backward (β = .28, $p < .01$), Finnish Picture-naming (β = -.19, $p < .05$), Sentence comprehension RTs (β = -.31, $p < .001$), Incongruent

Backward (β = .24, $p < .01$), Congruent Backward (β = .21, $p < .05$), Congruent Forward (β = .22, $p < .01$) and Incongruent Forward translation scores (β = .18, $p < .05$) were unique predictors of performance. Although a number of unique predictors were found for the multiple dependent variables, the pattern of unique predictors suggests that, as lexical translation scores increased, there was an associated increase in comprehension scores. Additionally, as scores increased on translation trials, there was also a decrease in response time (RT) on comprehension trials, also suggesting that, as lexical knowledge increased, there was an improved ability to more quickly and accurately create situational models for comprehension.

Regression analyses for Time 1 scores for Keyword Learning. When first assessing translation performance for Keyword learners for Congruent Backward translation scores, Incongruent Backward (β = .30, $p < .01$) and Sentence comprehension RTs (β = -.19, $p < .05$) were unique predictors, while Incongruent Backward (β = .34, $p < .001$), Congruent Forward (β = .16, $p < .05$) and Sentence comprehension scores (β = .20, $p < .05$) were also unique predictors of performance. For Congruent Forward translation scores, Sentence comprehension RT (β = -.26, $p < .01$), Congruent Backward (β = .20, $p < .05$), Finnish Picture-naming (β = -.17, $p < .05$) and Sentence comprehension scores (β = .26, $p < .01$) were unique predictors. For Incongruent Backward translation scores, only Sentence comprehension RT (β = -.24, $p < .01$) and Congruent Backward translation scores (β = .36, $p < .001$) were unique predictors. Lastly, for Incongruent Forward translation scores, Sentence comprehension RT (β = -29, $p < .01$), Sentence comprehension (β = .25, $p < .01$) and Incongruent Backward scores (β = .24, $p < .05$) were unique predictors of performance. These findings, showing similar results as those for Paired-associate and Context learners, suggest that, as translation scores increased, there was a significant decrease in response times for conceptual knowledge; in other words, as lexical

knowledge increased, there was an associated decrease in the time of processing of conceptual organization.

When assessing conceptual knowledge performance, Finnish Picture-naming RTs (β = -.45, $p < .001$) and Congruent Forward scores (β = -.25, $p < .05$) were unique predictors of Finnish Picture-naming scores. Lastly, when predicting Sentence comprehension scores, Incongruent Backward (β = .29, $p < .01$) and Sentence comprehension RTs (β = -.30, $p < .001$), as well as Congruent Backward (β = .19, $p < .05$), Congruent Forward (β = .21, $p < .01$), Incongruent Backward (β = .24, $p < .01$) and Incongruent Forward translation scores (β = .20, $p < .01$) were all unique predictors of performance.

Overview of Findings

In terms of translation performance as a function of language learning method, results indicated that Keyword learners' performance, in terms of translation accuracy scores, was better than that of Context learners on certain trial types (e.g., Congruent Forward and Backward translations). Interestingly though, RTs for Keyword learners were found to be longer than that of Context learners on incongruent translation trials, although times did not significantly differ from those of Paired-Associate learners. Additionally, significant differences were found between Keyword and Paired-Associate and Context learners on congruent forward translations, examination of within-group differences on translation performance (i.e., differences on translation trial types within each language learning method) indicated that congruent trial translation accuracy was greater than incongruent trial accuracy, with scores greater for congruent than incongruent trials for Paired-Associate and Keyword learners, but not for Context learners, and RTs were found to be shorter on congruent than incongruent trials for all learning methods. Furthermore, participants in all learning methods were able to create lexical links

between the newly acquired foreign vocabulary and both known languages (English and Spanish). Although links were created for both languages, the strength of those links (i.e., associations), based on RTs and translation scores, was weaker (i.e., RTs longer and scores lower) for those trials presented in Spanish than for those in English.

Furthermore, examination of conceptual/semantic processing (i.e., comprehension and picture-naming scores and RTs) showed no significant differences between the three learning methods on accuracy scores or RTs for either type of comprehension measures. This is to say, access to the conceptual store became available to participants using any of the three learning methods and processing times did not significantly differ across the methods, thus suggesting that access is available but at a cost in terms of processing time (i.e., processing times were longer and scores were lower in comparison to conceptual picture-naming scores in Spanish or English).

Lastly, when assessing performance across time, results suggest that for repeated testing learners (i.e., those who were tested both at Time 1 and Time 2), RTs decreased from Time 1 to Time 2, while performance scores also decreased across time. Additional comparisons of performance, through cross-sectional comparisons, indicated that those participants who were tested immediately after learning the novel vocabulary showed better performance at Time 2 than those whom were tested only at Time 2.

Chapter 4 - Discussion

Lexical Memory Model Formation

The results from this study have strong implications for our current understanding of bilingual memory and its organization (i.e., Lexical and Conceptual Links). Based on the results from the current experiment, all three language learning methods (i.e., Paired-Associate, Context

and Keyword) were able to successfully assist bilingual foreign language learners in creating lexical links between the newly acquired vocabulary (i.e., L3) and their currently developed lexicons; additionally, those methods also assisted in creating conceptual links between the acquired vocabulary and the conceptual store. This is not to say that the bilingual learners have formed a new lexicon anywhere near the capacity of their L1 or L2, but rather that it is beginning to form and is weak in relative strength. Although some of the predicted hypotheses were not supported, these findings indicate that, above all, learners were able to associate novel vocabulary from a foreign language to their known languages and were able to infer the direct meaning of the novel words. Considering the Word Association Model of Lexical access (Potter et al., 1984)the results from the present study differ from the predictions made by this model, since according to this model no associations should be made between the novel language lexicon (i.e., L3) and the conceptual store. Evidence observed in this study suggests that since Picture-naming scores in Finnish were not close to zero, and did not significantly differ from those scores of Context and Keyword learners; it is interpreted as demonstrating that conceptual connections exist. It is important to note that accuracy scores for Paired-Associate learners were lower and RTs higher, although not significantly so, in comparison with Context learners, possibly suggesting a weaker strength of the association in contrast to other learners.

One of the most notable findings which was observed was how all the language learning methods were able to assist in creating links similar to those proposed by the Revised Hierarchical Model, i.e., both lexical and conceptual links. Although it was predicted that more basic and less interactive methods, such as the Paired-Associate method, would create lexical memory organizations similar to those of a Word Association Model, while interactive and sophisticated methods, such as Context and Keyword methods would create more advanced

models of lexical access (e.g., Conceptually Mediated or Revised Hierarchical), this was not supported. Results from the current experiment demonstrated, based on translation and conceptual measures, that Keyword learners were able to more accurately translate the novel words and use them more appropriately in the sentence-completion task (see Figure 2). Interestingly though, no significant differences emerged when comparing Picture-naming scores in Finnish across the three learning methods. Although this interactive method was useful in producing better translation and sentence-completion scores, though not always significantly greater than the other two methods, a drawback to a method such as this was found in terms of time of processing (i.e., RTs). Since more interactive methods do rely on the accessing of interactive images and may require recalling the Keyword before accessing the appropriate translation equivalent, the present results are consistent with those of Avila & Sadoski (1996), Rodriguez & Sadoski (2000) and Wyra et al. (2007), who all found that Keyword learners' recall scores were superior but processing time was also longer.

Furthermore, in terms of translation and conceptual processing scores in Sentence-Completion, Context learners did not demonstrate significant superiority to Paired-Associate learning. Although it was predicted that Context learners' scores would be significantly lower than Keyword learners' scores, due to Context learning not providing such an explicit interactive image for the learner, it was still predicted that Context learners would perform better than Paired-Associate learners. Although this result was seen across the translation and sentence-completion tasks, Context learners had significantly better Finnish Picture-Naming scores than did Paired-Associate learners. This finding could suggest that a more sophisticated method such as Context learning, although not providing as vivid an interactive image as the Keyword learning method, was still able to generate a sufficiently vivid image for the learners, such that,

when presented with Picture-naming trials in a foreign language, they perform significantly better than those using the more basic methods of vocabulary acquisition (i.e., Paired-Associate).

Beyond basic vocabulary acquisition, the present study examined the effects of each language learning method on the learner's comprehension ability. In other words, it was of interest to examine how each learning method could affect comprehension ability. Comprehension ability, which is more than solely knowing the translation equivalent of a given word, represents semantic knowledge which has been acquired by a learner. By including such a critical variable to the present study, assessment of semantic knowledge representation and the creation of situational models could further be understood. Since the majority of foreign language learning studies do not focus on broader comprehension ability (i.e., semantic knowledge), but rather focus narrowly on vocabulary knowledge measured by translation ability, the current study's results were able to bridge a gap between these two areas and provide evidence of the effects of learning techniques on this critical issue. Results showed that Keyword learners had significantly better scores than did Paired-Associate and Context learners. The results suggest that, in terms of learners being able to accurately create situational models needed for comprehension, having an elaborative imagery (Keyword) method was successful in allowing situation models to form. Although reaction times (i.e., RTs) were significantly longer than for translation or picture-naming trials (Figures 3, 7, 9, 14, 16, 18), this result could be attributed to two important factors. The first factor which could contribute to differences in time of processing may be based on attempts to create situation models. The creation of situation models naturally creates longer processing times than language translations due to the construction of the current state of knowledge. The creation of situation models involves much more elaborative processing than solely recognizing if words are translation equivalents of each other, as suggested by

Kintsch (1998). Based on this, it could be assumed that longer reaction times are a product of this factor. An additional factor which could contribute to these increased times would be that four multiple choice options were provided to select from. By having such a large number of options, this naturally requires longer times for processing and identifying the correct response.

Translation Processing Effects (RTs and Scores)

When further examining the effects of language learning strategies on translation performance, Keyword learners' translation scores were better, although not always significantly so, than the other methods, suggesting that the use of a highly interactive method might produce better recall scores when later assessed (e.g., Keyword versus Context and Paired-Associate learning methods). One important implication of these results is in terms of Paivio's Dual-Coding Theory (1991), which suggests that use of both imagery and verbal codes produces better memory than either the verbal or imagery codes by itself. The examination of processing times during translation trials showed no significant differences across the three learning methods, although Keyword learners' times were non-significantly longer than those of Paired-Associate or Context learners. Even though no significant differences were found, a trend seems to emerge suggesting longer processing times. These observed findings do not entirely support van Hell & Candia Mahn's (1997) results, in which they observed similar patterns of reactions times being longer for Keyword learners than from Paired-Associate learners. Again, although no significant differences were found between the three learning strategies' reaction times, the observed trend does suggest similar results to those of the previous research. It is important to be cautious in over-interpreting the observed results, especially since no significant differences were found, but it is important to take note of the observed trend. Additionally, the translation scores also support

Fritz et al. (2000) and Benjamin & Bjork (2000), who also found better recall in Keyword learners than in rote rehearsal novice learners.

A surprising result observed in this study was that Context learners' translation scores were generally poorer than those of Keyword and Paired-Associate learners; this finding could reflect the complex nature of the technique. It was originally predicted that, since Context learners presumably were coding information using a verbal code, but could also create a mental situation model for the experimental sentence, that performance should be better than for Paired-Associate learners, since there presumably was no explicit use of verbal and imagery codes in the latter method. Rather than supporting this prediction, however, performance was either lower (i.e., RTs were longer) or equal (i.e., translation scores were equal) to that of Paired-Associate learners, possibly suggesting that the creation of situation models during Context learning was not achieved, thus leaving the learner with a similar memory representation to that of the Paired-Associate learners.

The use of Paired-Associate learning was initially intended to be treated as a control group since no elaborate rehearsal between the target word and its translation equivalents was being generated. Based on the observed results, however, it may be that the use of a non-elaborative, simplistic method may be as effective as methodologies that were once thought to be more useful due to their increased use of elaborative imagery and verbal codes. Although the result of imagery based techniques being superior to the non-imagery based technique used, was not observed, the findings support the work of van Hell & Candia Mahn (1997) and Ellis & Beaton (1993), who found that simplistic methods were as effective as or significantly more effective than elaborative methodologies. Although the results from the current study for Paired-Associate learners did not surpass those of Keyword learners, nor were they significantly better

than those of Context learners, the results do show similar patterns as those observed by van Hell & Candia Mahn (1997).

Thus, based on the results of the current study, a new model of bilingual memory organization can be proposed for bilingual foreign language learners. The new model of memory organization, in which different language learning methods affect memory organization differs from that of the previous models (i.e., Word Association, Concept Mediated and Revised Asymmetrical). Since a new lexicon is being formed, although very weak in strength and far from the level of the proficient languages of the bilingual, the lexical and conceptual connections differ in strength based on the particular language learning method used (see Figure 21a-c). It is important to note that it is not that the Word Association, Concept Mediated or Revised Asymmetrical model is incorrect, but rather that the assumptions made by these models can be used as a basis for a fluent bilingual is beginning to incorporate a third language, with different learning strategies producing somewhat differing models in terms of lexical and conceptual strength. Ultimately, based on the observed results, it is suggested that the use of differing language learning methods can create different lexical models.

The primary difference between the three models lies in the strength of association between the new vocabulary lexicon (i.e., proposed L3) and either of the already established lexicons (i.e., L1 and L2) and the conceptual store. The proposed models individually reflect each learning method's effect on the memory organization, since differences did exist in some instances when examining RTs and/or scores within each method. This is to say, three models are proposed, each differing based on the observed lexical and conceptual links. Since Keyword, Paired-Associate and Context learners differed in some instances on RTs and or performance scores on different trial types by language learning method.

The Paired-associate Learning Model appears in Figure 21a. Although the current results demonstrated that congruent backward and forward translation scores did not differ but RTs did differ, this suggests differences in terms of lexical strength direction, since RTs did differ with congruent forward trials being stronger (i.e., RTs lower/faster) than congruent backward links. Also, incongruent trials were weaker (i.e., RTs taking longer and translation scores being lower) but were equal in strength in terms of direction of lexical access. Lastly, when examining conceptual link strength, associations for Finnish were weaker than those of either of their known languages (i.e., Spanish and/or English).

The Context Learning Model (see Figure 21b) proposes that lexical links between the Finnish 'lexicon' and English lexicon are stronger and equal in strength, in both directions, in comparison the Finnish vocabulary and the Spanish lexicon. Incongruent lexical links (i.e., Spanish – Finnish links) are also equal in terms of direction of translation ability. Lastly, as seen with the Paired-Associate learning model, conceptual links are weaker for the Finnish semantic knowledge than for those of their other known languages.

The final memory organization model being proposed is that for Keyword learning (see Figure 21c). This model proposes that lexical links are stronger for translations which were congruent (i.e., English – Finnish translations), with equal strengths being found in both directions of testing (i.e., forward and backward), than for translations which were not congruent (i.e., Spanish – Finnish). As with the two previous models, Keyword learners' non-congruent translations (i.e., Spanish – Finnish) were weaker than congruent trials but also did not differ from each other in terms of strength of direction of testing (i.e., forward or backward). Lastly, when examining conceptual link development and strength, Finnish conceptual links (i.e.,

Finnish lexicon to the conceptual store) are weaker than those of their other known languages (i.e., Spanish and English).

Thus, based on the observed results and the proposed lexical memory organization models, each model produces benefits in terms of translation and comprehension performance and processing times, but some models do produce stronger association strengths. As observed in the current study, the Context learning model could be seen as the 'weakest' model, although it provides the most consistent results in terms of equal strengths for congruent and incongruent trials for both directions, since certain translation scores (e.g., congruent forward and backward translations) were poorer than for Keyword learners but equal in strength to Paired-Associate learners. Although this result was observed, access to the conceptual store was equal across all three learning methods, suggesting that all techniques are effective in allowing novel vocabulary words to access meaning. Furthermore, the results from the current study provide support for the Revised Hierarchical Model (RHM) of lexical access by demonstrating that the novel vocabulary do become associated with paired-language and semantic meaning is able to be achieved.

Translation Strength. A key issue which was examined was the strength of lexical associations created during the learning phase of the experiment. Results from the current study indicated that, in terms of lexical associations, Keyword learners were able to create stronger associations, as seen by better scores on Congruent Backward and Forward translation trials. Although RTs were longer than for Paired-Associate or Context learners, strength is measured based on both the number of correct responses attained and RTs. Further examination of this trend suggests that Paired-Associate learners' lexical strength was minimally greater than that of Context learners, although the difference in scores was not significant. Ultimately, this result suggests that using Paired-Associate or Context learning methods produces similar strengths of

association for lexical translations. In other words, both of these techniques allow learners to translate the foreign words to their English translation equivalents at similar rates Comparisons for Paired-Associate learners across translation trial types (i.e., forward or backward) showed comparable translation scores and translation times. This finding further supports the conclusion that lexical links were created in both directions (i.e., forward and backward) and that they are equal in strength, at least for Context learners; Keyword and Paired-Associate learners demonstrated significantly longer RTs for Congruent Backward translations. This result is also consistent with the predicted hypothesis (H_{3a}), since Keyword learners' performance was predicted to be significantly greater than both the Paired-associate and Context learners and the strength of these associations would be significantly stronger. This finding also occurred with Context learners' performance being equal in forward and backward translation scores, thus suggesting equal translation link strength in both translation directions.

When comparing the present results with those of previous research, the findings across all three learning methods do support the lexical link assumptions proposed by the Revised Hierarchical Memory Model (Kroll & Stewart, 1994). The RHM predicted that weaker translation associations/strength would be observed for the less proficient language but that performance for backward translation would be stronger than that for forward translation. The observed results in this study suggest that the novel language vocabulary is weaker in association than that of the known languages, thus supporting the assumptions of the RHM but not supporting the predictions of differences in translation strength based on direction. All learning methods demonstrated similar (i.e., non-significant differences) patterns of performance across both translation directions.

Effects of Translation Congruence

One of the most important results found in the current experiment was based on the congruence of the language task given at testing. This is to say, because virtually no empirical studies had examined L3 vocabulary learning in fluent bilinguals, it was critical to examine the effects of language learning strategies on translation ability, but most importantly whether the learner's other known language (i.e., Spanish) would also create lexical links to the novel language. Results indicated that the non-activated language, in which the bilingual learners also have a high degree of proficiency, was able to be successfully integrated with lexical links, both forward and backward, to the novel language. This finding is of great interest, specifically when comparing the congruent forward and backward translation scores, since lexical links in both directions were created for both English and Spanish with the novel Finnish vocabulary. It is important to note that the non-congruent trial translation scores were poorer and produced longer RTs, suggesting the relatively weaker strength of these trial types. A closer examination of reaction times for non-congruent translation trials showed that times were significantly longer than for congruent trials. This difference could possibly suggest the relative strength of the new associations, given that the language at learning was English and not Spanish. One possible argument which could be made, in regards to processing times being longer for non-congruent trials, is that translation may have occurred first from Spanish to English and later to the Finnish vocabulary item for translation, thus not truly having created a lexical link from the L3 to Spanish. If this interpretation were correct, the Word Association Model would predict that forward translation should not be possible, since no lexical links are created from the non-activated language to the newly acquired language, thus resulting in forward translation scores which would be close to zero. In the present study, results were not close to zero and translation

scores and reaction times for forward and backward translation were equal for all conditions. Based on this finding, it appears that links between L3 and Spanish were successfully created but were weaker in strength than links from L3 to English (see Figure 3 & 4). A secondary argument could posit that non-congruent trial performance scores were lower and RTs longer because of weaker (i.e., lower) fluency in Spanish than in English. Although this argument is possible, the sample of Spanish-English bilinguals used in this study were highly balanced on all competency self-ratings (i.e., reading, writing, speaking and understanding English and Spanish), thus casting doubt on the proficiency differences argument.

When further examining the results from non-congruent trials, the results could suggest that participants were not strongly inhibiting their non-used language. Since the current study took place in a community where both Spanish and English are widely used, participants may not have fully been in the monolingual mode (i.e., only in the English mode and completely suppressing the Spanish lexicon) and thus may have naturally created associations with Spanish translation equivalents. Even though experimenters controlled the language mode to their greatest degree, by asking participants to evaluate their levels of fluency in Spanish and having experimenters who could possibly know more than one language might have ultimately shifted participants to the bilingual mode, rather than solely maintaining them in the monolingual mode. With participants actively being in the bilingual mode and having an activation level of both languages, although English was probably the more highly activated language due the amount of English used by the experimenters and the instructions. associations between the novel words and both languages may have created rather than solely being associated with the English word translations. It is important to note that performance scores (i.e., translation scores and RTs) were

lower for non-congruent trials, thus suggesting the relatively lower activation level of Spanish than English.

Conceptual Scores (Picture-naming and Sentence completion)

The final set of performance measures was based on the conceptual link scores for Finnish picture-naming and sentence completion trials. The initial hypotheses (H_{1c}, H_{2a} and H_{3b} predicted that elaborative learning methods (e.g., Context and Keyword methods) would be more successful in creating conceptual links than would Paired-Associate learning. The observed results indicated that, in terms of Finnish picture-naming trials, performance did not significantly differ across the three learning methods, thus not supporting hypothesis (H_{1c}, H_{2a} and H_{3c}) possibly suggesting that in terms of conceptual knowledge all three methods are equally successful. When examining the strength of the associations being created, it could be suggested that in comparison to translation knowledge, conceptual knowledge was weaker than the learner's translation ability (see Figure 4). The weaker strength is also seen in comparisons to the already developed links of the known languages (i.e., Spanish and English) in which all three learning methods were significantly lower in terms of picture-naming scores for the Finnish vocabulary than for their known English and Spanish vocabulary (see Figure 5). This result of weaker strength for the newly developed language is also consistent with the predictions of the Revised Hierarchical Model (RHM), which predicts that links from the newly acquired or less dominant language do have access to the conceptual store but may rely on translation to the L1 to access the conceptual meaning. Thus, based on the observed result, our findings are consistent with the assumptions of the RHM and suggest that weaker associations are made for conceptual links than for lexical links.

Results from sentence completion scores were similar to those observed in the picture-naming trials. Based on these results, similar conclusions can made with regard to performance. One of the observed results which provide further evidence of the weaker association being made for conceptual links, including both sentence completion and picture-naming performance scores and RTs, is based on the number of correct scores. Since scores were not significantly different from those on Finnish picture-naming trials but were lower than those on translation trials, it can be concluded that differences in link strength (i.e., association strength differences between translation and conceptual links) are attributable to learners attempting to create situation models of comprehension. The creation of situation models for comprehension (i.e., creating semantic meaning) is more difficult than solely associating words based on their equivalency to a known translation. Thus, it is reasonable to assume that conceptual scores would be lower and strengths weaker, given that understanding the meaning of the novel vocabulary is likely occurring, rather than solely focusing on translations.

Based on these findings, it may be suggested that the use of any of three contrasting learning methods would produce similar results in terms of conceptual knowledge. Although scores were marginally better for Keyword learners, no significant differences were found. One potential explanation for the differences in the observed scores is that the techniques themselves only facilitate the acquisition of vocabulary terms and their translation equivalents. Rather than assisting with the creation of situation models or with understanding the meaning of the foreign words, these techniques moderately allow for the creation of conceptual links, but focus more strictly on the creation of lexical links. Since conceptual links were developed, it may be that the more elaborative Context and Keyword methods may produce a bit of a larger conceptual knowledge effect than does Paired-Associate learning, since as predicted by Paivio's (1991)

Dual-Coding Theory, the use of interactive techniques may facilitate creation of conceptual links due to the newly formed vocabulary accessing the imagery system from the initially developed lexicon.

Effects of Time of Testing

The results from the current study, in terms of effects of time of testing (e.g., repeated testing versus time two only testing), have strong implications of when to assess vocabulary knowledge. Translation scores were generally better, and RTs were shorter, for learners who were tested immediately after learning the given novel vocabulary. This result, although suggesting that performance was better immediately after testing, could be explained by pointing out that information may still be remaining in short-term and working memory, through the use of continued rehearsal, and that performance at Time 2 would certainly decrease since rehearsal has not been maintained. By having incorporated this methodological factor of testing immediately after learning and at a one-week delay, a more real-world situation was created in the present study. Thus, even though this result does suggest that performance decreases at Time 2, these observed scores at Time 2 may be a more realistic measure of vocabulary acquisition for novice learners.

Additional analyses compared individuals who were only tested at Time 2 and those individuals who were tested at both Time 1 and Time 2. Learners who were tested at both Time 1 and Time 2 generally performed better, with RTs lower and performance scores better at Time 2 than those learners who were only tested at Time 2. This comparison suggests a possible methodological factor which could account for the observed effect. Previous studies (e.g., Wang et al., 1992 and Thomas & Wang, 1996) argued that the use of repeated testing would inflate scores at Time 2 due to potential practice effects. The results from the current study are

consistent with such an argument, since learners who were tested at both Time 1 and Time 2 attained greater scores at Time 2 than those only tested at Time 2, but the observed results also provide a suggestion which could assist learners in attaining significantly greater scores at Time 2. Having learners immediately implement/use their given learning technique after initial learning would help them to outperform learners who are not immediately tested but only attempt to use it a later point in time.

To provide further evidence of the usefulness immediate testing after use of the given learning method, Time 2 only learners' scores were compared to those of repeated testing learners' Time 1 scores. In other words, a comparison of the scores and RTs for both testing groups, at the first instance which the learning method was given, was examined. Results demonstrated that in terms of processing times (i.e., RTs), performance was equal between the two testing groups, but in terms of translation and concept learning performance, learners who immediately used the given technique outperformed those who used the technique for the first time one week later. This is to say, using the given technique immediately after learning to use it provides a learner with better scores both immediately and later in time than those learners who delay the use of the learning method, whichever that method may be (i.e., Paired-Associate, Context or Keyword). It is important to note that performance did decrease at Time 2 for learners who used any method for testing at Time 1, but Time 2 scores remained greater than for those individuals who did not use the techniques until Time 2.

Strengths and Limitations

Many interesting results were observed in this study, which further explored many critical lexical memory model issues which were previously unanswered. Many methodological strengths have been identified in the current study which improved upon those of previous

research. First, although much research had already explored the organization of lexical memory models in bilinguals (Kroll & Stewart, 1994; Potter et al., 1984), the current study further explored if balanced bilinguals would be able to create lexical and conceptual links to an L3 similar to those observed in other memory organization models, based on different language learning methods. The use of language learning methods and organization of lexical memory models have always remained as separate, but important, issues. By merging both theoretical areas and providing a new organization model for novice learners who are balanced bilinguals, this study has created a bridge between both areas (see Figure 21a-c). Also, previous studies (Elhelou, 1994; Fritz et al., 2007; McDaniel & Pressley, 1984) had solely focused on the use of one or two language learning methods for examination of their effectiveness. The current study contrasted three learning methods, all differing in complexity and imagery production, and extended their use to the examination of memory model organization, rather than only examining their vocabulary acquisition effectiveness.

Secondly, the language which was selected to represent the novel language learned (i.e., Finnish) is one that does not have many common root endings and/or cognates with English or Spanish. Additionally, the incidence of Finnish in the geographical location where the study was conducted (South Texas) is extremely rare. Since the intent was to examine how a novel language's vocabulary would be organized in relation to the two already known languages, it was of particular importance to use a language which was not similar nor could be assisted by similarities to the known languages of the bilingual participants. Third, the vocabulary words and their translations were selected all fit within similar language parameters. Previous studies (e.g., Lawson & Hogben, 1998) have incorporated the use of abstract rather than concrete vocabulary when using any or all of the compared language learning techniques. Since techniques such as

the Keyword method depend on the interactive image created between the native language Keyword and the foreign word, the use of abstract items does not facilitate the acquisition of vocabulary or use of the method adequately.

Additionally, previous studies (Paivio & Madigan, 1968; Rodriguez & Sadoski, 2000) have not controlled for word frequency; the current study used only words within a frequency range, using Kučera and Francis (1964) and Snodgrass & Vanderwart (1980), to create a list of concrete words with moderately frequent occurrence. By using such a normed list, results could more strongly suggest true differences or no differences without the possibility that word frequency was a contributing factor in the results. Lastly, when assessing learners' performance across time, many methodological concerns may arise, including possible practice effects. In the current study, learners were either assessed at two time periods (i.e., repeated testing) or only at Time 2. This procedure was used to examine if possible practice effects could contribute to any performance differences observed at Time 2. Since this methodological concern could be a problem to any study, repeated testing also measured performance using a cross-sectional comparison of learners' performance at only Time 2.

Although the current study had many methodological strengths (i.e., positive methodological procedures), as with all studies, a number of possible limitations were also identified. First, although the use of language learning techniques generally consist of a phonological component to learning (i.e., pronunciation), the current study did not draw on the phonological component during learning. All words which were selected in English and Finnish were done so as to have the learner be able to easily pronounce the Finnish words using English phonological rules. However, there is no guarantee that the learner actually used the exact pronunciation. This issue is of importance when evaluating the usefulness of the Keyword

method since the pronunciation link is critical between the novel word and the Keyword used in the native language. A second limitation which could be identified is the use of pseudo-words rather than real Finnish vocabulary. Without the use of true Finnish vocabulary, the results are limited in terms of generalizability to the Finnish language. Although this methodological concern is noted, the use of truly novel (i.e., unfamiliar) vocabulary accurately represents the situation encountered by a novice learner when first exposed to new language vocabulary. The purpose of the current study was not generalize the results to specifically learning Finnish, but rather using an unfamiliar language's basic vocabulary to represent the acquisition of novel vocabulary. Thus, whether the participants inferred the correct pronunciation of the Finnish words is irrelevant, since the Finnish words are essentially being used as a source of unfamiliar vocabulary.

Implications and Future Directions

Many important implications and applications may be drawn from the current study. In terms of theoretical implications, the current study demonstrated that novice learners fluent in two languages, when using any of three differently vocabulary learning methods, were able to create lexical links with both their associated and non-associated languages. It was previously thought that novice learners would solely rely on the use of backward translations (i.e., from the new language to the L1) for conceptual access. Furthermore, the observed results demonstrated that a non-paired language (i.e., Spanish in this instance) was able to create lexical links with the novel language, even though those links may be lower in strength than the links created with the paired language. Lastly, due to the possible effect of many methodological concerns (e.g., repeated testing, use of only one language learning method, etc.), the current study aimed to

address many of the methodological concerns generally encountered in vocabulary learning studies.

Since educational programs, whose purpose is to assist students/learners to best acquire novel vocabulary, have always placed valued on the use of language learning methods, the current study's results have strong implications for educational settings. Based on the observed results, language learning programs can value the effects of any of the three language learning methods for the purposes of acquiring novel vocabulary. Although each method produced differences in lexical and conceptual link effectiveness, all three methods were successful in creating the basic lexical and conceptual links. By having all methods create the basic components needed for communication between lexicons and the conceptual store, language learning programs might use combinations of methods or structured order of methods (e.g., begin with Paired-Associate, followed by Context and ending with Keyword procedures) to produce the most effective acquisition of novel vocabulary.

Based on the results of the present study, a number of future studies are worth pursuing. A future extension might examine the combination of language learning methods for the purposes of examining their effects on vocabulary acquisition. Even though significant difference were not always observed across the three learning methods, combinations of learning methods may have an additive affect on vocabulary learning. Additionally, future studies plan to examine the use of Spanish as the base-paired language, rather than using English which was used in the current study, to confirm that non-paired languages will be able to create lexical links with the novel language vocabulary. One final extension would create a possible method which would allow suppression of a bilingual's non-activated language (e.g., Spanish in the current study) during language learning sessions. Some of the possible results observed in the current

study could have been affected by not having suppressed the non-used language. Although one of the principal aims of the current study was to examine if the non-activated language would be associated with the novel language, by creating a suppression method such as by having participants be in a highly activated Monolingual Mode (i.e., strong activation of only one language and suppression of other known languages) as proposed by Grosjean (1998), differences from those observed could also emerge.

The overall results from the current study offer us a glimpse into the effectiveness of language learning methods and their effect on memory model organization. This study should be used as a stepping stone to continue to examine lexical and conceptual link development as future directions. The results provide us some answers to the greater question of vocabulary acquisition and also for comprehension of foreign language information, specifically using bilinguals and bilingual memory models.

Notes

[1] The discussion of the creation of lexical models in these studies refers to the proposed organization being constructed/organized by the foreign language learners when using differing language learning methods. In other words, the creation of lexical and conceptual links and their integration into the discussed memory organization models will be the main focus of the current study, based on the use of different language learning methods.

[2] Within the bilingual literature a major theoretical debate has been argued as to whether the organization of lexical storage units, in terms of the number of units created, has shifted from being a single lexical store (i.e., Shared Storage Hypothesis) for all lexical items from all languages to independent stores (i.e., Independent Storage Hypothesis). The Shared Storage Hypothesis assumes that only one lexical store is available to the multilingual but within that store all lexical items from all their known languages are stored. Conversely, the Independent Storage Hypothesis assumes that each language is stored independently from the others and that the only communication between the stores would be based on lexical links. The current theoretical position associated with lexical memory organization is in favor of the Independent Storage Hypothesis, with the vast majority of research supporting the core assumption associated with this theory (for reviews see McCormack, 1977; Heredia & McLaughlin, 1992; Kroll & Stewart, 1994; Costa, Miozzo & Caramazza, 1999); thus, the present study assumes this theoretical framework as the basis for proposed lexical organization.

[3] We use L3 to refer to the Finnish words, since the present study used English and Spanish bilinguals with fluent speaking, reading, writing and oral comprehension skills who have already attained two separate lexical stores and are now creating a new lexical store with the Finnish foreign language vocabulary.

[4]The issue of which language is L1 and which is L2 is not critical in this study since all participants were demonstrated to be highly proficient and fluent in both languages. Since various ratings were collected (e.g., reading, writing, speaking and comprehending) for each language, participants whose ratings of 8 or greater (i.e., high proficiency) for reading, writing, comprehending and speaking English and Spanish were used as the fluent, proficient sample; participants not meeting this minimum requirement were excluded from the analyses of this study.

[5] The presentation time of each individual word pair for 20 seconds is just above what is generally used in vocabulary language learning studies. For example, studies using this presentation time include Thomas and Wang (1996) and Campos and Perez (1997). The presentation time per word pair was increased by 5 secs. (5000 ms.), so to provide participants with a bit more exposure to the pairs than is normally given in studies, in order to ensure adequate comprehension time since reading of sentences and creating of mental images will be taking place.

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Table 1

Comparison of Time 1 and Time 2 Mean RTs (msec) for Repeated Testing Learners Based on Language Learning Method.

	Paired-associate		**Context**		**Keyword**	
	Time 1	**Time 2**	**Time 1**	**Time 2**	**Time 1**	**Time 2**
Congruent Backward	1595.70	1383.88	1585.48	1396.27	1785.89	1549.01
	(473.53)	(376.87)	(342.44)	(365.40)	(434.75)	(381.71)
Congruent Forward	1513.58	1357.75	1578.27	1347.95	1672.22	1486.34
	(537.77)	(322.62)	(424.91)	(376.97)	(402.19)	(337.66)
Incongruent Backward	1897.17	1581.51	1713.97	1518.29	1972.08	1604.02
	(468.77)	(451.94)	(369.42)	(487.19)	(446.19)	(443.53)
Incongruent Forward	2004.98	1662.01	1806.86	1535.74	2132.93	1725.82
	(538.69)	(411.60)	(383.69)	(409.38)	(501.03)	(403.86)
Finnish Picture-Naming	1528.68	1381.76	1402.70	1240.53	1616.74	1470.28
	(529.36)	(513.96)	(454.33)	(364.90)	(535.42)	(529.40)
Sentence Comprehension	2494.16	2560.32	2497.29	2500.35	2458.09	2440.21
	(446.04)	(574.22)	(596.20)	(509.41)	(673.86)	(562.53)

Note. Numbers in parentheses represent standard deviations.

Table 2

Comparison of Time 1 and Time 2 Mean Accuracy Scores for Repeated Testing Learners Based on Language Learning Method.

	Paired-associate		**Context**		**Keyword**	
	Time 1	**Time 2**	**Time 1**	**Time 2**	**Time 1**	**Time 2**
Congruent Backward	11.70 (2.31)	10.56 (2.20)	10.84 (2.22)	10.32 (2.23)	12.64 (1.93)	11.35 (2.00)
Congruent Forward	12.02 (2.79)	11.21 (2.30)	11.39 (2.21)	10.47 (2.08)	13.40 (2.21)	12.00 (2.57)
Incongruent Backward	11.63 (1.91)	10.56 (2.35)	11.31 (2.30)	10.83 (2.65)	12.36 (2.33)	11.68 (2.43)
Incongruent Forward	10.67 (2.16)	10.02 (2.22)	10.71 (2.50)	10.22 (2.18)	11.67 (2.35)	10.82 (2.32)
Finnish Picture-Naming	7.96 (2.65)	7.02 (2.04)	9.14 (2.72)	7.66 (2.03)	9.07 (2.44)	8.09 (2.31)
Sentence Comprehension	8.63 (3.17)	7.89 (2.94)	8.56 (2.96)	8.17 (3.11)	9.67 (3.42)	8.93 (3.43)

Note. Numbers in parentheses represent standard deviations.

Table 3

Comparison of Mean Accuracy Scores for Repeated Testing and Only Time 2 Tested Learners at Time 2 Based on Language Learning Method.

	Paired-associate		**Context**		**Keyword**	
	Repeated	**Time 2 Only**	**Repeated**	**Time 2 Only**	**Repeated**	**Time 2 Only**
Congruent Backward	10.66 (2.17)	9.88 (2.16)	10.40 (2.19)	9.29 (2.17)	11.35 (2.20)	9.20 (2.23)
Congruent Forward	11.17 (2.30)	10.50 (2.01)	10.47 (2.08)	9.80 (2.34)	12.00 (2.57)	10.22 (2.59)
Incongruent Backward	10.60 (2.38)	9.86 (2.27)	10.85 (2.66)	8.96 (2.90)	11.68 (2.42)	9.65 (2.72)
Incongruent Forward	9.95 (2.31)	9.34 (2.34)	10.22 (2.20)	9.06 (2.76)	10.82 (2.31)	9.70 (2.62)
Finnish Picture-Naming	7.02 (2.08)	7.61 (2.03)	7.66 (2.04)	7.12 (1.35)	8.09 (2.16)	6.50 (2.10)
Sentence Comprehension	7.91 (2.97)	7.11 (2.45)	8.07 (3.21)	7.12 (2.80)	8.93 (3.43)	5.97 (2.20)

Note. Numbers in parentheses represent standard deviations.

Table 4

Comparison of Time 1 and Time 2 Mean RTs for Repeated Testing Learners Based on Language Learning Method.

	Paired-associate		**Context**		**Keyword**	
	Repeated	**Time 2 Only**	**Repeated**	**Time 2 Only**	**Repeated**	**Time 2 Only**
Congruent Backward	1405.80	1703.76	1384.39	1543.89	1549.01	1671.63
	(424.67)	(504.97)	(357.18)	(349.70)	(381.71)	(496.02)
Congruent Forward	1362.19	1565.26	1347.94	1451.58	1486.34	1542.36
	(324.84)	(402.16)	(376.97)	(352.16)	(337.66)	(472.61)
Incongruent Backward	1591.27	1715.82	1516.60	1754.85	1604.02	1782.26
	(474.20)	(466.88)	(491.35)	(419.36)	(443.52)	(542.61)
Incongruent Forward	1677.33	2002.37	1531.76	1763.22	1725.82	1943.06
	(410.24)	(530.33)	(411.88)	(475.31)	(403.86)	(564.73)
Finnish Picture-Naming	1364.42	1667.34	1226.93	1531.03	1470.28	1828.52
	(517.64)	(742.06)	(353.02)	(476.49)	(529.40)	(560.45)
Sentence Comprehension	2566.48	2706.22	2511.24	2665.66	2440.21	2892.91
	(579.17)	(479.58)	(514.33)	(536.70)	(562.52)	(676.38)

Note. Numbers in parentheses represent standard deviations.

Table 5

Comparison of Mean Accuracy Scores by Language Learning Methods Scores at Time 2 based on Time of Testing.

	Repeated Testing Learners			**Only Time 2 Learners**		
	Paired-associate	**Context**	**Keyword**	**Paired-associate**	**Context**	**Keyword**
Congruent Backward	10.67 (2.17)	10.40 (2.17)	11.36 (2.00)	9.88 (2.17)	9.29 (2.21)	9.20 (2.75)
Congruent Forward	11.18 (2.31)	10.47 (2.09)	12.00 (2.57)	10.50 (2.01)	9.81 (2.34)	10.23 (2.60)
Incongruent Backward	10.60 (2.39)	10.86 (2.66)	11.69 (2.43)	9.86 (2.28)	8.97 (2.90)	9.65 (2.72)
Incongruent Forward	9.96 (2.32)	10.23 (2.20)	10.82 (2.32)	9.34 (2.34)	9.06 (2.77)	9.70 (2.62)
Finnish Picture-Naming	7.02 (2.08)	7.67 (2.05)	8.09 (2.31)	7.61 (2.04)	7.13 (1.36)	6.50 (2.51)
Sentence Comprehension	7.91 (2.98)	8.07 (3.22)	8.93 (3.43)	7.11 (2.45)	7.13 (2.80)	5.98 (2.20)

Note. Numbers in parentheses represent standard deviations.

Table 6

Comparison of Language Learning Methods RTs at Time 2 based on Time of Testing.

	Repeated Testing Learners			**Only Time 2 Learners**		
	Paired-associate	**Context**	**Keyword**	**Paired-associate**	**Context**	**Keyword**
Congruent Backward	1405.80 (424.68)	1384.40 (357.18)	1549.00 (381.71)	1703.76 (504.98)	1543.89 (349.71)	1671.64 (496.03)
Congruent Forward	1362.19 (324.84)	1347.95 (376.98)	1486.34 (337.67)	1565.26 (402.17)	1451.59 (352.17)	1542.36 (472.62)
Incongruent Backward	1591.27 (474.21)	1516.61 (491.35)	1604.02 (443.53)	1715.82 (466.88)	1754.86 (419.37)	1782.27 (542.62)
Incongruent Forward	1677.34 (410.25)	1531.76 (411.88)	1725.83 (403.86)	2002.37 (530.34)	1763.72 (475.31)	1943.06 (564.73)
Finnish Picture-Naming	1364.42 (517.65)	1226.94 (353.03)	1470.28 (529.40)	1667.35 (742.07)	1531.03 (476.49)	1828.53 (560.46)
Sentence Comprehension	2566.49 (579.17)	2511.25 (514.33)	2440.22 (562.53)	2706.23 (479.58)	2665.67 (536.70)	2892.91 (676.39)

Note. Numbers in parentheses represent standard deviations.

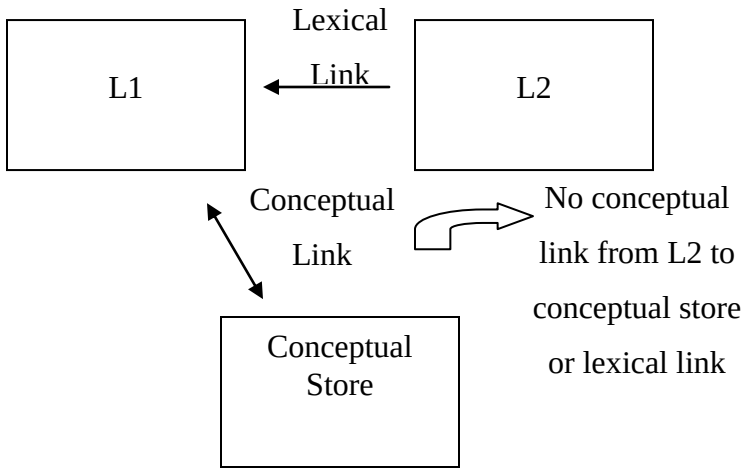


Figure 1a. Word Association Model (Potter et al., 1984)

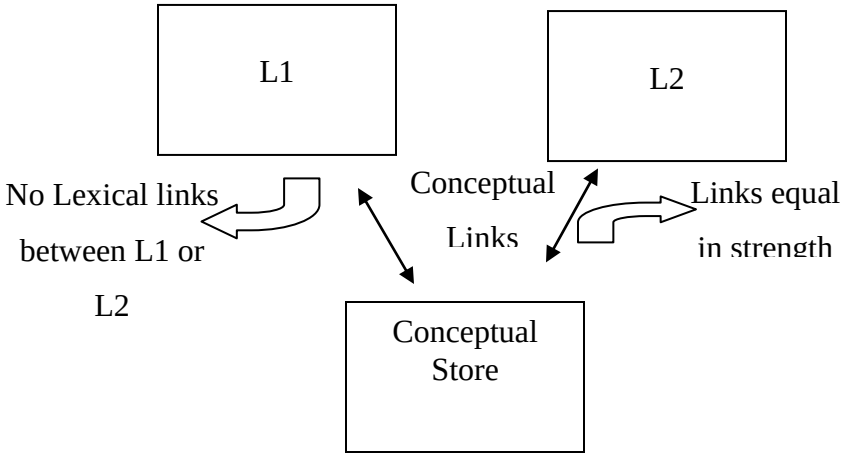


Figure 1b. Conceptual Mediation Model (Potter et al., 1984)

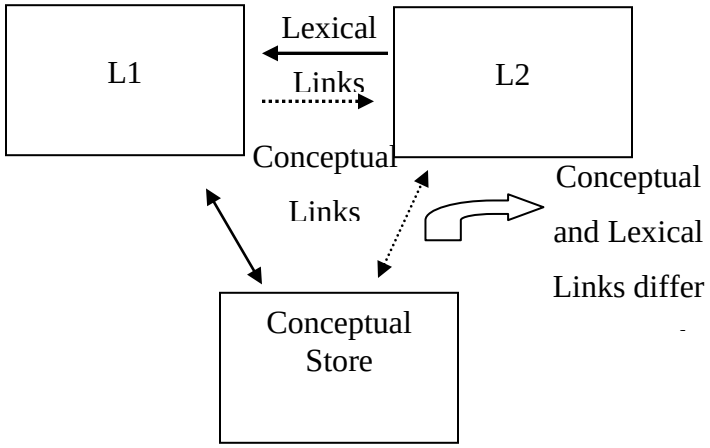
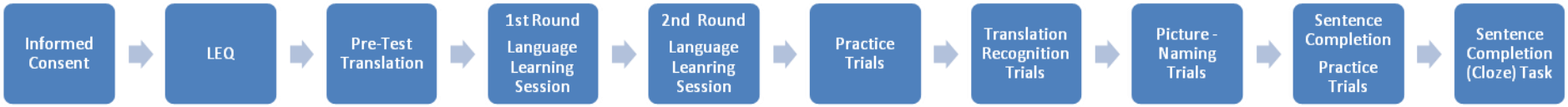


Figure 1c. Revised Asymmetrical Hierarchical Model (Kroll & Stewart, 1994)



3 minutes to complete

Each target pair presented for 20 sec. each for all 30 target words

Each target pair presented for 20 sec. each for all 30 target words

Only 5 backward translation practice trials

16 trials per type (congruent or non-congruent forward, congruent or non-

2 sessions: 15 congruent and 15 non-congruent trials

Only 5 Sentence Completion practice trials

15 Sentence Completion Trials

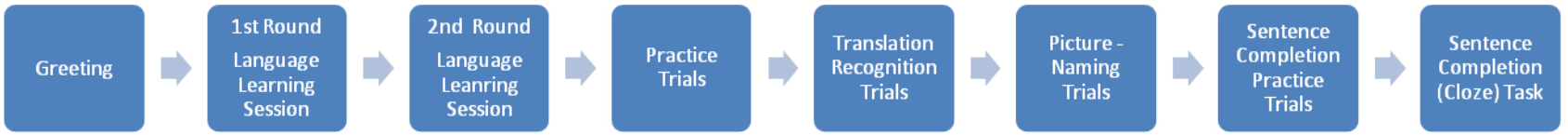
Figure 2a. Procedure used for Repeated Testing Learners at Time 1.

3 minutes to complete

Each target pair presented for 20 sec. each for all 30 target words

Each target pair presented for 20 sec. each for all 30 target words

Figure 2b. Procedure used for Time 2 Only Testing Learners at Time 1.



Each target pair presented for 20 sec. each for all 30 target words

Each target pair presented for 20 sec. each for all 30 target words

Only 5 backward translation practice trials

16 trials per type (congruent or non-congruent forward, congruent or non-

2 sessions: 15 congruent and 15 non-congruent trials

Only 5 Sentence Completion practice trials

15 cloze task trials

Figure 2c. Procedure used for Repeated Testing Learners and Time 2 Only Testing Learners at Time 2.

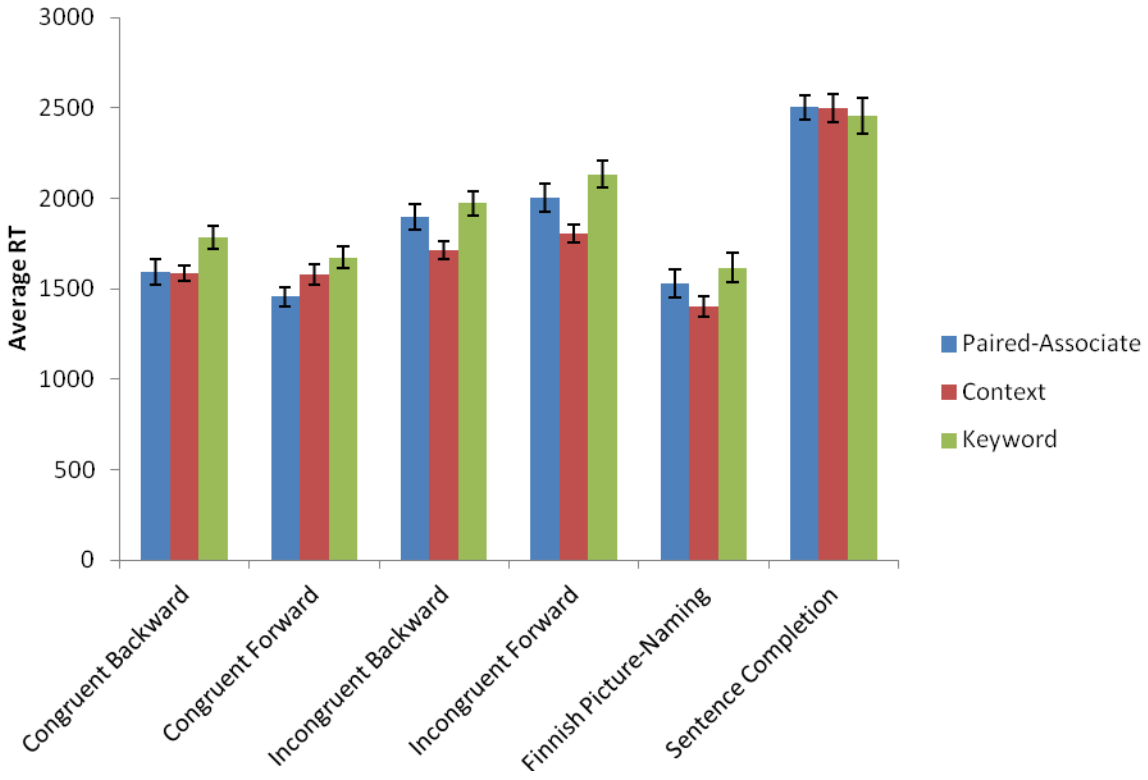


Figure 3. Comparison of Trial Procedure Reaction Times (RTs) based on the Language Learning Methods.

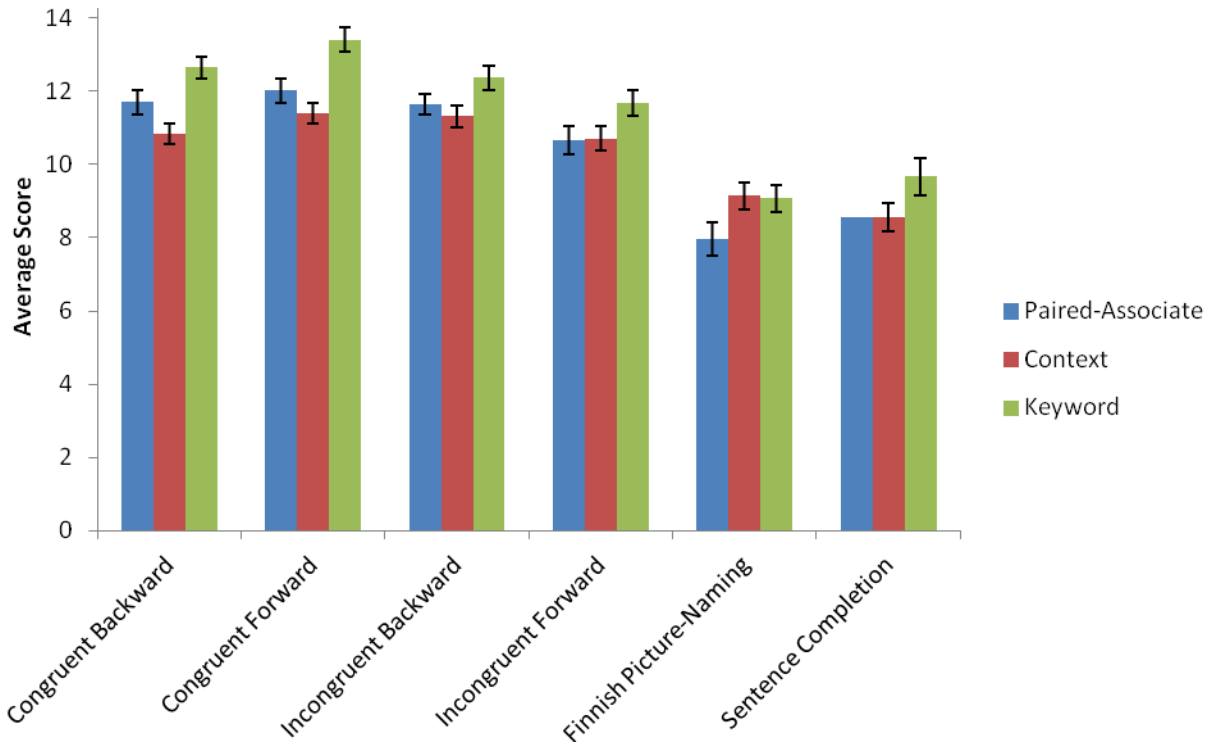


Figure 4. Comparison of Trial Accuracy Scores based on the Language Learning Methods.

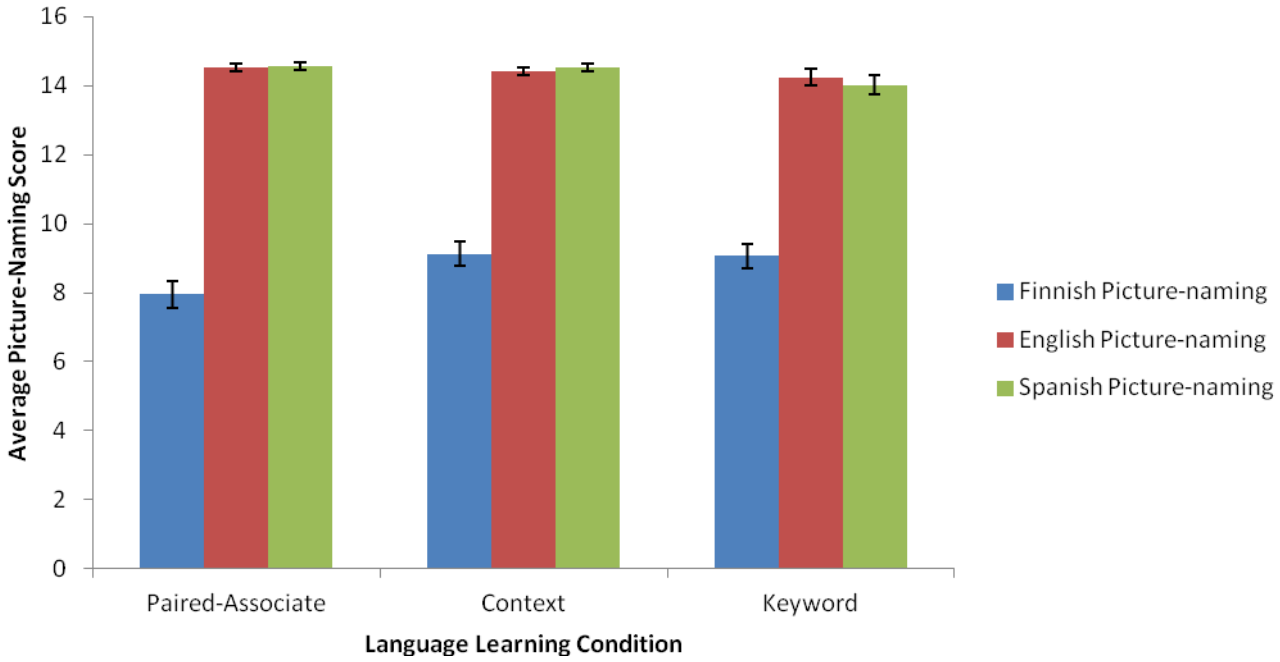


Figure 5. Comparison of Picture-Naming Accuracy Scores Based on Language Learning Method.

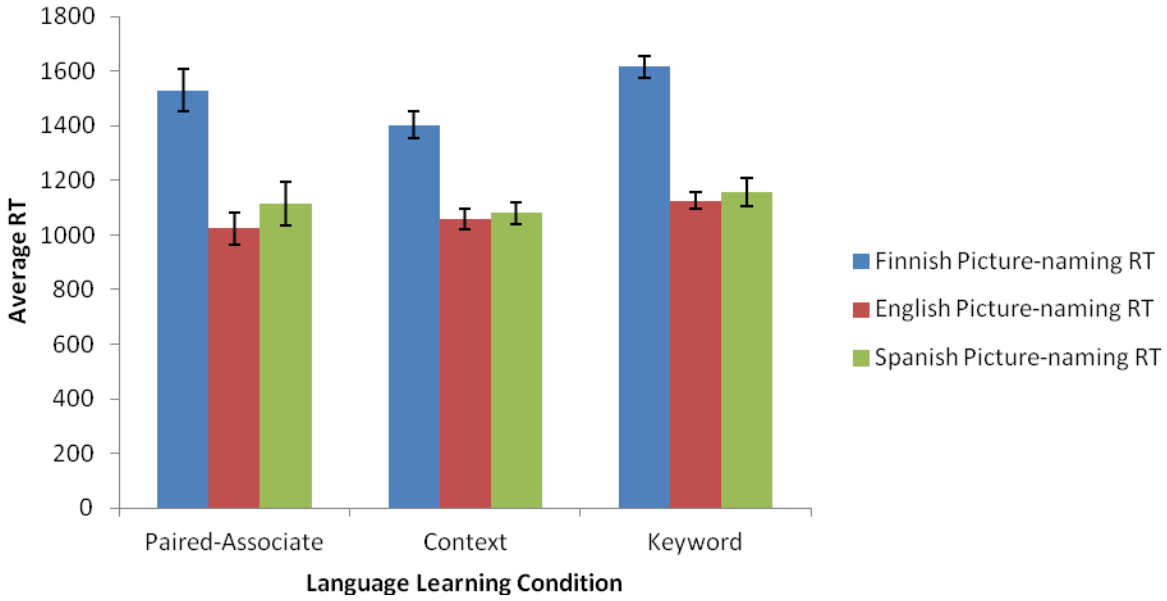


Figure 6. Comparison of Picture-Naming Trial Reaction Times (RTs) Based on Language Learning Method.

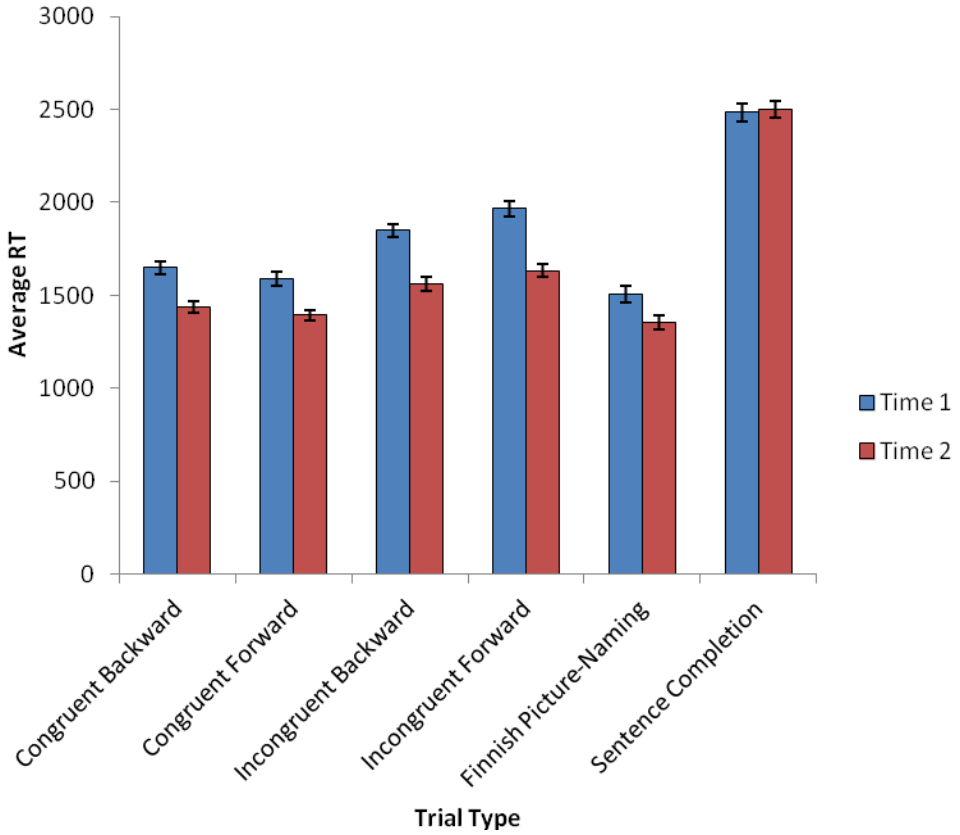


Figure 7. Comparison of Trial Reaction Times (RTs) Across each Testing Period for Repeated Testing Learners.

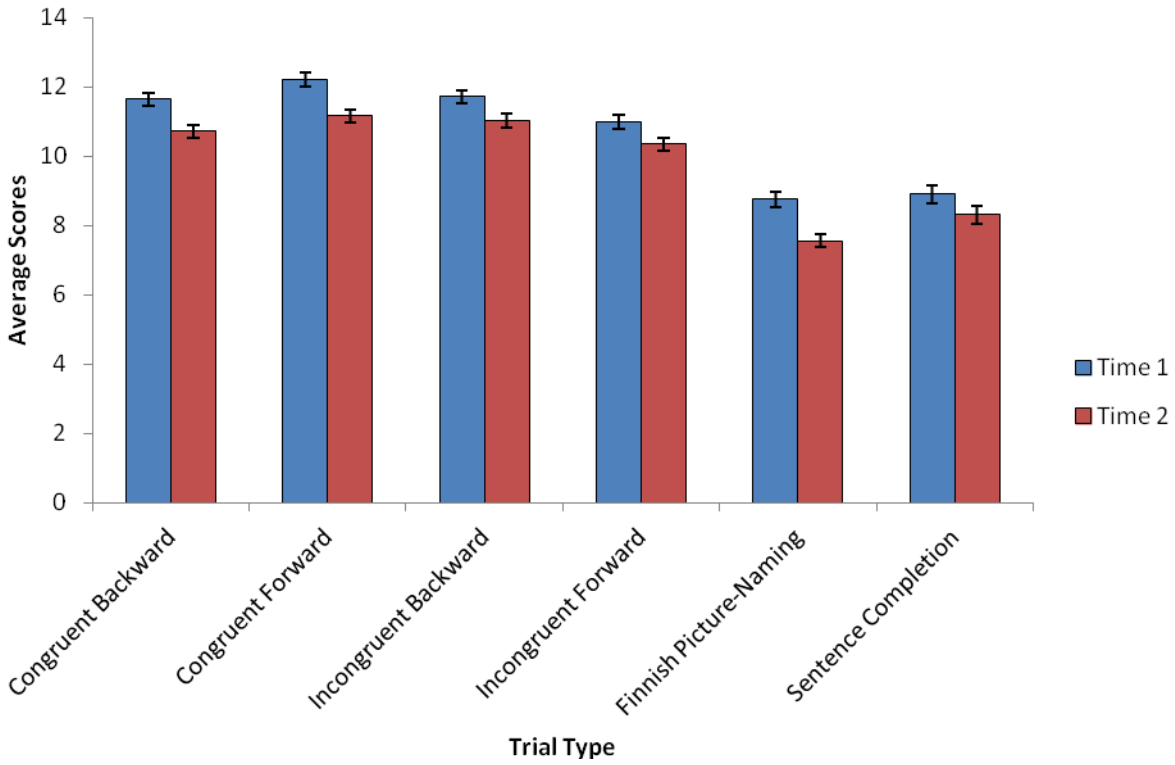


Figure 8. Comparison of Trial Accuracy Scores Across each Testing Period for Repeated Testing Learners.

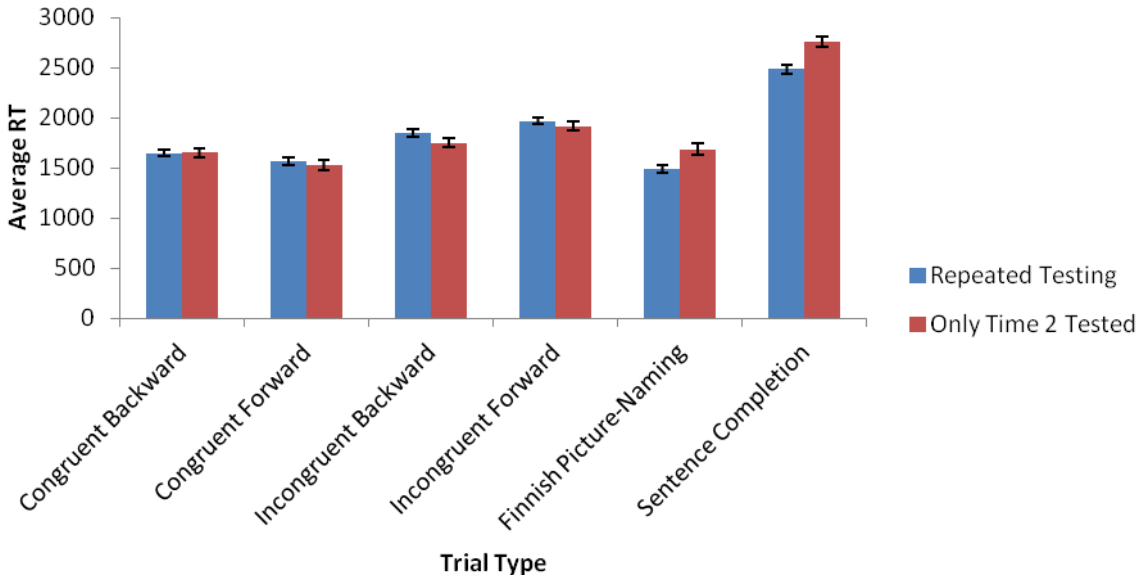


Figure 9. Comparison of Trial Reaction Times (RTs) based on the Time of Testing Condition for Repeated Testing Time 1 data and Only Time 2 Testing Time 2 data.

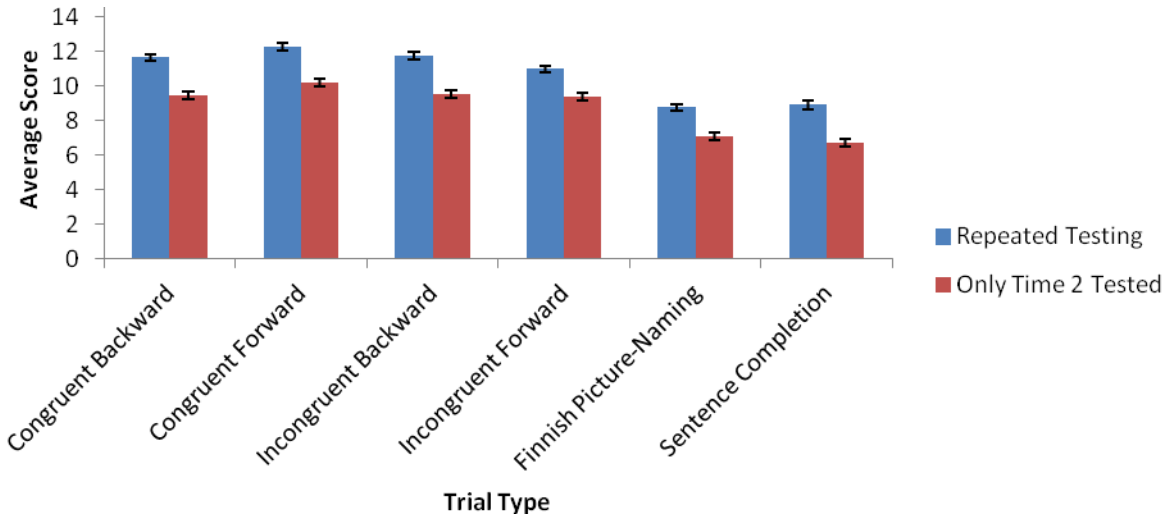


Figure 10. Comparison of Trial Accuracy Scores based on the Time of Testing Condition for Repeated Testing Time 1 data and Only Time 2 Testing Time 2 data.

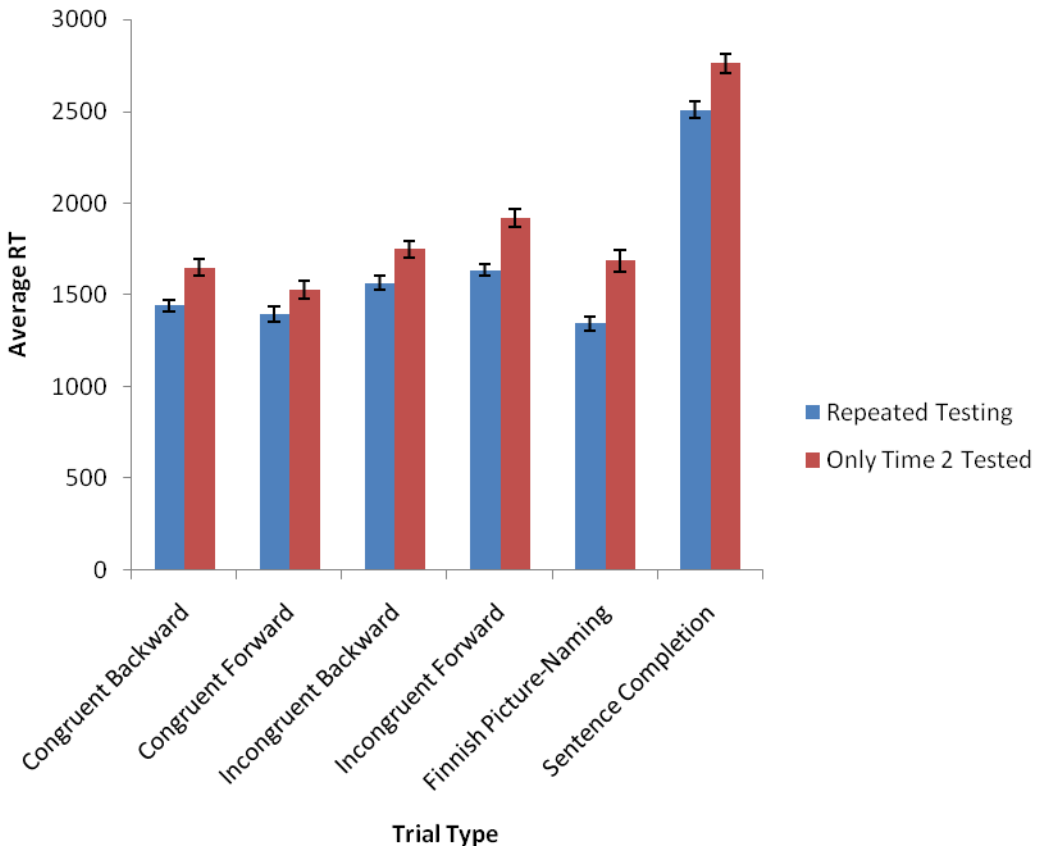


Figure 11. Comparison of Trial RTs based on the Time of Testing Condition for Repeated Testing Time 2 data and Only Time 2 Testing Time 2 data.

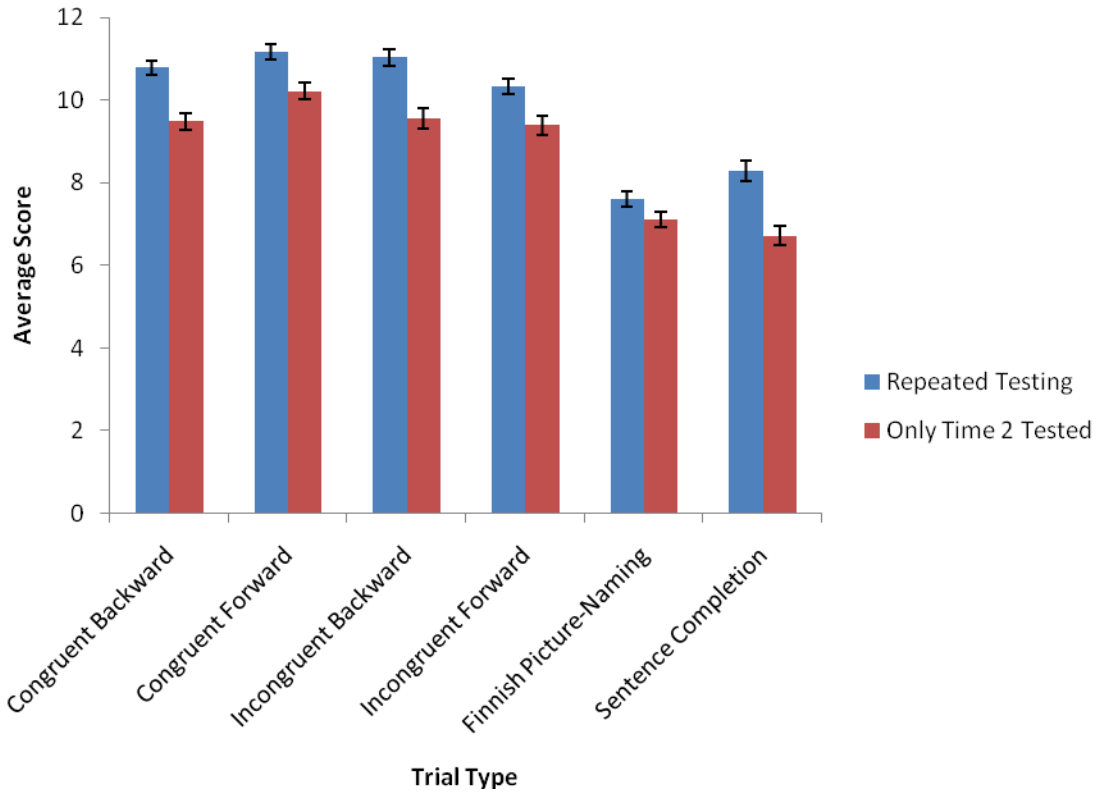


Figure 12. Comparison of Trial Accuracy Scores based on the Time of Testing Condition for Repeated Testing Time 2 data and Only Time 2 Testing Time 2 data.

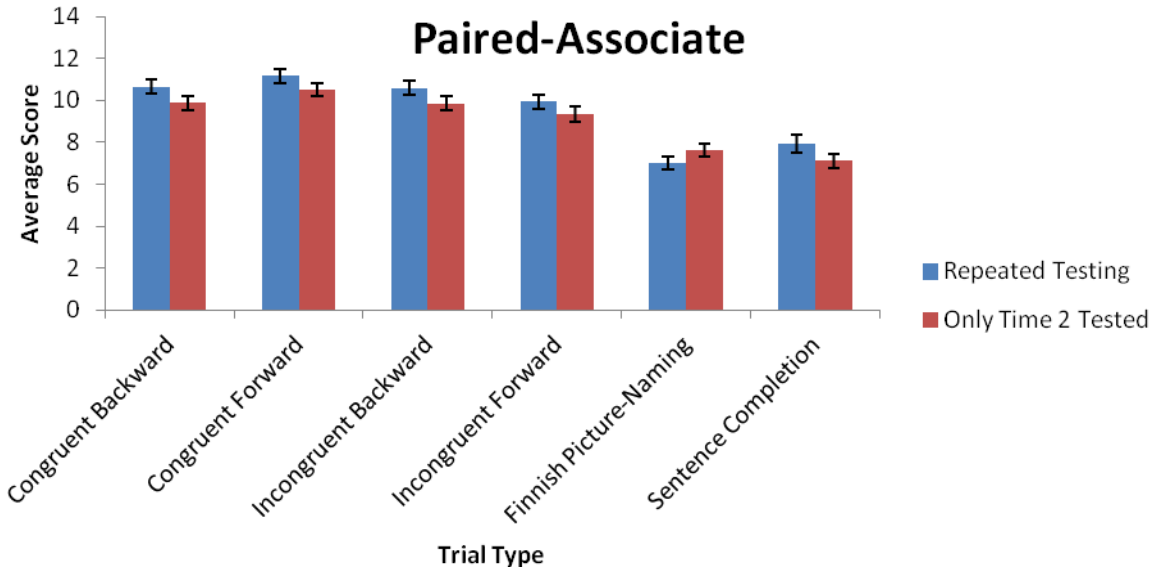


Figure 13. Comparison of Trial Accuracy Scores based on the Time of Testing Condition for Paired-associate Learners.

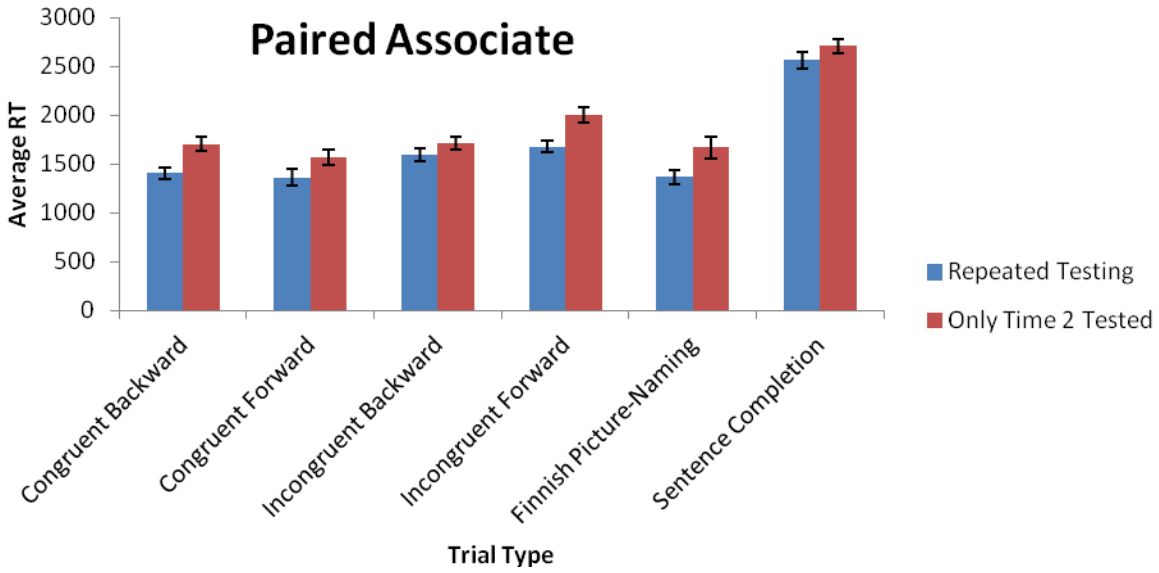


Figure 14. Comparison of Trial Procedure Reaction Times (RTs) based on the Time of Testing Condition for Paired-associate Learners.

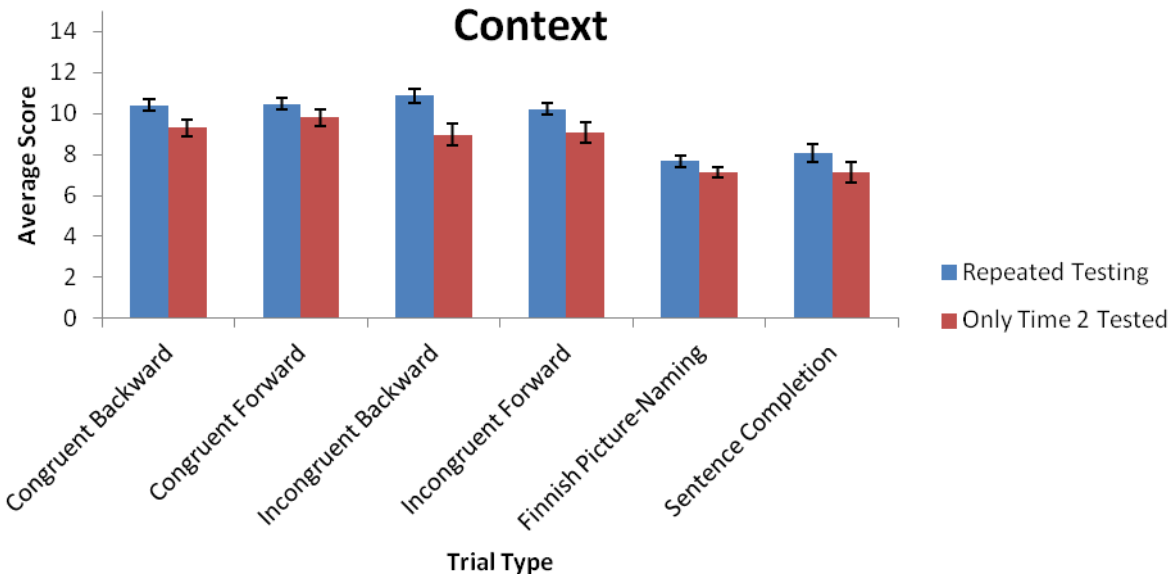


Figure 15. Comparison of Trial Accuracy Scores based on the Time of Testing Condition for Context Learners.

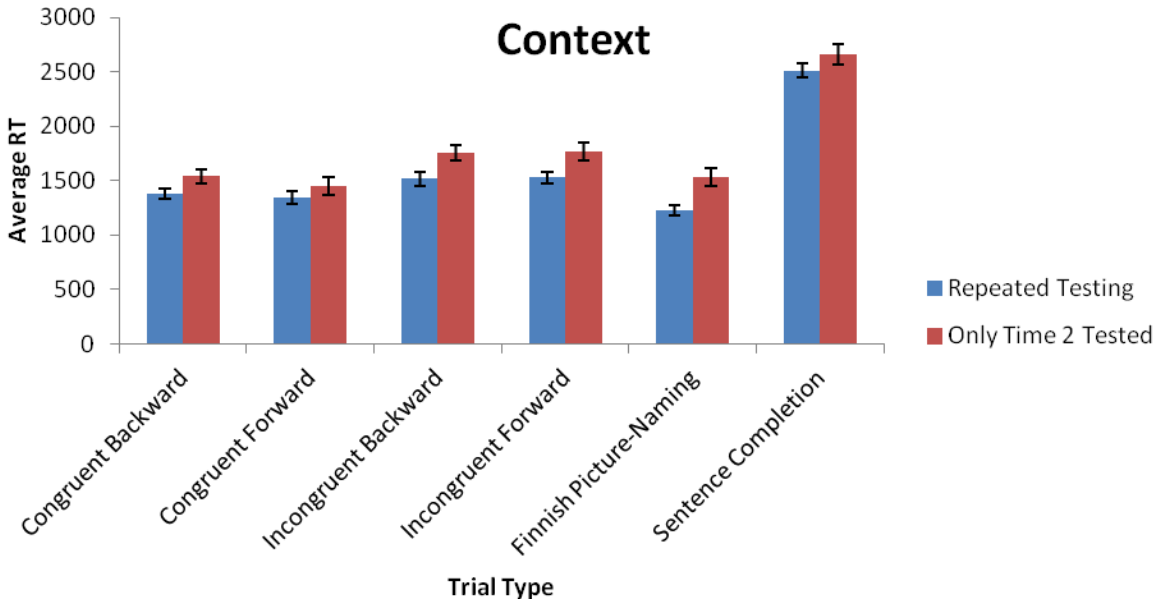


Figure 16. Comparison of Trial Procedure Reaction Times (RTs) based on the Time of Testing Condition for Context Learners.

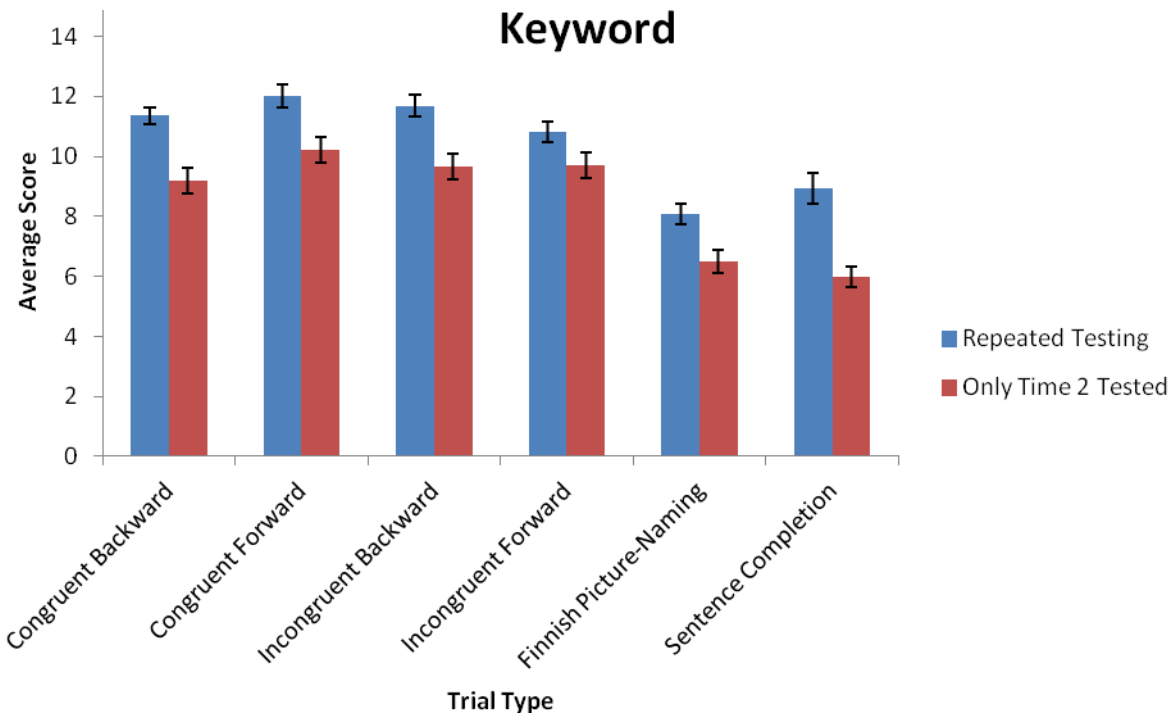


Figure 17. Comparison of Trial Accuracy Scores based on the Time of Testing Condition for Keyword Learners.

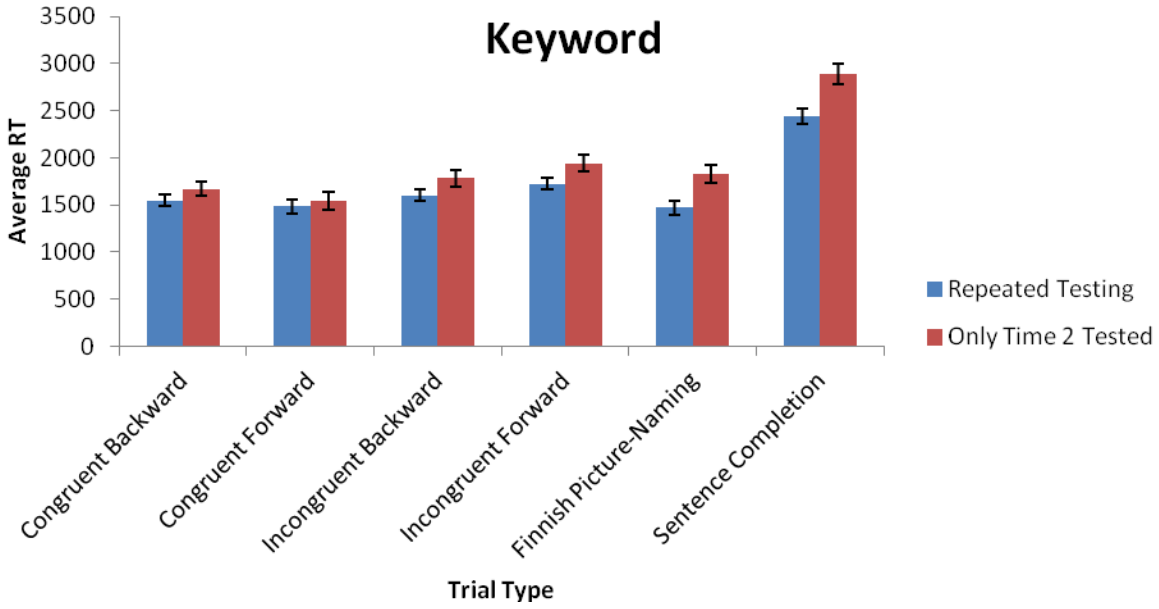


Figure 18. Comparison of Trial Procedure Reaction Times (RTs) based on the Time of Testing Condition for Keyword Learners.

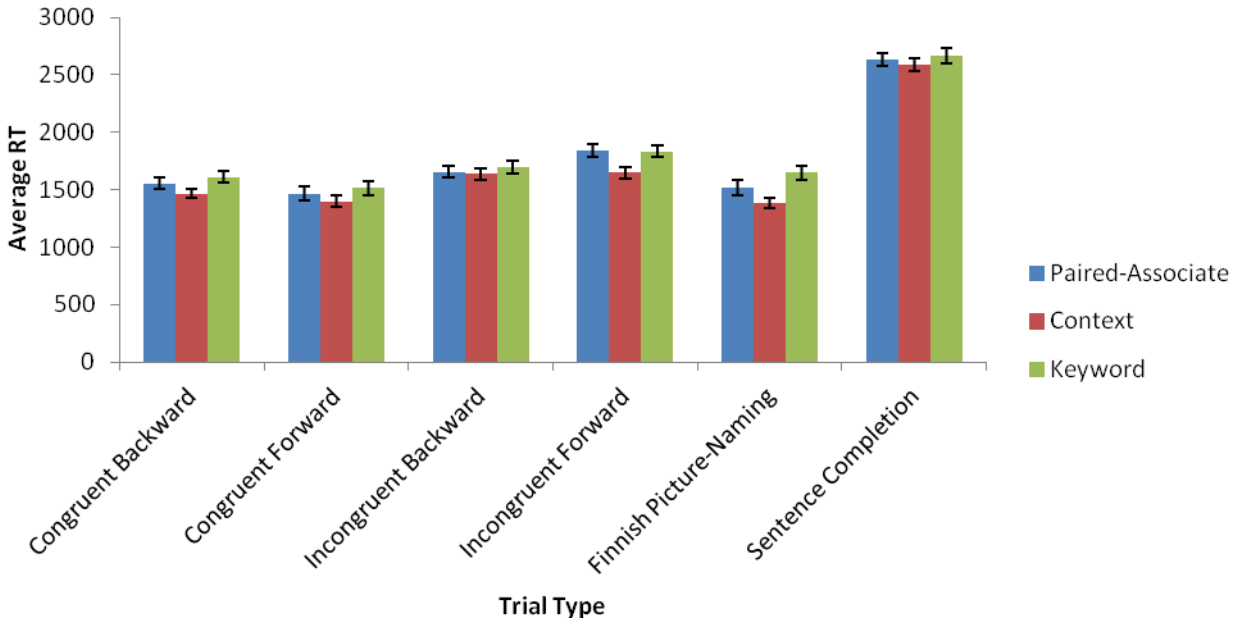


Figure 19. Comparison of Reaction Times (RTs) at Time 2 for Trial Types Based on Language Learning Method.

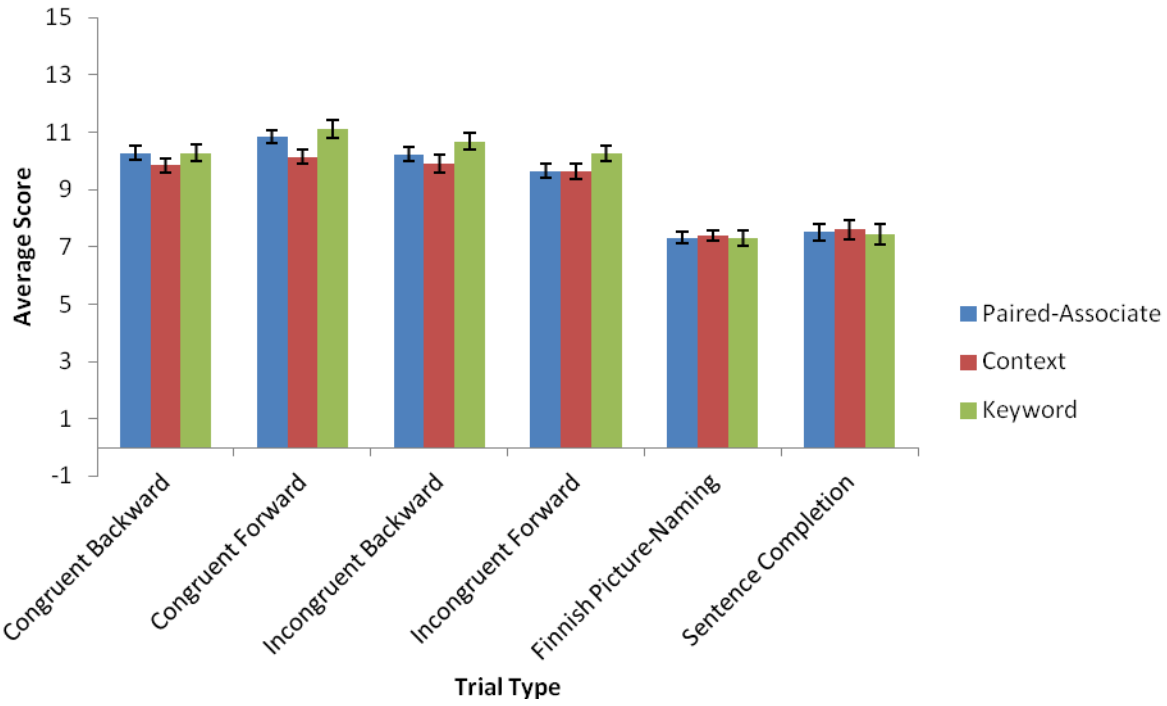


Figure 20. Comparison of Accuracy Scores at Time 2 for Trial Types Based on Language Learning Method.

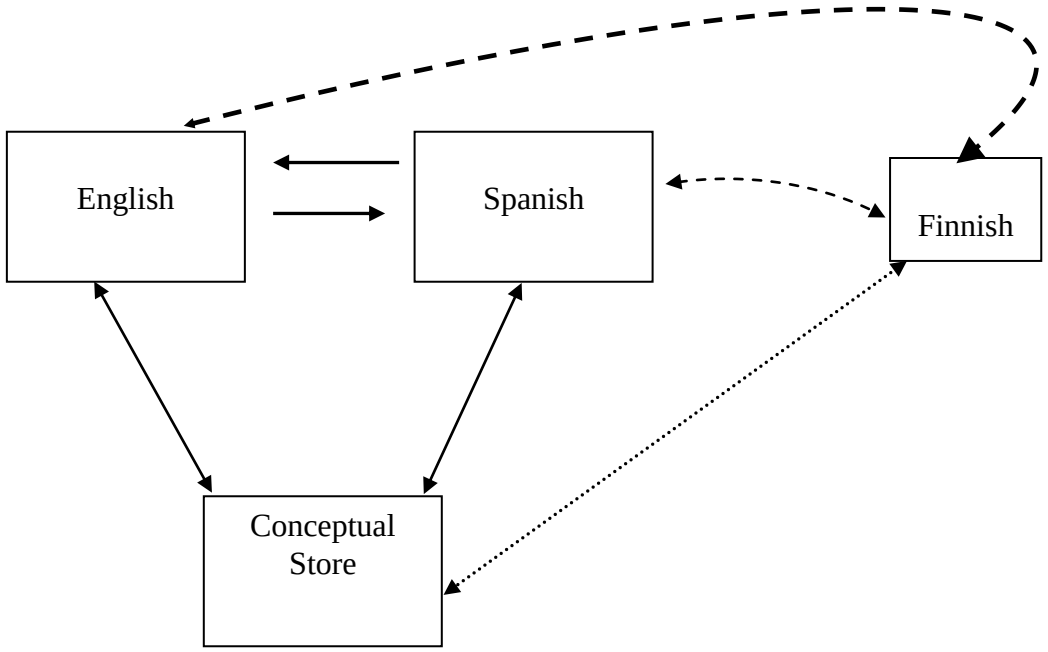


Figure 21a. Proposed Paired-Associate Learners Memory Model. Stronger associations were found for Congruent lexical links (i.e., English to Finnish or Finnish to English), and stronger associations were found for Forward translation than for Backward translation, while weaker associations were found for Incongruent lexical links (i.e., Spanish to Finnish or Finnish to Spanish). Incongruent lexical links did not differ in strength of direction. Lastly, weaker associations, than those of Congruent or Backward translations, were found for conceptual links (i.e., Finnish to the Conceptual Store). *Note*. *The darker and more solid that the lines/links are, the stronger the association being made.*

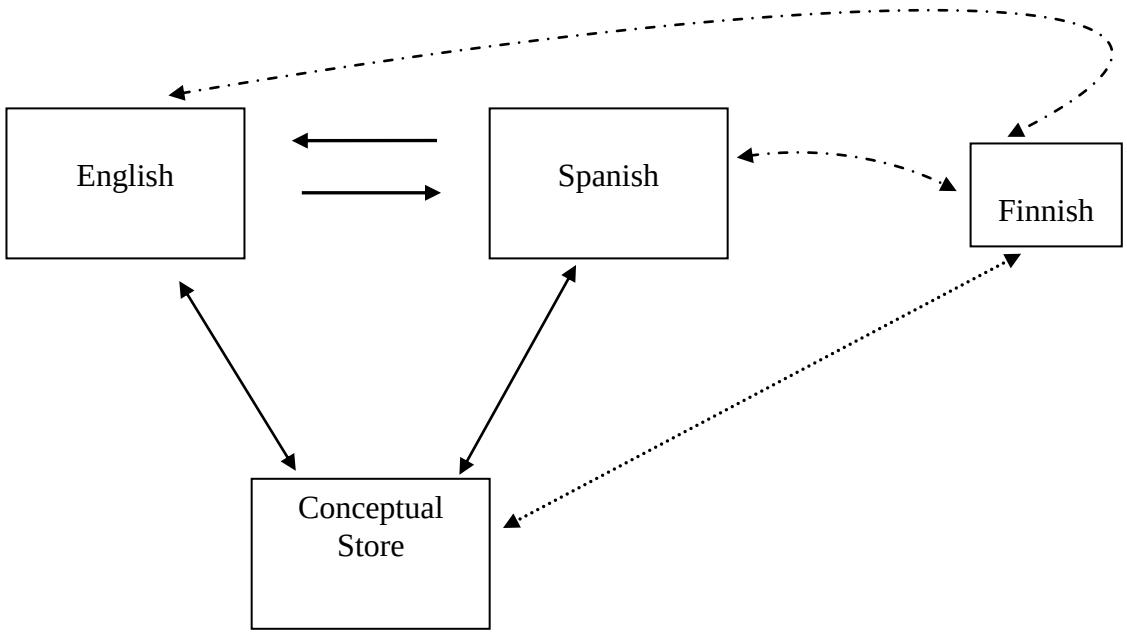


Figure 21b. Proposed Context Learners Memory Model. Equal strength in associations were found for both Congruent and Incongruent lexical links. Also, equal strength associations were found for Forward and Backward Congruent and Incongruent lexical links. Lastly, weaker associations, than those of Congruent or Backward lexical links, were found for conceptual links (i.e., Finnish to the Conceptual Store). *Note. The darker and more solid that the lines/links are, the stronger the association being made.*

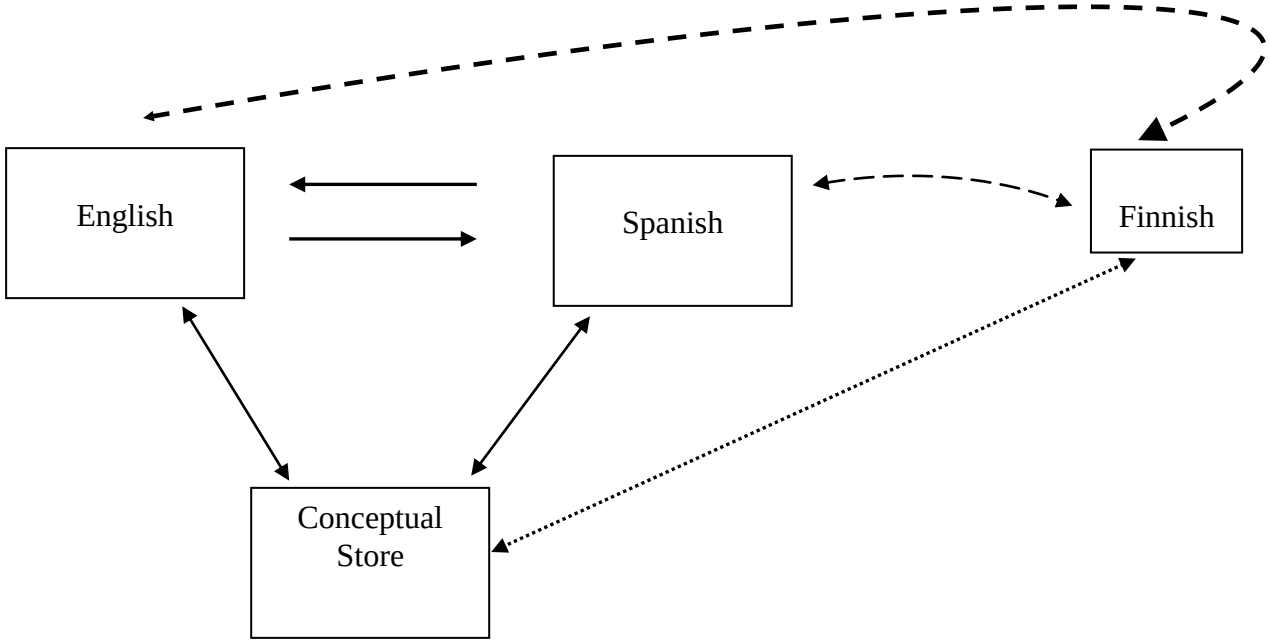


Figure 21c. Proposed Keyword Learners Memory Model. Similar to the Paired-Associate Model, stronger associations were found for Congruent lexical links (i.e., English to Finnish or Finnish to English), with stronger associations being found for Forward translations (i.e., English to Finnish) than for Backward translations (i.e., Finnish to English), while weaker associations were found for Incongruent lexical links (i.e., Spanish to Finnish or Finnish to Spanish). No differences in terms of direction of translation were found for Incongruent lexical associations. Lastly, weaker associations, than those of Congruent or Backward translations, were found for conceptual links (i.e., Finnish to the Conceptual Store). Although this model is similar to that of the Paired-Associate Model, stronger associations were found for Keyword learners than for Paired-Associate learners for Congruent Forward lexical links, while Keyword learners attained stronger associations than Context learners on Congruent Forward and Backward translations. *Note*. *The darker and more solid that the lines/links are, the stronger the association being made.*

Appendix A

Informed Consent Form

Language Performance

You are invited to participate in a research study that will measure your ability on various activities based on your language fluency in English and Spanish.

Your selection to participate in this study is based on your ability to understand English and Spanish. Your participation in this study is important for the purposes that we are intending to better understand the effects of using different language learning methods for the purposes of acquiring vocabulary from a foreign language.

You will not be required to give identifying information (e.g. Name or Social Security Number) for the study itself. You will be required to give your name and course instructor so that you may receive your appropriate credit(s) for your participation. No information that will be given during the course of the study will be able to be linked back to you or your name because all information that you will provide in the research packet will be anonymous. No potential risk(s) of any type are known or associated with this study. **The total time that this study will take to be completed will be between 45 minutes to 1 hour per session. A secondary testing session will be required of all participants which will take place one (1) week after the first session. All participants need to participate in both sessions to receive their course incentive.**

Alternatives to the participation in this study will be given by your course instructor and if at any point you wish to withdraw your participation from the study you can do so with no penalty whatsoever. If you have any questions please feel free to ask the researcher at this time or at any time during the course of the study. Once again thank you for your participation in this study.

Consent Statement:

You are voluntarily making a decision whether or not to participate. Your signature indicates that, having read and understood the information provided above, you have decided to participate.

Date: _____

Signature of Subject: _____

Signature of Investigator: _____

Appendix B

Please CIRCLE or FILL-IN your response to the following questions as best as possible. If you do not know please leave the question blank. If you have any questions please raise your hand so that the experimenter may assist you.

1) Circle your gender. Male Female

2) Provide your current age: _____

3) Circle your Ethnicity: **Circle only one** White/European American Black/African American
Hispanic/Latino
Asian Other:_____

4) Circle your current year in school. **Circle only one**
1st year (Freshman) 2nd year (Sophomore) 3rd year (Junior) 4th year (Senior) 5th year (Other)

5) What languages have you studied by taking courses in them?
English Spanish French Greek Latin Greek Finnish Other: _____

6) How many foreign language courses (e.g., French, Spanish, German, etc.) have you been enrolled in from high school, college and up to the present?_____

7) What languages do you know reasonably well?
English Spanish French Greek Latin Greek Finnish Other: _____

8) Which language did you learn first? **Circle only one**
English Spanish Other: _____

9) Which language did you learn second? **Circle only one**

English Spanish Other: _____

10) At what age did you learn your second language? _____

11) Do you consider yourself to be bilingual (Having the ability to use two languages in your daily speech). **Circle only one**

a. Yes
b. No

12) Do you know any words in Finnish?
a. Yes → If yes which words do you know? _____
b. No

Appendix B Cont.

Please RATE the following items by responding 1 to respond “Strongly disagree” and 9 as “Strongly agree”. If you have any questions please raise your hand so that the experimenter may assist you.

1 2 3 4 5 6 7 8 9

Strongly disagree **Strongly agree**

1) I can **read** English well. **Rating: _____**

2) I can **write** English well. **Rating: _____**

3) I can **speak** English well. **Rating: _____**

4) I can **understand spoken** English well. **Rating: _____**

5) I can **read** Spanish well. **Rating: _____**

6) I can **write** Spanish well. **Rating: _____**

7) I can **speak** Spanish well. **Rating: _____**

8) I can **understand spoken** Spanish well. **Rating: _____**

Appendix C

Sample Paired-Associate Word Pairs

Target Finnish Vocabulary with English Translation Equivalents

English	Finnish	English	Finnish	English	Finnish
anchor	**kankuri**	car	**vaunu**	lamp	**valaisin**
apple	**putki**	chair	**tuoli**	nose	**nokka**
arrow	**nuotli**	church	**kirkko**	pen	**karsina**
barrel	**astia**	clock	**kello**	phone	**soitella**
basket	**koppa**	couch	**leposhva**	piano	**hoyla**
bear	**tuottaa**	crown	**kruunu**	plane	**tasanne**
bed	**vuode**	desk	**tyopoyta**	ring	**soida**
bell	**tornikello**	door	**ovi**	shirt	**paita**
belt	**hihna**	dress	**leniki**	shoe	**kenka**
bicycle	**polkupy**	fence	**aita**	sock	**sukka**
bird	**pimu**	flag	**ilmaisin**	star	**tahti**
boat	**pursi**	flowers	**kukka**	table	**poyta**
book	**tilata**	glass	**lasinen**	thumb	**peukalo**
bread	**leipa**	glove	**hansikas**	train	**laahus**
brush	**pensseli**	hand	**osoitin**	tree	**vartio**
bus	**vayla**	hat	**cattu**	watch	**katsoa**
button	**nappi**	horse	**hevonen**	wheel	**ruori**
candle	**kynttila**	house	**talo**	window	**ikkuna**

Appendix D

Instructions: Please translate the given Finnish words with the appropriate English words. If you do not know a word (s) please try to the best of your ability to translate it and be aware that guessing will <u>NOT</u> be penalized. If you have any questions, please ask the experimenter now.

You have three (3) minutes to complete the translations.

Kankuri: _____

Putki: _____

Nuotli: _____

Astia: _____

Koppa: _____

Tuottaa: _____

Vuode: _____

Tornikello: _____

Hihna: _____

Polkupy: _____

Pimu: _____

Pursi: _____

Tilata: _____

Leipa: _____

Pensseli: _____

Vayla: _____

Nappi: _____

Kynttila: _____

Vaunu: _____

Tuoli: _____

Kirkko: _____

Kello: _____

Leposhva: _____

Kruunu: _____

Tyopoyta: _____

Ovi: _____

Leniki: _____

Aita: _____

Ilmaisin: _____

Skukka: _____

Lasinen: _____

Hansikas: _____

Osoitin: _____

Cattu: _____

Hevonen: _____

Talo: _____

Valaisin: _____

Nokka: _____

Karsina: _____

Soitella: _____

Hoyla: _____

Tasanne: _____

Soida: _____

Paita: _____

Kenka: _____

Sukka: _____

Tahti: _____

Poyta: _____

Peukalo: _____

Laahus: _____

Vartio: _____

Katsoa: _____

Ruori: _____

Ikkuna: _____

Appendix E

Sample Keyword list with Keyword sentences with phonologically similar Keywords

Anchor **Kankuri**
Keyword: Can
Sentence: Picture an anchor that is made up of cans.

Apple **Tynnyri**
Keyword: Tin
Sentence: Picture a tin bucket filled with fresh apples

Arrow **Nuotli**
Keyword: New
Sentence: Picture an arrow which is in the form of a knot.

Barrel **Hastia**
Keyword: Hat
Sentence: Picture a barrel filled with hats

Baskets **Hylsy**
Keyword: Hill
Sentence: Imagine the side of a hill filled with baskets

Bear **Torttaa**
Keyword: Turtle
Sentence: Image a turtle and bear racing against each other

Bed **Painoalusta**
Keyword: Pain
Sentence: Image a bed which gives you pain

Bell **Tornikello**
Keyword: Torn
Sentence: Imagine a bell which has been torn

Belt **Lintu**
Keyword: Lint
Sentence: Imagine a belt covered in lint

Bird **Pimu**
Keyword: Pen
Sentence: Imagine a bird holding a pen

Boat **Pursi**
Keyword: Purse
Sentence: Imagine a boat in the form of a purse

Book **Talita**
Keyword: Tail
Sentence: Imagine a book that has a very long tail

Bread **Lipa**
Keyword: Lip
Sentence: Imagine a piece of bread in the shape of lips

Bus **Vayla**
Keyword: Veil
Sentence: Imagine a bus covered in a wedding veil

Appendix F

Sample Context sentences

Anchor **Kankuri**

The ship's kankuri was lowered into the water

Apple **Putki**

The bright red **putki** was picked from the tree

Arrow **Nuotli**

The archer pulled his bow out and shot the **nuotli** into the air

Barrel **Hastia**

The h**astia** under the downspout was filled with rainwater

Basket **Koppa**

The fruit was put into the straw **koppa**

Bear **Tuottaa**

The **tuottaa** and her cubs went searching for food in the forest

Bed **Vuode**

The kids were sleeping in a small **vuode**

Bell **Tornikello**

The **tornikello** was ringing very loudly

Bicycle **Polkupy**

The chain broke off the **polkupy** and sent the rider coasting

Bird **Pimu**

There was a **pimu** that flew into the house

Boat **Pursi**

A new **pursi** carried the passengers out to the island

B**ook** **Tilata**

The student returned the **tilata** she had finished reading to the library

Bread **Leipa**

The baker took the fresh loaf of **leipa** out of the oven

Brush **Pensseli**

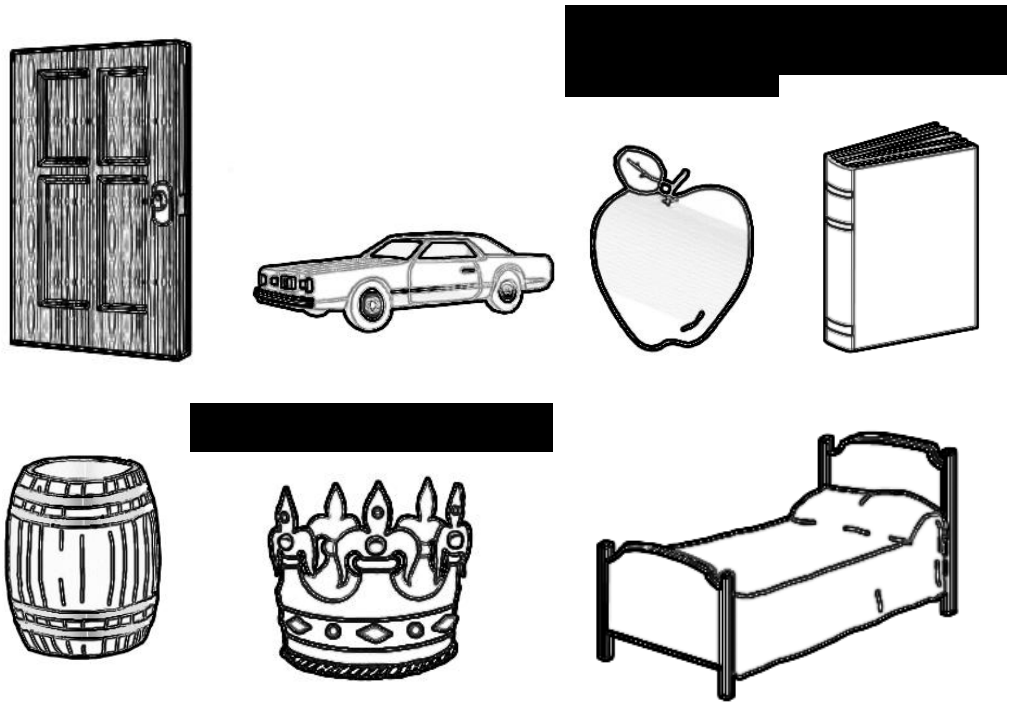
She used the **pensseli** to paint the fence

Bus **Vayla**

The school vayla picks up students and drops them off at school

Appendix G

Sample of monochrome images which were used in the Picture-Naming Task. Images were selected from Snodgrass & Vanderwart's (1980) standardized set of images.



Appendix H

Sample schematic of presentation which took place for practice trials. Only backward translations were used. Participants were instructed to answer "Yes" or "No" to if the presented word pairs are correct direct translations of each other. Prior to being shown the first trial, participant were instructed that before each word pair was presented, a fixation cross "+" would indicate that the word pair would be presented for five seconds. The fixation cross was given prior to each trial.

Screen 1

Participant will press spacebar to continue to 1st trial

Screen 2

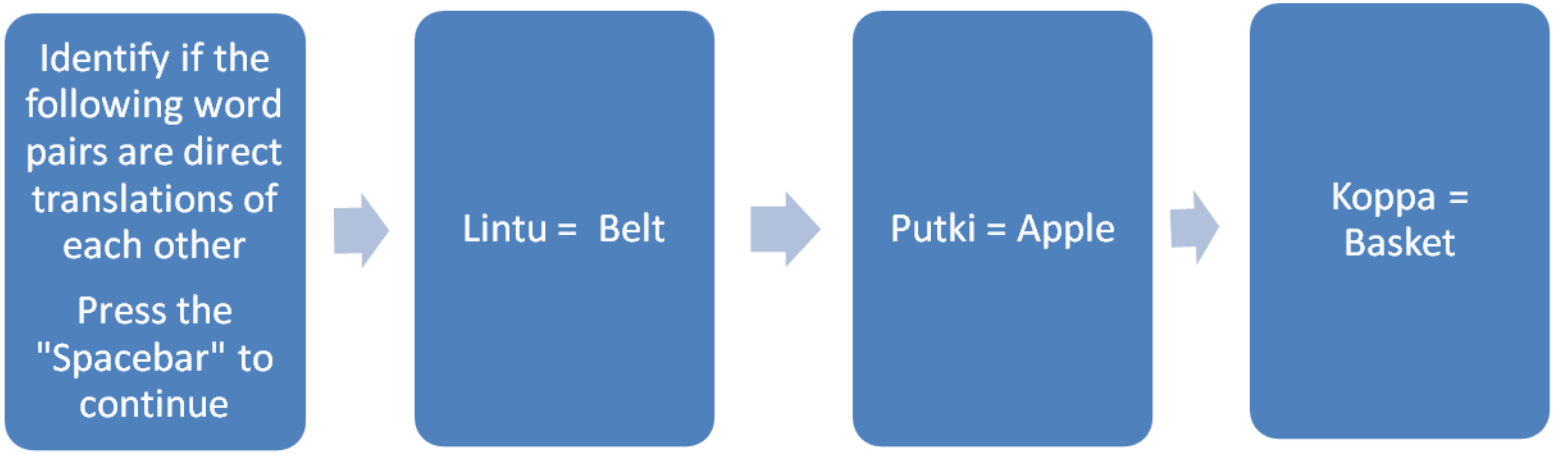
Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box

Screen 3

Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box

Screen 4

Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box



Appendix I

Below is a sample schematic of the method of presentation which took place during translation recognition trials. Participants were instructed to answer "Yes" or "No" to if the presented word pairs are correct direct translations of each other. Prior to being shown the first trial, participant were instructed that before each word pair was presented, a fixation cross "+" would indicate that the word pair would be presented for five seconds. The fixation cross was given prior to each trials.

Screen 1

Participant will press spacebar to continue to 1st trial

Screen 2

Participant will see the following screen for 5 sec. per trial.
Will need to press "Yes" or "No" on response box

Screen 3

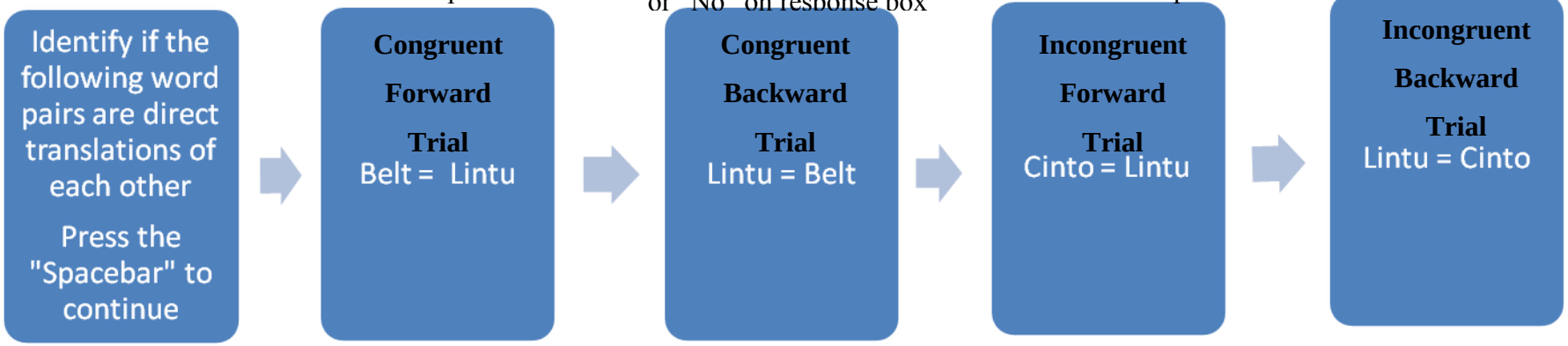
Participant will see the following screen for 5 sec. per trial.
Will need to press "Yes" or "No" on response box

Screen 4

Participant will see the following screen for 5 sec. per trial.
Will need to press "Yes" or "No" on response box

Screen 5

Participant will see the following screen for 5 sec. per trial.
Will need to press "Yes" or "No" on response box

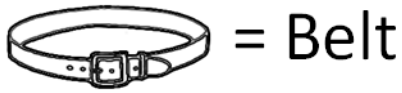


Appendix J

Below is a sample schematic of the method of presentation which took place during picture naming trials Participants were instructed to answer "Yes" or "No" to if the presented word pairs are correct direct translations of each other. Prior to being shown the first trial, participant were instructed that before each picture-word pair was presented, a fixation cross "+" would indicate that the picture-word pair would be presented for five seconds. The fixation cross was given prior to each trial.

Screen 2

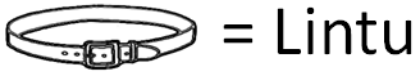
Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box



Congruent Language Learning Trial

Screen 3

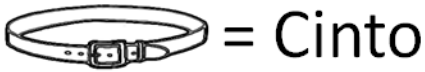
Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box



Congruent Foreign Language Trial

Screen 4

Participant will see the following screen for 5 sec. per trial. Will need to press "Yes" or "No" on response box



Incongruent Language Learning Trial

Appendix K

Below is a sample schematic of the method of presentation which took place during comprehension trials. Participants were instructed to answer "Yes" or "No" to if the presented word pairs are correct direct translations of each other. Prior to being shown the first trial, participant were instructed that before each sentence was presented, a fixation cross "+" would indicate that the sentence would be presented for five seconds. The fixation cross was given prior to each trial.

Screen 1

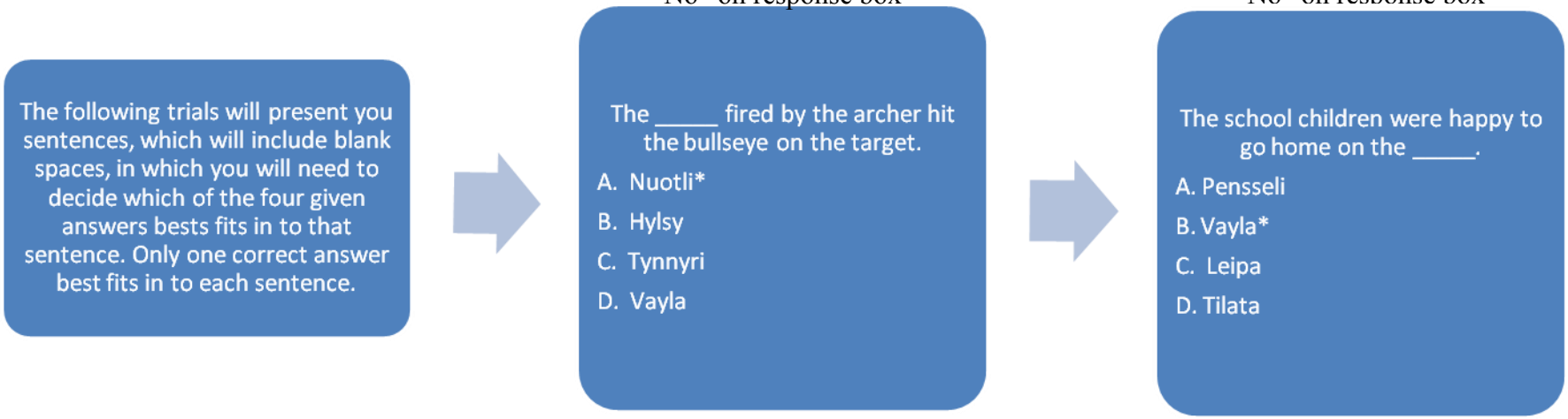
Participant will press spacebar to continue to 1st trial

Screen 2

Participant will see the following screen for 5 sec. per trial when answers appear. Will need to press "Yes" or "No" on response box

Screen 3

Participant will see the following screen for 5 sec. per trial when answers appear. Will need to press "Yes" or "No" on response box



Glossary

Backward Translation - Translation of foreign language words from Finnish (L3) to L1 or L2

Balanced Bilingual – Individual who self-reports as being equally proficient in Spanish and English based on language competency evaluations

Bilingual Mode – Activation of bilingual's both languages in which lexical access can be achieved from both languages

Bilingual Mode Theory – Bilingual theory which predicts that when bilinguals are given environmental cues, either one language (Monolingual Mode) or both languages (Bilingual Mode) may become activated

Competency/Fluency – Level of self-reported knowledge given by participants based on self-report fluency ratings. Average self-ratings of 8 or greater were considered to be high fluency, while average self-rating lower than 8 were considered to be low fluency

Comprehension Trials – Testing trial which presented participants which an English based sentence with a specific content word missing (i.e, Cloze task), followed by a set of four (4) multiple choice options from which to select the correct missing content word

Concept (Conceptual) Mediated Model of Lexical Access – Model of memory organization which predicts that no translation is needed between L2 and L1 and that L2 and L1 both have direct access to the conceptual store

Conceptual Store – Knowledge structure which stores/houses semantic (i.e., meaning) information associated with lexical items independent of the language being used

Congruent Translation Trials – Translation trials which presented Finnish target words with their English translation equivalent

Context Learning Method – Foreign language learning method which uses linguistic context information (i.e., contextual cues) from a sentence to identify the novel vocabulary

Dual-Coding Theory – Theory of memory storage and representation that assumes the existence of both a verbal and an image system in memory

Forward Translation - Translation of foreign language words from L1 or L2 to Finnish (L3)

Incongruent Translation Trials - Translation trials which presented Finnish target words with their Spanish translation equivalent

Independent Storage Hypothesis – Model of lexical organization which predicts that each language has its own separate lexicon

Keyword Learning Method – Foreign language learning method which uses image-based instruction which occurs in two steps. Step one associates the foreign word with a word in native language which sounds similar to the target word (creation of Keyword); Step two associates the Keyword word with a mental image of the target/foreign word so that the pronunciation of the target word will prime the interacting mental image, thus, leading to activation of the correct translation equivalent

Lexical Access – Process by which words in the mental lexicon are activated and later used

Lexical Memory Model(s) – Model(s) of bilingual language organization which predict that either the bilingual's languages communicate with each other (or not) and that there is communication between the languages and the meaning store (or not)

Lexical Store - Storage of previously learned vocabulary which is dependent on the language(s) which is/are known

Lexicon – Mental dictionary of lexical/vocabulary items associated with a particular language

Linguistic Context - Information which is explicitly provided and available for the

listener/hearer in a situation in which the information is needed for comprehension

Monolingual Mode - Activation of only one of the bilingual's languages in which lexical access is only designated for that one language

Paired-Associate Learning Method – Foreign language learning method, which is also known as Rote-Rehearsal, in which the learner is given only direct word translations of the target/foreign word

Picture-Naming Trials – Testing trials which presented participants with a color image and either an English, Spanish or Finnish word underneath the image

Propositional Level of Representation – In sentence or discourse memory, memory for the meaning apart from the exact words used

Reaction Times (RTs) – Time difference between when a stimulus/trial was presented to when a response is given to that stimulus/trial

Revised Asymmetrical Hierarchical Model (RHM)- Model of memory organization which predicts that translations occur between L2 to L1 and that L2 and L1 have direct access to the conceptual store

Semantic Properties – Word meaning associated with vocabulary words in any known language(s)

Situation Model (Comprehension)- A mental model of discourse which allows for the creation of the current situation given in discourse; a mental image of the events occurring in discourse

Surface Level of Representation – In sentence or discourse memory, representation of the exact words that were presented

Word Association Model of Lexical Access – Model of memory organization which predicts that only translation can occur between L2 to L1 and that no communication is available between L2 and the conceptual store