Inquiry: The University of Arkansas Undergraduate Research Journal

Volume 11 Article 7

Fall 2010

Translation Recognition in Learners of Arabic

Alia K. Biller
University of Arkansas, Fayetteville

Follow this and additional works at: http://scholarworks.uark.edu/inquiry

 Part of the Near Eastern Languages and Societies Commons

Recommended Citation
Biller, Alia K. (2010) "Translation Recognition in Learners of Arabic," *Inquiry: The University of Arkansas Undergraduate Research Journal*: Vol. 11 , Article 7.
Available at: http://scholarworks.uark.edu/inquiry/vol11/iss1/7

This Article is brought to you for free and open access by ScholarWorks@UARK. It has been accepted for inclusion in Inquiry: The University of Arkansas Undergraduate Research Journal by an authorized editor of ScholarWorks@UARK. For more information, please contact scholar@uark.edu, ccmiddle@uark.edu.

TRANSLATION RECOGNITION IN LEARNERS OF ARABIC

By Alia K. Biller

Department of Psychology

Faculty Mentor: William Levine

Department of Psychology

Abstract

The current study explored the role of phonology in the processing of Arabic words in native English speakers learning Arabic. Previous research demonstrates that three factors play a role in the mental processing of multiple languages: orthography, phonology, and semantics. Cognate studies have revealed that orthography is not the most important factor, but the roles of phonology and semantics are still indistinguishable from one another. The current study utilized phonologically-embedded English words within Arabic words at three different points in the word, beginning, middle, and end, to determine the role of phonology separate from that of semantics (e.g., تاريخ *, pronounced tareekh, and tar is a beginning overlap pair). Participants from the University of Arkansas Arabic language program completed a translation recognition task. They were shown an Arabic word, followed by an English word, and asked to identify whether the English word was the correct translation. It was predicted that participants would take longer to say "no" to false translations with phonological overlap than to false translations without phonological overlap and that less experienced learners would exhibit this effect to a higher degree than more experienced learners. While, as predicted, the reaction times for false translations with phonological overlap were substantially slower than reaction times for false translations without phonological overlap in beginning and middle overlap conditions, no significant differences were found. Arabic proficiency was found to be negatively correlated with amount of phonological interference. The results generally support the importance of phonology in the mental processing of multiple languages, which can be combined with other findings in language research to supplement language learning programs.*

Introduction

Learning a second language is almost a necessity in many fields today, including education, politics, and business. However, the processes of learning a second language vary, and their effectiveness depends on many different factors. For instance, approaches to language learning range from participating in a formal classroom setting to living abroad to using computer software. Second-language learning can also occur at any point in life, common points being early childhood, high school, and college. Furthermore, the relationship between the native language and the language being learned affects acquisition. For example, a native English speaker might be more adept at learning French than Mandarin Chinese due to the greater similarity between English and French. Any combination of approaches, ages, and languages may occur, along with many other factors, when learning a new language. Each combination specifically influences the rate of acquisition and retention and determines whether the learner ever truly acquires proficiency (Jared & Kroll, 2001). All of these factors are of great interest to researchers who wish to further uncover the process of learning another language.

The relationship between the native language and the language being learned is a factor of particular interest because the relationship itself has many components that can be explored. Some researchers investigate how similarities and differences in the grammar of two languages affect learning (Luk & Shirai, 2009). For example, does a native English speaker learn Arabic relatively slower than Indo-European languages because English has a sentence structure of subject-verb-object and Arabic has a sentence structure of verb-subject-object? Moreover, an extensive amount of research investigates how the relationship between multiple languages is represented in the mind (Drieghe & Van Heuven, 2002; Kerkhofs, Dijkstra, Chwilla, & De Bruijn, 2006). The main inquiries in this line of research are how the mind represents both languages and how these representations interact. In an examination of the literature, the exact nature of the mental representation of multiple languages often appears as a key to answering research inquiries. Within these mental representations, the associations among orthographic (i.e., the writing system of a language) representations, concepts, and phonological (i.e., the sounds that make up a language) representations emerge as playing an important role.

The current literature reflects an interest in the mental processing of multiple languages by articulating numerous theories. Kroll and Stewart (1994) proposed an influential theory called the "revised hierarchical model of lexical and conceptual representation" (RHM; see Figure 1), which is supported by much data. Its main tenet holds that processing and comprehending words in a second language (L2) is much more dependent on the first language (L1) than vice versa. This theory posits a strong link between L1 lexical items (i.e., words) and concepts. It also proposes that as an L2 is learned, the L2 lexical items are initially linked very strongly to the corresponding L1 word (e.g., *maison* in French to *house*) and very weakly to concepts (e.g., *maison* to all ideas about *house*). This results in L2 words being linked to concepts via L1 words during early stages of L2 learning. Therefore, an early L1 English learner of French seeing *maison* on a page would mentally (and unconsciously) progress from *maison* to *house* to all ideas about house instead of directly linking *maison* to all ideas about house. The RHM also posits that while the connection between L2 words and L1 words may be strong, the

reverse is much weaker. The same learner of French, upon seeing house, progresses very quickly and strongly to all ideas about *house* but very slowly and weakly to *maison*. In the later stages of L2 learning, the link between L2 words and concepts strengthens; thus, mediation via L1 words becomes less necessary over time. Many factors play a role in how all these links are established and how they develop.

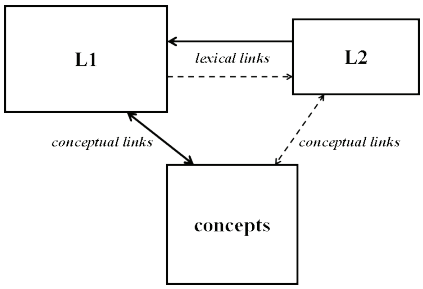

Figure 1. The revised hierarchical model (adapted from Kroll & Stewart, 1994).

The relative similarity between two languages can alter how they are mentally processed and, in turn, learned. Similarity can exist in many forms. Most important for the mental processing of words are phonological, orthographical, and semantic similarities (Gollan, Forster, & Frost, 1997). By investigating the roles of these similarities in the representation of multiple languages, researchers can gain insight into how words are processed, including whether processing one language activates another and how and under what conditions this happens.

Cognates are words in two languages that contain high degrees of orthographical, phonological, and semantic similarity in that they look and sound very similar and have almost the same meanings. False cognates (a.k.a. false friends or interlingual homographs and homophones) are words that have a high degree of orthographical and phonological similarity but no semantic similarity (Kim & Davis, 2003). *Bandage* in French and *bandage* in English, therefore, are cognates due to the fact that they have similar orthography, phonology, and the same meaning. *Avertissement* in French and *advertisement* in English are false cognates due to the fact that they have similar orthography and phonology but the French word means *warning* or *caution* and the English word is a type of publicity. Thus, cognates and false cognates allow the exploration of how similarities affect the mental processing of multiple languages.

In research literature, several facts about cognates have emerged. Cognates (*bandage-bandage*) are generally processed more quickly in the second language than words (matched on a number of variables such as frequency and length) that are non-cognate translations (*maison-house*) (Kim & Davis, 2003; Jared & Kroll, 2001; Gollan et al., 1997). Researchers often equate faster processing speed to significant priming effects. For instance, experimenters often utilize a lexical decision task (LDT) in which participants must decide whether a letter string on a computer screen is an actual word in the target language (e.g., *house* vs. *touse* if the target language is English). Frequently, participants complete a task before the LDT in which they somehow process words (e.g., read aloud a list of words). Thus, if participants initially read aloud the French words *bandage*, *maison*, and *bonjour*, they will likely most quickly decide that *bandage* is a word in English during the subsequent LTD. This result is called a priming effect because *bandage* in English was primed in the mental lexicon due to the presence of *bandage* in the first task. Priming effects are also seen in non-cognate translations (*maison-house*) but are not as strong (i.e., not as quickly identified during the LDT) (Gollan et al., 1997). Cognates and non-cognates provide an opportunity to test the three factors of orthography, phonology, and semantics in the mental processing of multiple languages in language learners and how they interact with one another.

Factors involved in the link between languages

There are many theories as to which of the three above-mentioned factors is most responsible for causing priming effects across languages. Gollan et al. (1997) argued that, because cognates have multiple shared lexical (i.e., orthographical, phonological, and semantic) representations, if the element of orthographic similarity were not present, priming effects would still occur. They conducted four studies with Hebrew-English cognates and non-cognate translation pairs which employed masked primes (i.e., a word was flashed quickly and then followed by random symbols) in one language and an LDT in the other language. Priming for both cognates and non-cognate translations was found, but only when the primes were in L1. Furthermore, priming for cognates was significantly stronger than priming for non-cognates in the same conditions. Gollan et al. argued that the stronger priming for cognates occurred because of their shared lexical representations. In other words, every time a cognate occurred in either language, the ability to recognize it in the other language increased. Therefore, under some conditions, orthographic overlap is not necessary for cognates to affect processing. In determining which lexical factors were most responsible for cognate priming and multiple-language processing in general, this study eliminated orthographic similarity, leaving phonological and semantic similarities as the causal factors.

Graduate and undergraduate students at Korean University participated in a study by Kim and Davis (2003) that examined the effect of task and similarity on priming. Cognates with semantic and phonetic overlap, non-cognate translations with only semantic overlap, false cognates with phonetic overlap (i.e., interlingual homophones), and a base group of words with no overlap across languages were utilized in different priming tasks, all of which were followed by an LDT. The results demonstrated significant priming following cognates and non-cognate translations. Thus, like the work of Gollan et al. (1997), this study eliminated orthographic similarity as necessary for priming, leaving phonological and semantic similarities as the causal factors and extending causality to different tasks and languages.

Bowers, Mimouni, and Arguin (2000) also posited that different lexical factors have different amounts of responsibility in the mental processing of multiple languages. However, they argued that orthographic similarity, rather than phonological or semantic similarity, is necessary to obtain cognate priming. Participants consisted of French-English bilinguals or Arabic-French bilinguals. The four conditions consisted of four different tasks, followed by an LDT. Notably, the cognate condition

involved reading cognates, and the cross-modal condition involved reading and speaking cognates. The French-English bilinguals demonstrated significantly greater cognate priming than cross-modal priming, while the Arabic-French bilinguals did not. However, the Arabic-French bilinguals did exhibit cognate priming. The authors argued that this result was due to the fact that cognate relations and their effects are bound to the orthographic system. However, these results only demonstrated that orthographic similarity may increase the strength of cognate priming and that lack of orthographic similarity does not eliminate cognate priming altogether.

Therefore, the links among L2 words, L1 words, and concepts in the RHM differ for cognates. Cognates compel the link that travels from L2 word to L1 word to concept (e.g., *bandage* to *bandage* to all ideas about *bandage*) to progress more rapidly than links for words that have lesser degrees of similarity (*maison-house* or *bonjour-house*). Both Kim and Davis (2003) and Gollan et al. (1997) revealed that of the three factors, orthography is not necessary to produce this quicker link. Yet, the roles of phonology and semantics are still indistinguishable from one another. It is unclear whether one factor facilitates the link more than the other.

The role of phonology in reading and production

Many tasks used in research on language processing involve visual presentation of words. However, even for silent reading, research demonstrates a considerable role of phonology in the reading process for monolinguals and bilinguals. For example, Ashby and Rayner (2004) tested the role of phonology, specifically syllables, in silent reading among monolinguals. Participants' eyes were tracked while they read, and each target word was preceded by a prime of either consonant-vowel (CV) or consonant-vowel-consonant (CVC) that matched or mismatched the target word on which reading time was measured. For example, the target word balcony had a CV match prime of ba and mismatch of tu, as well as a CVC match prime of bal and a mismatch of tug. The results revealed that matching CV or CVC to the target word produced shorter reading times. These findings support the theory that phonological representations, especially syllables, are utilized in silent reading.

Hoshino and Kroll (2008) studied the role of phonology in picture naming. Past research (Costa, Caramazza, & Sebastián-Gallés, 2000) illustrated that bilinguals name pictures more quickly when the picture is a cognate as compared to a non-cognate. The goal of Hoshino and Kroll's study was to determine whether the same effect exists when the scripts of the two languages differ. The participants were either Spanish-English bilinguals or Japanese-English bilinguals. In the critical trials, the participants were presented with pictures of an English-Spanish-Japanese cognate, an English-Spanish cognate, or an English-Japanese cognate and were told to say the name in English (the L2 for all participants) as quickly as possible; they were not alerted to the role of their L1 in the task. It was found that a similar pattern emerged for both groups of participants: faster naming when the picture was a cognate in their two languages. These results demonstrate the activation of phonology of the non-target language (L1), even when the orthographies differ.

Cross-language links in L2 development

Several studies have shown that similarities between words in two languages affect people in the early acquisition stages differently than those in the later acquisition stages. Most notably, Talamas, Kroll, and Dufour (1999) executed a study to specifically test multi-language processing at different levels of L2 proficiency. The authors cited the RHM, emphasizing that when an individual is beginning to learn a new language, there is a strong reliance on the L2-to-L1–to-concept link. However, words such as cognates seem to make the link progress more quickly. Talamas et al. proposed that with more learning, more-proficient L2 learners are better able to conceptually mediate L2, and mediation via L1 moves much more quickly or is eradicated completely. Because of this early reliance on lexical form (orthographical, phonological) to mediate access to concepts, the authors predicted that less-proficient bilinguals would be more sensitive to orthographical or phonological manipulations, while more-proficient bilinguals would be more sensitive to semantic manipulations.

To test these predictions, Talamas et al. (1999) created three groups of pairs of words for a translation-recognition task in English-Spanish: form-related pairs, semantically-related pairs, and unrelated pairs. In a translation-recognition task, each participant saw many word pairs and was asked to identify whether the second word in the pair was the correct translation of the first. When analyzing the false translation pairs, the authors found their predictions to be correct: the less-proficient participants were more influenced by form-related pairs, and the more-proficient participants were more influenced by semantically-related pairs. These findings suggest the occurrence of a shift in the process of second-language learning from a reliance on word form and sound (orthography and phonology) to a reliance on word meaning (semantics). Additionally, in their study, Gollan et al. (1997) found stronger priming effects for cognates in less-balanced bilinguals (i.e., those especially dominant in one language) in a post-hoc analysis. The cognates in Gollan et al.'s study were Hebrew-English and therefore only contained phonological and semantic overlap. Thus, Gollan et al. claimed that when less-balanced bilinguals process L2, they have a greater reliance on phonology than do more-balanced bilinguals.

Jared and Kroll (2001) performed a study that tested both the activation of phonological representations and the effects of level of proficiency on the mental processing of multiple languages. The participants were either French-English bilinguals or English-French bilinguals. The main goal of the study was to determine if French neighbors (i.e., words that share a word body with target word but have different pronunciations) slowed down the naming of English words. They created three groups of words. The first was the no-enemies group, meaning that the word bodies, the cluster of letters at the end of the word, were consistently pronounced in words across the English language and did not exist in French (e.g., *bump*, which has 'ump' as its ending, and which is pronounced consistently across all English words that contain it). The second group was the French-enemies group, which consisted of word bodies pronounced consistently in English and pronounced differently in French (e.g., bait [English] to *fait*, *lait* [French]). The third group was the English-enemies

group, in which the word bodies were inconsistent in English and nonexistent in French (e.g., *bead*, which has "enemies" such as *dead* and *head*). All participants named words presented to them in an English block, a French block, and then an English block again, after which they named pictures in French.

When analyzing the results, the authors also divided the participants into more- and less-proficient groups by accuracy in picture naming. Both proficiency groups showed more influence of French enemies only in the second block of English words, that is, only when previously exposed to French. Also, the less-proficient group showed more interference from the French-enemy pairs. Importantly, the study revealed that when the L1 was English, less-proficient bilinguals activated similar sounds in both languages to such an extent as to cause interference.

The current study

The current study builds upon the existing literature about the roles of phonological, orthographical, and semantic factors and levels of proficiency in the mental processing of multiple languages. The primary goal of the present study was to determine the extent to which phonology plays a role when a native-English speaker is reading Arabic. This was accomplished by using a translation-recognition task similar to that used by Talamas et al. (1999). While there already exists evidence that phonology plays a role in the processing of words by bilinguals across two languages with different scripts (i.e., alphabets), phonological effects have not been demonstrated in this type of translation task.

The translation recognition task allowed a test of the role of phonology without orthographic or semantic similarities in order to determine the degree of importance of phonology itself. The critical pairs were those that were incorrect translations and were also Arabic-English pairs in which the English word was embedded in the Arabic word (e.g., تاريخ [pronounced *tareekh*] – tar). Incorrect translation pairs were divided into three types based on where in the Arabic word the overlap occurred: a beginning, middle, or end (not rhyme) overlap (e.g., تاريخ [*tareekh*] – *tar* is a beginning overlap pair). Each embedded English word was used as its own control in a between-participants manner. For instance, if تاريخ – *tar* was seen by one participant; then the next saw tar paired with a different Arabic word (unrelated and length-matched to تاريخ).

The secondary goal was to test the effect of phonological similarity between groups with different levels of Arabic proficiency. This goal was accomplished by recruiting participants of varied experience and skill with Arabic.

It was predicted that the phonologically-related word pairs would interfere with making the translation-recognition decision more than phonologically-unrelated word pairs. Thus, phonologically-related pairs should have longer reaction times (RTs) than phonologically unrelated pairs. Although there is existing evidence that phonology plays a role in the processing of words by bilinguals across two languages with different scripts (i.e., alphabets) (Gollan et al., 1997; Kim & Davis, 2003), this has not been previously demonstrated in a translation task such as the one used in this study. Additionally, more experienced learners should have less interference than less experienced learners (c.f. Jared & Kroll, 2001, Talamas et al., 1999). Accordingly, experience should negatively correlate with measures of interference.

Method

Participants

The participants were 20 undergraduate students at the University of Arkansas enrolled in Arabic-language classes. Due to the structure of the Arabic program, each participant was in either the second, fourth, or sixth semester of study. An objective measure of the proficiency of each participant was gained from accuracy performance on a translation-recognition task which required recognition of correct and incorrect translations. Participants were recruited during a class meeting, at which students were informed of and offered the opportunity to participate in the study. All participants were monetarily compensated ($10) for their time.

Materials and Design

This study utilized a translation-recognition task. All Arabic words were found in book one of the Al-Kitaab Arabic textbook series (Brustad et al., 2004), the sole language source in the University of Arkansas' Arabic program. Due to the relative novice status of the participants, a frequency measure of written or spoken Arabic was not necessary or useful.

A list of 54 Arabic words was compiled as the experimental items of interest. Each of these Arabic words was paired with two English words: a correct translation (CT) and a false translation (FT). The FTs were of three types depending on where the English word's phonology overlapped in the Arabic word: beginning, middle, or end. For instance, a beginning overlap word was the tar in تاريخ (pronounced *tareekh*), a middle overlap word was the tab in مكتبة (*maktaba*), and an end overlap word was the loose in فلوس (*faloose)* (see the Appendix for a complete list of experimental items). CT reactions times were not of interest theoretically in this study. Additionally, the English word in each FT pair was paired with an Arabic word that was the same length as the original Arabic word to serve as a control.

A "family" of word-pairings thus contained three pairs: the CT, the FT, and the control. For example, one family began with the CT pair composed of the Arabic word تاريخ (*tareekh*) and its English translation of history. The FT in this family was تاريخ (*tareekh*) paired with tar. The related control was منطقة (*mintaqa*) paired with tar (see Table 1). Each participant only saw one of these three pairings. Therefore, the response time to tar in the FT pair was compared to the response time to tar in the control pair in a between-participants manner.

Table 1. Sample stimuli.

Overlap condition	Arabic word	Correct translation	False translation	Control
Beginning	تاريخ (tareekh)	history	tar	منطقة (mintaqa)
Middle	طاولة (teweela)	table	wheel	عايلة (aaila)
End	أخبار (ikhbaar)	news	bar	وظيفة (watheefa)

Note: Arabic words appeared in Arabic letters; the transliterations in parentheses are provided to illustrate the overlap in phonology between the Arabic and English words.

Two lists were created, each with 54 of the Arabic experimental words. One-third of the experimental words in each list were paired with the CT (*tareekh-history*), one-third were paired with the FT (*tareekh-tar*), and one-third were replaced by their control (mintaqa-tar). Of the 18 CTs in each list, one-third were beginning overlap, one-third were middle overlap, and one-third were end overlap. The same division occurred in the FTs and the controls. Each list was constructed so that if an Arabic word appeared with an FT on one list (e.g. *tareekh-tar*), then its control appeared on the other list (e.g. *mintaqa-tar*). Each participant only saw one list; that is, each participant saw tar only once.
In addition to the experimental trials, 54 filler trials were also seen by each participant. The purpose of the filler trials was two-fold. The first purpose was to equate the number of correct translations and incorrect translations seen by each participant. Thus, 36 filler trials were correct translations, and 18 filler trials were incorrect translations. Including both experimental and filler items, each participant saw 54 correct-translations pairs and 54 false-translations pairs. The second purpose was to ensure that some of the correct translations contained monosyllabic English words. This was necessary due to the fact that many of the FT English words were monosyllabic (e.g., tar). Therefore, the condition (CT, FT, control) and overlap (beginning, middle, end) were manipulated within participants, and the lists were manipulated between participants.

Procedures

Each participant was tested individually in a room with a computer using the DirectRT computer program. The labels "Y" and "N" were taped over the left and right arrow keys of the keyboard, respectively. During each trial, a (+) was seen in the middle of the screen until the spacebar was pressed to indicate readiness. The (+) was replaced by an Arabic word for 1500 ms, followed by a blank screen for 100 ms. An English word then appeared in the middle of the screen for 400 ms, after which a blank screen remained until the participant pressed the left arrow to indicate a correct translation or the right arrow to indicate an incorrect translation. The time from the appearance of the English word until the button press was recorded as the time required to decide whether the translation was correct. The (+) then reappeared.

Each participant first read instructions and completed two practice trials with an experimenter present. The participants were told to place the left hand on the spacebar and two right fingers on the left and right arrow keys. Upon concluding all trials, the order of which was randomized anew for each participant, the participants completed a language-history questionnaire (the results of which are not reported). The entire experiment lasted approximately 20 minutes. The participants were then debriefed and thanked.

Results

Data-screening

Twenty participants participated in the study. None of the data were excluded from analysis due to excessive errors on the translation-recognition task or noncompliance with instructions. For each participant, reaction times (RT) on correct translation-recognition trials that were classified as outliers according to Tukey's (1977) criterion were excluded from further analysis. This resulted in 6.0% of the RTs being excluded.

Correct Translations

For correct translations for experimental items, mean RTs and accuracy were calculated for each overlap type (beginning, middle, end). Beginning overlap showed a MRT = 1120, Macc = .83. Middle overlap showed a MRT = 1540, Macc = .89. End overlap showed a MRT = 1333, Macc = .89. Because these results are not of theoretical interest, they will not be discussed further.

False Translation and Controls

Mean RTs (see Figure 2) and accuracy (see Table 2) were calculated for FTs and their related controls for each overlap type (beginning, middle, end). For beginning and middle overlap items, reaction times for FTs were slower than those of the controls, as expected. For end overlap items, reaction times for FTs were very close to those of the controls.

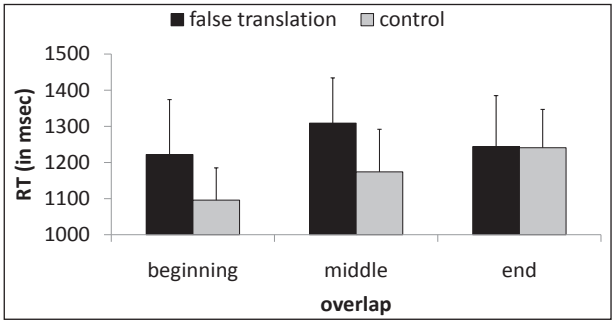

Figure 2. Mean reaction time for correct translation-recognition decisions as a function of condition (with standard error bars).

Table 2. Mean accuracies and reaction times on experimental trials as a function of condition.

	Accuracy		Reaction Time (in msec)	
Overlap condition	False Translation	Control	False Translation	Control
Beginning	.950 (.024)	.975 (.014)	1222 (151.7)	1095 (89.3)
Middle	.958 (.021)	.967 (.015)	1309 (124.7)	1174 (181.1)
End	.983 (.011)	.967 (.019)	1244 (141.1)	1241 (105.7)

Note: Standard errors/deviations are in parentheses

A 3 (overlap: beginning, middle, end) × 2 (condition: control, FT) repeated-measures ANOVA was conducted on RTs; an alpha level of .05 was adopted as the criterion for statistical significance. No significant main effect of condition was revealed ($F(1, 19) = 1.21$, $p = .29$), no significant main effect of overlap was revealed ($F(2, 38) = 1.56$, $p = .22$), and no significant interaction of overlap and condition was revealed ($F(2, 38) = 0.73$, $p = .49$). A 3 × 2 ANOVA was also conducted on accuracies, which were nearly uniform (all ≥ .95), with similar results. Therefore, neither condition nor overlap alone caused a significant difference in reaction time or accuracy. Additionally, no certain pairing of condition or overlap was significantly different for reaction time or accuracy.

Despite the ANOVA results, effect sizes were calculated for each condition. The mean reaction time, in milliseconds, for the FTs was slower than that of the controls for beginning overlap to an extent that the standardized effect size ($d = 0.26$) was at a

magnitude that is traditionally considered of medium size (Cohen, 1992). The mean reaction time for the FTs was also slower than that of the controls for middle overlap to such an extent that the standardized effect size (d = 0.34) was of medium size. The mean reaction time for FTs was very similar to that of the control for end overlap. Thus, only the effects seen in the beginning and middle overlap items were of medium size.

Proficiency

Proficiency was measured and correlated with interference measures. Performance (proportion correct) on filler trials was used as a measure of proficiency for each participant, ranging from .76 to .99 (M = .90, SD = .07). To examine the role of proficiency in the results, three interference scores were computed for each participant, one for each overlap condition. For instance, beginning interference for a participant was equal to that participant's mean beginning FT reaction time minus the mean beginning control reaction time. Proficiency scores were then correlated with the interference measures. Beginning and middle overlap correlations approached significance, while end overlap did not (beginning: r = -.40, p = .08; middle: r = -.39, p = .09; end: r = -.03, p = .92). The beginning- and middle-overlap correlations are both large in terms of effect size (Cohen, 1992). Therefore, the beginning and middle overlap conditions demonstrated a strong and nearly significant correlation, suggesting that the higher the proficiency, the lower the interference effect.

Discussion

This study was designed to examine whether phonological overlap across English and Arabic plays a role when native-English speakers read Arabic and whether less-experienced learners are more affected by phonological similarities than are more-experienced learners. Participants were recruited from University of Arkansas Arabic-language classes and were asked to complete a translation-recognition task. The false translations (FTs) of interest had an English word phonologically embedded at the beginning, middle, or end of the Arabic word (e.g., tareekh-tar). The reaction times of these FTs were compared to FTs in which no phonological overlap was present (e.g., mintaqa-tar).

Unlike cognates, the stimuli in this study contained Arabic-English word pairs with phonological similarities but without semantic similarities. Arabic and English were used in part because they share no orthographic similarities. It was predicted that pairs with phonological overlap would take longer to process than pairs without phonological overlap, resulting in longer reaction times. For beginning and middle overlap, FTs with phonological overlap produced the expected longer reaction times than FTs without phonological overlap. The differences were not significant, but the effect sizes for beginning and middle overlap were medium.

Earlier studies demonstrated that less-experienced learners are more affected by phonological similarities than are more-experienced learners (Gollan et al., 1997; Talamas et al., 1999). Therefore, it was predicted that the more-experienced learners would exhibit less interference, evidenced by a negative correlation between proficiency and interference. For each overlap type (beginning, middle, end), an interference measurement was calculated (FT reaction time – control reaction time) and was correlated with a measure of proficiency (proportion correct on filler trials). Beginning and middle overlap correlations approached significance at the .05 level. Thus, less-experienced learners appeared to be more affected by phonological overlap than were more-experienced learners.

The results of this study did not provide statistical confirmation of the predictions for the role of phonological overlap in processing Arabic words. There was nearly-significant evidence for predicted proficiency effects. The small sample size (n = 20), due to the difficulty in recruiting participants and time constraints, contributed to the lack of significant findings. Generally, the larger the sample size, the clearer the effects revealed in the data because irrelevant factors have less influence. Effects similar in magnitude to those reported above might be significant with a larger sample.

The end-overlap condition never mirrored the patterns shown in the beginning- and middle-overlap conditions. Various syllabic hypotheses posit that at least the first one or two syllables trigger lexical access, if not the first few sounds (e.g., Tagliapitra, Fanari, Collina, & Tabossi, 2009). The beginning overlap condition contained phonological overlap in the first syllable, and the middle overlap condition usually contained phonological overlap in the second syllable. According to the syllabic hypotheses, the first two syllables contain a great deal of information that plays an important role in (unconsciously) looking up words in one's mental dictionary (see also Ashby & Rayner, 2004). Thus, it is not surprising that the beginning- and middle-overlap conditions were more affected by phonological overlap than was the end-overlap condition. The pattern of data matches the predictions reasonably well, and beginning- and middle-overlap effects may be more evident with a larger sample size. Because the end overlap condition does not follow the pattern of results or predictions, it is probable that the end of a word plays little or no part in phonological processing. Therefore, further research would benefit by eliminating this condition.

Of the three factors that influence the links in the RHM (Kroll & Stewart, 1994), only phonology was tested in this study. Previous research nearly eliminated orthographic similarity as a necessary cause of cognate priming but demonstrated that it strengthens cognate priming (Bowers et al., 2000; Gollan et al., 1997; Jared & Kroll, 2001; Kim & Davis, 2003). Of the two remaining factors, phonological similarity affects less-experienced learners more than semantic similarity (Talamas et al., 1999). As less-experienced learners read relatively new words, they initially sound out the word, which, assuming they know the translation, activates the correct L1 translation and then finally the concept. In the process of sounding out the word, the English embedded word is also activated, or primed, which makes it harder to reject the FT (tar). Because more-experienced learners recognize words on sight instead of sounding them out, they are not as affected by phonological similarity. Of course, due to the nonsignificant outcomes in this study, this effect is only speculative, although there is evidence for this speculation in the findings of previous research (Talamas et al., 1999).

To further enhance this line of research, a condition

containing semantic overlap should be included and compared to the phonological-overlap condition in this study. The same basic experimental design is usable, but the critical FTs would contain semantic similarities instead of phonological (e.g. tareekh[history]–time). Proficiency correlation would be expected to demonstrate the opposite of those observed in the phonological condition. Semantic overlap is expected to interfere more with the processing of more-experienced learners than that of less-experienced learners (Talamas et al., 1999). The size of the effects overall in the two conditions should also be compared in order to determine if one condition exhibits stronger effects, which would indicate a more influential link in the mental processing of multiple languages.

Conducting other types of research concerning the degree of phonological and semantic similarity would also enhance these findings. A comparison of the effects of homophones, cognates, and non-cognates in Arabic-English bilinguals would further demonstrate which factors affect the processing of multiple languages. However, Arabic and English have a small percentage of homophones and cognates, very few of which are encountered by novice learners of Arabic. Moreover, many Arabic words that became an English word contain a definite article and noun. For example, الكحل is pronounced alkuhool, and means "the alcohol," whereas the English word alcohol is simply a bare noun without an article. Thus, this type of study would benefit from using participants from a truly bilingual population rather than relative novices in Arabic. Also, this type of study involving any two languages without orthographic overlap (e.g. English-Japanese) would likely produce more knowledge in the field of mental processing of multiple languages.

The current study built on previous findings and research concerning cognates but utilized words with partial phonological overlap instead of the full phonological and semantic overlap of cognates. The results revealed that phonological similarity may play an important role in the mental processing of multiple languages, but more research is necessary to determine its exact role. Often, language researchers work in tandem with coordinators of second language learning (SLA) and teaching English as a second language (TESOL) programs in order to implement new techniques. Phonology as a field is growing in importance within the SLA and TESOL communities (Jared & Kroll, 2001). By solving one piece of the puzzle at a time, researchers can discover the complicated process by which second languages are acquired.

References

Ashby, J., & Rayner, K. (2004). Representing syllable information during silent reading: Evidence from eye movements. *Language and Cognitive Processes*, 19, 391-426.

Bowers, J., Mimouni, Z., & Arguin, M. (2000). Orthography plays a critical role in cognate priming: Evidence from French/English and Arabic/French cognates. *Memory & Cognition*, 28, 1289-1296.

Brustad, K., Al-Batal, M., & Al-Tonsi, A. (2004). *Al-Kitaab fii ta-allum al-Arabiyya with DVDs: A textbook for beginning Arabic* (2nd ed.). Washington, DC: Georgetown University Press.

Cohen, J. (1992). A power primer. Psychological Bulletin, 112, 155-159.

Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 26, 1238-1296.

Drieghe, A., & Van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system; From identification to decision. *Bilingualism: Language and Cognition*, 5, 175-197.

Gollan, T., Forster, K., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew-English bilinguals. *Journal of Experimental Psychology*, 23, 1122-1139.

Hoshino, N., & Kroll, J. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition,* 106*,* 501-511.

Jared, D., & Kroll, J. (2001). Do bilinguals activate phonological representations in one or both of their languages when naming words? *Journal of Memory and Language*, 44, 2-31.

Kerkhofs, R., Dijkstra, T., Chwilla, D., & De Bruijn, E. (2006). Testing a model for bilingual semantic priming with interlingual homographs: RT and N400 effects. *Brain Research*, 1068, 170-183.

Kim, J., & Davis, C. (2003). Task effects in masked cross-script translation and phonological priming. *Journal of Memory and Language*, 49, 484-499.

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, 33, 149-174.

Luk, Z., & Shirai, Y. (2009). Is the acquisition order of grammatical morphemes impervious to L1 knowledge? Evidence from the acquisition of plural -s, articles, and possessive's. *Language Learning*, 59, 721-754.

Tagliapitra, L., Fanari, R., Collina, S., & Tabossi, P. (2009). Syllabic effects in Italian lexical access. *Journal of Psycholinguistic Research*, 38, 511-526.

Talamas, A., Kroll, J. F., & Dufour, R. (1999). From form to meaning: Stages in the acquisition of second-language vocabulary. *Bilingualism: Language and Cognition*, 2, 45-58.

Tukey, J. W. (1977). Exploratory data analysis. Reading, MA: Addison-Wesley.

Mentor Comments: Dr. Levine's comments highlights Alia's use of her academic preparation in linguistics, psychology, and Arabic in developing this complex study related to second language acquisition.

The primary goal of Alia Biller's honors thesis research was to examine the representation and processing of Arabic words in native-English speakers who are learning Arabic. Although there is a huge amount of research in the cognitive psychology

of bilingualism, there is little research on bilinguals whose two languages are written in different scripts, and, to our knowledge, none on the pairing of English and Arabic. By examining learners relatively early in the acquisition of a second language, and across a range of proficiencies, Alia was able to find evidence of phonological overlap between the representation of Arabic and English words. This suggests that even in these two languages that do not share a script, reading Arabic words activates (irrelevant) English words that share sound information, especially among learners of Arabic with relatively-low proficiency. This research has theoretical implications for how a second language is mapped onto one's native language during acquisition, and potentially has practical implications for how second-language-acquisition programs might be fine-tuned to help students increase their proficiency more quickly. We will be presenting these findings at the 51st Annual Meeting of the Psychonomic Society in St. Louis in November, 2010. Alia's research represents the culmination of two-and-a-half years of collaboration between us, and is my laboratory's first foray into bilingualism research. This was made possible by her desire to prepare herself for a career in linguistics. Her interest in Arabic, language in general, and psychology, made this project a natural for us to work on together, and would not have happened if not for her sharp focus on her goal. It is very rewarding that Alia will be continuing her studies in the Master's in Applied Linguistics program at Boston University beginning in Fall, 2010, and that we will be able to continue our collaboration on this research.

Appendix: Experimental stimuli

Key to layout

Arabic Word, English Translation (English sound) (English Transliteration): classification and number of letters

Control: Arabic Word, English Translation (English Transliteration): classification and number of letters

Beginning Overlap Stimuli

أيضاً , Also (eye) (eyedan): adv4

فعلاً , Really(faalan): adv4

تاريخ, History (tar) (tareekh): noun5

منطقة , Area/region (mintaqa): noun5

صاحب , Friend (saw) (saahib): noun4

مساء , Evening (msaa): noun4

كتاب , Book (key) (ketaab): noun4

والد , Father (waalid): noun4

جيش , Army (Jay) (jaysh): noun3

جيش , Literature (adaab): noun3

سورة , Picture (sue) (suura): noun4

نهار , Daytime (nehaar): noun4

جريدة , Newspaper (jar) (jareeda): noun5

مدينة , City (madeena): noun5

ليلة , Night (lay) (layla): noun4

خالة , Maternal aunt(khaala): noun4

سياحة , Tourism (sea) (seeyaha): noun5

رسالة , Letter (resaala): noun5

بريد , Mail, post (bar) (bareed): noun4

غداء , Lunch (ghadaa): noun4

ورقة , Piece of paper (war) (waraqa): noun4

موظّف , Employee (muwathafa): noun4

حمّام , Bathroom (ham) (hammam):noun4

مجلّة , Magazine(majalla): noun4

Middle Overlap Stimuli

مترجم , Translator (gym) (mutarjim): noun5

موضوع , Subject (mowdoaa): noun5

قلواط , Table (wheel) (teweela): noun5

قلئاع , Extended family (aaila): noun5

مكتبة , Library (tab) (maktaba): noun5

مسلسل , T.V. series (musalsal): noun5

حقيقة , Actual, real (key) (hakekeya): adj5

متأخر , Late (mutakher): adj5

طفولة , Childhood (fool) (tafoola): noun5

بناية , Building (benaaya): noun5

تجارة , Trade (jar) (tejaara): noun5

مدرسة , School (madrasa): noun5

إقتصاد , Economics (tea) (iqtesaad): noun6

محاضرة , Lecture (muhadera): noun6

مباراة , Game (bar) (mubaara): noun6

مستقبل , Future (mustaqbal): noun6

علاقة , Relationship (lack) (3laaqa): noun5

أسبوع , Week (usbooa): noun5

مهندس , Engineer (hand) (muhandis): noun5

وزارة , Ministry (wezaara): noun5

مقالة , Article (call) (muqaala): noun5

جامعة , University (jaamiaa): noun5

منتصف , Middle (toss) (muntasof): adj5

مشغول , Busy (mushghool): adj5

End Overlap Stimuli

دائماً , Always (man) (da-imaan): adv6

بسرعة , Quickly (bisuraa): adv5

أخبار , News (bar) (ikhbaar): noun5

وظيفة , Position, job (watheefa): noun5

قصة , Story (saw) (qissa): noun3

لغة , Language (lugha): noun3

فلوس , Money (loose) (faloose): noun4

أسرة , Family (usra): noun4

علوم , Sciences (loom) (3loom): noun4

شارع , Street (shaaria): noun4

زميل , Classmate (meal) (zameel): noun4

صفحة , Page (safha): noun

أفراد , Individuals (rod) (aafrod): noun5

ساعة , Hour (saaa)

خريف , Autumn (reef) (khreef): noun4

صديق , Friend (sadeek): noun4

ازدحام , Over crowdedness (ham) (izdehaam): noun6

صيدلية , Pharmacy (sydalia): noun6

وحيد , Loneliness (heed) (waheed): noun4

درجة , Degree (daraja): noun4

أخلاق , Morals (lack) (ikhlaq): noun5

حديقة , Garden/yard(hadeeqa): noun5

مكان , Place (can) (makaan): noun4

حادث , Accident (haadith): noun4