

LANGUAGE PROCESSING IN ARABIC-ENGLISH
BILINGUALS: A MIXED METHODS INVESTIGATION

By

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Abstract:

This study examines second language activation in Arabic-English bilinguals for whom Arabic was the first language. Modeling its design on Colomé (2001), the research compared processing in a picture-phoneme matching task for Arabic-English bilinguals tested in the United States or in Saudi Arabia to determine whether activation of English differed in the two settings as predicted by Grosjean's (1982) language mode theory. Relying on a pragmatic worldview, an explanatory sequential mixed methods approach was adopted to gain a full perspective of the research problem. The results showed no differences in the activation of English for the two settings, but did indicate that both groups of participants experienced some interference of English. Overall, interference from English was observed in error rates, but not in response times. Correlational analyses revealed that individual differences in error rate in the English phoneme condition were predicted by the number of hours per week that participants used English. Individual differences in response time were predicted by the frequency of the English translation equivalent of the Arabic name of the picture. Finally, the study established the language processing mechanism of Arabic-English bilinguals as one in line with Grosjean's (1982) language mode theory, as Arabic-English bilinguals may be more likely to employ separate language strategies for sociocultural reasons than other types of bilinguals.

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CHAPTER I

INTRODUCTION

In the bilingual language processing literature, there has been a long standing debate regarding the extent to which the bilingual's two languages are stored separately or together in their memory (Grosjean, 1982; Dijkstra & Van Heuven, 2002; Kroll & Stewart, 1994). Prior research has supported three opposing theories of bilingual memory: a) the revised hierarchy model (RHM), which advocates language separation (Kroll & Stewart, 1994), b) the bilingual interactive activation plus (BIA+) model, which argues for language co-activation (Dijkstra & Van Heuven, 2002), and c) the language mode theory, which suggests that during bilingual language processing, the extent to which both languages are activated simultaneously can be influenced by a number of variables, including where the bilingual is and whether the people present know one or both of the bilingual's two languages (Grosjean, 1982). The focus of the present research was to examine whether a bilingual's second language (thereafter L2) is activated during first language (thereafter L1) processing and to determine whether the location in which a bilingual is tested influences the level of activation of the L2. Bilingual language processing was investigated for Arabic-English bilinguals for whom Arabic was the first language, which is a category of bilinguals that has been highly neglected in the literature.

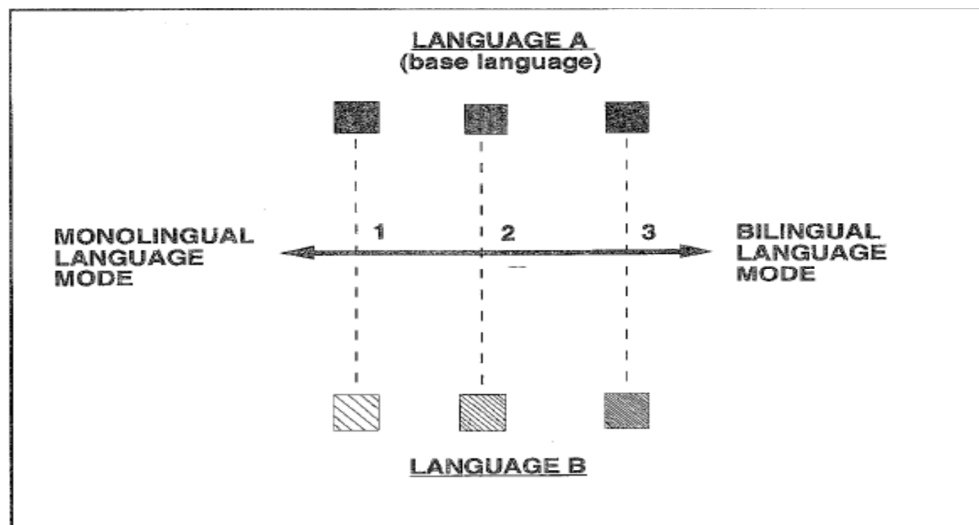
Theoretical Framework

The present research is conducted in relevance to the language mode theory (Grosjean, 1982) which revolves around the *language mode continuum* (Grosjean, 1997, p. 169).

Grosjean introduced his model as one for bilingual language processing. The main underpinning of his theory is that a bilingual does not constantly use one specific language processing mechanism. However, language processing fluctuates according to the person and situation variables surrounding the speaker and the speech event. Since these variables can change in a very rapid manner, the language processing mechanism of the bilingual may also change rapidly. Grosjean asserted that this rapid change occurs on a language continuum with two endpoints, a monolingual endpoint and a bilingual endpoint (Figure 1).

Figure 1

Language mode continuum (Grosjean, 1997, p. 169)



The variables that affect the bilingual's status on the language mode continuum are numerous. For example, it can be affected by the bilingual's proficiency level in both

languages, the interlocutor, the topic being discussed, sociocultural considerations, life domains, etc. Grosjean asserted that such variables affect the bilingual's *language choice* mechanism, hence her *base language* (Grosjean, 2013, p. 15). If the bilingual decides that only one language is needed, she will be closer to the monolingual endpoint of the continuum. If she decides that both languages are needed, she will be closer to the bilingual endpoint of the continuum. In many cases, the bilingual will find herself in the mid area of the continuum. Such a situation occurs if both languages are needed, however one more than the other.

Figure 1 shows the points at which a bilingual's languages may exist on the language mode continuum. Once the speaker chooses her base language, it will be in full activation (i.e., the dark squares at the top). Language B, which is the non-target language, can be activated at different levels (i.e., the three squares at the bottom). The leftmost square at the bottom indicates low activation of the non-target language. It indicates low rather than no activation because it is impossible for a bilingual to totally deactivate one of her two languages. The rightmost square indicates high activation of the non-target language.

The baseline of Grosjean's theory is that bilinguals, on a daily basis, find themselves at different points of the language mode continuum according to the factors and variables surrounding the speech event. Accordingly, bilingual language processing is highly dynamic and the activation of the two languages is influenced by many person and situation variables. This is supported by the literature. Many studies showed that bilingual language processing is sensitive to the episodic context (Blanco-Elorrieta & Pytkkanen, 2015; Duyck, Vanderelst, Desmet & Hartsuiker, 2008; Fishman, 1964; Fishman, 1965; Giles, Taylor & Bourhis, 1973;

Grosjean, 2000; Reder, Nhouyvanisvong, Schunn, Ayers, Angstadt & Hiraki, 2000; Sahgal, 1991; Siachitema, 1991).

One such affective variable is the proficiency level of the bilingual in both languages. This is because language processing is affected by the type of information the speaker is more familiar with and has better mastery of (Poulisse & Bongaerts, 1994). Proficiency level also affects the language control abilities of bilinguals. When highly proficient bilinguals establish strong control abilities, this enables them to process language using a language-specific selection mechanism, even when using one of their weaker languages (Costa & Santesteban, 2004). For example, if a bilingual who is highly proficient in both languages is speaking to another bilingual who is also highly proficient in the same two languages, she will be in more comfortable using both languages. However, if the recipient is not proficient in one of the two languages, the bilingual will suppress the language not needed and try to deactivate it. Since these speaking circumstances can change rapidly, the level of language activation can also change very quickly. For instance, if the bilingual suddenly realizes the other participant is uncomfortable with one of the two languages, she will immediately attempt to deactivate that language. This is usually the case because bilinguals accommodate with their recipient(s). They do so by including more of the interlocutor's language into their speech (Grosjean, 2000). They sometimes do this to be socially viewed in a more preferable manner (Giles, Taylor & Bourhis, 1973).

Bilinguals are also affected by the nature of their life domains. They associate each domain with the language that best serves its needs. Accordingly, their language decisions are affected by the dynamics of the situation of the domain (e.g. topic, participants). For instance, the youth constantly use their first language in situations when they are dealing with

their grandparents (Siachitema, 1991) but a more universal language when in social events that include peers from other speech communities (Sahgal, 1991). Additionally, bilinguals are also affected by subjective word frequency. High-frequency words have more contextual associations, each of which strives to be chosen, which causes high levels of competition, a delay in activation, and impeded response times (Reeder et al., 2000).

Bilinguals are also affected by the location of the speaking event, which strongly affects the status of their base language, and in turn its level of activation. This is due to the location's tendency to increase the amount of usage of that specific language. One example of the effect of location on language processing is MC, an adult English-German speaker. At the age of 26, MC was at a relatively low proficiency level in German because of his rare use of it in his daily routine. However, when he moved to Germany at the age of 36, he started using the German language on a daily basis and became highly proficient in it. This change of routine in his language use, caused a decline in his other two languages, English and French (Grosjean, 2013). Similar to MC's situation, is EP's situation, who is also an adult bilingual. The language configuration of EP shifted between the ages of 20 and 30 when he transferred to Switzerland. Consequently, EP's German language improved drastically, and he also acquired two new languages, Spanish and Swiss German because they are languages used in Switzerland (Grosjean, 2013). Accordingly, one concludes that using a language in its native setting is quite different from using it in its non-native setting. Hence, location is assumed to have a noticeable effect on the language dominance of a bilingual as well as how active the two languages may be at a certain point of time.

Research has proven that bilingual language processing is a highly complicated process. Accordingly, researchers in psycholinguistics have been striving to establish a full

and comprehensive understanding of the mechanisms used to process language. Grosjean's theory is not the only bilingual language processing model in the literature. Rather, the literature includes other models which focus on word processing and which attempt to explain this complex issue.

One line of research in bilingual language processing asserts that the two languages of a bilingual are separated at the lexical level (Costa, 2005; Costa, Miozzo & Caramazza, 1999; Gerard & Scarborough, 1989; Hernandez, Bates & Avila, 1996; Kroll, Bobb, Misra & Gou, 2008; Li Heij, 2005; Ojemann & Whitaker, 1978). Advocating this view, the revised hierarchy model (RHM) (Kroll & Stewart, 1994) asserts that bilinguals' concepts are shared between the two languages, but their lexical items are constantly separated from one another. Support for the RHM has come from experiments in which it was shown that words from the non-target language do not affect the participants' lexical decision latencies when they are making judgements about words from the target language (Gerard & Scarborough, 1989).

The primary competing model to the RHM is the BIA+ model of bilingual memory (Dijkstra & Van Heuven, 2002) whose advocates argue that once activation is established at the orthographic level, active nodes pass on activation to their associated phonological and semantic representations in both languages. The activated phonological and semantic representations are affected by extra-linguistic factors, such as the task demands. Consequently, the two languages of a bilingual are believed to be connected at the lexical level, and language activation is nonselective (Bijeljac-Babic, Biardeau & Grainger, 1997; Chee, 2006; Colomé, 2001; Crinion, Turner, Grogan, Hanakawa, Noppeney, Devlin, Aso, Urayama, Fukuyama, Stockton & Usui, 2006; Dijkstra, 2001; Kaushanskaya & Marian, 2007; Marian, Spivey & Hirsch, 2003; Van Heuven, Dijkstra & Grainger, 1998).

Evidence for the model has come from experiments showing that the phonological attributes of one language can influence the processing of the word onset for words from the other language (Marian, Spivey & Hirsch, 2003). In addition, research has found that a bilingual with brain deficits in areas responsible of controlling the two languages involuntarily switches between her/his languages. Considering such switching as the normal status of the bilingual's two languages is a strong indication of their interconnectedness and co-activeness (Crinion et al., 2006).

Background Research

Understanding language processing in bilinguals is challenging because it not only involves language processing, but also the status of the two languages of the bilingual during processing. Do the two languages interact? In what way do they interact? Are the representations (i.e., semantic, phonological, and lexical) of the two languages shared or separated? The literature includes many studies aspiring to answer these questions.

In order to understand language processing in bilinguals, researchers needed to first determine the type of speaker which can actually be labelled as a bilingual. That is, they needed to establish the characteristics of bilingual membership. Such an issue has been a rather controversial issue in the literature. On the one hand, some researchers established extremely high standards of bilingualism to the extent that the speaker needs to have native-like proficiency in both languages to be a true bilingual (Bloomfield, 1933; Deuchar & Quay, 2001; Skutnabb-Kangas, 1984; Thiery, 1978). On the other hand, other researchers gave rather lenient definitions of a bilingual. Such researchers proclaimed that minimal knowledge in a second language is enough for a person to be bilingual (Diebold, 1964; Edwards, 2008; Hockett, 1958; Macnamara, 1967).

Since the two previous views are quite paradoxical, other researchers opted to take a more mid-view of bilingualism. Such researchers based their views on the regular usage of the two languages rather than on full command or minimal familiarity with one of the two languages (Baker, 1993; Grosjean, 1982, 2013; Mackey, 1968, 2002; Myers-Scotton, 2006; Wei, 2000; Weinreich, 1968). This moderate view is the view of bilingualism adopted in the present study and by which participants were recruited.

Researchers have established that bilingual language processing involves two mechanisms, *activation* and *selection* (Costa, 2005). These two mechanisms are applied at three levels of processing: 1) a semantic level, 2) a lexical level, and 3) a phonological level (Costa, 2005). The dilemma in the literature is whether candidates of both languages go through the three levels of processing, or whether a bilingual can limit language processing to the language she desires to speak.

One line of thinking in this area is that lexical items of both languages are active at the semantic level where specifying the language of production occurs (e.g. De Bot, 1992; Poulisse & Bongaerts, 1994). However, selection thereafter is limited to the target language only. Researchers call this the *language-specific model* of bilingual language processing. This view coincides with the RHM of bilingual memory (Kroll & Stewart, 1994). At the other extreme, another view argues that activation of both languages is not limited to the semantic level but flows to the lexical level in which the most activated items are selected. Researchers call this the *language-independent model* of language processing. This view coincides with the BIA+ model of bilingual memory (Dijkstra & Van Heuven, 2002).

Another element which affects language processing in bilinguals is the nature of the two languages of the bilingual. Language processing in bilingual categories whose languages

are highly dissimilar transpires differently than in those whose languages are considerably dissimilar (Coderre & Van Heuven, 2014).

Arabic and English belong to different language families, hence are highly different at several levels. First, Arabic uses abjads, whereas English uses alphabets. Second, Arabic is written from right to left, whereas English is written from left to right. Third, Arabic includes only long vowels, whereas English includes both long and short vowels. Furthermore, Arabic follows a root-pattern system, whereas English doesn't. In addition, the two languages differ in their word stress patterns. Finally, the phonemes of the two languages do not completely overlap. Taking into consideration these differences between Arabic and English, Arabic-English bilinguals might exhibit different language processing mechanisms from bilinguals who speak considerably similar languages.

Studies addressing language processing in Arabic-English bilinguals are quite scarce. Among these studies is Qasem and Foote (2010) who measured L2 interference. The researchers used a translation recognition task in which participants saw pairs of words and judged whether the second word (i.e., the Arabic word) was a translation of the first (i.e., the English word). The researchers concluded that interference occurred at the morphological level more than at the orthographic level. L2 interference at the orthographic level was higher in highly-proficient bilinguals than in low-proficient bilinguals. Moreover, Coderre and Van Heuven (2014) established that Arabic-English bilinguals' language connectedness is less when compared to that of bilinguals who speak more similar languages. Arabic-English bilinguals demonstrated less interference and longer response times. In the study, the participants performed a Stroop task and a Simon task. In the Stroop task the participants saw words such as 'red' and 'blue' not written in the color they denote and were asked to read the

word ignoring the color in which it was written. Whereas in the Simon task, they needed to respond in two different conditions. In the first, the stimulus and response tab were in the same location (e.g., both on the left); whereas in the second, they were in different locations (e.g., one on the left and the other on the right). However, a drawback in Coderre and Van Heuven's (2014) is that the researchers examined results obtained from 17 Arabic-English bilinguals only. Accordingly, one may assume that the power of their results (Cohen, 1988) is not very strong. Moreover, in both experiments (i.e., Qasem & Foote, 2010 and Coderre and Van Heuven, 2014), the participants were explicitly exposed to the non-target language. Such a strategy does not actually reflect the original activation status of the non-target language.

Other studies in the literature have addressed different issues of language processing in Arabic-English bilinguals. For example, Dalrymple-Alford (1968) found a priming effect in the language processing of Arabic-English bilinguals. That is, the perception of a word in one language induced the priming of its equivalent in the other language. In addition, the researcher also found that interlingual interference was weaker than intralingual interference. Moreover, Saegert, Obermeyer and Kazarian (1973) found that the lexical items of the two languages of Arabic-English bilinguals are kept in a single dominant semantic system. In this central system, each word is connected with a language tag. Liepmann and Saegert (1974) expanded such a finding by determining that Arabic-English bilinguals stored their languages on a semantic basis rather than on a language basis. Finally, Blanco-Elorrieta and Pytkkanen (2015) found that script and cultural context had a significant effect on the language selection process of Arabic-English bilinguals.

One element which also affects bilingual language processing is the type of stimulus to which the speaker is exposed. One of the problems inherent in many studies examining language activation is the use of a procedure which incorporates the non-target language. Doing so has evident consequences since “[i]t is plausible to assume that when speakers have to switch regularly between languages ... competition for selection often can no longer be restricted to the target language” (Roelofs, Piai, Garrido Rodriguez & Chwilla, 2016, p. 9). Such a procedure purposefully intertwines and interconnects the two languages of a bilingual because the speaker is not motivated in any manner to inhibit the non-target language even if language separation is plausible (Marian & Spivey, 2003).

Such a problem can be resolved by the implementation of a picture-naming task (e.g. phoneme-monitoring) which exclusively incorporates the target language only; hence, allowing a genuine examination of the non-target language to determine its original level of activation. In such type of a task, the speaker is usually exposed to an identity word, a related distractor, and an unrelated distractor. These three elements usually compete for activation. The activation of the identity word and the related distractor converge on the lemma of the related distractor. Such convergence does not occur between the unrelated distractor and the other two elements (i.e., the identity word or the related distractor). The identity word usually takes a longer time to overcome the related distractor than does the unrelated distractor. Thus, the related distractor is the strongest competitor among the three. This causes inhabitation of the identity word and the possible occurrence of language interference.

The phoneme-monitoring (PM) task is commonly used to study bilingual language processing. In this type of procedure, the subject is first exposed to a stimulus, which is the target sound. The participant is then required to press a response tab as rapidly as possible to

determine either a negative or affirmative reaction to the speech sound, such as it being part of the name of a picture or not.

There are two main types of PM tasks, the standard type and the generalized type. In the former, the participant is instructed to focus on a specific part of the word, such as the onset of the first syllable. Whereas in the latter, the participant is left to examine the entire word.

PM has been used in numerous studies for a variety of objectives. For example, Sasisekaran and De Nil (2006) used PM to investigate phonological encoding in people who stutter. The researchers found that people who stutter have longer response times when compared to people who do not stutter. Moreover, Ganushchak and Schiller (2009) used PM to investigate the effect of time pressure on error-related negativity (i.e., an electrical brain signal which occurs when a person makes a behavioral error) during L2 verbal monitoring in German-Dutch bilinguals. The researchers found that L1 interference increased when the participants were under time pressure which led to increased amplitude in the error-related negativity. In addition, Zou, Wang, Qu, Lui, Shum, Cheung, and Chan (2014) used PM to investigate whether people who exhibit characteristics of schizophrenia (i.e., a deficit in verbal self-monitoring) are susceptible to developing such a deficit. The researchers found that people with traits of the condition do not suffer from deficits in verbal self-monitoring. Finally, Camen, Morand and Laganaro (2010) used PM to identify the times at which grammatical gender encoding and phonological encoding occurred in language processing. They found that the abstract conceptual formation of the picture name and its phonological encoding either proceed in parallel or overlap with nearly a 10 mm gap between them.

Overview of the Study

The present research reports two experiments modeled closely on Colomé (2001), but involving Arabic-English bilinguals, which is a category of bilinguals that has been severely neglected in the bilingual language processing literature. One advantage of examining L2 activation in Arabic-English bilinguals is that it provided an opportunity to test the prediction of Grosjean's (1982) language model theory that L2 would generally be activated more when used in an environment in which both languages are used frequently versus an environment where L1 is used predominantly. Accordingly, using a phoneme-monitoring task to gather data, the study examined whether Arabic-English bilinguals experienced more L2 interference when performing a language processing task in L1 when the experiment was conducted in the United States (i.e., where both L1 and L2 were regularly used) or when the experiment was conducted in Saudi Arabia (i.e., where use of L2 was less frequent). The present research aspired to add to the literature in this regard.

Since the present study sought to compare L2 activation between two groups of Arabic-English bilinguals, members of the first group were those who used their two languages in a native setting of their L1 (i.e., Saudi Arabia); whereas members of the second group were those who used their two languages in a native setting of their L2 (i.e., the United States). Using a picture-naming method, participants performed a phoneme-monitoring task, where they experienced two types of stimuli. The first was a picture, whereas the second was a speech sound. The objective of the task was for the participants to make a judgment of whether the speech sound was part of the name of the picture or not. The speech sounds to which the participants were exposed were three types: 1) a speech sound contained in the Arabic name of the picture, 2) a speech sound contained in the English name of the picture,

and 3) a speech sound unrelated to either language. Accordingly, a 2 x 3 factorial design was applied with Subject Type as the between-subject factor and Phoneme Type as the within-subject factor.

The rationale of the experiment was two-fold. The first was related to response times. If response times pertaining the second phoneme type (i.e., the speech sound related to the English name of the picture) were longer than those related to the third phoneme type (i.e., the speech sound not related to either the English or the Arabic names of the picture), the participants' L2 would be determined as active. The second rationale was related to the accuracy of the participants. Namely, if the participants demonstrated elevated error rates in the second phoneme type (i.e., the speech sound related to the English name of the picture), it would be determined that they experienced L2 interference which is an indication of L2 activeness.

The main experiment was followed by a control experiment to determine that the results obtained were due to the bilingualism of the participants and their knowledge of the English language. The main experiment was also followed by a qualitative phase to examine the person and sociocultural variables which may have influenced the quantitative results. Data in this phase of the study was gathered through semi-structured interviews.

Following is an overview of Colomé (2001), the study on which the present research is modeled.

Colomé (2001)

Colomé (2001) examined L2 activation in Catalan-Spanish bilinguals by implementing four experiments (i.e., three main experiments and a control experiment).

Using response time and error rate as indicators of language activation, Colomé (2001) attested the language-independent notion by the use of a phoneme-monitoring task. The objective of the study was to determine whether the non-used language of a bilingual can be deactivated when the participant is instructed to make monolingual judgments about a certain word. In the phoneme-monitoring task used by Colomé (2001), the participant first saw a picture and then a letter. The researcher instructed the participants to focus on the abstract sound represented by the letter, rather than on the letter itself. The participants then made judgments of whether the speech sound they were thinking about was part of the Catalan name of the picture or not.

Colomé (2001) conducted three experiments in which each picture was displayed in three different conditions. In the first condition, the picture was followed by a letter from the L1 name of the picture (i.e., Catalan). In the second condition, the picture was followed by a letter from the L2 name of the picture (i.e., Spanish). Whereas in the third condition, the picture was followed by a letter unrelated to either the Catalan or the Spanish names of the picture. The rationale of the task was that, if the participants' second language was active, it would take them longer to reject the speech sound from the Spanish name of the picture than it would take them to reject the unrelated speech sound. In addition, Colomé (2001) examined the participants' error rates to determine whether any L2 interference occurred.

In the first experiment, the participants saw the letter before the picture; and in the other two experiments, the order of picture and letter was reversed. Colomé (2001) also used different stimulate onset asynchronies (SOA) in each experiment (i.e., -2000, +200, +400). Conducting measurements at the sublexical level, the researcher found that, regardless of the order of presentation or the SOAs used, the participants in all three experiments took longer

to reject the speech sound from the Spanish name of the picture than they did to reject the unrelated speech sound. The researcher also asserted that the participants demonstrated significantly more error rates in the second condition (i.e., the speech sound from Spanish name of the picture). Finally, Colomé (2001) proclaimed that such results indicated that the L2 of the participants (i.e., Spanish) was activate while in a setting exclusively using their L1 (i.e., Catalan).

Statement of the Problem

While the status of L2 activation has been examined in previous studies, there is still a need to examine such activation in light of different variables, factors, and experimental conditions. Findings established in previous studies addressing non-target language activation, although insightful, leave the literature striving for more detailed findings. For instance, even though Colomé (2001) succeeded in demonstrating the connectedness of the languages of Catalan-Spanish bilinguals, two experimental issues need to be taken into consideration. First, Colomé (2001) examined bilinguals who spoke highly similar languages. Assuming that the high similarity of the two languages of the participants played a role in the language co-activeness found, it would be interesting to examine bilinguals at the other end of the spectrum (i.e., bilinguals who speak highly dissimilar languages). Second, since both Catalan and Spanish use the same orthographic systems, the letters used as stimuli belonged to both the target and the non-target languages. Thus, they may have potentially played a role in the activation of the non-target language.

As previously mentioned, there is a need to study L2 activation in bilinguals who speak highly dissimilar languages. One may argue that Qasem and Foote (2010) and Coderre and Van Heuven (2014) attempted to fill this gap; however, the aim of neither of these

studies was to specifically examine L2 activation in Arabic-English bilinguals. Rather, they did so as they were examining other issues related language processing such as executive control abilities. Moreover, in both studies, the participants were explicitly exposed to the non-target language. Such a strategy does not actually reflect the original activation status of the non-target language. Furthermore, a drawback in Coderre and Van Heuven's (2014) is that the researchers examined results obtained from 17 Arabic-English bilinguals only. Accordingly, one may assume that the power of their results (Cohen, 1988) is not very strong.

Accordingly, the literature needs a study which examines the language processing of highly dissimilar languages in which the original state of the non-target language and its true activation status is investigated without purposefully stimulating it by the task used to collect data. The present study intends to accommodate this need by recruiting Arabic-English bilinguals and gathering its data using a phoneme-monitoring task which genuinely includes the target language only. Thus, any non-target language activation found will not be the result of the methodology employed. Rather, it will reflect the true status of the two languages of the bilinguals examined. In addition, the present study intends to examine an appropriate number of participants to achieve more valid results.

In addition, the literature has proven that variables are affective factors in bilingual language processing; such as proficiency level (Poulisse & Bongaerts, 1994), the life domain in which the bilingual is using the language (Fishman, 1965), the characteristics of the person at the other end of the conversation (Paradis & Nicoladis, 2007), the topic of the conversation (Grosjean, 2000), and social acceptance (Giles & Powesland, 1975). Nevertheless, the literature lacks an empirical study which examines the role of location on the language

processing mechanisms of bilinguals. The present study intends to add to the literature in this regards.

Research Design

According to the worldview adopted, pragmatism, the focus in the current research is mainly on the research problem rather than on the method itself. Therefore, for the sake of reaching a full understanding of the problem, two designs will be utilized in a mixed methods approach, namely, a quantitative design and a qualitative design. The choice to incorporate these two forms of design is driven by the need to reach a better and more comprehensive understanding of the research problem tackled, an understanding superior to that sought when using only one of the two designs in isolation from the other. This superiority lays in that a mixed methods approach compensates for the weaknesses, shortcomings and limitations of each type of design when used alone. More specifically, the mixed methods approach intended in the current study is an explanatory sequential one which will be employed to first, define the situation and then explain, elaborate on, and give meaning to why such a situation exists; hence serving the ‘what’ and ‘why’ aspects of the research problem.

Although the current study is modeling on Colomé (2001), it opts to adopt a different approach than that of Colomé (2001). Whereas Colomé (2001) applied a mere quantitative approach in tackling L2 activation in bilingual language processing, the present research aims at addressing the research problem through a mixed methods approach. Opting away from the approach applied by Colomé (2001) is based on a number of factors.

First, the nature of the two languages addressed in the present research (i.e., Arabic and English) is noticeably different from the nature of the two languages addressed in Colomé (2001) (i.e., Spanish and Catalan). Spanish and Catalan being very similar (Colomé, 2001), they share a number of language aspects such as orthography, grammatical structures, vocabulary items, and certain language expressions. Consequently, there is a great deal of overlap between the two languages. Arabic and English, on the other hand, are highly different languages (Coderre & Van Heuven, 2014; Dajani & Omari, 2013). They do not share the same orthography; they share an extremely limited number of cognates, and they belong to two different language families. Accordingly, unlike Spanish and Catalan, Arabic and English are quite dissimilar and overlap in very limited aspects. Furthermore, in relation to culture, Spanish and Catalan are used in a *societal bilingualism* setting (Sebba, 2011) and share a large arena of sociocultural background. Arabic and English, on the other hand, are mostly used in a setting of *individual bilingualism* (Hoffmann, 2014) and have totally different sociocultural backgrounds which nearly never overlap. Consequently, putting such lingual and sociocultural differences into consideration, a mixed methods approach was adopted in the present research.

Another element which stimulated the application of an approach different from that of Colomé's (2001), is a matter of objective. Colomé (2001) is a purely psycholinguistic experimental study which aims at specifically testing a theory and either accepting or refuting hypotheses. The current research, on the other hand, aims at presenting extensive findings to provide a complete and wide-ranging account of the research problem. The account aspired is one which focuses on the psycholinguistic aspect of the problem (i.e., the

quantitative section) and its sociolinguistic aspect (i.e., the qualitative section) to justify final quantitative results.

Mixed methods approaches are rather useful in studies pertaining to different areas of the social sciences, including studies in psycholinguistics. Researchers have chosen to adopt such type of an approach since “employing both approaches in a principled manner in a single study can facilitate a deeper understanding of complex phenomena” (Abbuhl, Gass & Mackey, 2013, p. 125). Consequently, studies in the field of psycholinguistics have applied a variety of different types of mixed methods approaches. For example, a range of psycholinguistic studies have incorporated both corpus data and experimental data in their studies (Gilquin & Gries, 2009). Other psycholinguistic studies have integrated neuroimaging data (e.g. fMRI, EEG) with experimental data obtained from, for example, lexical-decision tasks (Rodriguez-Fornells, Rotte, Heinze, Nosselt & Münte, 2002), and picture-word inference tasks (Roelofs et al., 2016). In line with these mixed methods psycholinguistic research studies, the present research applied such an approach to investigate L2 activation in bilingual language processing. The mixed methods approach used incorporated two sets of data into its design: 1) quantitative data obtained by means of a phoneme-monitoring task, and 2) qualitative interview data.

The mixed methods approach attempted was an *explanatory sequential mixed method* approach (Creswell, 2014) in which quantitative data were gathered, statistical analyses were conducted, and numerical results were found. Once quantitative findings were reached, they were justified by the social element of language use affecting language activation in Arabic-English bilinguals, hence the qualitative section of the research was implemented.

Variables of the Study

Independent Variables

Subject Type

Subject Type incorporates two levels: a) Arabic-English bilinguals tested in Saudi Arabia, and b) Arabic-English bilinguals tested in the United States. Hence, this variable refers to the two bilingual groups of the experiment. Since the only main difference between the two groups is their location, this variable tackles the effect of location on the dependent variables.

Phoneme Type

Phoneme Type does not refer to the phonological characteristics of the phoneme. Rather, it reflects the speech sound's relatedness to the languages of the bilinguals of the study (i.e., related to Arabic, related to English, or unrelated to either language). Accordingly, it includes three levels: a) sound contained in the Arabic noun describing the picture, b) sound contained in the English noun describing the picture, and c) sound unrelated to either the Arabic or English nouns describing the picture. Each level represents a condition in the experimental task. Hence, Phoneme Type and Condition will be used synonymously in the present study.

Dependent Variables

Response Time

Response time is the time it takes the participant to make a judgment regarding the sound she/he hears. It is calculated in milliseconds from the time the sound ends to the time

the participant responds. A significant difference in response time between Conditions 2 and 3 (i.e., the two negative conditions) reflects language activeness, whereas no significant difference between them indicates language inactiveness.

Error Rate

Error rate is the measurement of the accuracy of the participants. A significant difference in error rate between Conditions 2 and 3 indicates the occurrence of L2 interference, whereas no significant difference between the two negative conditions indicates lack of L2 interference.

Purpose of the Study

The present explanatory sequential mixed methods study addressed L2 activation in Arabic-English bilinguals when in a monolingual state of using their L1. First quantitative data were collected for the purpose of testing hypotheses, then qualitative data were gathered to explain the quantitative results obtained.

In the first, quantitative phase of the study, a phoneme-monitoring task was used to measure Response Time and Error Rate (i.e., L2 activation) of Arabic-English bilinguals in two locations: 1) an Arabic native-speaking location (i.e., Saudi Arabia), and 2) an English native-speaking location (i.e., the United States). The data gathered were used to determine whether Subject Type and Phoneme Type had a main effect on L2 activation.

The second, qualitative phase was administered as a follow-up to the quantitative phase. Its aim was to assist in explaining the quantitative results. In this phase of the study, data were gathered by means of semi-structured interviews to study the language use and

language choice behaviors of Arabic-English bilinguals and how they are affected by the personal and social tendencies surrounding them.

Research Hypotheses and Questions

The present study intended to examine L2 activation in Arabic-English bilinguals. It did so by testing five hypotheses in the quantitative phase, answering one question in the qualitative phase, and finally answering a mixed methods question to link the two phases to one another. The hypotheses of the study were:

- Arabic-English bilinguals are expected to encounter L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3.
- Arabic-English bilinguals in an English-speaking setting are expected to encounter more L2 interference reflected in differences in Error rate and Response Time between Conditions 2 and 3 than Arabic-English bilinguals in an Arabic-speaking setting.
- For Arabic-English bilinguals, Error Rate and Response Time in Condition 2 will be related to their English language proficiency and the amount of English they use each week.
- For Arabic-English bilinguals, Error Rate and Response Time in Condition 2 will be related to the frequency of the English translation equivalent of the Arabic word describing the picture.
- Monolingual Arabic participants are not expected to show any L2 interference in Error Rate or Response Time between Conditions 2 and 3.

The qualitative research question of the study was:

- What are the factors that affect the language selection mechanism in Arabic-English bilinguals?

The mixed methods question of the study was:

- How does the qualitative data help explain the results obtained from the quantitative phase of the study?

Significance of the Study

The present study benefits three types of audiences. First, it benefits those involved in psycholinguistics by adding to the knowledge of how the mind of a bilingual works when communicating with others through language. Specifically, the present study adds to the knowledge of how two very dissimilar languages engage and interact in the mind of an Arabic-English bilingual. It also adds to the knowledge of whether location plays a role in language processing in cases where the two languages are extremely different.

Furthermore, the present study benefits those interested in the sociolinguistic aspects of language use. It specifically adds to their knowledge about the sociocultural consequences subconsciously imposed by bilinguals on their language use and language choice mechanism. Such information can be used in understanding the mentality of the Arab community and their perspective of the manner by which interpersonal lingual communication should take place.

Finally, the present study benefits the TESL/TEFL field. Language teachers need to have knowledge of how the human brain works with language. They also need to be knowledgeable of how language processing changes when other elements (e.g. L2 proficiency, amount of language usage, characteristics of the material being taught, etc.)

change. Such knowledge helps them understand the influence of such variables on language development. It hence enables them to make appropriate judgments regarding issues such as their teaching methods, strategies, and content. It also helps them understand the psychology of communication in mono- and intercultural contexts, which is especially beneficial when teaching intercultural language classrooms.

Definition of Key Terms

Bilingualism

The definition of bilingualism adopted in the present study is a definition introduced by Grosjean. The definition focuses on the regular use of the two languages as a main characteristic of a bilingual. It does not consider high proficiency level as a characteristic of a bilingual, neither does it accept mere familiarity of a language as a trait that gives a person eligibility to be labeled as a bilingual. Grosjean (1992) asserts, “[b]ilingualism is the regular use of two (or more) languages, and bilinguals are those people who need and use two (or more) languages in their everyday lives” (p. 51).

Bilingual language processing

The present study views bilingual language processing as “the cross-language interactions that take place during comprehension and production at the lexical and sub-lexical levels” (Schwartz & Kroll, 2007, p. 965). The study views these cross-language interactions as the selectiveness mechanisms applied by bilinguals during language processes (i.e., language co-activation, language separation, or a circumstantial language processing).

Language activation

The present study views language activation as “the availability of representations at different levels of processing. When a given representation is more available for production, ... its level of activation is high; when it is less available, ... its level of activation is low” (Costa, 2005, p. 309). Such representations include semantic, lexical and phonological representations.

Language interference

The present study views language interference as “those instances of deviation from the norms of either language ... as a result of [bilinguals’] familiarity with more than one language, i.e. as a result of language contact” (Weinreich, 1968, p. 1). In the present study, participant errors are considered to be “instances of deviation.” Accordingly, the statistical analyses of Error Rate in the experiment are considered to reflect the L2 interference the participants are experiencing.

Dissertation Layout

The present research consists of seven chapters. The first chapter is the Introduction of the research. It consists of twelve sections; the theoretical underpinning of the study, an overview of past related research, an overview of the present study, an account of Colomé (2001), a statement of the problem, the research design, a description of the variables of the study, the purpose of the study, the research hypotheses and questions, the significance of the study, definition of key terms, and finally the dissertation layout.

Chapter two introduces a review of related literature. The literature reviewed deals with six topics. It starts with an overview of the notion of bilingualism. It then elaborates on

how bilingual language processing takes place. It then discusses the theories of bilingual memory and the language processing models associated with them. Next, it discusses language processing in picture-naming tasks. Following, it gives an overview of language processing in Arabic-English bilinguals. Finally, it elaborates on the phoneme-monitoring task, the procedure used in the present study.

Chapter three describes the methods applied in the quantitative phase of the study. It starts with a description of the participants of the experiment. Then it describes the experimental design. Next, it gives a thorough description of the experimental procedure. Following, the chapter accounts for the apparatus used. Finally, the chapter provides an overview of the manner in which the data is analyzed.

Chapter four is the Results and Discussion chapter pertaining to the quantitative phase. It begins with a description of the data trimming criteria. Then it provides an overview of the compatibility of the two bilingual groups of the main experiment. Consequently, the actual statistical analyses follow. First, Error Rate is analyzed; then Response Time is analyzed; and finally, correlations are conducted. A comparison between the present results and those of Colomé' (2001) follows. The chapter also links statistical results to the quantitative hypotheses of the study.

Chapter five is devoted to the qualitative phase of the study. It firsts discusses the methods applied. It then presents the thematic scheme used to analyze the interview data. Following, it presents the themes found and supports them with actual examples from the data. The chapter ends with a discussion section which accounts for the research questions of the study (i.e., qualitative and mixed methods).

Chapter six provides a description of the control experiment of the study. It first describes the methods of the experiment which includes a description of the participants, the experimental design, and the procedures of the experiment. The chapter then presents the results and discussion section of the chapter.

The last chapter is the General Discussion chapter which consists of ten sections. The first section evaluates L2 activation in Arabic-English bilinguals. Section two examines the status of location as an affective factor in Arabic-English bilinguals' language processing mechanism. Section three discusses how L2 word frequency affects language processing in Arabic-English bilinguals. Section four compares the present results with the three theories of bilingual memory; whereas section five discusses the variables affecting language processing in Arabic-English bilinguals. Section six discusses conflicting findings in the literature and justifies differences in results. Section seven provides the limitations of the study, whereas section eight provides future directions. Following, section nine presents the importance of the findings of the study. The chapter ends with a conclusion section.

CHAPTER II

LITERATURE REVIEW

The current chapter presents a literature review which tackles the most prominent and relevant areas related to the present research. The chapter consists of six sections three of which are totally theoretical (sections one, two, and four), and the remaining of which have a theoretical component in addition to an empirical component (sections three, five and six).

Each topic reviewed in this chapter is related to the study in a certain manner. Since the problem tackled originates from the field of bilingualism, the following literature review begins with an overview of different views of the characteristics of a bilingual. This section begins with earlier views, then discusses more recent views. Following, section two addresses the general issue being examined in the present research, bilingual language processing. It discusses the three levels of bilingual language processing (i.e., the semantic level, the lexical level, and phonological level) and the two mechanisms which occur in each level (i.e., activation and selection). Section three presents the major views of bilingual memory (i.e., the revised hierarchy model, the BIA+ model, and the language mode theory) and their corresponding approaches to bilingual language processing. The mindset behind each view of language processing and a number of supporting empirical studies are provided. Next, section four is devoted

to language processing in picture-naming, the method used in the present study. Consequently, section five deals with Arabic-English bilinguals. It begins with a comparison of their two languages; then it reviews available studies in the literature which specifically address language processing in Arabic-English bilinguals. Finally, section six provides a description of the phoneme-monitoring task, and then reviews a number of studies which use this task type in a manner similar to that used in the current study. Table 1 presents the six sections of the literature review accompanied by example citations.

The definition of Bilingualism

The current section provides an overview of the different definitions of bilingualism introduced by researchers in the field. It should be noted that the definitions discussed do not address the criteria of what constitutes a bilingual in societies such as those which have two official languages, namely the phenomenon referred to as ‘societal bilingualism’ (Sebba, 2011). Rather, in coordination with the aim of the present research, the focus is on the phenomenon of bilingualism as related to individuals, namely ‘individual bilingualism’ (Hoffmann, 2014). Furthermore, it should be noted that the phenomenon of bilingualism addressed here refers to the use of conventionally acknowledged languages not the use of two dialects of the same language known as *diglossia* (Sayahi, 2007). Moreover, the type of bilingualism dealt with is coordinate bilingualism; that is, it addresses bilinguals who have acquired their two languages in different settings, such as learning one at home and the other at school. This is in comparison to compound bilingualism which refers to bilinguals who have acquired their two languages in the same setting, such as their household.

Table 1

Components of the literature review of the present study

<i>#</i>	<i>Section</i>	<i>Sub-section</i>	<i>Source or example study</i>
1	The definition of bilingualism	Older views	Bloomfield (1933)
		Recent views	Grosjean (2013)
2	Bilingual language processing	Levels of processing	Costa (2005)
		Mechanisms of processing	Costa (2005)
3	Bilingual memory and models of language processing	Language-independent processing (Theory)	Poullisse (1999)
		Language-independent processing (Empirical evidence)	Colome (2001)
		Language-specific processing (Theory)	Li Heij (2005)
		Language-specific processing (Empirical evidence)	Roelof et al. (2016)
		Variable-dependent processing (Theory)	Grosjean (1997, 2011, 2013)
	Variable-dependent processing (Empirical evidence)	Grosjean (2000)	
4	Language processing in picture-naming tasks		Levelt et al. (1999)
5	Language processing in Arabic-English bilinguals	Arabic vs. English	Ryding (2005)
		Empirical studies	Qasem and Foote (2010)
6	The phoneme monitoring task	Description	Connine and Titone (1996)
		Application	Zou et al. (2014)

The present section first begins with reviews of earlier views of the phenomenon of bilingualism, two of which are quite paradoxical. Then it addresses a number of views on bilingualism which are more recent. The aim of the present section is to show the extent to which bilingualism is controversial. In addition, it aims at highlighting the difficulty in defining the characteristic features which constitute this complex phenomenon (Appel & Muysken, 2006). For example, in the controversy of what constitutes bilingualism, researchers have debated issues such as the level of competence and performance the speaker needs to demonstrate in each language to be considered bilingual, the frequency of usage of the two languages, the speaker's sociocultural knowledge of each language, the domains in which each of the two languages are used, etc.

Earlier Views of Bilingualism

Among the researchers who established high measures in determining bilingual membership is Bloomfield. In his 1933 book, *Language*, Bloomfield adopted an extreme perspective of bilingualism based on the level of competence of the speaker. In his view, Bloomfield (1933) asserted that the speaker needs to achieve the highest levels of competence in both languages to be a true bilingual. Consequently, he defined bilingualism as the "native-like control of two languages" (Bloomfield, 1933, p. 56). His definition was a rigorous one which crossed out of the scope of bilingualism speakers who even minimally do not meet the standards of language-nativeness, if such aspect even exists. In explaining his point of view, Bloomfield (1933) proclaimed that if an adult who has spoken her native language her entire life moved to a country which speaks a different language, she will start to regularly use that language while stopping to use her

native language. Accordingly, that speaker will not be bilingual because her native language will become imperfect and she will end up “in the position of speaking no language well” (Bloomfield, 1933, p. 55). In Bloomfield’s opinion, that person is by no means bilingual.

Two researchers, Thiery and Skutnabb-Kangas, followed the same mentality demonstrated by Bloomfield. However, they took their definition a step beyond the native-like usage of the two languages. They further included the native-like awareness and command of the sociocultural demands of both languages. Accordingly, a true bilingual needs to speak native-like and properly use the culture of the language to successfully communicate with both groups (Skutnabb-Kangas, 1984; Thiery, 1978). Consequently, in their opinion, a speaker who does not meet these criteria in both languages, is not a true bilingual.

At the other end of the spectrum, several researchers adopted a very different approach than that of Bloomfield’s, Skutnabb-Kangas’s and Thiery’s. Rather, they tended to be quite lenient with their definitions of bilingualism by basing them on the speaker’s familiarity with the second language rather than her level of competence. For example, several researchers stated that a bilingual is a person who exhibits a minimal level of L2 skill in either speaking, reading, writing, or listening (e.g. Diebold, 1964; Hockett, 1958; Macnamara, 1967).

According to such researchers, a bilingual can be one who has some comprehension skills in their L2 while having no production skills in that language whatsoever. Such a view is considered minimal when compared to Bloomfield’s maximal definition (Baker, 1993). In this view, bilingualism is viewed as a sequence of continua,

which differ from one individual to another in relation to a variety of dimensions such as proficiency level and frequency of usage. Thus, a speaker who is, for example, more proficient in reading than in writing will be more bilingual when reading than when writing (Macnamara, 1967). Furthermore, a Dane and a Norwegian, each of whom regularly speaks a specific variety of their languages, and who have learned by experience to understand the speech patterns of each other, are also considered bilingual if they are able to minimally communicate (Hockett, 1958). Consequently, believers of this minimal view of the phenomenon of bilingualism consider Bloomfield's maximal view as only one end of the continuum of bilingualism (Diebold, 1964).

Other researchers, in their definitions of bilingualism, opted to take more of a mid-position than the two paradoxical views previously mentioned. Such researches did so by adopting the notion of language usage rather than the speaker's competence level or familiarity with the two languages. For example, in relation to his 1968 book, *Languages in contact: Findings and problems*, Weinreich (1968) proclaimed that "[t]he practice of alternatively using two languages will be called here bilingualism, and the persons involved bilinguals" (p. 1). Accordingly, he opened the spectrum of bilingualism to include a wide range of different people who may exhibit different levels of language skills and who may not share many characteristics amongst each other. However, he did limit his definition to speakers who alternate between the two languages which indicates the regular usage of the two languages.

Similarly, Mackay (1968) described bilingualism as "the alternative use of two or more languages by the same individual" (p. 555). However, he added that it is an entirely relative phenomenon. Mackey (1968) asserted that such relativity depends on a number

of factors. The researcher stressed four elements: 1) the degree to which the speaker uses each of the two languages, 2) the choice of functions for which the speaker uses each of the two languages, 3) the extent to which and the reasons behind the speaker alternating between the languages, and 4) the amount of interference of one language while speaking the other and the degree to which the speaker is able to avoid such interference. In summary, Mackey (1968) asserted that bilingualism varies from one person to another in degree, function, alternation and interference.

Such a moderate view of bilingualism did not fade out, but remained to be a view adopted by many researchers in the 80's and 90's. For example, Grosjean (1982) simply defined bilingualism as "the regular use of two or more languages" (p. 1). In 1992, Grosjean maintained his earlier definition and expanded it by adding, "bilinguals are those people who need and use two (or more) languages in their everyday lives" (p. 51). In his definitions, Grosjean upheld that a bilingual is a person who can communicate in each of the two languages in a manner which satisfies that person's communication needs.

Grosjean (1982, 1992) also argued that having equal command of both languages is the exception not the norm, and that it is unrealistic to think that a bilingual needs to be completely and equally proficient in all four language skills within all life domains. Furthermore, Grosjean (1982, 1992) stressed the role of the environment in the development of both the speaker's native language and her L2. He maintained that the domains in which each of these languages is used, is a key factor in the development of not only one language over the other, but also the development of one language skill over the other within each language.

Following the footsteps of Grosjean and many other researchers, Baker (1993) also adopted a moderate view of bilingualism. Using a number of analogies, he asserted that the two languages involved in bilingualism appear in different styles and scopes, and will most likely vary in strength and size. Baker (1993) elaborated on how variable bilingualism is by commenting on the speaker's language skills. According to Baker (1993), a bilingual's language skills cannot be described as being either black or white, but rather exist in different shades of grey as well as in different colors. By such a description, Baker (1993) further supported Grosjean's notion that the language skills of a bilingual are not necessarily developed equally. Furthermore, the researcher proclaimed that the four traditional language skills (i.e., speaking, listening, reading and writing) include within them different dimensions which need to be further considered in characterizing a person as bilingual. Baker (1993) called such sub-divisions "the skills within the skills" (p. 6) and listed them as:

- (1) pronunciation
- (2) extent of vocabulary
- (3) correctness of grammar
- (4) the ability to convey exact meaning in different situations
- (5) variation in style

(p. 6)

Furthermore, Baker's (1993) description of bilingualism considered different elements of language production. However, he did not put any stress on the level of language proficiency needed in such production.

Recent Views of Bilingualism

Examining more recent views of bilingualism, most researchers uphold quite a reasonable, moderate view of who is bilingual. For example, Mackey (2000) defined

bilingualism as “the alternate use of two or more languages by the same individual” (p. 27). It seems that the main focus of researchers such as Mackey, is that the speaker’s languages are used regularly in one’s every-day life without really putting emphasis on whether the speaker is totally proficient in the two languages or not. Likewise, Wei (2000) gave a quite general definition of bilingualism by maintaining that a bilingual is “someone with the possession of two languages” (p. 7). Although using the word *possession* might indicate the concept of mastery, Wei continued by commenting that different bilinguals may exhibit different proficiency levels because they use their languages for different purposes.

Similarly, Grosjean (2013) maintained his original view of what constitutes bilingualism by asserting that it is “the use of two or more languages (or dialects) in everyday life,” (p. 5). This definition of Grosjean is nearly identical to his older one other than including the expression *everyday life* which seems to carry a very similar meaning to the word *regular* used in his earlier definition. Grosjean (1997, 2013) elaborated on his definition by introducing what he called the *complementarity principle*. In this principle, Grosjean asserted that bilinguals learn their languages for different purposes, use them with different people, and access them in different domains of their lives because various facets of life may require one language however not the other. Therefore, the definition of a bilingual cannot be restricted to specific elements such as fluency or native-like accent. Rather, it is very much possible to find a bilingual who does not read in one of her two languages simply because she does not need that specific language skill.

According to Grosjean, the complementary principle sheds light on a number of elements. First, it echoes how the bilingual’s languages are shaped, namely, what the two

languages are, when and why they are used, with whom they are used, etc. Second, it sheds light on the possible motives which may change how the two languages are shaped. An example of such motives is a change in the environment in which the two languages are used which, in turn, may lead to changes in the bilingual's language skills, the bilingual's base language, or the bilingual forgetting one of the two languages and becoming a functional monolingual. Finally, the complementarity principle explains the fact that a bilingual is not necessarily able to translate between the two languages simply because she may not have the same range of vocabulary in both languages and/or a complete command of the pragmatics of one of the two languages. In a nutshell, the complementarity principle maintains that the two languages of a bilingual complement each other in giving a complete picture of the bilingual's use of language in her everyday life.

Adopting a slightly more specific view of bilingualism, Myers-Scotton (2006) described this phenomenon as “the ability to use two or more languages sufficiently to carry on a limited casual conversation” (p. 44). Although Myers-Scotton (2006) stressed speaking as a key factor in being bilingual, she was not very specific about the level of speaking skill required by a bilingual to be described as such. However, she did stress that having very minimal abilities such as being able to produce L2 formulaic phrases (e.g. *Thank you* and *Please*), read a menu, or place an order at a restaurant is by no means enough to be considered bilingual. Myers-Scotton (2006) concluded her definition by asserting that the cutting point criterion in being a bilingual is showing the ability to make some L2 internal structural relations while speaking.

Although the majority of views in the twenty-first century sustain a moderate view of bilingualism, there are some which chose to lean towards one end of the spectrum rather than the other. Some have opted to adopt an extreme view of bilingualism similar to that of Bloomfield (1933), whereas others have chosen to adopt a minimal view of bilingualism such as that of Macnamara (1967).

One example of the extreme views of what constitutes a bilingual person is Deuchar and Quay (2001) who proclaimed that bilingualism is “the acquisition of two languages in childhood” (p. 1). In their study, they viewed bilingual acquisition as the exposure to both languages within the first two years of the child’s life. Such researchers crossed out of the spectrum of bilingualism all those who have learned their L2 after the age of two by calling them second language learners rather than bilinguals, regardless of what proficiency level they demonstrate in their L2.

In regards to the more lenient definitions of bilingualism in the twenty-first century, in his 2008 article, Edwards stated that “[e]veryone is bilingual. That is, there is no one in the world, (no adult, anyway) who does not know at least a few words in languages other than the maternal variety” (Edwards, 2008, p. 7). Edwards elaborated on his definition by declaring that knowing only a few L2 words indicates that the speaker has a certain level of competence in her L2, hence is bilingual. He added that even though there are different levels of bilingualism, this does not deny those who have minimal skills in their L2 of being bilingual. Altarriba and Heredia (2008) commented that such a view suggests that any person in the process of learning a language is bilingual regardless of their proficiency level in that language.

Bilingual Language Processing

The current section is devoted to language processing in bilinguals; that is, how the bilingual brain creates and understands the two languages. This information is important because it sheds light on the specific objective of the current study, which is language activeness in bilinguals.

Language processing, in general, involves three levels of representation, a semantic level, a lexical level, and phonological level. Each of these three levels encompasses two mechanisms, 'activation' and 'selection' (Costa, 2005). To better understand the three levels of language processing, the two language processing mechanisms need to be first defined.

The first mechanism, activation, is "the availability of representations at different levels of processing" (Costa, 2005, p. 309). It is a mechanism which occurs in the form of a continuum in which representations which are more available for language usage have a high level of activation. Whereas representations which are less available for language usage have a low level of activation. Activation which occurs in each processing levels is the result of the activation of candidates in the levels proceeding it. That is, for a phonological representation to be activated, the lexical representation needs to be activated in advance. Likewise, for the lexical representation to be activated, the semantic representation needs to be activated previously also. Such a process is called *activation flow* (Costa, 2005) which indicates that activation flows from the semantic representation to the lexical representation to the phonological representation. The second mechanism involved in language processing, selection, is the decision made by the speaker regarding which activated candidates to use for further processing. A complex issue related to

activation and selection is whether candidates of both languages go through all three levels of processing (i.e., semantic processing, lexical processing, and phonological processing) or whether a bilingual can limit language processing to the language she desires to speak.

One stream of research in this area argues that specifying the language of production occurs at the semantic level where the development of the conceptual representation of the word occurs (e.g. De Bot, 1992; Poulisse & Bongaerts, 1994). These studies assert that although both languages are activated at the semantic level, once the target language is specified, the activation flow thereafter is specific to the target language. This entails the inhabitation of the non-target language. Thus, only words from the target language are activated at the lexical representation level. Researchers call this the *language-specific model* of language processing.

The other stream of research related to this aspect agrees with their debaters in that activation of both languages occurs at the semantic representation level. However, they argue that such activation leads to an activation flow of both languages in the lexical representation level (e.g. Dewaele, 2001; Green, 1993; Poulisse, 1999). In this line of reasoning, candidates of both languages (i.e., each lexical item and its translation equivalent) are activated at the lexical representation level. Researchers call this the *language-independent model* of language processing.

Similarly, researchers also argue over language selection. One line of research advocates the *language-specific selection hypothesis*, whereas another line of research argues for the *language-independent selection hypothesis*. The former of these hypotheses is blind to activation and does not consider it a cue for selection. Rather, it

proclaims that selection is specific to the target candidates ignoring their corresponding translations. This suggests that when using one language, the other language becomes irrelevant (Costa, 2005).

On the other hand, the language-independent selection hypothesis argues that selection is sensitive to the activation level of candidates from both languages. Hence, it considers activation a mechanism for selection. In this line of reasoning, researchers proclaim that selection is determined by the level of activation of the candidates (e.g. Caramazza, 1997; Levelt, 2001). Consequently, if the difference in the activation level between the target candidate and its non-target equivalent is large, the selection process is effortless and occurs in a rapid manner. Whereas if the difference between them is minimal, the selection process becomes more difficult, takes a longer amount of time, and interference of the non-target language may occur (Costa, 2005).

Once activation and selection at the lexical representation level has occurred, the last process in language production is the phonological representation level. Similar to views of lexical activation, phonological activation is also viewed in different ways by different researchers. Advocates of the discrete models of language production assert that only the phonological representations of selected candidates from the lexical representation level are activated (e.g. Levelt, Schriefers, Vorberg, Meyer, Pechmann & Havinga, 1991; Schriefers, Meyers & Levelt, 1990). Whereas advocates of the cascade models of language production assert that the phonological representations of all activated candidates in the lexical representation level, whether selected or not, are activated to a certain degree (e.g. Caramazza, 1997; Dell, 1986; Rapp & Goldrick, 2000).

In regards to selection at the phonological stage of language processing, much research has agreed that it is also determined by the level of activation of the phonological representation. Thus, those highly activated are selected more easily than those with low levels of activation. Furthermore, in cases where there is minimal difference in the activation level between the target candidate and its non-target equivalent, non-target language interference may occur (Costa, 2005).

Theories of Bilingual Memory and Corresponding Models of Bilingual Language Processing

Researchers have been striving to determine whether bilinguals have the capacity to deactivate their languages as they desire, and also discover the process by which they select the language they aim at using. Accordingly, researchers in the field were and are still very much questioning whether language processing is language-independent, language-specific, or somewhere in between. The former of these models upholds the view that activation flows in both languages (i.e., the target word and its translation equivalent in the non-target language); the second upholds the view that activation flows in one language only (i.e., the target word only); whereas the last view maintains that language activation fluctuates and is highly circumstantial. Following is a review of the different bilingual language processing models and the theories of bilingual memory they correspond with.

BIA+ and Language-Independent Processing

One notion in the language processing dichotomy asserts that a bilingual's memory is a single system in which her two lexicons co-exist. According to the bilingual

interactive activation plus (BIA+) model (Dijkstra & Van Heuven, 2002) of bilingual memory, bilingual word recognition involves the manifestation of two systems, a word identification system and a task/decision system. The first of these two systems works in relevance to linguistic information extracted from the language input, such as information related to effects of cross-linguistic orthographic, phonological and semantic similarities. Whereas the second of these two systems, works in relevance to extra-linguistic factors such as participant strategy, task demands, interlocutor instructions, etc.

The word identification system consists of an orthographic level and a phonological and semantic level, each of which has lexical and sublexical levels. Activation within and between these levels is determined by the similarities between the input word and the internal lexical representations. Regarding the orthographic level, activation in languages which share a writing system is affected by elements such as neighborhood density, target word frequency of usage, and within- and between-language neighborhoods (Dijkstra & Van Heuven, 2002). Whereas in cases where the two languages have different writing systems, the number of neighbors will be less and the activated items may be particular to one of the two languages only. Since this is a top-bottom effect, word recognition in the latter type of languages will be more rapid because of the absence of cross-language orthographic activation.

The orthographic level has within it four levels of nodes: 1) letter features, 2) letters, 3) words, and 4) languages. Within the letter feature level, when a sequence of letters occurs, letter features of each letter are activated in relation to the letter's position in the word. Activated letter features activate letter nodes in their corresponding positions. Within the letter level, a letter activates all words which contain it in the

appropriate position and reduces the activation of mismatches. Within the word level, all words are connected and have the capacity to activate or inhibit activation of other words. Activated words work in two directions; they further activate the letters they contain, and also activate relevant language nodes. Finally, active language nodes inhibit the activation of word nodes from the non-target language. This entire process is affected by different types of linguistic information such as the syntactic and semantic contexts of the word. Duration of this process depends on word characteristics such as its frequency and the frequency of items similar to it.

Once activation is established at the orthographic level, active nodes pass on activation to their associated phonological and semantic representations in both languages. Phonological and semantic representation are affected by extra-linguistic factors such as subjective frequency, which may cause a difference in activation between nodes of the two languages. For example, the speaker may end up with L2 phonological and semantic codes being less activated than L1 codes. However, as the different codes interact, the speaker develops a stronger ability to identify them in a short amount of time, which decreases the role codes play in making a word decision.

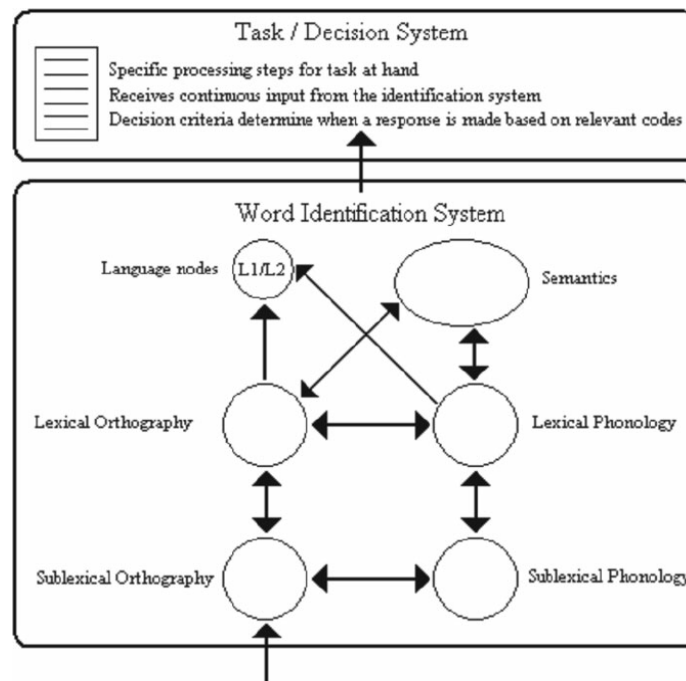
The other system involved in word recognition, the task/decision system, works at the task schema level. For example, issues such as task type and task strategy affect the use of lexical codes even if the pattern of activation applied in the word recognition process remains unchanged. This occurs because language nodes are only representations in the identification system. They do not play the role of language filters, nor do they determine language membership. Rather, language membership is dealt with at the task level where the speaker makes language decisions. Furthermore, in the task/decision

system, non-linguistic information has the capacity of changing or stabilizing the decision criteria of the word recognition process. This occurs because the task/decision system is an automatic system which works very early into the word recognition process.

Furthermore, in this system, and by means of high levels of attention sensitivity, episodic contextual features activate and select items in coordination with the task schema.

Figure 2

BIA+ model of word recognition (Dijkstra & Van Heuven, 2002, p. 182)



Examining the role of task more specifically, the task design specifies the mental processes needed to successfully do the task. A decision mechanism, which is part of the task design, keeps track of the word identification system by comparing the different types of activations with the input to make appropriate decisions. When it comes to language decisions, only codes that assist the recovery of language tags help in making appropriate decisions. Since the word identification system provides the task/decision

system with output information, the latter system makes decisions and modifies those decisions as the former system is in progress. In short, the interaction between the two systems is very dynamic. Figure 2 is a visual representation of the BIA+ model.

The BIA+ model of bilingual memory is strongly related to the language-independent notion of language processing which also suggests that the languages of a bilingual are constantly co-activated even when using only one of the two languages. That is, activation is nonselective and the bilingual subconsciously calls on both languages when reading, speaking, listening or writing in either of the two languages (e.g. Bijeljac-Babic, Biardeau & Grainger, 1997; Chee, 2006; Colomé, 2001; Crinion et al., 2006; Dijkstra, 2001; Kaushanskaya & Marian, 2007; Marian, Spivey & Hirsch, 2003; Van Heuven, Dijkstra & Grainger, 1998).

On a theoretical base, and in support of the language-independent notion, researchers have proclaimed that, although candidates from both languages are activated, the selection mechanism is designed to choose the candidates with a higher level of activation due to the intent to use one specific language. Accordingly, since candidates from the target language are more active than those from the non-target language, the former will be selected rather than the latter (Poulishse, 1999). Such argument is complemented by the *Inhibitory Control model* (Green, 1986, p. 216), a model which presumes the presence of a mechanism which suppresses the activation of candidates from the non-target language. The existence of such a mechanism ensures that the target candidates are constantly more active than the non-target ones.

In addition to the theoretical observations proposed above, a number of empirical studies have provided the literature with a variety of findings which provide strong

support for the notion of language-independence in bilingual language processing. Such findings offer proof of the interconnectedness of the two languages of a bilingual and their simultaneous activation in language processing.

Using response time and error rate as indicators of language activeness, Colomé (2001) attested the language-independent notion by the use of a phoneme monitoring task. The researcher tested a group of Catalan-Spanish bilinguals in a series of experiments to determine whether the non-used language of a bilingual can be deactivated when the participant is instructed to make monolingual judgments about a certain word. In the task, the participants saw a picture, then a letter. The participants needed to make a judgment of whether the sound represented by the letter was part of the name of the picture or not. Colomé (2001) conducted three experiments in which each picture was displayed in three different conditions. In the first condition, the picture was followed by a letter from the Catalan (i.e., L1) name of the picture. In the second condition, it was followed by a letter from the Spanish (i.e., L2) name of the picture. Whereas in the third condition, the picture was followed by a letter unrelated to either the Catalan or the Spanish names of the picture. The rationale of the task was that, if the participant's second language was active, it would take her longer to reject the letter from the Spanish name of the picture than it would take her to reject the unrelated letter. In the first experiment, the letter was displayed before the picture; and in the other two experiments, the order of picture and letter was reversed.

Colomé (2001) found that the participants in all three experiments took longer to reject the sound from the Spanish name of the picture than they did to reject the unrelated sound. The participants also demonstrated significantly more error rates in the second

condition (i.e., sound from the Spanish name of the picture). Finally, Colomé (2001) proclaimed that such results indicated that the L2 of the participants was activate while in a monolingual setting solely using Catalan (i.e., their L1).

Researchers have also found that even a slight phonetic prompt has the ability to activate the non-target language of the bilingual. For example, Marian, Spivey and Hirsch (2003) found that applying phonological attributes of one language to the onset of a word from the other language stimulates non-target language activation. Such a finding strongly supports the language-independent model because it shows the robust effect of a sublexical level of language on language activation.

In addition to previous observations, researchers have also aimed at presenting more technical evidence by the use of strategies such as neuroimaging. Using functional magnetic resonance imaging (fMRI) and positron emission tomography (PET) to scan brain activity in bilinguals, Crinion et al. (2006) examined the activity of the left caudate responsible for controlling the language choice of bilinguals. The researchers did so by means of a “context monitoring” mechanism (Chee, 2006, p. 528). Crinion et al. (2006) conducted their experiment by administering a semantic decision task to two bilingual categories, German-English bilinguals and Japanese-English bilinguals.

In their experiment, the researchers exposed the participants to stimuli which reflected matching/different linguistic/semantic conditions. First, Crinion et al. (2006) determined the essential role of the left caudate in controlling which language to use in production. Then they examined a participant with a deficit in his left caudate. They found that, in the production process, the participant involuntarily switched between the languages. Such a tendency in the participant indicated that the languages of a bilingual

are originally interconnected and are constantly active. Their findings stress the fact that a bilingual's two languages coexist in an intertwined manner.

The Revised Hierarchy Model (RHM) and Language-Specific Processing

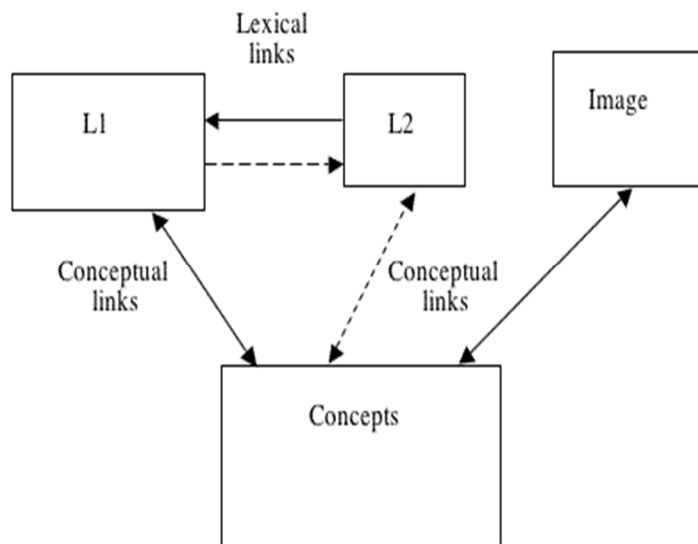
Another competing notion in the language processing dichotomy asserts that a bilingual's memory comprises two separate lexicons which, although work together, exist in isolation from each other. Addressing this notion of bilingual memory, Kroll and Stewart (1994) introduced the revised hierarchy model (RHM) of bilingual memory. Their theory aimed at specifying the language processing levels at which the two languages are connected, and the levels at which they are disconnected. They used translation and picture-naming tasks in developing their theory.

According to RHM, two elements are active in a bilingual's memory: 1) the lexical nodes of the two languages, and 2) concepts. However, their activation level differs according to the L2 proficiency level of the bilingual and her dominant language (i.e., L1 or L2). In many cases, the bilingual will have a larger vocabulary knowledge in the L1 than in the L2, which enables the bilingual to have a stronger ability to associate words from the L2 to the L1 than vice versa. Moreover, within each of the bilingual's two languages, associations between words and concepts are stronger in the L1 than in the L2. This may be the result of late L2 acquisition. That is, when a person acquires her L2 beyond childhood, the connections between the lexical items of the L1 and concepts, are already quite strong. When that person first starts learning the L2, L2 words are connected to the L1 system through lexical connections. When the bilingual's L2 becomes more proficient, the person keeps the connections already established between the L2 words and the L1 system, however starts to establish direct connections between

L2 words and concepts. Accordingly, the bilingual system becomes bidirectional, however with different strengths. Connections from L2 to L1 are stronger than those from L1 to L2. In addition, the connections from the bilingual's L1 to the bilingual's conceptual memory are stronger than those from the bilingual's L2 to the bilingual's conceptual memory. Accordingly, translation from L1 to L2 is affected by conceptual information. Yet, translation in the opposite direction is not influenced by a conceptual effect, but by a lexical effect. Consequently, translation from L2 to L1 will be faster than that from L1 to L2. In relation to picture-naming, exposure to the picture accesses the participant's conceptual nodes which make contact with one or both of the languages of the participant. Figure 3 is a visual representation of the revised hierarchy model.

Figure 3

The revised hierarchy model of lexical and conceptual representations in bilingual memory (Kroll & Stewart, 1994, p. 158)



The revised hierarchy model is strongly related to the language-specific approach to language processing, which suggests that language processing can be suppressed to one language only. That is, the languages of bilinguals, even those who use both languages regularly, work independently from each other at the selection level. This notion of language processing suggests that a bilingual speaker has the ability to consciously call on one of her two languages when reading, speaking, listening or writing, while inhibiting the non-target language (Costa, 2005; Costa, Miozzo & Caramazza, 1999; Gerard & Scarborough, 1989; Hernandez, Bates & Avila, 1996; Kroll, Bobb, Misra & Gou, 2008; Li Heij, 2005; Ojemann & Whitaker, 1978).

On a theoretical base, researchers have proposed a number of arguments in which they advocated the language-specific notion of language processing. One such argument is the *preverbal message notion* promoted by researchers such as De Bot (1992), Green (1993), Li Heij (2005) and Poulisse (1997). According to this line of reasoning, any and all word stimuli, by necessity contains all needed contextual information to trigger the word needed in a specific context. In this argument, researchers claim that two words such as ‘dog’ (English) and ‘chien’ (French), although carrying the same conceptual content, do not express the same meaning because each carries the features of the language to which it belongs (Li Heij, 2005). Thus, once a bilingual chooses to use her L1, words from her L2 will not be activated because they do not carry all features provided in the preverbal message and which have guided her to the specific word she needs to use. Hence, the intention to use one language highly activates the target language because “language [cue] is one of the features used for selection purposes” (Poulisse, 1997, p. 216).

A second argument in favor of the language-specific notion of language processing is the bilingual's use of the *binding-by-checking mechanism* (Roelofs, 1998). This notion proposes that the selected word is always in line with the meaning the speaker has in mind. (Roelofs, 1998) proclaimed that this mechanism enables the bilingual to match the appropriate word with the language intended for usage. He asserted that in cases where there is a mismatch between the word and the language, the binding-by-checking mechanism filters the selection by discarding the nonmatching word before it is further processed.

In addition to the theoretical observations mentioned above, empirical evidence supporting the language-specific notion is available in the literature. For example, Gerard and Scarborough (1989) applied a lexical-decision task on a group of Spanish-English bilinguals to test whether the participants' memory search mechanism can work in isolation of their L1 knowledge. The stimuli presented in the task were one of three types: 1) cognates, 2) homographs, and 3) non-homographic non-cognate control words and their translations. The first and third type of stimuli had similar levels of frequency in both languages. However, the level of frequency in the second type of stimuli, differed across the two languages (i.e., high in English and low in Spanish or the opposite).

In their experiment, Gerard and Scarborough (1989) instructed their participants, using English, to locate certain words from a list. The researchers found that words from the non-target language (i.e., Spanish) did not affect the participants' lexical decision latencies when choosing the English word, even in cases where the displayed Spanish word had a high level of frequency. However, the researchers did find traces of encoding in the non-target language and some integration between the two languages. Basing their

conclusions on the high amount of control abilities demonstrated by the participants at the lexical level, the researchers asserted that Spanish-English bilinguals mostly process language using a language-specific mechanism.

On a similar note, however pursuing a different type of procedure, Hernandez, Bates and Avila (1996) asserted that the co-activation of a bilingual's two languages needs high levels of consciousness and preparedness by the bilingual. In their study, the researchers used cross-language priming, a type of experiment which investigates the degree to which the participant's languages are interconnected with (i.e., primed) or isolated from (i.e., not primed) one another.

Hernandez, Bates and Avila (1996) administered a discourse-level naming task (i.e., a word pronunciation task) to a group of Spanish-English bilinguals. The task consisted of a group of auditory texts in which certain words were omitted and replaced by a Spanish or English word (i.e., the target word) shown on a screen. The target word displayed on the screen was either semantically or linguistically related or unrelated to the omitted word. In the task, the participants were instructed to read the visual word within one second, during which their response times were recorded.

In their experiments, Hernandez, Bates and Avila (1996) used two designs. Their first design aimed at examining cross-language priming. In it, they used a mixed design in which the language of the target word did not match the language of the auditory text. For example, while the participant was listening to an auditory text in Spanish, a blank would occur and the participant would see a word which filled that blank, however written in English not Spanish. The participant was then required to read that word in English ignoring Spanish. The second design aimed at examining within-language

priming. It was a blocked design in which the language of the target words always matched the language of the auditory text. Accordingly, the word on the screen and the auditory text were in the same language.

Hernandez, Bates and Avila (1996) conducted three experiments. In their first experiment, the target words were presented in normal circumstances. In the second experiment, the target words were degraded by placing asterisks between every two letters. Whereas in the third experiment, participants were asked to either delay their responses or execute them in a faster manner than in the previous two experiments. The researchers found that priming of the two languages only occurred when the participant had a high level of predictability of the target language (i.e., the blocked design), as well as when they were asked to delay their responses (i.e., experiment three). Such results indicated that within-language priming is a lexical process whereas cross-language priming is a post-lexical process. This in turn indicated that a bilingual's two languages are originally separate from each other (Hernandez & Reyes, 2002). Such findings suggest that language processing is language-specific.

Moreover, other studies, such as Marian, Spivey and Hirsch (2003), added very specific findings to the bilingual language processing research arena. They found that the two languages of a bilingual are highly sensitive, and that keeping them apart at the semantic level is extremely difficult. However, this does not apply at the lexical level. Marian, Spivey and Hirsch (2003) conducted three eye tracking experiments on Russian-English bilinguals. In their first experiment, they used both languages of the participants (i.e., Russian and English) to examine whether the two languages worked in parallel or worked separately. The researchers then followed this experiment with two further

experiments which had the same objective yet were administered in one language only. The aim of using one language only was to examine whether the results upheld in a monolingual setting or not.

In all three experiments, the participants wore head-mounted eye trackers during which they were instructed to pick up an item such as a 'a marku' (i.e., a stamp in Russian). In front of them there would be a stamp (i.e., the target object), a marker (i.e., the language competitor object) and a number of other objects placed as distractors. The objective of the eye tracking task was to examine whether the participants gazed at the object with the similar pronunciation in their L2, which in this case is the marker. If so, this would be an indicator that the participant's second language is active and language processing is language-independent. The researchers found that in all three experiments, the participants significantly gazed at the language competitor object, then retracted to the object they were instructed to pick up. Accordingly, Marian, Spivey and Hirsch (2003) concluded that language processing is language-independent in its early stages, the phonological processing stage, but becomes more specific at stages where the word unfolds, the lexical processing stage, even in a monolingual setting.

The researchers further supported their findings with neuroimaging. The results showed a similar pattern of activation at the initial stages of language processing in both their bilingual experiment and a monolingual experiment. Such tendency indicated that both languages of a bilingual are active at the semantic level even when the participant is speaking in a monolingual setting. Results also showed that at the later stages, activation of each language occurred in a different area of the brain, hence were processed independently from each other.

Furthermore, using a picture-word inference task, both Costa and Caramazza (1999) and Roelofs et al. (2016) tested the language-specific notion on two groups of bilinguals. In both experiments, the researchers' objective was to identify how lexical selection is achieved. However, the latter not only measured response times, but also incorporated a technical aspect in their experiment by measuring brain waveforms.

On the one hand, Costa and Caramazza (1999) applied their experiment on two groups. The first was a group of Spanish-English bilinguals; they were asked to name pictures in their dominant language (i.e., Spanish). The second was a group of English-Spanish bilinguals; they were asked to name pictures in their non-dominant language (i.e., Spanish). The participants needed to name the pictures in the presence of a strong Spanish or English distracting word. The researchers applied two types of conditions in their experiment. The first was a semantic condition in which the picture and target word were semantically related. The second was a translation condition in which the target word was the translation of the picture's conceptual item.

Costa and Caramazza (1999) found that response times were constantly faster when the picture and the target word referred to the same conceptual item than when they referred to different conceptual items. This occurred whether the language of the distractor matched the language in which they were instructed to respond, or whether the two languages were different from each other. Such findings are strong indicators that a bilingual's two languages have separate lexicons, each of which operates on its own.

On the other hand, Roelofs et al. (2016) applied their experiment to one group only, however they added two additional conditions than those used by Costa and Caramazza (1999). The conditions they added were an unrelated condition (i.e., the

picture and target word were not semantically related) and a control condition (i.e., a string of X's). Testing a group of Dutch-English bilinguals, the researchers calculated response times as well as event-related brain potentials (ERP) (i.e., a type of brain waveform that peaks at 400 milliseconds).

Roelofs et al. (2016) found that the ERP was small in both the semantic and translation conditions. However, in the translation condition, the response times were shorter and the amount of errors were less than that of the semantic condition. Such a finding suggested the existence of less competition in the translation condition (i.e., competition between languages) than in the semantic condition (i.e. competition between meanings within the same language), which supports the language-specific selection hypothesis.

Also using technical methodologies in testing selectivity in language processing, Rodriguez-Fornell et al. (2002) used fMRI in addition to the ERP used in Roelofs et al. (2016). Applying a lexical-decision task, Rodriguez-Fornells et al. (2002) randomly displayed 150 Spanish words and 300 Catalan words to their participants. The latter were non-cognates with Spanish. Within each group of words, half had a low frequency of usage while the other half had a high frequency of usage. In addition, the researchers used 150 pseudonyms inspired from both languages. Participants needed to press a tab only when a Spanish word appeared on the computer screen while ignoring Catalan words and pseudonyms.

Comparing results from Spanish monolinguals to that of Catalan-Spanish bilinguals, Rodriguez-Fornells et al. (2002) found that, in the ERP, bilinguals did not show any frequency sensitivity in non-target words, which excluded meaning recall of

such words. In relation to the fMRI, by examining different routes of phonological processing, the researchers found that bilinguals resorted to indirect phonological access routes to avoid L1 interference. Both findings strongly support the language-specific notion of language processing in bilinguals.

The Language-Mode Theory and Variable-Dependent Processing

In 1982, Grosjean introduced the *language-mode theory*. The primary premise of Grosjean's theory is that a bilingual's language system is organized in a dual-subset manner. That is, the two languages of a bilingual can be activated as one system or activated separately from one another.

According to Grosjean, when a bilingual is preparing herself to speak, two operations occur. The first operation, called 'language choice' (Grosjean, 2013, p. 15), is selecting the language the speaker is going to use. The language chosen is referred to as the 'base language' (Grosjean, 2013, p. 15). This choice is usually determined by a number of factors such as the bilingual's proficiency level in both languages and the interlocutor (Grosjean, 2013). The second operation performed when speaking, is deciding whether the other language is needed or not. This decision determines the bilingual's language mode which Grosjean defines as "the state of activation of the bilingual's languages and language processing mechanisms at a given point in time" (Grosjean, 2013, p. 15). Consequently, when making this decision, if the other language is not needed, its activation will be outstandingly minimal, and the speaker will be in a monolingual language mode. On the other hand, if the other language is needed, it will be activated, however less than the base language, and the speaker will be in a bilingual language mode.

In Grosjean's theory, the two language modes (i.e., the monolingual mode and the bilingual mode) are two endpoints of a language continuum for bilinguals, the 'language mode continuum' (Grosjean, 1997, p. 169). The baseline of this theory is that bilinguals, on a daily basis, find themselves at different points along the continuum according to the factors and variables surrounding the speech event. For example, if a bilingual who is highly proficient in both languages is speaking to another bilingual who is also highly proficient in the same two languages, she will be closer to the bilingual endpoint of the continuum. This is also the case if the bilingual is interpreting between her two languages. However, if the recipient is not proficient in one of the two languages, or the bilingual is reading a book in one of her languages, she will be closer to the monolingual endpoint of the continuum. Since speaking circumstances can change rapidly, Grosjean asserts that moving from one point on the language continuum to another point can occur very quickly. For instance, if the bilingual suddenly realizes the other participant is uncomfortable with one of the two languages, she will immediately make an attempt to deactivate that language.

Grosjean also maintains that the languages of a bilingual will "wax and wane" (Grosjean, 2013, p. 11) over the years according to life experiences. The two languages may be affected by different variables such as education, job circumstances and requirements, living conditions, interactions with other people, etc. Affected by such variables, one language may become stronger than the other at certain periods of the bilingual's life and weaker at other periods. This in turn will strongly affect the psycholinguistic processing of the two languages. Such a view supports the instability of

language dominance, hence the fluctuating degrees of language activation a bilingual may experience.

Following are a number of empirical studies which give support to Grosjean's language mode theory. The studies presented exemplify the effect of a number of variables on language processing in bilinguals. The variables examined are:

- 1) life domains
- 2) language proficiency level
- 3) the need to communicate effectively
- 4) social considerations
- 5) word frequency of usage
- 6) location inducing language usage

Life domains. Bilinguals have the tendency to associate certain domains of their lives with one of their two languages (Grosjean, 2013). For example, they may steadily use their L1 at home and in their social lives, but use their L2 in their professional or academic lives. More specifically, bilinguals establish language-specific domains according to "institutional contexts or socio-ecological co-occurrences" (Fishman, 1965, p. 73). Thus, making such language decisions is affected by the dynamics of the situation (e.g. topic, participants), and the expectations and norms of the society. As these language decisions are repeated by members of the community, they become social characteristics that define the language attitudes of the society as a whole.

The dynamics of the situation which govern language choice in a certain domain are numerous. For example, language choice can be dictated by the topic of the conversation (Grosjean, 2000), the role-relations and powers of the participants (e.g.

father-son, student-teacher, employee-employer) (Fishman, 1965), the media of interaction (i.e., reading, writing, listening, speaking), the type of language processing taking place (i.e., inner-speech, comprehension, production), or the formality and intimacy of the situation (Fishman, 1964).

The existence of language-specific domains in bilinguals' lives affects them in several manners. For instance, when speaking in a certain domain, this places the bilingual closer to one endpoint of Grosjean's language mode continuum than the other. When at the monolingual endpoint, the bilingual will have the base language in a state of full activation and the non-target language in a minimal activation mode. Whereas when in a bilingual mode, both languages are noticeably activated, however one somewhat more than the other; and the two languages fold out in the form of code-switching (Grosjean, 1997).

Furthermore, establishing language-specific domains, bilinguals end up with a difference in the lexical repertoire of their two languages. The bilingual won't by necessity have equivalent sets of vocabulary words in the two lexicons because each is used for specific purposes only (Grosjean, 1994). However, together, the two lexicons reflect the "complete language system" of the bilingual (Grosjean, 1985, p. 471). Following are studies which examined language choice in certain domains in certain societies.

Aiming to identify the functional roles of the primary languages of India, Sahgal (1991) investigated the language use of three high scale Indian groups (i.e., Hindus, Bengalis, and Tamilians) in three different life domains (i.e., family, friendship, and institution). All three groups lived in a high scale area in Delhi. The Hindi group

originated from that area, whereas the Bengalis and Tamilians were immigrants from the East and South of India. Using a questionnaire, the researcher asked the participants to judge their language use when speaking to different interlocutors; each interlocutor was associated with one of the three domains examined. The participants ranked their language use on a four-point scale. Dominance configuration scores of language dominance in domains were calculated.

Sahgal (1991) found that language usage varied across domains. In the family domain, all three groups used their mother tongue as their dominant language. Yet, in the friendship domain there was some variation. The Hindi group used Hindi, whereas the Bengalis and Tamilians used English to accommodate their need to communicate with people from outside their speech community. In the institutional domain, the researcher found that English was the dominant language for all groups. This was because English was the official language of all administrative and academic settings in India.

Adopting a more specific perspective, Siachitema (1991) examined language choice in the subdomains of the Zambian household. The researcher examined household language use across three different social classes of the community. The first social class lived in a shantytown, the second lived in a medium cost building, and the third lived in a high cost building. Siachitema (1991) administered an oral questionnaire in which she asked participants to identify the language they would potentially use in: 1) a certain family situation, 2) when speaking to a certain family member, and 3) when talking about a specific topic.

Siachitema (1991) found that in all three social classes, the primary language used at home was the mother tongue, however English was also used. Results showed that the

mother tongue was the language used between the elderlies and younger members of the household. The researcher also found that the use of English was not related to age, rather to education and material success. Furthermore, she established that English was used by young family members as a strategy to escape traditional obligations especially when wanting to defer from the elderly and feel superior to them.

Language proficiency level. L2 proficiency level is also a potential affective factor in bilingual language processing. A possible explanation of this is that bilinguals who are less proficient in their L2, have weaker connections between the information of their L2 system than bilinguals who are more proficient. Because of the weak connections between the phonological, orthographic and semantic information of their L2, these weaker bilinguals demonstrate longer L2 activation and processing time when compared to the more proficient bilinguals. In addition, weak connections in the target language are likely to cause weaker attention control abilities which in turn may lead to weaker control of interference and a stronger urge to respond in the non-target language (Van Hell & Tanner, 2012).

The effect of L2 proficiency level on bilingual language processing was examined in numerous studies, most of which used language switching tasks. Among such studies are Costa and Santesteban (2004) and Poulisse and Bongaerts (1994) who tested Spanish-Catalan bilinguals and Dutch-English bilinguals, respectively. In their experiments, each sample of bilinguals contained subgroups of different proficiency levels. Analyzing language switches in a picture naming task (Costa & Santesteban, 2004) and unintentional switches in natural speech (Poulisse & Bongaerts, 1994), these studies found a strong relationship between proficiency level and non-target language activation.

More specifically, Poulisse and Bongaerts (1994) found that, when speaking in their L2, highly proficiency bilinguals exhibited fewer L1 interferences than low-proficiency bilinguals. They also found that the L1 words of bilinguals with lower L2 proficiencies had a higher frequency level than their L2 words. Thus, the L1 words were activated more for lexical selection than the L2 words, which led to the high use of L1 words while using their L2. Accordingly, Poulisse and Bongaerts (1994) demonstrated that the proficiency level of a bilingual dictates her language use, hence language activation mechanisms. This occurs because language activation is affected by the type of information the speaker is more familiar with and has better mastery of.

Presenting very similar results, Costa and Santesteban (2004) took it a step further by testing multilinguals who were highly proficient in their L1 and L2 but moderately proficient in their L3. First, they demonstrated that such participants, when instructed to switch between their L1 and L2 in a picture-naming task, did so in an easier manner than the lower proficiency participants. This indicated that their control abilities were stronger. Next, they tested the same participants by instructing them to switch between their L1 and L3. They found that, likewise, they faced no problems in the task. Costa and Santesteban (2004) concluded that highly proficient bilinguals do not demonstrate different switching latencies regardless of whether they are switching between two strong languages or between two languages one being stronger than the other. Accordingly, the researchers declared that bilinguals who are highly proficient in at least two languages, have overall strong control abilities. They also asserted that these strong control abilities enable such bilinguals to process language by means of a language-specific selection

mechanism, even when using one of their weaker languages (Costa & Santesteban, 2004).

The need to communicate effectively. Another element which also affects a bilingual's choice of language activation is the bilingual's motivation and need to communicate effectively. Such motivation and need enhances the participant's ability to consider elements such as the interlocutor's familiarity with the language (Nicoladis, 2008). This tendency in bilinguals is commonly called *interlocutor sensitivity* and can be defined as speakers "using more of their language A with an interlocutor who speaks language A, and more of their language B with an interlocutor who speaks language B" (Paradis & Nicoladis, 2007, p. 277).

Grosjean (2000) examined the effect of the interlocutor and the type of topic being discussed on the level of activation in French-English bilinguals. His objective was to examine the participants' use of their languages in a naturalistic setting. He did so by asking them to summarize French stories and retell them, using their own words, to a certain type of addressee. Each participant received one of three tasks: 1) to tell the story to a French person who had just arrived to the United States, uses French at home, and knows minimal English; 2) to tell the story to a French person who had been in the United States for seven years and only speaks French at work but not at home; and 3) to tell the story to a French person who had been in the United States for seven years, speaks English at work, has French and American friends, and uses both languages at home. To accommodate the topic variable, Grosjean (2000) gave the participants a number of stories with a French theme and others with an American theme. The aim of

the experiment was to count the number of French and English syllables used in the participants' story summaries.

Grosjean (2000) maintained that the participants' usage of the English language increased as the addressee's description included more usage of the English language. In addition, Grosjean (2000) found that the type of topic being discussed had a noticeable role in the language activation of his participants. English syllables in the American themed stories occurred ten times as often as those which occurred in the French themed stories.

Social considerations. The literature has also shown that language choice is affected by certain interpersonal aspects demonstrated by members of a speech community to achieve certain social goals. For example, people attempt to reduce the dissimilarities between them and other people in the speech community for the sake of not being negatively evaluated.

One theory which explains the above tendency is the *interpersonal speech accommodation theory* (Giles, Taylor & Bourhis, 1973). Basing his theory on the social psychological notion of *similarity-attraction* (Giles & Powesland, 1975), the researchers argued that speakers adjust their language choice according to their audience to minimize the social differences between them and their audience. Giles et al. (1973) calls this process *accommodation*. 'Accommodation' is dictated by the characteristics of the speaker's addressees (Appel & Muysken, 2006), the people surrounding the speech event (Giles et al., 1973), and the "socio-historical context in which the interaction is embedded" (Sachdev & Giles, 2008, p. 354). This is different from the 'interlocutor sensitivity' notion in that it includes a social element in which the speaker wants to attain

membership within a specific society (Sachdev & Giles, 2008). Thus, this theory is not solely based on accommodating the interlocutor's language needs per se. In summation, the interpersonal speech accommodation theory explains "the motivations underlying certain shifts in people's speech styles during social encounters and some of the social consequences arising from them" (Gallois, Ogay & Giles, 2005, p. 122).

Empirically, several studies have supported the interpersonal speech accommodation theory by establishing how the need to socially accommodate a speaker's addressee affects her language processing mechanism. For example, findings have shown accommodation effects on the speaker's gestures, response latencies, head nodding and facial affect, and pausing frequencies and length (Giles, Coupland & Coupland, 1991). It also affects the speaker's choice of language as demonstrated in Giles et al. (1973) discussed below.

Giles et al. (1973) empirically tested their accommodation theory on a group of Canadians in Quebec where English and French are both commonly used. In their experiment, each participant heard a description of a picture told by a male interlocutor in one of four language conditions: 1) French, 2) a mixture of English and French, 3) fluent English, and 4) non-fluent English. The experiment had four stages. First, the participants drew a picture (i.e., a distracting move), then they answered a questionnaire rating their reactions to the interlocutor and the interlocutor's performance. The participants thereafter described another picture to the same interlocutor. Finally, they filled out a questionnaire justifying the language(s) they used and how they felt by using that/those language(s).

Analyzing the language choices of the participants, results showed fourteen categories of accommodation ranging from speaking totally in French to speaking totally in English. In the questionnaires, participants commonly expressed a preference to accommodate their interlocutor's language for the aim of narrowing the cultural gap between them and their interlocutors. The aim of doing so, was to be socially viewed in a more preferable manner. Accordingly, such results of language convergence are evidence that culture and cultural considerations are affective factors in language activation and language processing in bilinguals.

Word frequency of usage. One further element which affects language activation and processing is the subjective frequency of usage of the lexical item being processed. That is, how frequently the speaker has been exposed to and/or has used that specific lexical item. A number of theories have been proposed to explain how frequency affects language processing, one of which is Morton's (1969) *logogen model*. In this model, the main element is the logogen which is a unit of recognition used to identify lexical items. A logogen identifies lexical items by triggering into the semantic, visual, acoustic and contextual attributes of the language to which the lexical item belongs. Logogens are not words; they are rather information about words. Once this information reaches a certain threshold, it helps the speaker retrieve that specific lexical item (Morton, 1969). In addition, once a word is used frequently enough by the speaker, its threshold becomes lower and its retrieval becomes faster (Duyck, Vanderelst, Desmet & Hartsuiker, 2008). Such explanation indicates that word frequency and recognition latencies are correlated negatively; the higher the frequency, the shorter the response time.

An empirical study which supports Morton's logogen model is Poulisse and Bongaerts (1994). In their study, the researchers noticed that weaker bilinguals conducted switches using more function words than content words. The researchers declared that such a tendency was the result of being more exposed to the former type of words than they were exposed to the latter type. Difference in exposure resulted in a difference in activation level between the two types of words. The researchers declared that such a pattern of switching between languages, is related to the frequency level of the words as specifically manifested in the participants' lexicons. The fact that the participants were more exposed to function words than they were to content words resulted in function words having a lower threshold than content words, hence being activated more easily and in a more rapid manner.

Similarly, Gerard and Scarborough (1989) supported the effect of word frequency on response time. Applying a lexical-decision task on a group of Spanish-English bilinguals, the researchers tested whether the participants' memory search mechanism can work in isolation of their L1 knowledge. They administered a task in which the stimuli used were one of three types: 1) cognates, 2) homographs, and 3) non-homographic non-cognate control words and their translations. The researchers found that frequency of usage of the lexical item correlated negatively with the participants' response time.

Other theories give low-frequency words an advantage over high-frequency words in language recognition. In such theories, researchers argue that low-frequency words refer to clearer and more unique representations in the speakers' linguistic memory. Thus, processing them is more rapid and more accurate than processing high-

frequency words (McClelland & Chappell, 1998). High-frequency words, on the contrary, have a lot of information connected to them. Hence, they trigger more cross points in the linguistic memory, each of which is related to a certain prior episodic context in which the word was used. Filtering out these cross points to reach the correct conceptual representation, which fits the current episodic context, takes more time than that of low-frequency words. Accordingly, high-frequency words are activated slower than low-frequency words (Reder et al., 2000). Such a view indicates that word frequency and recognition response time correlate positively; the higher the frequency, the longer the response time.

Empirically, the low-frequency advantage view was established by Reder et al. (2000). The researchers conducted three experiments where in the first and second they administered a remember/know judgment task to predict word frequency patterns. In the first experiment, participants needed to judge a group of words as either *remember*, or *know*. In the second experiment, they needed to judge the words as either *old* or *new*. In the third experiment, the participants studied four lists of words and tried to remember them. Each list correlated with a certain color and a certain font. After performing a distractor task, each participant was asked to remember the words in the lists. Then the procedure of experiment 1 was repeated, where the researchers asked the participants whether a word was *remember*, or *know*. Next, the researchers showed each participant a word from the four lists and asked her/him to determine the correct color and font associated with it. The aim of this last procedure was to stimulate the participants' accuracy in retrieving the contextual information of the words.

In their findings, Reder et al. (2000) found that high-frequency words were *old, know* words, whereas low-frequency words were *old, remember* words. They also found that the third experiment reduced the amount of *remember* answers in high-frequency words because it stimulated them to make more accurate responses. This indicated that high-frequency words involve immense contextual confusion because they have more contextual associations each of which strives to be chosen. Accordingly, activation is delayed and takes a longer time.

Location inducing language usage. It is argued that language processing can also be affected by the external environment in which the two languages are being used (Bialystok, 2009). More specifically, Grosjean (2013) explained how the location in which the speaking event takes place strongly affects the status of a bilingual's base language, and in turn her language choice process. This is due to the location's tendency to increase the amount of usage of that specific language.

One example of the effect of location on language processing is MC, an adult English-German speaker. At the age of 26, MC was at a relatively low proficiency level in German because of his rare use of it in his daily life. However, when he moved to Germany at the age of 36, he started using the German language on a daily basis and became highly proficient in it. This change of routine in his language use, caused a decline in his other two languages, English and French (Grosjean, 2013). Similar to MC's situation, is EP's situation, who is also an adult bilingual. The language configuration of EP shifted between the ages of 20 and 30 when he transferred to Switzerland. Consequently, EP's German language improved drastically, and he also acquired two

new languages, Spanish and Swiss German because they are also languages used in Switzerland (Grosjean, 2013).

The cases of MC and EP show that using a language in its native setting is quite different from using it in its non-native setting. Hence, location is assumed to have a noticeable effect on the language dominance of a bilingual as well as how active the two languages may be at a certain point of time. Accordingly, such changes suggest that language use “is dynamic and leads to a change in a person’s language configuration and hence language processing” (Grosjean, 2013, p. 10).

Language Processing in Picture-naming

Picture naming tasks involve showing participants pictures as stimuli (i.e., the picture denotes a specific noun such as people, animals, objects, etc.) and the participants are asked to name the picture as quickly as possible. When applied on bilinguals, the task will most likely include a translation distractor as well as the identity word itself. For example, if an Arabic-English bilingual is required to name an item such as a banana in Arabic, they would need to say the Arabic word *mawzah* (i.e., identity word) and ignore saying the English word *banana* (i.e., translation distractor). While performing such a task, a number of elements surface and play a role in the language processing of the bilingual. Language processing models explain this in different ways.

On the one hand, the language-independent approach to language processing views translation distractors as strong competitors because there is a total match between the translation distractor and the picture. This match causes a large amount of priming in the target word; however, reverse priming, which is stronger than the target priming, also

occurs. The reverse priming surfaces in the form of interference. Accordingly, translation equivalents are viewed as inhibitors rather than facilitators (Roelofs et al., 2016).

Furthermore, according to the language-independent model, two elements contribute to elevated response times. The first is related to competition which takes place at the pre-articulatory level. At this level, the distractor reaches the pre-lexical level before the target picture name. The more shared features between the target name and the non-target name, the longer the response time will be. The second element which contributes to elevated response times is the non-target item. Selecting the target language is affected by the activation level of the non-target item. Hence, when faced with a stimulus which increases the activation level of the non-target item (e.g. the phoneme onset of the non-target name), difficulty to choose the target item will increase, and response time will be longer (Hall, 2011). Both elements above signal the occurrence of non-target language interference with elevated response times.

On the other hand, the language-specific approach to language processing proposes a different view. This approach argues that translation equivalents help activate the target items. Thus, at the conceptual and lemma levels, both the target item and its translation equivalent are active. However, activation of the translation equivalent does not compete with the target item at the lexical level. Accordingly, translation equivalents are facilitators rather than inhibitors because the translation facilitative effect (i.e., between languages) is smaller than the identity facilitative effect (i.e., within language). Moreover, the translation facilitation effect causes shorter response times due to its facilitative nature (Roelofs et al., 2016). Furthermore, according to the language-specific model, exposure to a phonological related distractor, activates not only the nodes related

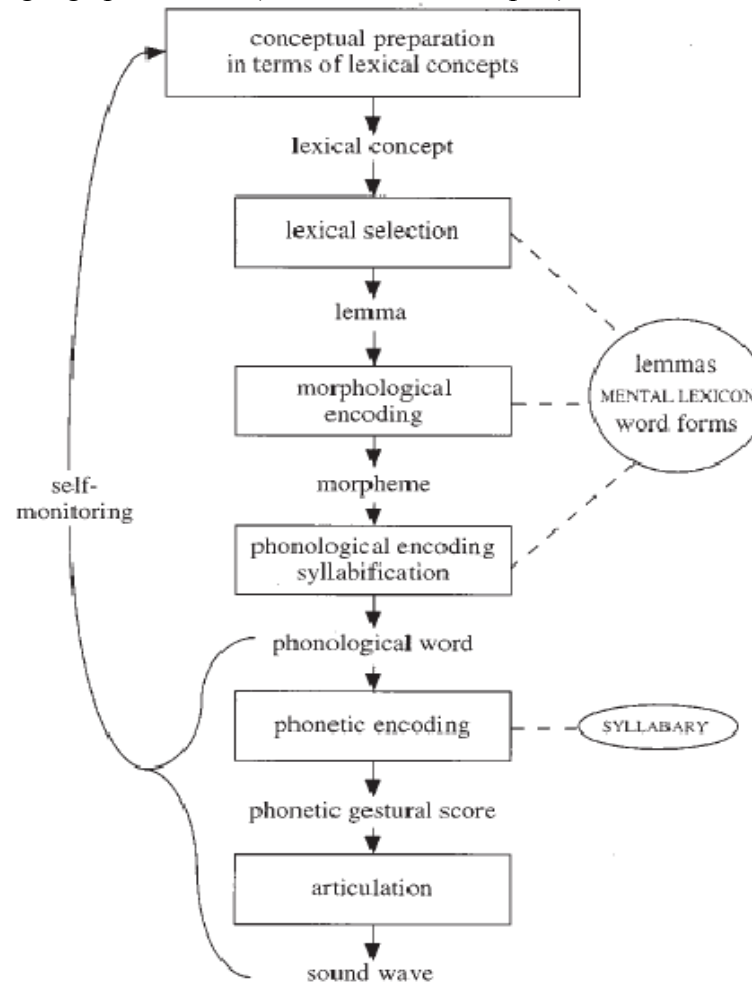
to the non-target language, but also those related to the target language. Thus, the non-target phonological stimulus acts as a facilitator and quickens response times (Hall, 2011).

Retrieval of lexical entries stimulated by pictures can be explained by examining theories of language production. Levelt, Roelofs, and Meyer (1999) introduced a theory of speech production in which the first several stages involved how a speaker prepares a concept, selects a lexical item, morphophonologically encodes the lexical item, and finally phonetically encodes the lexical item. In relation to the present study, such steps can explain the participants' interpretation of the picture stimulus. Figure 4 is a visual display of the speech theory introduced by Levelt et al. (1999). The last stage is irrelevant to the present study, hence will not be reviewed.

In their theory, Levelt et al. (1999) introduced the stages of how a speaker reaches the target word. The first of these stages is "perspective taking" (p. 3) which is determined by two sources of information: 1) the pragmatic context-dependent considerations, and 2) the articulatory and visual input. On the one hand, the former of these two sources of information is dealt with within a network of concepts. In this network, each concept spreads its activation to semantically related nodes. It then identifies the specific pragmatic considerations related to the episodic context of the word being retrieved. On the other hand, the latter source of information involves the type of sensory input displayed to the participants; that is, whether the participants receive auditory or visual stimuli.

Figure 4

Theory of language production (Levelt et al., 1999, p. 3)



The second stage in reaching the target word is the “lexical selection” stage (Levelt et al., 1999, p. 3), where the speaker retrieves the lemma from the mental lexicon. In this stage, the lexical concept spreads activation to the lemma node. The speaker then scans the activated lemma nodes and chooses the one with the highest activation level. The syntactic component of the target word comes in at this point where the speaker attaches all relevant syntactic features to the lemma. In picture-naming tasks, the syntactic feature ‘noun’ is linked to the lemma as its part of speech. Next, the speaker

searches for the diacritic parameters of the word; the conceptual representation of the target word provides such information.

The third stage of the speech production theory is “morphophonological encoding and syllabication” (Levelt et al., 1999, p. 4). The first element in this stage is the speaker’s retrieval of the word’s phonological form from her mental lexicon. Words with phonological forms of higher frequency unfold more rapidly than words with lower frequency phonological forms. Accessing the phonological form of the word involves three types of information: 1) the word’s morphological structure (i.e., morphological markings such as pluralism), 2) the word’s metrical structure (e.g. word stress), and 3) the word’s segmental structure (i.e., the phonemes which compose the word). The speaker does not deal with syllabication in this stage because it is a more advanced process determined by the phonological environment of the word.

The fourth stage in the speech production theory of Levelt et al. (1999) is “phonetic encoding” (p. 5). The speaker achieves this type of encoding by tapping into her syllabary (i.e., scores of frequency of within- and between-syllable usage). Doing so, the speaker determines the most common phonological syllables that suit the word. For example, exposure to an onset [t] will activate syllables that begin with [t]. The speaker refines these according to scores of commonness. The binding-by-checking mechanism then inhibits activated [t] items that do not match the target word. Finally, the speaker conjoins the appropriate phonological syllables and mentally retrieves the target word. In summation, the stages reviewed above indicate that “a lexical entry is an item in the mental lexicon, consisting of a lemma, its lexical concept (if any), and its morphemes (one or more) with their segmental and metrical properties” (Levelt et al., 1999, p. 6).

In their theory, Levelt et al. (1999) introduced an inhibitory mechanism. The researchers asserted that establishing a phonological word, phonetically encoding it, and testing its commonness are self-monitored by the speaker. The self-monitoring applied by the speaker affects encoding duration, which in turn affects response times in participants. When the stimulus is an auditory one, self-monitoring is more forceful and causes more delay.

According to Levelt et al. (1999), distractors are always inhibitory in picture-naming tasks. This is because when the task involves an identity word, a related distractor, and an unrelated distractor, the activation of the identity word and the related distractor will converge on the lemma of the related distractor. The unrelated distractor will not exhibit such convergence with either the identity word or the related distractor. Furthermore, the identity word will take a longer time to overcome the related distractor than will the unrelated distractor. Thus, the related distractor will be the strongest competitor among the three which causes inhibition of the identity word and the possible occurrence of language interference. Language interference and errors in this case will occur at the stage where semantic information is mapped onto lexical entries.

Language Processing in Arabic-English Bilinguals

The present section consists of two subsections. The first subsection provides a general overview of the basic differences between Arabic and English. The objective of this comparison is to highlight and stress the minimal overlap between the two languages. Such a comparison is important in stressing the fact that when two languages are different on numerous levels, language processing may unfold differently than when the two languages are considerably similar (Coderre & Van Heuven, 2014). The second

subsection reviews six studies which specifically study language processing in Arabic-English bilinguals.

Arabic vs. English

Arabic and English are noticeably different at several levels (Coderre & Van Heuven, 2014; Dajani & Omari, 2013). Following, they are compared in relation to areas relevant to the present study, namely, their writing systems, their phonological systems, and their morphological systems. It should be noted that the Arabic variety discussed is Modern Standard Arabic. This is the variety commonly used throughout the Arab world by educated people, in print media such as newspapers, and in official oral events such as speeches.

First, Arabic and English belong to two different language families; hence, their writing systems are extremely different. On the one hand, Arabic is a Semitic language which stems from the Afro-Asiatic language family. It is written from right to left in *abjads*, which includes twenty-eight letters presenting only consonants and long vowels, all of which have one pronunciation only. Short vowels do not exist in the Arabic writing system in the form of letters. They rather transpire as diacritics placed above letters. Such diacritics are optional in writing and are mostly included in oral language production intuitively. Furthermore, Arabic is always written with its letters connected to each other, unless the script of the letter itself does not permit doing so (Arabic, 2016). Moreover, Arabic does not acknowledge upper and lower case in letters. Rather, the way in which a letter is written may change according to its position in the word (i.e., beginning, middle, or end).

English, on the other hand, is a West Germanic language that stems from the Indo-European language family. It is written from left to right in twenty-six alphabet letters. English alphabet letters include both consonants and vowels (i.e., short and long), in which certain letters may be pronounced in more than one way. Furthermore, English can be written connected (i.e., cursive) or unconnected (i.e., print). Moreover, English has two cases, upper case and lower case.

Second, the two languages are different in relation to their phonological systems. On the one hand, Arabic includes thirty different consonant phonemes and three vowel qualities (Javed, 2013). Compared to other languages, the number of Arabic consonant phonemes are over average, whereas the number of Arabic vowel phonemes are noticeably under average (Newman, 1984). Regarding consonants, Arabic includes ten phonemes which are absent from the English language. Table 2 below presents the ten Arabic phonemes in question.

Unlike Arabic, English has twenty-four consonant phonemes and nineteen vowel phonemes (i.e., eleven vowels and eight diphthongs). English consonant phonemes include five which are not used in the Arabic language. Table 3 provides an elaboration of the five English phonemes referred to.

In addition, Arabic and English differ in their word stress. Arabic stress tends to be regular and predictable and does not affect either the meaning or the part of speech of the lexical item. Unlike Arabic, English word stress is irregular and random and may affect the meaning of the word and/or change its part of speech.

Table 2

Arabic consonant phonemes absent from the English language

Arabic letter	IPA symbol	Place of articulation
ء	/ʔ/	glottal stop
ح	/ħ/	voiceless pharyngeal fricative
خ	/x/	voiceless velar fricative
ص	/sˤ/	voiceless alveolar fricative
ض	/dˤ/	voiced alveolar stop
ط	/tˤ/	voiceless alveolar stop
ظ	/ðˤ/	voiced dental fricative
ع	/ʕ/	voiced pharyngeal fricative
غ	/ɣ/	voiced velar fricative
ق	/q/	voiceless uvular stop

Table 3

English consonant phonemes absent from the Arabic language

English letter	IPA symbol	Place of articulation
p	/p/	voiceless bilabial stop
v	/v/	voiced labiodental fricative
ch	/tʃ/	voiceless post-alveolar affricate
g	/g/	voiced velar stop
ng	/ŋ/	voiced velar nasal

Moreover, the two languages differ in regards to consonant clusters (i.e., phoneme grouping not letter grouping). In Arabic, consonants are almost always separated with vowels. Accordingly, consonant clusters are not the norm. However, the language includes some consonant clusters of two phonemes (e.g. son /ibn/). English, on the other

hand, includes many consonant clusters consisting of three consonant phonemes in word initial position (e.g. strength /streŋkθ/) and four consonant phonemes in word final position (e.g. texts /tɛksts/) (Ngaston, 2011).

Third, at the morphological level, each of the two languages is subject to a different system. Arabic is a highly derivational language which follows a root-pattern system. Accordingly, Arabic words are composed in regards to two elements: 1) the root which represents the semantic component of the word, and almost always consists of three consonants, and 2) the word pattern which represents the grammatical component of the word and which is “a discontinuous morpheme consisting of one or more vowels and slots for [the] root phonemes” (Ryding, 2005, p. 48). In summary, the Arabic word is formed by applying the pattern to the root since neither of them can be used in isolation from the other. In addition to being a highly derivational language, Arabic is also highly known for its word inflectional endings which reflect the grammatical function of the word (e.g. distinguishing between the subject and object of the word) (Shamsan & Attayib, 2015).

The morphological system of English is similar to Arabic in some regards, but highly different in others. Similar to Arabic, English words also consist of a root. However, in English, the root is the base morpheme which consists of both consonants and vowels, and is stripped from any added elements. Also like Arabic, English is subject to derivational morphology, however minimally when compared to Arabic. Derivational morphemes are added to English roots to change the part of speech of the word. That is, they are used to create new words. Furthermore, English is also subject to inflectional morphology where roots are usually accompanied by a prefix and/or a suffix. This is to

indicate the number, tense, person, case, and gender characteristics of the word. In regards to grammatical function, unlike Arabic, English resorts to word order rather than word inflectional endings.

Empirical Studies

The amount of research available in the literature which specifically investigates language processing in Arabic-English bilinguals is quite limited. As of the knowledge of the researcher to this point of time, only a few studies with Arabic-English bilingual subjects which are directly related to bilingual language processing have been published.

Among the very limited studies which measured L2 interference in Arabic-English bilinguals is Qasem and Foote (2010). In their study, the researchers tested two models: 1) the morphological decomposition model (MDM), which states that activation spreads through the morphological characteristics of a lexical item not its orthographic characteristics; and 2) the revised hierarchy model, which indicates that the higher the L2 proficiency level in bilinguals the less the bilingual resorts to L1 translation equivalents when processing L2 lexical items. In their study, Qasem and Foote (2010) administered a translation recognition task to two groups of Arabic-English bilinguals, a high proficiency group and a low proficiency group. Both groups saw pairs of words and judged whether the second word (i.e., the Arabic word) was a translation of the first (i.e., the English word).

Concerning the MDM model, the researchers found that, regardless of proficiency level, more morphological interference occurred than orthographic interference, a finding which supports the model in question. Additionally, the researchers found no negative

correlation between L2 proficiency level and L2 interference, a finding which rules out the RHM model. Qasem and Foote (2010) also found that the highly proficient participants exhibited more orthographic interference than the lower proficient participants. This can be explained by the highly proficient participants extensively using their L2 which may have negatively affected their L1 and triggered a restructuring process in their languages.

A further study which measured L2 interference in Arabic-English bilinguals is Dalrymple-Alford (1968). The aim of the study was to compare interlingual interference to intralingual interference in bilinguals. The researcher tested a group of Arabic-English bilinguals using a Stroop test consisting of four conditions where some items were in English and others in Arabic. The four conditions were: 1) condition X in which a string of X's were written in five different colors, 2) condition CW in which color words were written in non-congruent colors, 3) condition M in which color words were written in congruent colors, and 4) condition N in which non-color words were written in five different colors. The researcher instructed the participants to name the color of the word in Arabic regardless of the language of the word itself. The researcher measured the response times of the participants.

Dalrymple-Alford (1968) expected the longest response times to be related to condition M (i.e., the color word written in English), because of the semantic similarity between the interference word and the response. Yet, the results showed that response times in condition M were significantly shorter than the other three conditions. This ruled out the existence of interlingual interference. Dalrymple-Alford (1968) asserted that such results signal the existence of a priming effect in which the perception of a word in one

language induced the priming of its equivalent in the other language. In addition, it also suggested that interlingual interference is weaker than intralingual interference in Arabic-English bilinguals.

A further study on language processing in Arabic-English bilinguals is one which focused on the effect of language similarity and difference on the executive control (EC) abilities in language processing. In this study, Coderre and Van Heuven (2014) compared response times of three groups using a Stroop task and a Simon task. A Stroop task is a task in which words such as 'red' and 'blue' are not written in the color they denote. In the task, the participant is asked to read the word ignoring the color in which it is written. Whereas a Simon task is a task which compares response times of two different conditions. In the first, the stimulus and response tab are in the same location (e.g., both on the left); whereas in the second, they are in different locations (e.g., one on the left and the other and the right).

The three groups tested were German-English bilinguals (highly similar languages), Polish-English bilinguals (less similar languages), and Arabic-English bilinguals (highly different languages). The researchers measured language interference and response times by means of the two task types they administered. The rationale of Coderre and Van Heuven (2014) was that when bilinguals use two similar languages, they will demonstrate high EC abilities to dominate cross-linguistic influences. This leads to limited occurrences of interference and short response times.

In their findings, Coderre and Van Heuven (2014) found that Arabic-English bilinguals, compared to the German-English bilinguals and Polish-English bilinguals, showed less L2 interference and longer response times, findings which contradicted their

assumptions. However, they attributed their findings to the fact that since Arabic and English are limited cross-linguistically, weak interference of word concept with color concept occurred. Furthermore, the researchers asserted that the Arabic-English bilinguals' longer response times may be due to their weaker EC abilities which is the result of their two languages being highly different.

Furthermore, Saegert, Obermeyer and Kazarian (1973) set out to study the organizational characteristics of the two languages of a bilingual. They did so by administering a free-recall test to a group of Arabic-English bilinguals. The participants needed to recall bilingual word lists as well as unilingual word lists. Results showed no difference in recall between the two types of lists when the words were from different semantic categories. The results also showed that when recalling the unilingual word lists, the participants faced interference. Whereas, when recalling bilingual word lists, they clustered words of the same language together. Consequently, the researchers asserted that the occurrence of language interference indicated that the two languages are intertwined at the semantic level. As a result, they proclaimed that the lexical items of Arabic-English bilingual's two languages are stored in "one central semantic system to which words are linked with language tags" (Magiste, 1982, p. 30). Accordingly, the two languages are highly interconnected at the initial levels of language processing. The researchers do not comment on the status of the two languages at more advanced levels. However, since the participants applied a language-organization technique while recalling the bilingual word lists, one concludes that a level of separation between the two languages existed at the more advanced stages of language processing.

In addition, Liepmann and Saegert (1974) applied the same recall test as in the previous study to a different group of Arabic-English bilinguals. However, they constructed the lists in a manner where there would be a great deal of overlap in items among the lists (i.e., the language of each item randomly varied across lists). The aim of the study was to test whether the participants would be able to keep track of the language of items during recall. If so, such a tendency would be strong evidence for the language-specific notion (i.e., items are stored on a language basis). However, if the participants correctly recalled the items but were not able to keep track of the language of the item, such aspect would be evidence that the items were stored according to their semantic characteristics not the language to which they belong. Results obtained showed that the bilinguals in question were not accurate enough in their recall which supports the language-independent notion (i.e., language items are stored on a semantic basis not a language basis).

The most recent study found in the literature on language processing in Arabic-English bilinguals is Blanco-Elorrieta and Pylkkanen (2015). In this study, the researchers investigated language selection and how it is neurophysiologically and behaviorally affected by two natural cues, script and cultural context. By use of magnetoencephalography (MEG), the researchers studied the brain activity of a group of Arabic-English bilinguals while performing a number-naming task. In the first condition (i.e., a match condition), the participants saw a number in written format in either Arabic or English (i.e., the script cue) and were asked to say the correct digit in the language of the cue given. Then they saw a number of dots with either an Arab or Western man standing next to them (i.e., the cultural context cue) and were asked to say the correct

number according to the cultural context provided. In the second condition (i.e., the mismatch condition), the participants performed the same task, however gave the answer in the opposite language of the cue provided.

MEG results showed a difference in brain activity in both conditions between the two types of cues. To rule out that the differences in results were related to the type of answer required (i.e., naming a number character in the script cue and naming a numerosity in the cultural context cue), the researchers conducted a second experiment. In their second experiment, the participants first saw a number of dots or their matching number. They then needed to name the number in English correctly and quickly. MEG results did not show any significant difference in brain activity between the two experiments. Accordingly, Blanco-Elorrieta and Pylkkanen (2015) declared that script and cultural context have a significant effect on the language selection process of Arabic-English bilinguals.

The Phoneme Monitoring Task

One of the problems inherent in many studies examining language activation is the use of a procedure which incorporates the non-target language. Doing so has evident consequences since “[i]t is plausible to assume that when speakers have to switch regularly between languages ... competition for selection often can no longer be restricted to the target language” (Roelofs, Piai, Garrido Rodriguez & Chwilla, 2016, 2016, p. 9). Such a procedure purposefully intertwines and interconnects the two languages of a bilingual because the speaker is not motivated in any manner to inhibit the non-target language even if language-separation is plausible (Marian & Spivey, 2003). This problem can be solved by incorporating a phoneme-monitoring task.

Description

Phoneme monitoring (PM) is a research procedure used in experimental studies in the field of psycholinguistics. In this task type, the subject is exposed to a phoneme stimulus (i.e., the target sound) which is either placed within a sentence or a list of words or non-words. Once the participant is exposed to the stimulus, she needs to press a response tab as rapidly as possible to determine either a negative or affirmative response to the speech sound. The participant's response is triggered by a predetermined aspect such as whether the phoneme is part of a specific picture or not. In PM tasks, the dependent variables may be latencies of phoneme identification, accuracy detection, or false alarms. Whereas the independent variables may be one of two types: 1) the characteristics of the target sound such as its "frequency, congruity/incongruity with context, lexical status, similarity to real word, position of the target in a word" (Connine & Titone, 1996, p. 636); or 2) numerous list variables such as the "nature of the foils, warning tones to speed responses, [or a] secondary task" (Connine & Titone, 1996, p. 636).

PM tasks have been used for many different objectives. For example, in relation to detecting sentence effects, they have been used to test prosody (e.g. Pitt & Samuel, 1990a; Shileds, McHugh & Martine, 1974), semantic context (e.g. Eimas & Nygaard, 1992; Foss & Blank, 1980), and syntactic complexity and processing resources (e.g. Hakes, 1972; Frauenfelder, Segui & Mehler, 1980). In addition, PM tasks have also been used in relation to lexical detection aspects such as matters concerning word ambiguity (e.g. Connine, 1994; Pitt & Samuel, 1995), associative priming (e.g. Frauenfelder & Sagui, 1989), and lexical frequency (Dupoux & Mehler, 1990; Eimas, Hornstein &

Payton, 1990). Furthermore, PM has also been used to detect pre-lexical issues such as in experiments related to the participants' monitoring abilities (e.g. Cutler & Otake, 1994; Segui, Frauenfelder & Mehler, 1981), phonological similarity (e.g. Cutler, Butterfield & Williams, 1987; Frauenfelder, Segui & Dijkstra, 1990), perceptual salience (e.g. Cutler, Van Ooijen, Norris & Sanchez-Casas, 1996; Nix, Mehta, Dye & Cutler, 1993), and attentional variables (e.g. Mehta & Cutler, 1988; Pitt & Samuel, 1990b). (All examples are adapted from Connine & Titone, 1996).

In general, there are two major types of PM tasks. The first type is the standard PM task. In this type, the participant focuses on one specific phoneme which is in a single and stable location in the name of the picture. The first to apply this PM task type was Foss (1969). In his study, the researcher instructed participants to press a tab when a word began with a [b] sound while he recorded their response times. The aim of Foss (1969) was to examine decision making during sentence comprehension. Foss did so by placing the target words at different positions in the sentence (i.e., early in the sentence vs. late in the sentence) and after either low or high frequency words.

Although standard PM proved to be beneficial and yielded valid results, it suffered from shortcomings. The major shortcoming was its lacking ability to determine whether the participants were making their responses at a lexical level or a pre-lexical level (Connine & Titone, 1996). As a result, researchers developed a second type, the generalized PM task. In this PM task type, the target phoneme had the potential of being in a number of different locations within the picture name. Hence, the participant would not be guided to focus on a specific location but left to find the answer in a number of possible locations within the word. The first to apply the generalized PM task were Segui

and Frauenfelder (1986) and Frauenfelder and Segui (1989) (Connine & Titone, 1996). In the former study, the researchers asked the participants to identify plosive phonemes in matched low and high frequency words for the aim of investigating the effect of the lexical level of the target item on the processing of sounds. In the latter study, Frauenfelder and Segui's (1989) aim was to study the effect of context on lexical processing. In their study, the researchers required participants to respond to word-medial targets half of which followed related words, and half of which followed nonrelated words. Thus, the participants needed to focus on different positions within the picture name.

Application

As mentioned previously, the PM task can be used to study a wide range of elements related to the field of psycholinguistics. For example, investigating phonological encoding in people who stutter, Sasisekaran and De Nil (2006) applied two PM tasks. In the first, the participants performed a silent naming task; whereas in the second, they performed a perception task. The researchers compared results of two groups, a group of people who stuttered (PWS) and a group of people who did not stutter (PNS). In the silent naming task, the participants first heard a speech sound then saw a picture. They were then instructed to press a green tab if the sound was part of the name of the picture and a red tab if it was not. Similarly, in the perception task, the participants also heard a speech sound, yet it was followed by a word not a picture. Again, they were instructed to either press a green or red tab according to their response.

Results showed significant differences in response time in the PM silent naming task between the PWS group and the PNS group; the PMS group response times were

slower. However, no significant differences were found in the PM perception task. Such results suggest that although PWS participants are slower in encoding, they do not suffer from overall monitoring deficits.

Moreover, Ganushchak and Schiller (2009) used PM to investigate the effect of time pressure on error-related negativity (i.e., an electrical brain signal which occurs when a person makes a behavioral error) during L2 verbal monitoring. Testing German-Dutch bilinguals, the researchers conducted their experiment using a PM go/no-go task (i.e., a decision-making task in which the participant in some instances gives a motor answer and in others withholds her response). In the task, the participants first heard instructions for each item, which pointed out the sound stimulus they were supposed to focus on, such as, “React now to the sound /l/ like in table, play, tale” (Ganushchak & Schiller, 2009, p. 413). Once the participants heard the instructions, they then saw a picture and responded by pressing a tab if the sound was part of the name of the picture and held back their response if not. The participants performed the task twice. In the second trial, they were required to give more rapid responses than in the first trial. Using ERP evidence, results showed more L1 interference when performing the task under time pressure, interference which in turn led to increased amplitude in the error-related negativity.

Following nearly the same methodology applied in Ganushchak and Schiller (2009), Zou et al. (2014) investigated whether people who have some characteristic features of schizophrenia (i.e., a deficit in verbal self-monitoring) are susceptible to developing such a deficit. In their PM go/no-go task, Zou et al. (2014) exposed their participants to the same type of instructions as that given in Ganushchak and Schiller

(2009). Likewise, they followed the stimulus with a picture. The participants needed to make a decision of whether the phoneme was part of the name of the picture or not. Also relying on ERP evidence, the researchers found that, unlike victims of schizophrenia, people with traits of the condition do not suffer from deficits in verbal self-monitoring.

Furthermore, wanting to identify the times at which grammatical gender encoding and phonological encoding occur in language processing, Camen, Morand and Laganaro (2010) administered a gender monitoring task and a PM task. In the former task, the participants needed to make a decision of whether the label of a picture matched the grammatical gender suggested. Whereas in the latter task, the PM task, the participants needed to determine whether the picture name contained the phoneme presented or not. In both tasks, the participants needed to press a certain tab for *yes* and another for *no*. Data were analyzed using event-related brain potential (i.e., a method of measuring the direct response of the brain regarding a specific sensory, cognitive or motor experience). Results showed that the abstract conceptual formation of the picture name and its phonological encoding either proceed in parallel or overlap with nearly a 10 mm gap between them.

Conclusion

The present literature review first gave an overview of the phenomenon of bilingualism, the general field to which this study is related. It then proceeded to a description of how language processing takes place in bilinguals, which is the general focus of the present research. This review of language processing presented an in-depth understanding of its two mechanisms, language activation and language selection, the specific aspects being investigated in the present research. Subsequently, the chapter

presented the three approaches to language processing and their corresponding bilingual memory models; supporting empirical evidence from the literature followed. The purpose of reviewing bilingual memory models was to exhibit the three paradigms of language processing, one of which the present results will fall within. Discussion of the third paradigm, Grosjean's language mode theory and variable-dependent processing, displayed a number of affective factors which have the potential of influencing language processing. These were reviewed as they are expected to surface in the results of the present study. Next, the chapter dealt with language processing in picture-naming because of it being directly related to the performance of the participants of the present study. Consequently, the differences between the two languages used in the current study, Arabic and English, were highlighted; then available studies which focus on language processing in Arabic-English bilinguals were overviewed. The objective of this section was to emphasize the difference between the two languages in question and how such an issue may possibly affect the results of empirical research related to language processing. Finally, the chapter ended with a description of the phoneme monitoring task (i.e., the instrument used in the current study), and an examination of several studies which applied it in a manner similar to that applied in the present study.

The present literature review highlighted the fact that the literature is poor in studies which examine L2 activation in Arabic-English bilinguals (i.e., bilinguals who speak highly dissimilar languages). Modeling its design on Colomé (2001) and applying it to Arabic-English bilinguals, the present research aims at filling this gap in the literature. The present literature review also showed a lack of studies which compare language processing between two groups who speak the same two languages, however in

different settings (i.e., L1 setting vs. L2 setting), hence highlighting the effect of location on bilingual language processing. The present study also aims at filling such gap in the literature. Accordingly, the present research aims at adding to the literature by providing a study which simultaneously examines the effect of two variables, location and language dissimilarity on language processing, a study which, as of the knowledge of the researcher, is absent from the literature.

CHAPTER III

METHODS – QUANTITATIVE PHASE

The quantitative method employed in this phase of the study aimed at serving the objective of the experiment. Hence, it aimed at examining how Arabic-English bilinguals process their languages, whether they experience L2 interference, and whether the location of testing is an affective factor in their processing mechanism. These aims were aspired by adopting a deductive approach to research which tested a theory by means of: 1) setting a number of research hypotheses, 2) gathering data, 3) analyzing the data, and 4) generating generalizable findings. As previously stated in chapter one, the hypotheses tested in the current research are:

- Arabic-English bilinguals are expected to encounter L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3.
- Arabic-English bilinguals in an English-speaking setting are expected to encounter more L2 interference reflected in differences in Error rate and Response Time between Conditions 2 and 3 than Arabic-English bilinguals in an Arabic-speaking setting.
- For Arabic-English bilinguals, Error Rate and Reaction Time in Condition 2 will be related to their English language proficiency and the amount of English they use each week.

- For Arabic-English bilinguals, Error Rate and Response Time in Condition 2 will be related to the frequency of the English translation equivalents of the Arabic word describing the picture.
- Monolingual Arabic participants are not expected to show any L2 interference in Error Rate or Response Time between Conditions 2 and 3.

The present chapter consists of five sections. It first presents a general account of all participants recruited in the experiment; then it gives a detailed description of each group. Subsequently, the chapter describes the design of the phoneme monitoring task used as a data gathering tool. Next, it offers a detailed account of the procedure followed in the construction and administration of the phoneme monitoring task. Next, a report of the machines and equipment used in recording the sounds played in the phoneme monitoring task, and those used in the actual administration of the task follows. Finally, the chapter ends with an elaboration on the way by which the data were statistically analyzed.

Participants

Two groups of Arabic-English bilingual participants were recruited using a snowball sampling technique to take part in the current study (see Appendix A for a description of the population). The first group ($n = 55$) was a group of Arabic-English bilinguals who use their two languages in a native setting of their L1, an Arabic-speaking setting (i.e., Saudi Arabia). The second group ($n = 60$) was a group of Arabic-English bilinguals who use their two languages in a native setting of their L2, an English-speaking setting (i.e., the United States). All participants performed the task; however, only those proven qualified were used for data analysis.

In an attempt to establish professional, ethical and valid results, a number of standards were implemented in regards to the participants recruited. First, for privacy reasons, no names were saved. Rather, every participant was assigned a number to be used throughout the experimental process. In addition, a cutting point error rate was established and used to eliminate unqualified participants from data analysis. More information about the exclusion criteria is provided in the Results and Discussion chapter. Furthermore, the researcher ensured that all participants had normal or corrected-to-normal vision, and no one suffered from motor problems in their hands or fingers.

To ensure accordance with the definition of bilingualism adopted in the current study, a number of elements need to be pointed out. First, all bilinguals recruited in the current study used both languages on a daily basis. They mostly used Arabic in their personal and social lives, and English for either professional or academic purposes. Second, they were non-balanced bilinguals. They all learned English as their L2, and felt more proficient in their native language, (i.e., Arabic). Third, all participants received English classes for at least six years in high school and, at the time of testing, have been using English for either occupational or academic purposes for at least three years. This gave a total of a minimum of nine years of English usage on a daily basis.

In relation to demographics, participants of both groups provided information about their sex, age, occupation and residency. They also provided a self-rating of their English language proficiency level on a ten-point scale, one being the weakest and ten being the strongest. Furthermore, they reported on the amount of hours of English they used per week, and the age at which they started learning English. Following is a detailed description of each group.

Arabic-English Bilinguals in Saudi Arabia

The first group recruited to participate in the current study is a group of Arabic-English bilinguals who use their two languages in an Arabic speaking country (i.e., Saudi Arabia). Fifty-five participants were tested in this group where five were proven unqualified, hence excluded from data analysis. Accordingly, a total of 50 participants (females = 27, males = 23), ranging from 21 to 56 years of age ($M = 30.7$), participated in the data analysis phase. Results of a z-test to compare the two proportions (i.e., females and males) at a 0.05 level of significance showed no significant difference between the number of females and males in the current group ($z = 1, p = 0.32$). Moreover, participants in this group demonstrated a mean of 7.8 from a total of ten in regards to their L2 proficiency level. The majority of participants in this group used English for occupational purposes. More specifically, they worked in either hospitals, banks, or higher education establishments (i.e., universities, academic institutes, etc.).

Arabic-English Bilinguals in the United States

The second group recruited to participate in the current study is a group of Arabic-English bilinguals who used their two languages in an English speaking country (i.e., the United States). Sixty participants were tested in this group where eleven were excluded for their unqualified performance. Accordingly, a total of 49 participants (females = 24, males = 25), ranging from 18 to 56 years of age ($M = 28$), participated in data analysis. Similar to the previous group, they demonstrated a mean of 7.7 from ten in their L2 proficiency level. The participants in this group used English for academic purposes either as students or teachers; the majority being students. The students were either undergraduate students who were in the third or fourth year of their program, or

they were graduate students. Although their majors widely ranged (i.e., engineering, chemistry, architecture, computer sciences, fire protection, etc.), they were all exclusively instructed in English. They performed all of their academic obligations in English as well. The teachers, on the other hand, ranged from being preschool teachers to being ESL instructors preparing students for their bachelor or graduate studies.

Design

The experimental design used was modeled on Colomé's (2001), however in relevance to the variables of the current study. Accordingly, a 2 x 3 mixed factorial design was used with Subject Type as the between-subjects factor with two levels: a) Arabic-English bilinguals tested in Saudi Arabia, and b) Arabic-English bilinguals tested in the United States, and Phoneme Type as the within-subject factor with three levels: a) *yes* response-Arabic sound contained in Arabic noun describing the picture, b) *no* response-English sound contained in English noun describing the picture, and c) *no* response-sound unrelated to either Arabic or English noun describing the picture.

The phoneme monitoring task consisted of three blocks each of which included 54 items, giving a total of 162 items in the entire task. An equal number of items (i.e., 54) were used to represent each level of the within-subject factor of the study (i.e., Phoneme Type). These were randomly distributed in the blocks of the task.

Procedure

Each participant performed the three blocks of the PM task, each consisting of 54 items. In each item of the task, the participant saw a picture, heard a speech sound, and then was instructed to press a *yes* tab if the sound was part of the name of the picture and

a *no* tab if it was not. Response times were then measured in milliseconds. The task first started with a training session which was followed by the three main blocks of the task. More specifically, the task involved four major elements: 1) the task materials, 2) the task blocks, 3) the three experimental conditions of the task (i.e., Phoneme Type), and 4) the filler items used in the task. Following is a description of each of these elements.

Materials

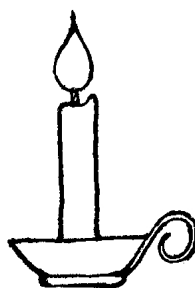
The materials used in the task included a group of speech sounds which were implemented in place of the letters used in Colomé (2001). Choosing to use sounds rather than letters was based on a number of elements. First, using letters had the potential of destructing the objective of the study in the sense that, since Arabic and English use different orthographies, visually exposing the participants to one of the two orthographies would purposefully stimulate the language of the letter (Van Heuven, Dijkstra & Grainger, 1998). Second, numerous researchers (e.g. Ganushchak & Schiller, 2009; Sasisekaran & De Nil, 2006; Zou et al., 2014) used speech sounds rather than letters in their language processing experiments because they viewed them as a reliable type of stimuli which yields valid and strong results. Similarly, the current research opted to use speech sounds as well.

A total of fourteen speech sounds were used as target sounds. The sounds used are those which overlap between the Arabic and English languages and which do not greatly differ in their articulation between the two languages. The speech sounds used are: /f/, /h/, /z/, /m/, /s/, /k/, /l/, /n/, /ʃ/, /ð/, /b/, /w/, /dʒ/, and /j/. All speech sounds used in the task were consistent in regards to their tone and following vowel sound.

Furthermore, in line with Colomé (2001), the task included a total of 60 white-on-black line pictures, where 27 were used in the experiment items, a further 27 were used in the filler items, and six were used in the training items. Pictures were obtained from Google Images by typing the name of the picture and either ‘line picture’ or ‘sketch’ in the search panel. See Appendix B for a list of the pictures used in the phoneme monitoring task. Once the best option was chosen, it was copied and pasted into E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA). Each picture was assigned both an Arabic name and an English name. Figure 5 is an example of the type of pictures used in the task.

Figure 5

Example picture used in the phoneme monitoring task (Candle, 2016)



To ensure material appropriateness, three measures were taken. First, to make certain the speech sounds used in the task would not purposefully trigger the participant’s English language, the researcher tested them on four additional participants who were Arabic native speakers. They confirmed that the speech sounds were pronounced with high Arabic articulation standards. Furthermore, to ensure the appropriateness of the names of the pictures, the researcher confirmed the Arabic names by four Arabic native speakers, and the English names by two English speaking linguists. Resorting to native

speakers rather than linguists in the confirmation of the Arabic names was due to the fact that casual Arabic was used in the task, hence needing every day Arabic speakers to ensure choosing the most common name used in everyday life. Such type of judgment was not relevant to the English names because of the consistency between the English every-day names of the pictures and their standard names.

Blocks

The task consisted of three blocks preceded by a training session. The implementation of a training session was to strategically prepare the participants and ensure complete and accurate understanding of the process of the task. The training session consisted of six items each of which displayed a different picture. Three of the training items required a *yes* answer, while the other three required a *no* answer. The program shuffled the training items for each participant.

Following the training session, the experimental task began. The experimental task consisted of three blocks with intervals between them. Each block displayed all experimental and filler items, giving a total of 54 items in each block. Accordingly, each picture appeared three times in the entire task (i.e., once in each block). Each time the picture appeared, a different speech sound followed it, each of which represented one of the three conditions (i.e., Phoneme Type) of the task. Furthermore, each speech sound of the fourteen used, appeared in all three experimental conditions.

Each item consisted of four elements. First, a picture appeared for 300 milliseconds (i.e., first stimulus). Next, a blank white screen was displayed for 100 milliseconds. Following, a speech sound ranging from 200 to 230 milliseconds in length

was played (i.e., second stimulus). Finally, the participant had a time span of 3000 milliseconds (i.e., 3 seconds) to respond. Accordingly, the stimulus onset asynchrony (SOA) used in the experiment was 400 milliseconds. Once the three second answer slot ended, the software gave the participant feedback in Arabic regarding her/his response. This feedback was one of three possibilities: 1) *correct*, 2) *incorrect*, or 3) *time out*. The program shuffled the items within blocks for each participant with no intervals between them. Each block continued for around 3-4 minutes depending on the participant's response times.

Experimental conditions

Three experimental conditions (i.e., Phoneme Type) were implemented in the phoneme monitoring task, one affirmative condition and two negative conditions. The first condition, the affirmative one, included a speech sound which was part of the Arabic name of the picture. Being an affirmative condition, it entailed a *yes* answer by the participant. The second condition, a negative condition, included a speech sound from the English name of the picture. This was a negative condition because it entailed the respondent to give a *no* answer to the stimuli. In these two conditions, the stimulus sound was constantly the onset of the first syllable of both the Arabic name of the picture as well as the English name. The third and final condition, which was also a negative condition, consisted of a speech sound unrelated to either the Arabic name or the English name of the picture. Similar to the second condition, it also stimulated the participant to give a *no* answer. Each condition occurred equally across the three blocks of the task.

All names of pictures used in all three experimental conditions were subject to three measures. First, all Arabic names and their English translations were non-cognate

words. Second, both Arabic and English names were two or more syllables long. Finally, names from both languages started with a consonant sound. Following, Table 4 presents several examples of how the three conditions were presented. See Appendix C for a complete description of the items in the phoneme monitoring task.

Table 4

Exemplification of the three experimental conditions used in the phoneme monitoring task

Picture name		Condition 1 Arabic sound (YES)	Condition 2 English sound (NO)	Condition 3 Unrelated sound (NO)
English	Arabic			
banana	mawzah	/m/	/b/	/f/
carrot	djazarah	/dj/	/k/	/m/
strawberry	farawlah	/f/	/s/	/k/

Fillers

The 27 filler items used in the experiment followed the same procedure as that applied in the experimental items. The participant saw a picture, heard a speech sound, and then made a judgment regarding whether the speech sound was part of the Arabic name of the picture or not. However, three elements were implemented to avoid participants developing a routine type of strategy in their answering method. First, instead of one affirmative answer and two negative answers, filler items required two affirmative answers and one negative answer. Second, for the purpose of presenting the participant with a variety of word lengths, a number of filler items consisted of one syllable only.

Finally, to ensure the participant would focus throughout the task on the entire name of the picture, the sound stimulus in the filler items was located in different parts of the Arabic and English names of the pictures. This contrasted with the experimental items where the sound stimulus was consistently the onset of the first syllable.

To establish a totally monolingual setting, the entire procedure of the experiment unfolded in Arabic. Participants were contacted in Arabic, whether in writing or orally. Furthermore, all conversation with the participant, before and during the task, was in Arabic. In addition, the interlocutor answered all questions in Arabic. Finally, all written information displayed before and during the task was in Arabic. In cases where the participant used English, the interlocutor immediately converted the conversation to Arabic and resumed the procedure. Furthermore, demographic information was only gathered after the application of the actual experimental task. Such a strategic move was applied to ensure the participants were not aware that the task involved English in any way. Regarding the software used for testing, E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) was used to display the pictures, play the speech sounds, and record response times which were measured from the time the sound ended to the instant the participant gave a response.

Participants were contacted personally by the researcher through either a telephone call, a text message, or an email. Those who agreed to participate did so as volunteers. They were not paid nor compensated in any manner. Furthermore, they all provided informed consent by clicking a continue tab on the laptop on which they performed the task.

Each participant was tested individually, by the researcher or a qualified individual, in a quiet isolated area in approximately 20-30 minute sessions. Each testing session consisted of six phases. First, the interlocutor gave the participant detailed oral instructions regarding the method of the task (see Appendix D for task instructions). Second, the participant received a booklet containing the black-on-white pictures used in the task with their Arabic names written underneath. The participant studied the Arabic picture names for approximately five minutes. This was to ensure the participant's familiarity with the names used. Third, the participant read the participation information on the screen of the laptop used for testing. The interlocutor encouraged the participant to thoroughly read it and ask questions if she/he felt the need to do so. Fourth, the participant gave consent to be recruited in the study by pressing a continue tab on the keyboard of the laptop used for testing. Fifth, the participant went through a training session consisting of six items which followed the same strategy as that employed in the experimental task itself. After the training session, the participant had the opportunity to ask questions or express the need for more clarification. Then she/he received feedback regarding her/his performance on the training session and whether she/he correctly understood the task strategy or not. Upon their request, ten participants repeated the training session to ensure complete and correct understanding of the task. Finally, the participant performed the task by completing all three blocks of the task. Each participant performed the task only once, and only those who completed the entire task were eligible for data analysis.

Regarding the final phase, which is performing the actual experimental task, several measures were implemented. First, the participants sat in front of the laptop

screen used for testing which was placed on a solid surface (i.e., a table). Second, they wore noise cancelling headphones to guarantee they hear the speech sounds clearly, and to also block any outside noise that may occur. Next, prior to the task, participants heard an auditory sample of the speech sounds used in the task. They evaluated the sample in relation to adequate volume and appropriate sound quality. Additionally, participants were instructed to place their right index finger on the *no* tab (i.e., the M tab on the laptop keyboard) and their left index finger on the *yes* tab (i.e., the Z tab on the laptop keyboard). They were also instructed to rest their elbows on the table. Placing fingers on the specific answer tabs and resting their elbows on a solid surface was to ensure limb stability to accommodate rapid answers. Furthermore, to guarantee the participant would not mix up the two answer tabs, stickers with a *no* label and a *yes* label were placed in parallel to the *no* tab and the *yes* tab, respectively.

In addition, the interlocutor clarified a number of issues and reinforced others with each participant before beginning the task. First, if they were to face a telephone effect while hearing the speech sounds, they needed to make the best judgment possible. However, only very few participants reported facing such a problem. Second, they needed to answer as quickly as possible with the initial response that comes to mind. Finally, they were reminded that intervals occurred between blocks only, and that stopping within a block would require repeating the entire task from the beginning. Fortunately, such a case did not occur.

Apparatus

The speech sounds used in the phoneme monitoring task were recorded in a sound-proof booth by a linguist with the supervision of a senior phonologist. Using a

desk-mounted microphone (SM58), all sounds were recorded using USB to Audacity®¹. They were then analyzed in PRAAT (Boersma, 2001) to ensure tone and following vowel consistency. Each sound was recorded in a separate audio file to be used in the phoneme-monitoring task. The phoneme-monitoring task was administered using E-Prime 2.0 software (Psychology Software Tools, Pittsburgh, PA) on a fifteen inch HP laptop, and participants heard the sounds wearing Sony MDRZX110NC ZX-series Noise Cancelling Headphones.

Data Analysis

The statistical procedures used to test the hypotheses are factor analyses of variance with Subject Type as the between-subject factor and Phoneme Type as the within-subject factor. Factor analyses of variance were performed to find results pertaining to the two dependent variables, Error Rate and Response Time. Error rate and response time data were analyzed using analyses of variances (ANOVAs) in which both subjects and pictures were treated as random effects in accordance with recommendations by Clark (1973). Such type of analysis is usually conducted to avoid the *language-as-fixed-effect fallacy* (Clark, 1973) which is a mistake performed by researchers who tend to assume that since their results are generalizable to the population, they are also generalizable to all language materials which may potentially be used in the experiment. More specifically, such an analysis type is used to stress that both subjects and items are random effects in the experiment.

¹ Audacity(R) software is copyright (c) 1999-2016 Audacity Team. [Web site: <http://audacityteam.org/>. It is free software distributed under the terms of the GNU General Public License.] The name Audacity(R) is a registered trademark of Dominic Mazzoni.

The between-subject factor (i.e., F1) was calculated by collapsing across items (i.e., pictures); whereas the within-subject factor (i.e., F2) was calculated by collapsing across subjects. All measures were performed at a 0.05 level of significance. Statistical analyses were conducted using SPSS (21.0).

Correlation analyses followed to examine whether any correlations existed between the dependent variables and the participants' characteristics (i.e., L2 proficiency level, number of L2 hours used per week, and age of L2 acquisition). A further correlation analysis was conducted to determine any correlations between the dependent variables and the frequencies of the English names of the pictures displayed in the phoneme-monitoring task.

CHAPTER IV

RESULTS AND DISCUSSION – QUANTITATIVE PHASE

The present chapter first starts with an elaboration of the data trimming scheme used to remove unqualified items and participants from data analysis. It then presents a comparison of the participant characteristics of the two groups of the experiment. Following, the chapter displays the relevant analyses of variance (ANOVAs) concerning a behavioral task in which the two dependent variables (i.e., Error Rate and Response Time) are analyzed. Such an analysis aims at attesting the hypotheses of the study. Next, the chapter offers correlational analyses conducted to display the relationships found between the dependent variables and the participants' characteristics on the one hand and with item characteristics on the other. Finally, the chapter compares the present results with those of Colomé' (2001) to examine whether the language processing of Arabic-English bilinguals and Catalan-Spanish bilinguals are the same or different. The chapter ends with a conclusion section.

Data Trimming

The mean error rate (in percent) was calculated for each picture across participants. The means were reviewed in order to determine whether any pictures may have been unfamiliar to the participants, leading to excessive errors. Following procedures used by Colomé (2001), the dataset was trimmed, removing observations

from those trials involving the two pictures with error rates higher than 30 percent (i.e., woodpecker and ladder). The mean error rate (in percent) for each picture across groups is displayed in Appendix E.

Using the trimmed dataset of pictures, mean error rate (in percent) was also calculated for each participant in each of the two groups: a) bilinguals tested in Saudi Arabia, and b) bilinguals tested in the United States, for each of the three conditions: a) *yes* response-Arabic sound contained in Arabic noun describing the picture, b) *no* response-English sound contained in English noun describing the picture, and c) *no* response-sound unrelated to either Arabic or English noun describing the picture. Following Colomé (2001), participants' mean error rates were reviewed in order to identify those with excessive errors because of the possibility that they failed to fully comply with the instructions of the experiment.

The criteria for data cutoff of participants used was different from that used by Colomé (2001). Although Colomé (2001) excluded participants with a mean error rate above 80 percent, a 70 percent cutoff criteria was used in the present research. This change was implemented because error rates in Colomé's (2001) experiments were approximately 10 percent lower than in the present research, hence the criteria for identifying non-compliant participants was 10 percent higher than that used by Colomé (2001).

The total number of participants removed from the dataset for low performance was 16 which included five bilingual participants tested in Saudi Arabia, and eleven bilingual participants tested in the United States. The remaining dataset (N = 99) included

50 participants in Group 1 (i.e., bilinguals tested in Saudi Arabia) and 49 participants in Group 2 (i.e., bilinguals tested in the United States).

Furthermore, response times associated with correct responses were screened initially for very short or excessively long responses. Following procedures used by Colomé (2001), response times shorter than 200 milliseconds and longer than 3000 milliseconds were eliminated from the dataset. Choice of a 200 millisecond minimum was determined by the fact that “the processing of ... cues may be achieved at around 200 ms after their presentation” (Blanco-Elorrieta & Pylkkanen, 2015, p. 13). This eliminated approximately 2 percent of observations.

Participant Characteristics

The characteristics of the participants in the two groups were compared in a series of t-tests in which a level of a 0.05 alpha level was used. Comparisons showed that the participants were compatible in age $t(97) = 1.73, p = 0.09$, L2 proficiency level $t(97) = 0.48, p = 0.63$, and age of L2 acquisition $t(97) = 1.90, p = 0.06$. The two groups did not differ significantly in the number of males and females $t(97) = 0.69, p = 0.49$. As expected, bilinguals tested in the United States reported using English significantly more each week than bilinguals tested in Saudi Arabia $t(97) = -2.28, p = 0.02$.

Error Rate

The resulting dataset was then analyzed using analyses of variances (ANOVAs) using Subject Type as the between-subjects factor having two levels: a) bilinguals tested in Saudi Arabia, and b) bilinguals tested in the United States, and Phoneme Type as the within-subject factor having three levels: a) *yes* response-Arabic sound contained in

Arabic noun describing the picture, b) *no* response-English sound contained in English noun describing the picture, and c) *no* response-sound unrelated to either Arabic or English noun describing the picture.

Table 5

Mean Error Rates (in percent) and standard errors for participant analysis (F₁)

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	ER	SE	ER	SE	ER	SE
Group 1 (Bilinguals in Saudi Arabia) n=50	12.88	0.01	12.67	0.01	10.40	0.01
Group 2 (Bilinguals in the United States) n=49	15.76	0.02	16.33	0.01	11.92	0.02

Note: SE = Standard Error; ER = Error Rate

Table 6

Mean Error Rates (in percent) and standard errors for item analysis (F₂)

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	ER	SE	ER	SE	ER	SE
Group 1 (Bilinguals in Saudi Arabia) n=50	13.64	0.02	12.92	0.02	10.80	0.02
Group 2 (Bilinguals in the United States) n=49	15.92	1.61	16.60	1.50	11.84	2.28

Note: SE = Standard Error; ER = Error Rate

The between-subject factor, referred to as F_1 , is calculated by treating subjects as a random effect, hence collapsing across items (i.e., pictures). Whereas the within-subject factor, referred to as F_2 , is calculated by treating pictures as a random effect, hence collapsing across subjects. All measures were performed at a 0.05 level of significance. Table 5 displays mean error rates and standard errors from the F_1 analysis. Table 6 displays mean error rates and standard errors from the F_2 analysis.

Data analysis concerning Arabic-English bilinguals as one group (i.e., Group 1 and 2 combined) was conducted to compare the difference in Error Rate between Conditions 2 and 3. Results of t-tests across subjects and items showed a significant difference in Error Rate $t(1,98) = -3.55, p = 0.001, t(1,49) = -2.61, p = 0.01$, respectively. Accordingly, Arabic-English bilinguals in general experience L2 interference as reflected in their Error Rate in the two negative conditions of the experiment. These findings support the first hypothesis of the study, “Arabic-English bilinguals are expected to encounter L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3.” Such a finding indicates partial L2 activation in Arabic-English bilinguals.

Examining the entire factorial design (i.e., two levels of Subject Type and three levels of Phoneme Type), Error Rate differed significantly across the three conditions, resulting in a significant main effect of $F_1(2,194) = 5.04, p = 0.007, \eta^2 = 0.05, F_2(2,96) = 4.70, p = 0.01, \eta^2 = 0.09$. Posthoc tests were performed using Fisher’s Least Significant Difference (LSD) (Toothaker & Miller, 1996) to establish which levels for Condition were significantly different. The LSD measure was specifically chosen because of its

appropriateness in dealing with three independent means, an issue which has been proven analytically (Hayter, 1986) and empirically (Seaman, Levin & Serlin, 1991).

For the F_1 analysis, the LSD was 0.032 for an alpha level of 0.05. Comparing the obtained LSD value to the absolute value of the differences between means, results indicated that Condition 1 (i.e., Arabic sound contained in Arabic noun describing the picture) was significantly different in Error Rate from Condition 3 (i.e., sound unrelated to either Arabic or English word describing the picture), $|-0.032| = 0.032$. Condition 2 (i.e., English sound contained in English noun describing the picture) was also significantly different in Error Rate from Condition 3, $|-0.033| > 0.032$. However, Conditions 1 and 2 were not significantly different in Error Rate from each other, $0.001 < 0.032$.

For the F_2 analysis, the LSD was 0.033 for an alpha level of 0.05. Comparing the obtained LSD value to the absolute value of the differences between means, results indicated that Condition 1 (i.e., Arabic sound contained in Arabic noun describing the picture) was significantly different in Error Rate from Condition 3 (i.e., sound unrelated to either Arabic or English noun describing the picture), $|-0.035| > 0.033$. Condition 2 (i.e., English sound contained in English noun describing the picture) was also significantly different in Error Rate from Condition 3, $|-0.034| > 0.033$. However, Conditions 1 and 2 were not significantly different in Error Rate from one another, $0.000 < 0.033$. The main effect of Subject Type and the interaction between Subject Type and Phoneme Type were not significant, $F_1(2,194) = 0.47, p = 0.63, F_2(2,96) = 0.52, p = 0.60$ and $F_1(1,97) = 3.12, p = 0.08, F_2(1,48) = 1.40, p = 0.24$, respectively.

The insignificant effect of Subject Type on Error Rate refuted the second hypothesis of the study, “Arabic-English bilinguals in an English-speaking setting are expected to encounter more L2 interference reflected in differences in Error rate and Response Time between Conditions 2 and 3 than Arabic-English bilinguals in an Arabic-speaking setting.” Thus, it can be generalized that Arabic-English bilinguals’ Error Rates are not affected by the language-nativeness of the environment in which they are using their two languages. As a result, location is not an affective factor in the language processing mechanism of Arabic-English bilinguals.

Nevertheless, the significant effect of Phoneme Type on Error Rate indicated the occurrence of L2 interference in both groups in the with-in language condition (i.e., Condition 1) as well as in the between-language condition (i.e., Condition 2). Hence, it can be generalized that the occurrence of a sub-lexical L2 stimulus, activated the L2 of Arabic-English bilinguals; however, this activation may only be partial.

Response Time

Similar to the procedure followed in analyzing Error Rate, the resulting dataset was analyzed in relation to Response Time using analyses of variances (ANOVAs). In these analyses, Subject Type was used as the between-subjects factor having two levels: a) bilinguals tested in Saudi Arabia, and b) bilinguals tested in the United States, and Phoneme Type as the within-subject factor having three levels: a) *yes* response-Arabic sound contained in Arabic noun describing the picture, b) *no* response-English sound from English word describing the picture, and c) *no* response-sound unrelated to either Arabic or English word describing the picture). To avoid the *language-as-fixed-effect fallacy* (Clark, 1973), both subjects and pictures were treated as random effects in all of

the analyses conducted with the data. Accordingly, the F-ratio of Response Time was calculated by means of the F_1 and F_2 ratios previously described. Descriptive statistics of F_1 and F_2 pertaining to the Response Time variable are displayed in Tables 7 and 8.

Table 7

Mean Response Time (in milliseconds) and standard errors for participants analysis (F_1)

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	RT	SE	RT	SE	RT	SE
Group 1 (Bilinguals in Saudi Arabia) n=50	680.89	28.53	950.64	39.81	936.81	41.47
Group 2 (Bilinguals in the United States) n=49	691.44	28.82	954.87	40.21	960.80	41.90

Note: RT = Response Time; SE = Standard Error; msec = millisecond

Table 8

Mean Response Time (in milliseconds) and standard errors for item analysis (F_2)

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	RT	SE	RT	SE	RT	SE
Group 1 (Bilinguals in Saudi Arabia) n=50	718.33	21.86	958.08	28.05	945.75	26.28
Group 2 (Bilinguals in the United States) n=49	702.18	21.53	958.36	25.34	957.32	22.76

Note: RT = Response Time; SE = Standard Error; msec = millisecond

Data analysis concerning Arabic-English bilinguals as one group (i.e., Group 1 and 2 combined) was conducted to compare the difference in Response Time between Conditions 2 and 3. Results of t-tests across subjects and items showed an insignificant difference of $t(1,98) = 0.37, p = 0.71, t(1,49) = 0.35, p = 0.72$, respectively. Accordingly, Arabic-English bilinguals in general do not experience L2 interference as reflected in their response times in the two negative conditions of the experiment. These findings refute the first hypothesis of the study, “Arabic-English bilinguals are expected to encounter L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3.”

Regarding the factorial design, mean Response Time varied significantly across Condition, resulting in a significant main effect of Phoneme Type $F_1(2,194) = 209.64, p = 0.000, \eta^2 = 2.16, F_2(2,96) = 122.00, p = 0.000, \eta^2 = 2.54$. Fisher’s Least Significant Difference (LSD) (Toothaker & Miller, 1996) test was carried out to establish which levels within the two independent variables were statistically significant in Response Time. For the F_1 analysis, LSD was 41.40 for an alpha level of .05. Thus, Response Time in Condition 1 (i.e., Arabic sound contained in Arabic noun describing the picture) was significantly different from Response Time in Condition 2 (i.e., English sound contained in English noun describing the picture), $|-266.59| > 41.40$. Condition 1 Response Time was also significantly different from Response Time in Condition 3 (i.e., sound unrelated to either the Arabic or English noun describing the picture), $|-262.63| > 41.40$. However, Conditions 2 and 3 were not significantly different from one another, $|-3.95| < 41.40$.

For the F_2 analysis, LSD was 62.87 for an alpha level of 0.05. Thus, Condition 1 (i.e., Arabic sound contained in Arabic noun describing the picture) was significantly

different in Response Time from Condition 2 (i.e., English sound contained in English noun describing the picture), $|-247.93| > 62.87$. Response Time in Condition 1 was also significantly different from Response Time in Condition 3 (i.e., sound unrelated to either the Arabic or English noun describing the picture), $|-241.28| > 62.87$. However, Response Time in Conditions 2 and 3 were not significantly different from each other, $|-6.65| < 62.87$. The main effect of Subject Type and the interaction between Phoneme Type and Subject Type were not significant, $F_1(1,97) = 0.07, p = 0.80, F_2(1,48) = 0.002, p = 0.96$ and $F_1(2,194) = 0.23, p = 0.80, F_2(2,96) = 0.30, p = 0.74$, respectively.

Similar to the Error Rate analysis, the insignificant effect of Subject Type on Response Time also refuted the second hypothesis of the study, “Arabic-English bilinguals in an English-speaking setting are expected to encounter more L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3 than Arabic-English bilinguals in an Arabic-speaking setting.” Thus, it can be generalized that Arabic-English bilinguals’ latencies are not affected by the language-nativeness of the environment in which they are using their two languages. As a result, location is not an affective factor in Arabic-English bilinguals’ language processing mechanism. The significant effect of Phoneme Type on Response Time is not relevant and does not reflect on the participants’ language processing mechanism as related to their bilingualism. Rather, it merely confirms that affirmative responses transpire more rapidly than negative responses.

Correlations

In order to explore the extent to which individual differences in Error Rate and Response Time were related to participants’ characteristics, correlation analyses were

performed using error rates and response times for each condition for each participant with their L2 proficiency level, number of L2 hours used per week, and age of L2 acquisition. These correlations were examined for each of the two bilingual groups.

Results showed that Group 2 (i.e., bilinguals tested in the United States) demonstrated a positive correlation between Error Rate in Condition 2 (i.e., English sound contained in English noun describing the picture) and number of L2 hours used per week, $R = 0.38$, $p = 0.007$. However, this positive correlation was absent from the other two conditions (i.e., Conditions 1 and 3), and was not present in Group 1 (i.e. bilinguals tested in Saudi Arabia).

The positive correlation between Error Rate in Condition 2 and the amount of L2 used per week in Group 2, partially supports the third hypothesis of the study, “For Arabic-English bilinguals, Error Rate and Response Times in Condition 2 will be related to their English language proficiency and the amount of English they use each week.” That is, the more participants (in the United States) used English per week, the more interference they encountered in Condition 2 (i.e., English sound from English noun describing the picture). More specifically, L2 interference stimulated the participants to make judgments based on their English language rather than on their Arabic language. These results being specific to Arabic-English bilinguals in the United States (i.e., Group 2), gives precedence to location and how increased language usage affects the language processing mechanism in Arabic-English bilinguals, a finding which supports previous research (Bialystok, 2009; Grosjean, 2013).

Furthermore, mean error rates and response times for each participant were correlated with the word frequency of the English word that described the picture.

Estimates of English word frequency were obtained from the News on the Web Corpus (NOW) available on the Corpus of Contemporary American English (COCA) (News on the Web Corpus, 2016). NOW encompasses a total of 3.6 billion words of data. The data of the corpus was extracted from web-based media outlets, such as online newspapers and magazines within the period from 2010 to the time at which the corpus was accessed. The frequency of each picture name was located by entering the word in the search panel and accessing its estimated frequency within the corpus.

Results also showed a positive correlation between Response Time in Condition 2 (i.e., English sound contained in English noun describing the picture) and the frequency of the English noun describing the picture for both Group 1 (i.e., bilinguals tested in Saudi Arabia), $R = 0.40$, $p = 0.05$ and Group 2 (i.e. bilinguals tested in the United States), $R = 0.47$, $p = 0.02$. This positive correlation supports the fourth hypothesis of the study, “For Arabic-English bilinguals, Error Rate and Response Times in Condition 2 are related to the frequency of the English translation equivalents of the Arabic word describing the picture.” These results suggest that despite the overall lack of a difference in mean Response Time in Conditions 2 and 3, response times were related to a characteristic associated with the English translation equivalents of the pictures tested in the experiment, namely, their frequency of usage. Such a finding supports previous research (Duyck et al., 2008; Poulisse & Bongaerts, 1994).

In order to understand the obtained results more adequately, they need to be interpreted in regards to Grosjean’s language mode continuum. Results showed that location did not prompt L2 interference in Arab-English bilinguals. It also showed that exposure to a sub-lexical L2 stimulus caused partial L2 activation. Such findings indicate

that Arabic-English bilinguals have the ability to activate the target language and suppress the non-target language as the situation demands. Thus, it can be concluded that Arabic-English bilinguals are nearer to the monolingual endpoint of the continuum than they are to the bilingual endpoint.

Colomé (2001)

The present study agreed with Colomé (2001) in regards to the effect of Phoneme Type on Error Rate. Both studies established a significant difference between Condition 2 (i.e., *no* response-sound from the L2 noun describing the picture) and Condition 3 (i.e., *no* response-sound unrelated to either language) indicating the occurrence of L2 interference. Colomé (2001) conducted three different experiments which differed in their stimuli organization and SOA. Tables 9 and 10 display means of Error Rate and Response Time in Conditions 2 and 3 of Colomé (2001) and the present study. The tables also display p-values. It should be noted that the tables display results of Arabic-English bilinguals as one combined group.

Tables 9 and 10 show a variation of results. First, Colomé (2001) only found L2 interference affecting Error Rate in the subject analysis of experiment 2. Second, the researcher found L2 interference affecting Response Time throughout the three experiments with the exception of the item analysis in experiment 2. Hence, when examining Colomé's (2001) results combined, it is apparent that Catalan-Spanish bilinguals do not experience total activation of their L2 at all times. Rather, their L2 activation is partial, an observation also found in the present study, however displayed in a different manner.

Table 9

Error Rate means and p-values in Colomé (2001) and the present study

	Condition 2 <i>no response</i> L2 sound	Condition 3 <i>no response</i> unrelated sound	p-value	
			by subject	by item
<i>Colomé (2001)</i> <i>(Experiment 1)</i>	8.72	6.72	p < 0.40	p < 0.30
<i>Colomé (2001)</i> <i>(Experiment 2)</i>	8.10	4.32	p < 0.02	p < 0.09
<i>Colomé (2001)</i> <i>(Experiment 3)</i>	6.65	6.45	no significant difference	
<i>Present Study</i>	14.76	11.32	p = 0.001	p = 0.01

Table 10

Response Time means and p-values in Colomé (2001) and the present study

	Condition 2 <i>no response</i> L2 sound	Condition 3 <i>no response</i> unrelated sound	p-value	
			by subject	by item
<i>Colomé (2001)</i> <i>(Experiment 1)</i>	1152	1111	p < 0.02	p < 0.05
<i>Colomé (2001)</i> <i>(Experiment 2)</i>	1028	979	p < 0.00	p < 0.06
<i>Colomé (2001)</i> <i>(Experiment 3)</i>	972	924	p < 0.02	p < 0.02
<i>Present Study</i>	958	952	no significant difference	

Results of the present study exhibited consistency in its analyses by subject and by item. That is, whenever an analysis by subject was significant, the analysis by item

was also significant, a tendency not found in Colomé (2001). Error Rate in the present study was strongly significant by both subject and item between Conditions 2 and 3. The strength of the difference surpassed Colomé's (2001) results in all three experiments. However, the present study did not find a significant difference in Response Time between Conditions 2 and 3. Thus, as in Colomé (2001), Arabic-English bilinguals' L2 is partially active and not totally inhibited. Nevertheless, it is apparent that the languages of Arabic-English bilinguals, although somewhat connected, they are more separated than the languages of Catalan-Spanish bilinguals. The increased separation of languages in Arabic-English bilinguals, when compared to Catalan-Spanish bilinguals, can be explained in regards to three issues.

First, the difference in results between the two studies can be related to the linguistic nature of the two sets of languages. Catalan and Spanish belong to the same language family; they are both Romance languages. Furthermore, they share a highly similar linguistic system. For example, their graphemic representations are nearly identical and only minimal differences exist. They overlap in five vowels out of a total of eight and share the same range of consonant phoneme types with one exception; Catalan includes voiced fricatives whereas Spanish doesn't. In addition, they are both overtly marked for gender and number. Moreover, the two languages have a lexical similarity of 85 percent (Ethnologue: Languages of the world, 2016) which is noticeably high.

Such a high level of overlap facilitates easy learning between the two languages. This is explicitly stated in INTERCAT: Experience university in Catalan which asserts that "[e]xperience shows that it will take someone who knows Spanish less than a fortnight before they can understand someone speaking in Catalan. And if they set their

mind to it, in just a few weeks they will be able to speak it and almost without realizing it, they will have increased their linguistic resources” (Catalan in Education, para. 4). Consequently, this high linguistic overlap between the two languages has an apparently strong effect on the language processing mechanism of Catalan-Spanish bilinguals because “the larger the overlap between the input string and a representation in the mental lexicon, the more the internal representation is activated” (Dijkstra & Van Heuven, 2002, p. 182).

The advantage of language similarity was absent from the present study since Arabic and English have highly different linguistic systems. Although Arabic and English share some phonological similarities, they are highly different at the lexical and orthographic levels of language processing. This obviously affects the degree to which the L2 of Arabic-English bilinguals is activated when exclusively using their native language. Consequently, “[i]f the two languages differ with respect to their input codes (e.g., letter sets), the activated set of neighbors may become much smaller” (Dijkstra & Van Heuven, 2002, p. 183). Therefore, bilinguals who speak two languages which share a high degree of overlap (e.g. Catalan and Spanish) will experience more L2 activation than bilinguals who speak two languages with a low degree of overlap (e.g. Arabic and English).

The second possible explanation of the increased separation of the languages of Arabic-English bilinguals when compared to Catalan-Spanish bilinguals is the manner in which the two languages are used in the society. On the one hand, Catalan-Spanish bilinguals are ‘societal bilinguals’ (Sebba, 2011). They are part of a community in which the two languages are used at all levels of the society, and all levels of communication.

For example, in the Catalan society, there is an equal number of Catalan and Spanish TV stations, both languages are primarily taught at all school levels, both languages are used in university courses (Colomé, 2001), and all street signs are displayed in both languages. Moreover, at least 97 percent of the population of Catalonia comprehends both Catalan and Spanish, and 85 percent of the population speaks the two languages (Ethnologue: Languages of the world, 2016). This widespread knowledge and use of Catalan and Spanish within one region, is a strong indication of their strong coexistence and the fact that they work side by side in the Catalan community.

Arabic-English bilinguals, on the other hand, are ‘individual bilinguals’ (Hoffmann, 2014). They belong to a community which primarily uses Arabic as the main language at nearly all levels of the society and all levels of communication. Not all members of the Arab society are expected to have the capacity to speak English, nor are they expected to use it on a daily basis. In general, those who do so, use it for either occupational or academic purposes only. In summary, Catalan-Spanish bilinguals use both languages in all life domains, whereas Arabic-English bilinguals have language-specific domains, as established in the following chapter (i.e., the qualitative phase of the present study).

The third element which potentially played a role in Arabic-English bilinguals showing a weaker connection between their languages than Catalan-Spanish bilinguals is the type of stimuli used. The bilinguals in Colomé (2001) had the advantage of receiving their stimulus in a visual form. Since Catalan and Spanish share the same orthographic system, the letter shown belonged to the linguistic systems of both languages. Although Colomé (2001) instructed her participants to think of the letters as speech sounds, the

likelihood of a ‘graphemic facilitative effect’ is very much possible. This effect has a high potential of inducing the activation of the participants’ L2. Participants of the present research did not have such an advantage.

To conclude, the difference in results between the two experiments is expected. When observing these differences in relation to the variables of the experiment, the nature of the two sets of languages, and how the two sets of languages are used by their respective societies, they make perfect sense. The L2 of Catalan-Spanish bilinguals has a higher-advantage than the L2 of Arabic-English bilinguals, hence is more activate. When observing the two bilingual categories in relation to the language mode continuum, neither is exactly at one endpoint. Rather, both are within the mid-range of the continuum with each being closer to a different endpoint than the other. Even though Catalan-Spanish bilinguals are closer to the bilingual endpoint, they are not totally at it. Similarly, although Arabic-English bilinguals are closer to the monolingual endpoint, they are not totally at it as well.

Conclusion

The results of the analyses comparing the two groups of Arabic-English bilinguals were counterintuitive; no significant differences emerged. The insignificant effect of Subject Type on Error Rate and Response Time indicated an insignificant effect of location on language processing in Arabic-English bilinguals. However, in line with Colomé (2001), results confirmed a significant effect of Phoneme Type on Error Rate and Response Time in both factors (i.e., F_1 and F_2). The significant effect of Phoneme Type on Error Rate indicated that both groups equally experienced L2 interference effecting their Error Rates in conditions containing a phoneme related to one of their two

languages. English negatively affected their *yes* answer to the Arabic phoneme and their *no* answer to the English phoneme.

In the significant effect of Phoneme Type on Response Time, Condition 1 (i.e., *yes* response-Arabic sound contained in Arabic noun describing the picture) was significantly different in Response Time from Conditions 2 and 3 (i.e., *no* responses). This is an expected effect since giving an affirmative response is easier and more rapid than giving a negative response.

Regarding relationships between variables, results showed a positive correlation between Error Rate of Condition 2 (i.e., English sound from English noun describing the picture) and the amount of hours of English usage per week in participants of Group 2 (i.e., bilinguals tested in the United States). Such a finding supports the effect of increased usage of the language (when moving to a native-speaking setting) on bilingual language processing. Furthermore, results showed a positive correlation between Response Time of Condition 2 (i.e., English phoneme contained in English noun describing the picture) and word frequency in both groups. Such a finding suggests that, regardless of location, Arabic-English bilinguals experience high levels of competition when processing high frequency words.

Comparing the present results with the results of Colomé' (2001), it is apparent that the languages of Arabic-English bilinguals are more separated than the languages of Catalan-Spanish bilinguals. A number of justifications have been proposed; however, further examination is needed. To gain a better perspective of why the languages of Arabic-English bilinguals are noticeably separated, an examination of the personal and social attitudes of Arabic-English bilinguals and how they affect their language

processing tendencies needs to be explored. The following qualitative phase of the study aspires to explain and elaborate on the quantitative results obtained.

CHAPTER V

QUALITATIVE PHASE

The present chapter is specific to the methodology, results and discussion specific to the qualitative phase of the research. The objective of applying a mixed methods approach, which consisted of a quantitative phase followed by a qualitative phase, was to obtain quantitative results and explain them by means of qualitative findings. In specific, first, solid quantitative results which examine the activeness of the English language in Arabic-English bilinguals needed to be found. Once such activeness of the English language in Arabic-English bilinguals was detected, it needed to be justified by the social and cultural elements of language use and language choice, hence the qualitative component was employed.

The worldview adopted in this phase of the study is a constructivist perspective (Berger & Luckmann, 1967). Accordingly, the aim of the current qualitative analysis was to observe the reality of language use and language choice in the everyday life of Arabic-English bilinguals. The term reality in the present context refers to the qualities of the social phenomenon which cannot be changed, which originate in the thoughts and actions of members of the speech community, and which are strong enough to impose themselves on the consciousness of Arabic-English bilinguals' language use and language choice (Berger & Luckmann, 1967). Furthermore, the analysis aimed at studying the

participants' knowledge of such a reality, and to ensure that the obtained reality is true and has precise characteristics. In addition, the analysis examined whether the reality is socially distributed in the speech community being observed (i.e., Arabic-English bilinguals).

First, the chapter presents the methodology applied. Next, it introduces the two themes extracted from the qualitative data. Finally, it addresses the two research questions of the study, the qualitative question and the mixed methods question (Creswell, 2014).

Methods

The qualitative design incorporated in the present research was conducted to understand the meanings individuals attribute to the research problem and which reflected on the behavioral task of the study. Using semi-structured interviewing, a procedure commonly applied in qualitative studies, data were gathered and interpreted to detect information which could give meaning to the results of the quantitative phase. This chosen methodology aimed at answering the qualitative question (question 1 below) and the mixed methods question (question 2 below) of the study previously mentioned in chapter one, namely,

1. What are the factors that affect the language selection mechanism in Arabic-English bilinguals?
2. How does the qualitative data help explain the results obtained from the quantitative phase of the study?

The present Methods section begins with a description of the participants recruited in the qualitative component of the present study. It then proceeds to a description of the design of the semi-structured interview used to gather qualitative data. The section continues with an explanation of the procedure followed in conducting the semi-structured interviews. Finally, an account of the equipment used in recording the interviews and the actual analysis of the interview data follows.

Participants

Arabic-English bilinguals ($n = 12$) participated as interviewees in the qualitative phase of the present study. Six of the interviewees resided and used their two languages in Saudi Arabia (females = 3, males = 3) while the other six resided and used their two languages in the United States (females = 3, males = 3). The twelve interviewees were taken from the pool of participants recruited for the main experiment of the study. They performed the phoneme monitoring task approximately three months prior to the actual interview. Accordingly, they were somewhat familiar with the nature of the study at the time of the interview which assisted the researcher in obtaining information highly relevant to the main objective of the study.

All twelve interviewees used Arabic as their main language in their everyday life, while English was mainly used for either occupational or academic purposes. They all learned English as a second language; and they have been using English on a daily basis for at least nine years (i.e., six years of English instruction and three of actual usage academically or occupationally). Following is a description of the two groups of interviewees.

Bilinguals in Saudi Arabia. Participants of the first group were Arabic-English bilinguals who lived and used their two languages in Saudi Arabia, an Arabic speaking setting. Their ages ranged from 23 years old to 45 years old ($M = 32.33$). They demonstrated a mean proficiency level of 7.9 out of 10. Regarding their language habits, they all used Arabic at home and for social purposes as their main language. Concerning their English usage, five participants used it mainly for occupational reasons, whereas the sixth participant used it for academic purposes (Deem). Those using it for occupational reasons worked in either a bank or a hospital, whereas the participant who used it for academic purposes, was a college senior majoring in English literature.

Bilinguals in United States. Participants of the second group were Arabic-English bilinguals who lived and used their two languages in the United States, an English speaking setting. Their ages ranged from 18 years old to 34 years old ($M = 24.5$). They demonstrated a mean proficiency level of 8 out of 10. Pertaining their language habits, similar to the first group, all participants used Arabic at home as their main language. All six interviewees used English for academic reasons. They were either students or teachers in an academic institute. However, they differed from the Saudi group in that, depending on their interlocutors, they used both Arabic and English for social purposes.

Similar to the quantitative component of the study, t-tests for independent means were conducted at a 0.05 significance level to test the two groups' compatibility. Results showed no significant difference in either age, L2 proficiency level, or age of L2 acquisition $t(10) = 1.69, p = 0.12, t(10) = 0.16, p = 0.87, t(10) = -1.39, p = 0.20,$

respectively. Regarding sex, equal numbers of each sex were recruited in each group. See Appendix F for the interviewees' demographic information.

Design

The interviews conducted were semi-structured. That is, although questions were asked, they were structured in an open-ended manner to allow relevant open discussions.

Below are a number of example questions used in the interviews:

1. When do you mostly use English? Why?
2. When do you mostly use Arabic? Why?
3. In what situations do you feel confident using either of your two languages?
4. What aspects determine your choice in speaking one language over the other?

Procedure

A purposeful sampling technique was applied. Participants recruited were those who were not outliers. Accordingly, only participants who had a true connection to the traditions and culture of the Arab society (as opposed to people who had admiration to western cultures and way of living) were recruited as interviewees.

The researcher personally contacted each participant by either a telephone call, text message, or email. She familiarized them with the objective of the interview and its format. Once they complied to being recruited as interviewees, each interviewee gave verbal consent to participate. Participants were ensured that the interviews would be confidential and only the researcher herself would have access to them. They were also informed that the committee involved in evaluating the study may gain access upon request.

The researcher met each interviewee in a quiet location of her/his choice; either their home, a study room in a library, or the interviewer's home. Participants were given pseudonyms to meet the ethical and confidential standards of the study. Prior to the actual interview, the researcher explained the purpose of the interview, and the interviewees had the opportunity to ask questions if they felt the need to do so. Moreover, in order to gain a general idea of how the interview would proceed, the interviewees were given a number of example questions which had the potential of being asked in the interview. In addition, the interviewees were told that their participation was totally voluntary and that they would not be compensated in any manner; hence, they could deny participation at any time before or during the interview. Once they agreed to participate, the researcher obtained verbal consent and the interview proceeded. The interview was then conducted in the language choice of the interviewee (i.e., either Arabic or English).

The researcher strongly encouraged open discussions for the purpose of developing a rapport and dialogue between the interviewer and interviewee. The aim of conducting open discussions and dialogues was to extract certain themes which may be key factors in explaining the quantitative results reached. Consequently, in addition to the questions prepared beforehand, further questions, which were triggered by the discussion itself, were formed during the interview.

During the interview, the researcher had a number of aims in mind. First, it was essential for the interviewer to not only obtain answers, but also reasons for answers. In addition, it was crucial for the researcher to engage with the interviewee's cultural and personal experiences to gain specific insights related to their everyday language use habits. The fact that the researcher herself was an Arabic-English bilingual, helped the

interviewees feel comfortable to open up about such issues. Finally, the researcher made sure she exhausted all questions and only stopped when no further information was being obtained. Due to the different nature of the interviewees and how open and detailed they were, interviews ranged from eight to twenty minutes ($M = 13:03$). All interviews were recorded and later saved on a secure laptop.

Apparatus

The interviews were recorded using an iPhone six using the Voice Memos application on the device. Once completed, they were sent by email to a laptop and played using VLC Media Player (version 2.2.4). Choice of this specific media player was determined by its ability to increase sound level. The researcher wore Sony MDRZX110NC ZX-series Noise Cancelling Headphones while analyzing the interviews.

Results

The present section begins with a review of the strategy employed in analyzing the interview data, which follows a thematic coding procedure proposed by Braun and Clarke (2006). It then discusses the two themes extracted from the qualitative data: 1) Arabic-English bilinguals' language choice is determined by their perceptions of the domain of the speech event affected by the dynamics of the situation itself, and 2) Arabic-English bilinguals' language choice is determined by certain sociolinguistic considerations embedded within the speech community. Each theme is supported by numerous excerpts and examples taken from the data. Finally, the two research questions (i.e., the qualitative research question and the mixed-method research question) are addressed.

Data Analysis

Data was analyzed with the specific aim of extracting the social and cultural themes which govern language use and language choice in Arabic-English bilinguals. The analysis phase started only after all interviews (i.e., Group 1 and Group 2) were conducted. First, the analysis examined the interviewees' sociocultural and attitudinal experiences to detect the actual and real circumstances which dictate and/or influence their language usage (i.e., L1 and L2). Second, the analysis gained perspective on the qualitative and mixed-method research questions of the study, thus providing a conceptual account of the quantitative results obtained.

The conceptual framework of the thematic analysis of the interviews was based on the theoretical stands of Braun and Clarke (2006). Consequently, an inductive, bottom-up approach was adopted and applied, in which themes found were strongly linked to the data itself in a manner which aimed at resolving the research questions proposed. Furthermore, the analysis mostly tackled the explicit level of the data rather than its interpretive level. Hence, the analysis mostly involved ideas that the interviewees explicitly expressed, and little attempt was made to analyze any assumptions or underlying ideas which may have been available in the data.

Data analysis followed a constructivist perspective (Berger & Luckmann, 1967). Accordingly, it was believed that the meanings and experiences expressed by the interviewees are those which are socially inherent in the speech community as a whole and which are not limited to the individuals themselves. Thus, the thematic analysis sought "to theorize the sociocultural contexts, and structural conditions, that enable the individual accounts" of the interviewees (Braun & Clarke, 2006, p. 85). In summation,

the analysis aimed at deriving repeated patterns of meaning which provide an understanding of a social phenomenon which played a role in the surfacing of the quantitative results obtained.

In relation to the specific procedure of analysis, a thematic coding procedure proposed by Braun and Clarke (2006) was applied. Accordingly, the researcher reviewed all recorded interviews a number of times to thoroughly examine the data and gain an in-depth understanding of its content. Subsequently, the material was coded for information which reflected on attitudes and behaviors related to the participants' language use and language choice. The goal of the coding procedure was to locate relevant information, label the information, and finally develop a thematic map to find relationships and connections between the coded materials. Consequently, themes were extracted, revised and named. Afterwards, the researcher applied a crosschecking procedure in which themes repeated among the interviewees were focused on. The crosschecking procedure was conducted by locating: 1) similar ideas, and/or 2) keywords (i.e., the actual keyword or synonyms of it), linking them to the interviewees themselves, and observing whether they were repeated across interviewees or not. In cases where they were repeated, the researcher established them as social patterns not individual behaviors. The social patterns found are those which are presented as themes in the present research.

The analysis also detected examples and illustrations (i.e., in Arabic and/or English) of the categories and which supported the established themes. It should be noted that the researcher did not fully transcribe the interviews. Rather, a 'quote-research' (Folkestad, 2008) strategy was applied in which the researcher transcribed (orthographically) only relevant, clear, and adequate quotes and presented them as

illustrations which elaborate on and support the themes found. Finally, the analysis yielded an analytic narrative of the research problem.

The thematic analysis resulted two main themes: 1) Arabic-English bilinguals' language choice is determined by their perceptions of the domain of the speech event affected by the dynamics of the situation itself, and 2) Arabic-English bilinguals' language choice is determined by certain sociolinguistic considerations embedded within the speech community. It should be noted that the categories derived from the data may overlap in the sense that a certain idea can potentially fall within more than one category.

On the one hand, categories of the first theme revolved around the idea of accommodation with the physical setting, the people involved in the speech event, the topic, and the situation. They also revolved around the idea of prescriptivism and appropriateness in relation to the dynamics of the domain. On the other hand, the categories of the second theme were related to social appropriateness, identity, and group membership as related to the Arabic-English community. They were also very much related to Arabic-English bilinguals' self-concept as related to the manner by which they are viewed by the society.

As mentioned in the Methods section above, some interviewees chose to do the interview in Arabic, whereas others chose to do it in English. The quotations presented in Arabic are those derived from interviews conducted in Arabic; the English translations are provided beneath the quote. For those who opted to use English, the quote is provided in English only. It should be noted that the aim of the analysis was not to address Arabic-English bilinguals' usage of either Arabic or English. Rather, it examined elements that affect the processes by which they determine which language to use and which language

to put aside. Accordingly, the themes presented are not specific to their Arabic usage or their English usage; alternatively, they focus on Arabic-English bilinguals' language usage in general and the elements that affect their language selectiveness procedures.

In the proceeding section, the two themes are presented, discussed and illustrated using excerpts and examples from the interviews. These themes are those which were repeated among the interviewees. A discussion section follows in which the qualitative and mixed methods research questions are addressed to give an account of the analytic narrative derived from the data.

Theme # 1: Arabic-English Bilinguals' Language Choice is Determined by their Perceptions of the Domain of the Speech Event Affected by the Dynamics of the Situation Itself.

As stated in previous research, the domain in which a language is used has a strong effect on a bilingual's choice of that language (Fishman, 1965; Grosjean, 1994; Landry & Bourhis, 1997). This was strongly expressed by the interviewees. A number of interviewees asserted that when speaking to another Arabic-English bilingual, they have a strong tendency to use only one of their two language. Choice of the language is dictated by the type of the domain in which they are speaking. That is, when conversing in a specific domain of their lives, they rarely code switch, and mostly use one specific language of the two they speak. This was explicitly expressed by Nasser who said,

اللغتين عندي معزولة. في ناس تشبك عربي و انجليزي في كل شي في كل نواحي حياتها. أنا لا .

My two languages are separate. Some people use both Arabic and English in everything; in all aspects of their lives. I don't do that.

Data analysis showed that Arabic-English bilinguals determine their language-specific domains according to the purposes and needs for which they are speaking. This is in line with assertions by Grosjean (1994). More specifically, Arabic-English bilinguals establish language-specific domains as the result of accommodating with a number of issues, namely, the topic being discussed (Grosjean, 2000), speaking to a certain person in a certain situation, past experiences and situations, habitual forces (Fishman, 1965), and their interlocutor (Paradis & Nicoladis, 2007).

One element which stimulates Arabic-English bilinguals to use one language over the other, is a sense of dedication to use one of their two languages in a certain situation. This dedication is driven by the need to accommodate with two factors, namely, the nature of the setting (i.e., bilingual vs. monolingual) and the native language of the people involved in the conversation. With these two factors in mind, Arabic-English bilinguals determine the language that should be used. This was evident in the majority of interviewees whose statements showed that, in an Arabic monolingual setting (i.e., in the absence of non-Arabic speakers), when an Arabic-English bilingual is speaking to another Arabic-English bilingual, they feel that the domain of the conversation is an Arabic domain, hence use the Arabic language. Whereas when speaking to an Arabic-English bilingual in a bilingual setting (i.e., in the presence of non-Arabic speakers), they conceive the domain as an English speaking domain. This tendency was summarized by Fishman (1965) who explicitly pointed out that, “proper usage, or common usage, or both, dictate that only one of the theoretically co-available languages will be chosen by particular classes of interlocutors on particular occasions” (p. 67-68).

A number of interviewees expressed such language tendency by saying that using Arabic with another Arabic speaker feels more “natural and comfortable” even if both speakers are proficient in a second language such as English. This was emphasized by both Nora and Yara who asserted that, although the official language of their work places is English, and although there are strict guidelines to always use English while at work, they use Arabic when speaking to their Arabic-English colleagues. However, they only do so if no non-Arabic speakers are present. Nora summed this up by saying, “it’s not natural to speak in English. This is our second language. And you know, in Arabic we can express our feelings more than in English.”

Maha elaborated on using Arabic with other Arabic-English bilinguals at work by explaining that when in Saudi Arabia, she uses English only while teaching in the classroom. Yet, outside of the classroom, she tends to speak Arabic with her Arabic-English colleagues because “if the other person speaks the same language, there is no reason for me to use English. I might code switch in certain words, but I wouldn’t use English for the whole conversation.” Talking about her personal life, Maha added that when having a conversation with her sisters, who also live in English speaking countries, “we don’t use English as a means for conversation ... there is no reason [to use English]. If we share the same native language, there is no reason.”

In addition, when Ali was asked which language he would choose to use when speaking to a person in Saudi Arabia, however not knowing whether that person is an Arabic speaker or a non-Arabic speaker, he said,

بتكلم عربي. لأنها لغة البلد و أي أحد أتكلم معاه المفروض يكون بالعربي

I would use Arabic because it's the language of the country, and anyone I speak to, it should be Arabic.

The choice of words used by Ali indicate a strong dedication to Arabic in this situation. Using the word *should* shows that he has strong feelings regarding this issue. This is also expressed when he stated that Arabic is *the language of the country*, which reflects a sense of belonging and a sense of patriotism.

On the same note, Faisal commented on his language choice when speaking to other Arabic-English bilinguals while in the United States. He explained that he would never conduct such a conversation in English. Faisal expressed this by asserting,

*أحس أنني سويت شي غلط لأن لغتنا هي العربي. المفروض نتكلم و نناقش الأشياء بالعربي. ما يحتاج ندخل
الإنجليزي في حوارنا*

I'll feel like I did something wrong because English is not our language. We are supposed to speak and discuss things in Arabic. We don't need to incorporate English in our dialogue.

Faisal's statement of feeling guilty when speaking English shows that this is something very much embedded in his principles and sense of being; and most likely involves his sense of identity.

Layla, who tends to speak to her children in English because they are not very proficient in Arabic, also conveyed a very strong sense of dedication to Arabic. She stated that she feels a sense of remorse when she does not use her native language with her children. Layla explained,

This is something I'm ashamed of because I feel this is their mother language ... I feel this is my language, the Arabic language, and I should be proud of it no matter what. I need to speak to my kids in Arabic. It doesn't matter wherever we go. I need to talk to them in Arabic.

Layla's usage of the strong words *ashamed* and *proud* show how important such an issue is to her; and it gives an indication of the way she wants to raise her children. It also suggests that she perceives her family setting as an Arabic speaking domain.

This sense of dedication also surfaced in situations where the speaker tried to use a certain language to achieve a certain goal. For example, Yara, who is keen to improve her kids' English proficiency level, said, "I tried to dedicate like one hour a day for English language [with kids], but I failed." Yara explained that it was very unnatural to use English at home even though she had a strong desire to do so. She added that this also applies with her husband when they travel. Although they are extensively surrounded by English while traveling, and although they are both highly proficient in English, they find it very difficult to speak to one another in English. When she was asked about the reason, she simply said, "it's not natural."

In addition, Yousef proclaimed that when encountering an Arabic-English bilingual who, like himself, is highly proficient in English, he sometimes develops an impulse to speak to that person in English, however suppresses it. Yousef explained, "... you have to have that willpower to turn it off." When asked whether the willpower needed to suppress English in the United States amounts to that needed in Saudi Arabia, he said, "you need more willpower here (the United States) to suppress English because America is an English environment."

On the same note, when Mohammad was asked why he does not use English at home although all of his family members are highly proficient in English, he simply, but very seriously said, “why should I?” Such a short statement reflects the strong, embedded view perceived by Mohammad of the language of the household (i.e., a specific domain), which is apparently Arabic.

Similarly, the majority of interviewees expressed their dedication to English when conversing in a bilingual speaking situation; that is, in the presence of non-Arabic speakers. They declared that this dedication to English stands even if the non-Arabic speaker is a bystander and not the person they are directly addressing. For example, Nora stated that in such a situation “it’s rude to speak in Arabic.” Likewise, Nasser explained,

نتكلم إنجليزي احتراماً لهم. علشان يفهون.

We use English out of respect, and so they (the non-Arabic speakers) can understand.

Hence, it is apparent that Arabic-English bilinguals view such a domain as an English-speaking domain.

Another factor which drives bilinguals to establish language-specific domains is accommodating with a “habitual choice [which] is far from being a random matter of momentary inclination” (Fishman, 1965, p. 67). A number of interviewees expressed an involuntary urge to establish language-specific domains on the basis of a built-in habit of using a certain language with a specific person. Such built-in habit was established during childhood and is very difficult to overcome. For example, Abdul said that he mostly uses English with his sister regardless of whether they were in Saudi Arabia, the United States,

or any other place in the world. He explained that this is something he cannot overcome because he and his sister grew up together in the United States, and that “that’s the way we communicate.” Similarly, Yousef expressed the same feelings, however it involved a built-in habit to use Arabic with a cousin who, like him, also studies in the United States. He explained that conversations with the cousin in question are constantly in Arabic because, “when I was little before I came to America, I always talked to him in Arabic. So, it’s going to be awkward for me to be speaking to him in English. It’s gonna feel awkward.” In both cases, Abdul’s case and Yousef’s case, it seems that conversing with a certain person resonates a certain language-specific domain in their minds; a domain which has been established during childhood and which they have become accustomed to.

Furthermore, Arabic-English bilinguals establish language-specific domains according to predetermined views of which language better assists in achieving the goals of a certain domain. This surfaced in most of the interviewees’ replies to a question regarding their language use, in Saudi Arabia, when ordering in a restaurant not knowing whether the waiter is an Arabic speaker or a non-Arabic speaker. This question was particularly important because, in Saudi Arabia, waiters are almost always foreigners. Although Saudi waiters do exist, it is not the norm. Responding to this question, the majority of interviewees stated that they would use English without trying to identify the actual language of the waiter beforehand. For example, Yara asserted, “usually, I start with English in public areas like restaurants, shops, malls ... even if it’s an Arabic speaker. It’s by habit.” Mohammad also expressed this tendency by proclaiming,

أنا ما أقرر إني استعمل إنجليزي. الإنجليزي بطلع من نفسه.

I don't make the decision to use English. It just happens.

Additionally, Maha explained that, in such a situation, she always uses English because, “I know for sure they know English.” Similarly, Deem expressed the same predetermined perspective by automatically using English when making reservations. Deem pointed out,

الناس اللي تشتغل في هالأماكن المفروض يكونوا مستعدين للتعامل مع طبقات مختلفة من المجتمع.
أنا متأكدة إنهم يعرفون إنجليزي علشت كذا أستعمله.

People who work in these places are supposed to be prepared to deal with different classes of the society. I'm sure they know English, so I use English with them.

Such a tendency is confirmed by an observation made by Ali who, when asked if he regularly hears English on the Saudi street, answered,

لا . يمكن بس في المطاعم و الناس تطلب .

No. maybe only in restaurants when people are ordering.

The above remarks suggest the existence of a strong determination by Arabic-English bilinguals to accommodate the language choice with the needs and nature of their life domains. Such a determination regulates their language choice and leads to the automatic use of one of their two languages without certain confirmation that it is the appropriate language to be used with the person being encountered.

Similar to the assertions above regarding language use with waiters, Arabic-English bilinguals also appear to associate a certain language to a certain domain in reference to a specific situation or to past experiences for the purpose of being

appropriate. This results in the formation of language-specific domains. Such an association is expressed by Fishman (1965),

[N]ot only do multilinguals frequently consider one of their languages more dialectal, more standard, more vernacular-like, more argot-like than the others, but, in addition, they more frequently associate one of their languages with informality, equality, solidarity than the other. As a result, one is more likely to be reserved for certain situations than the other.

(p. 70)

This was demonstrated by Deem and Maha who spoke about a common habit in the Saudi society for people to use English when in a high scale restaurant. Maha explained, “there are certain places people think they have to speak English more because it’s more prestigious. So, in five star restaurants, they speak English.” This suggests that people who go to such places, recognize it as a domain which has an elevated level of sophistication and complexity. Hence, they make an effort to match such sophistication and complexity by diverting from the norm. Accordingly, they establish it as an English-speaking domain.

Also wanting to be appropriate, Deem described a family situation in which the attitude of her younger sister, who is not very proficient in English, causes her brother and Deem to divert from using English. However. This is only true if the topic of discussion was not related to her brother’s life in the United States. Such a tendency suggests that the presence of the younger sister determines a nearly no-English speaking domain. Deem explained,

إذا احنا نتكلم بالإنجليزي عن أشياء لها علاقة بالمدرسة، الناس اللي حولنا عادي. بس إذا حسوا إننا نخطط لشيء، (أسم الأخت) تتضايق و بيان على وجهها. و هذا عادي. لو أنا في مكانها كان حسيت نفس الشيء.

If we're talking in English about things related to school, people around us don't mind. But if they feel we're planning something, (younger sister's name) gets annoyed and it shows on her which is normal. I would feel the same if I were in her situation.

In addition to the role played by the situation and the experiences of the participants in creating language-specific domains, the type of topic discussed also has such an affect (Fishman, 1965; Grosjean, 2000). Accordingly, Arabic-English bilinguals take into consideration the type of topic being discussed, hence apply a topic-language association process to categorize topics into Arabic-specific topics and English-specific topics. For example, Abdul stated that he always tackles business topics using the English language. He explained, "I basically use English as business language, because it's more flexible than Arabic." Likewise, Abdul asserted that in certain situations that involve either swearing or approving, he tends to use English rather than Arabic. It seems that Abdul has established such domains as English speaking domains. He proclaimed that swearing and giving approval "are English things. English is more useful in swearing and giving approval ... everybody understands *ok, yes*." Abdul also pointed out that when counting, he automatically switches to English even when originally using the Arabic language.

Similarly, Ali gave an example of a topic he prefers to speak about in English and another he prefers to speak about in Arabic. He said,

ادرس تخصصي بالإنجليزي علشان كذا احس إنني اتكلم عنه بالإنجليزي أفضل من بالعربي. الدين العكس ‘

أتكلم عنه أحسن بالعربي

I study my major in English; therefore, I feel I can talk about it better in English.

Religion is the opposite. I always talk about religion in Arabic.

In addition, Yousef pointed out that, while speaking Arabic, he chooses to sometimes use certain English words simply because the ideas they carry belong to the English language and the English speaking community. Yousef explained that the English word he would opt to incorporate is “an English term or slang that revolves around the American life that cannot be translated to Arabic, like *swag* or something specific to English.” Yousef added that he specifically uses English when speaking about “technical issues related to computers or video games.” This is perhaps due his high exposure to such information in English, hence labeling such a topic as an English topic. Likewise, Layla, who is a very poetic person, affirmed that she resorts to English if the phrase she needs to express is more beautiful in English than in Arabic. She explained,

Only if there’s a phrase that is more beautiful to say in English, I would go to English. Each language has its own beauty ... if there is a phrase that is so beautiful, you cannot even translate it and get the same beauty. That is maybe the only thing that would trigger me to go to English [while speaking Arabic].

Additionally, Nora extended this tendency by applying it to topics she believes the recipient is more comfortable to speak about in a certain language. Having a brother and sister who attend school in the United States, she was asked about the specific situations in which she speaks to her siblings in English; Nora commented,

You know, sometimes it depends on the topics we are talking about. If (brother's name) is talking about school, about his homework, if (sister's name) is talking about her TV shows, her art, usually we talk in English. Things related to their lives in America.

These tendencies of choosing a certain language because of a certain topic can be explained in the sense that “certain topics are somehow handled better in one language than in the other in particular multilingual situations” (Fishman, 1965, p. 71).

The above topic-language association process applied by Nora not only emphasizes the role of the topic in a bilingual's language choice, but also highlights the role of the recipient in the process (Appel & Muysken, 2006; Nicoladis, 2008; Paradis & Nicoladis, 2007). For example, Nora expressed that although all of her family members know English, she only frequently uses English with one brother and one sister (i.e., the brother and sister who study in the United States). She explained that she frequently speaks to her brother in English because, “I know how he is. He prefers to speak in English.” She asserted that when she is with him, she feels she is speaking to an English speaker rather than an Arabic speaker. She does this although he teases her about her English accent, which he claims has a Saudi tone in it. The fact that Nora bears her brother's teasing and continues to speak with him in English, further stresses the role of the interlocutor in developing language-specific domains. Additionally, Nora pointed out that she does not use English with her other brother, who also studies in the United States. She said, “... you know, I'm used to him not comfortable talking in English. He just started being ok with that. So, I'm not sure; we didn't try talking in English.” Again, Nora developed a language-specific domain which was dictated by her interlocutor.

Similarly, Yousef stated that when meeting with other Arabic-English bilinguals in the United States, he leaves the choice of language to them. He clarified,

If they start speaking Arabic, I speak Arabic ... One time I had to go to this place where it's a bunch of Saudi guys, and the moment we went there, they all spoke Arabic. So, the whole night we just spoke Arabic; but we're [all] living here in America, but all of us spoke in Arabic. And that's the first time I've met them.

When asked why he would leave the choice to them, and what concern he may have speaking English, he answered,

My concern is if I started [the conversation] in Arabic, and they can't pick up, like because some of them just got here. So, I leave it to them to decide if they're comfortable speaking English or Arabic. Or for people who have been here so long, Arabic could be a little rusty to them; so, if we speak Arabic, they can mess up here and there, and they feel uncomfortable. And it's their house. I don't want them to feel uncomfortable in their house.

The above assertions provided by the interviewees provide a strong indication of the Arabic-English bilinguals' language processing strategies and the manner by which certain elements stimulate them to create language-specific domains. Accordingly, one can conclude that a number of issues (e.g. topic, interlocutors, past experiences) affect the language processing mechanisms in Arabic-English bilinguals.

Theme # 2: Arabic-English Bilinguals' Language Choice is Determined by Certain Sociolinguistic Considerations Embedded within the Speech Community

Previous research has established that language choice in bilinguals is affected by certain interpersonal aspects that exist in the society, such as speakers attempting to reduce the dissimilarities between them and other members of the speech community for the sake of not being negatively evaluated (Giles et al., 1973), or inflating such dissimilarities for a certain reason. Such social considerations are extremely evident in Arab societies. They play a strong role in Arabs' lives and have a noticeable effect on their values, attitudes, and interpersonal relations (Feghali, 1997).

Data analysis showed that Arabic-English bilinguals take into consideration a number of social aspects which play a role in determining their language choice in a certain situation. For example, they may choose to use a certain language to be socially appropriate (Giles et al., 1973). They may also use a certain language to establish group membership within a specific speech community (Sachdev & Giles, 2008). Furthermore, they may choose to speak a language to avoid being stigmatized by members of the speech community. Finally, they may seek social security by distancing themselves from a certain social situation or social taboo by abandoning one language and using the other.

Respect of others and social appropriateness, which is a strong social phenomenon (Downie & Telfer, 1970), was an aspect repeatedly expressed by the interviewees in that it had a robust influence on their language choice decisions. For example, Abdul demonstrated that when speaking to an Arabic speaker who is highly proficient in English, although he would prefer to engage with that person in English, he makes his decision in accordance with the people surrounding the speech event. Abdul explained, "if the audience has a certain level of proficiency in the English language, I will go to English preferably. But if the audience doesn't, it will have to be in Arabic."

Abdul's use of *have to be* shows the strong effect of such an aspect on his language choice.

Likewise, Yousef expressed the same concern when speaking to family members. Talking about family gatherings, he asserted that, "there is social pressure ... because some of my uncles and cousins don't speak English, and then speaking English in front of them is, I think a little rude." Yousef then goes on to give an example of such a situation and its impact on his uncle who obviously demonstrates a higher family rank than he. The presence of the uncle in the social gathering puts pressure on Yousef. He explained, "He's my uncle! You don't want to make him feel bad about him not being as good in English as you."

Also expressing a similar situation, Faisal, who lives with four Saudi roommates in the United States, explained that although the roommates were accustomed to speaking some English when discussing school matters, when a new roommate, who knows almost no English, moved in, the amount of English used at home dropped drastically. Faisal stated,

احنا في البيت اربع شباب سعوديين ساكنسن سوا. الأخير اللي جانا توه جاي للمعهد و مسكين لغته
الإنجليزية زيرو. فلمن نجتمع و الشباب كلهم في الجامعة و كلهم عارفين إنجليزي كويس، يا إما ما نحكي
بالإنجليزي و لو زلت كلمة نقولها مرة مترجمة.

At home, we are four Saudi guys living together. The last one who joined us, he's just starting the English course; poor guy almost knows zero English. So, when we get together, all of us are college students who are quite proficient in English,

but because of him, we refrain from using English; and if we unintentionally say a word in English, we always give its translation.

Furthermore, Maha stated that even though speaking English to her three year old daughter is something “I do intentionally” both in Saudi Arabia and in the United States, she does not speak to her daughter in English in front of Arabic speakers as “a sign of respect.” Maha’s change of behavior in front of Arabic speakers reflects a social concern which has an effect on her language choice.

On the same note, Ali explicitly expressed that respect of others is an element which is embedded in the values of families, an issue which can be viewed as the values of the society as a whole. He stated that he always initiates conversations with Arabic-English bilinguals in Arabic because,

اتربينا إنا لازم نحترم الشخص اللي معنا و إنه لازم اصير طبيعي مع الكل.

we were raised to respect people and be natural with them.

Ali also commented on the appropriateness of using English in the society by explaining that, when with two friends, one being more proficient in English than the other, he refrains from using English with one friend (i.e., the more proficient friend) but not with the other (i.e., the less proficient friend). Rather, he prefers to speak to both in Arabic. Ali explained,

كأني أفضل واحد منهم على الثاني

It's like I favor one of them over the other.

Mona revealed a similar view, however complemented it by a desire to be part of the speech community. She stated that when in Saudi Arabia, she tries not to speak English in public so that “people don’t get the wrong idea. To respect them. It’s just better that I don’t speak in English in public” When asked why, she said, “it might bother them. They might think I’m better than them.” Her last statement echoes her desire to be part of the group she is speaking with; that is, the speech community she wants to be part of.

Moreover, the effect of speaking a language different than that of the speech community, and its effect on people’s perceptions of the speaker’s membership of the speech community, was reflected in Abdul’s interview by his daughter. During the interview, Abdul’s teenage daughter, who is not very proficient in English, walked in while Abdul and the interviewer were speaking in English with a strong American accent. Listening to her father and the interviewer (i.e., people she is accustomed to speak to in Arabic) the daughter showed a sense of confusion by saying,

أحس إنه انتوا مو انتوا. ما عرفتكم.

I feel you’re not you. I don’t recognize you.

The daughter’s statement reflected her perception of people who speak too American and how this distances them from the speech community they are originally part of.

Moving on to a different social consideration, a common label used in the Arab community is *mac chicken* which is used to refer to people who heavily code-switch between Arabic and English. Such a label has two connotations. It can carry a negative connotation to socially degrade a person, or it can be used to brag that a person is highly

proficient in English. The phrase *mac chicken* came up several times in the interviews where several interviewees referred to its negative connotation. They commented that they had a strong desire to avoid being labeled as such. For example, Abdul stated that he tries not to switch between Arabic and English in public because “people have a negative attitude, a very negative attitude. They call it mac chicken. I don’t want to be called that.”

Furthermore, when Ali was asked about the community’s perception towards bilinguals who constantly code-switch, he stated,

أحس الناس عندهم نظرة دونية لهم. لناس ما تحب هالشى. بيبين علو وجيههم.

I feel people look down at them. People don’t like that. It shows on their faces.

Although Mohammad himself is an Arabic-English bilingual, he expanded on this issue by making very bold remarks. With an edgy attitude, he said that a person who code-switches is always perceives as,

مبتعث مغسول مخه. هذا شخص مسكين مختلط عليه الأمر. هالشى موب طبيعي. حتى لو صادفته برا البلد، أنا ادري إنه عايش أغلب حياته بالعربي. المفترض إنه إذا كان يكلمني، يكلمني بالعربي. المفترض إنه عنده كترول إنه إذا صار معي يتكلم بالعربي و إذا صار مع أحد من أهل الديرة يتكلم انجليزي. لازم يكون عنده كترول. شى ينرفز.

a person who lived abroad and is brain washed. I pity such a person. He is a confused person. This is not normal. Even if I encountered this person abroad, when talking to me, he should talk to me in Arabic. He should have the ability to control himself and, when with me, speak to me in Arabic, and when with a person from that country (the foreign country), speak English. It’s annoying.

Some interviewees also expressed a strong desire to avoid the community's negative attitude towards a person who engages with other bilinguals solely using the English language. Their statements suggest that such a behavior can potentially cause them to be stigmatized by the community. For instance, Abdul talked about his childhood and the agony of facing the judgments passed on by the community towards him as a child who sometimes resorted to English rather than Arabic when speaking in public. He stated,

Ever since we were kids, whenever you spoke in English in front of an audience that does not speak English ... their reaction is, first of all, they have a sense of inferiority, second of all, they think you're stuck up, third, [they think] you're trying to say something you don't want them to understand.

Likewise, Maha commented on the community's negative views when facing an Arab speaking English by pointing out that other people "will think I'm showing off because speaking another language, especially English, is perceived as prestigious, so they might think I'm looking down on them or I'm just showing off." Layla expanded on this issue by explaining that, while in the United States, she used to speak English in social gatherings with her Arabic-English bilingual friends. However, she refrained from doing so because, "I got a lot of comments. Some of them were saying you're arrogant, you want to just show off." Ali also expressed similar concerns, however he distinguished between using English in front of close friends and in front of those he may not be totally acquainted with. He declared,

مع أصدقائي القراب، هم عارفين إنني أدرس برا. ما عندهم مشكلة. بس إذا أنا مع ناس ما أمون عليهم مرة،

الأفضل إنني أتكلم عربي.

With my really close friends, they know I study abroad; they wouldn't mind. But if I'm with people who I'm not really close to, it's better if I speak in Arabic.

Finally, a few interviewees commented that making a certain language choice may be an attempt to establish a state of social security away from the community to which they belong. This is sometimes performed to avoid a certain social situation. For example, Yara explained that even though she tends to use Arabic with female Arabic-English bilinguals at work, when engaging with males (who are also proficient in English), she resorts to English. Yara clarified, “with girls, we use Arabic most of the time, but with men, males, usually we talk in English.” Since it is clear that such a behavior is an attempt to establish a certain degree of social distance between herself and men in the workplace, this strongly supports the indication that using English between Arabic speakers, causes social distance between them.

In addition, in cases where the bilingual is performing a social taboo, she/he may chose a certain language to establish a state of social security away from the community to which they belong. Both Nora and Deem declared that when cursing, they use English regardless of the setting in which they are. Nora stated, “I don't usually say bad words, but when I need to, I use English.” When asked why, she said, “I don't know. Maybe because it doesn't make me feel bad when I use English, and I think I'm hoping no one will understand me.” Similarly, Deem commented on her use of curse words in English by stating,

*اكثير الالفاظ هندي إذا بقولها اقولها بالإنجليزي. كثير ناس يسوون كذا. يمكن لأنهم يحسوون إنهم اندر كفر.
بالعربي العيب اكبر.*

Most of these words, if I'm going to say them, I'll say them in English. A lot of people do that. Probably because they feel undercover. And it's more offensive in Arabic.

Discussion

In reference to the first research question, the qualitative question, “What are the factors that affect the language selection mechanism in Arabic-English bilinguals?” data analysis showed that the two main elements which affect language selection in Arabic-English bilinguals are: 1) the type of domain in which they are using the language, and 2) sociocultural considerations. In relation to the former, Arabic-English bilinguals associate their life domains with one of their two languages according to the purpose for which they are using language and the dynamics of the situation; hence, establishing language-specific domains. Arabic-English bilinguals develop such language-specific domains according to a number of elements. For example, they establish them in relation to the topic of the conversation such as that demonstrated by Abdul who always uses English when speaking about business matters. They also establish them according to the person or people contributing to the communicative event, such as Nora who uses English with her siblings who study in the United States. In addition, they determine them in reference to their social experiences and situations, such as the tendency proposed by Maha of specifically using English in high scale restaurants. Furthermore, they establish them by reflecting on the setting of the communicative event, such as strictly using Arabic when speaking to an Arabic-English bilingual in an Arabic speaking setting; however, only if no non-Arabic speakers are present. Moreover, they establish them on the basis of forceful and built-in habits they cannot overcome, such as Yara’s failing attempt to speak

English to her children at home. Establishing such language-specific domains, when speaking in an Arabic monolingual setting, Arabic-English bilinguals rarely code switch or use the language unassociated with the domain.

The second affective factor derived from the data is the culture to which Arabic-English bilinguals belong. Their sociocultural circumstances have a noticeable effect on their language choices. Arabic-English bilinguals may choose to speak one language over the other out of respect for the person or people involved in the communicative event. For example, they speak English in the presence of a non-Arabic speaker, even if that non-Arabic speaker is not the addressee. They may also opt to use one of their two languages to reduce the dissimilarities between them and members of their speech community and gain membership into that community. This was evident in Mona who does not speak English in public when in Saudi Arabia. Moreover, Arabic-English bilinguals may choose to use one of their two languages to avoid being downgraded by other members of their speech community or be called *mac chicken*, such as that expressed by Mohammad and Abdul. Finally, Arabic-English bilinguals may choose to use one language over the other as a strategic move to distance themselves from a certain social situation or a certain social taboo. This was viewed in Yara who uses English to establish social distance with male co-workers, and Nora and Deem who swear in English to avoid social inappropriateness in their native community.

In relation to the second research question, the mixed method question, “How does the qualitative data help explain the results obtained from the quantitative phase of the study?” a number of issues regarding the procedure followed in the quantitative phase need to be pointed out. While conducting the experiment, the researcher aimed at

establishing a monolingual setting in which Arabic was the target language. This was achieved by the administration of a number of standards. First, participants were instructed to perform the task in Arabic; no mentioning of English or its involvement in the task transpired before or during the task. Furthermore, the interlocutor ensured only Arabic was used throughout the testing session. Even in situations when participants tried to incorporate English into the dialogue, the interlocutor immediately converted the conversation to Arabic. In addition, many of the participants did not know the interlocutor on a personal level and were not sure of her/his L2 proficiency level. No indication of such information was given to them or was implied in any way; hence, they were left to be baffled of whether the interlocutor was a monolingual or a bilingual. Moreover, all written materials given to the participants throughout the testing session (i.e., picture names, participation information, and feedback during the task) were in Arabic. Additionally, all participants were aware that their interlocutor was a person who shared their own culture, traditions, and religion; so they perceived her/him as a member of their own social and speech community who shared their cultural standards and values. Finally, the testing session took place in a quiet secure location; hence, no non-Arabic speakers were present.

Drawing on the qualitative data obtained, one can make conclusions about the participants' interpretation of the testing session. First, they perceived it as an Arabic-speaking domain for a number of reasons. The participants were speaking to an Arabic speaker who, in their presence, did not utter a word of English. This occurred in a setting where only Arabic speakers were present, a situation similar to that described by a number of interviewees as a setting in which using Arabic is *more natural*. Furthermore,

the participants needed to accommodate the Arabness of their interlocutor, an accommodation intensified by their lack of knowledge of the language(s) their interlocutor may or may not have the capacity of speaking. In addition, they were instructed to perform the task in Arabic which may have stimulated them to build a portrait of the topic as one associated with the Arabic language.

In addition to establishing the testing session as an Arabic-specific domain, a number of social issues evidently played a role in their language selectiveness mechanism. First, since the interlocutor used Arabic and only Arabic, the participants were obliged by cultural standards to use Arabic as well, hence suppressing their English language. Second, they were conversing with a member of a speech community they were also members of; wanting to ascertain their membership, they would be driven to choose Arabic as their base language which would entail its activation (Grosjean, 1997). Finally, using English would have put the participants at a risk of social degrading (e.g. being labelled as *mac chicken*). In order to avoid such a risk, they would need to narrow the gap between them and their interlocutor by using Arabic to achieve social acceptance (Giles et al., 1973).

These issues suggest that Arabic-English bilinguals' perception of the speaking specificity of a situation such as that of the testing session, as one pertaining to the Arabic language. Such perception is a prompter to suppress their English language and set their language processing mechanism near the monolingual endpoint of the language mode continuum. Consequently, this suggests that the connectedness of the languages of Arabic-English bilinguals are strongly affected by the variables of the speech event, which goes in line with Grosjean's language mode theory.

The fact that the qualitative data predicted that Arabic-English bilinguals' language processing mechanism is variable-dependent, sheds light on the results obtained in the quantitative phase of the present research. The partial L2 activation found sets Arabic-English bilinguals closer to the monolingual endpoint of the language mode continuum (Grosjean, 1997) which indicates that one of their two languages was more activated than the other. The qualitative results reflect tendencies which have the potential of separating the languages of Arabic-English bilinguals from one another in a manner greater than the languages of Catalan-Spanish bilinguals. Catalan-Spanish bilinguals are most likely not confronted with the personal and social dilemmas Arabic-English bilinguals are faced with when using their two languages because they are part of a society which regularly uses their two languages with little reservations.

Summary

The analysis of the qualitative data yielded two themes which are viewed as influencing factors affecting Arabic-English bilinguals' language selectiveness mechanism. The first theme reflected Arabic-English bilinguals' tendency to establish language-specific domains, and adhere to those domains. The second reflected their tendency to take into consideration the sociocultural norms of their community, and choose to use a certain language accordingly.

The unfolding of these themes sheds light on the participants' perception of the language-specificity of the testing session in the quantitative phase. They labeled it as an Arabic-specific domain and were culturally determined to select Arabic as their base language. Adhering to these two issues set them near the monolingual endpoint of Grosjean's language mode continuum. Thus, being affected by the circumstances of the

communicative event, Arabic-English bilinguals are declared as those who adhere to a variable-dependent language processing mechanism. The qualitative results also explain why the languages of Arabic-English bilinguals may be more separated than the languages of Colomé's (2001) Catalan-Spanish bilinguals.

CHAPTER VI

CONTROL EXPERIMENT

The main experiment was followed by a control experiment. The strategy was also used in Colomé (2001). The aim of conducting a control experiment in both the present research and that of Colomé (2001) was to establish whether the pattern of results observed from the bilingual participant groups, specifically for the conditions in which participants should have responded *no* to the speech sound (i.e., Conditions 2 and 3), occurred due to interference from the participants' L2 (i.e., English). In the control experiment, participants were monolingual native speakers of Arabic; thus, no interference was expected, and no differences between Conditions 2 and 3 were anticipated.

Colomé (2001) analyzed data from 24 monolingual participants in her experiment. The current experiment met that standard by analyzing data from 24 monolinguals as well. In Colomé's (2001) control experiment, instead of recruiting monolinguals of the native language of her bilingual participants (i.e., Catalan monolinguals), the researcher recruited Spanish monolinguals. She did so for practicality and historical reasons. Regarding the instrument itself, due to Colomé's (2001) inability to recruit Catalan monolinguals, she needed to somewhat change the content of the instrument; hence, she did not use the exact instrument used in her main experiments.

The present research did not face such a problem; the same task was administered to both the monolingual group and bilingual groups. In her results, Colomé (2001) found no significant differences between the two negative conditions, hence declared results of her main experiments as valid and truthful results which emerged as a consequence of the bilingualism of her participants. A similar pattern of results is expected to emerge from the present experiment. The following sections provide a description of the participants recruited in the control experiment, the design and procedure of the experimental instrument, and the experimental results. The chapter ends with a discussion that elaborates on the results obtained and which links them to the hypothesis related to the monolingual participants.

Methods

Participants

A total of 28 monolinguals were tested as a control group in the study. As in the main experiment, for privacy reasons, each participant was assigned a number rather than using their real name. In addition, a cutting point error rate was established and used to eliminate participants unqualified for data analysis. The elimination criterion is equivalent to that explained in the Results and Discussion chapter (i.e., Chapter Four). Furthermore, it was ensured that all participants had normal or corrected-to-normal vision, and no one suffered from motor problems in their hands or fingers.

Regarding demographics, participants of the control experiment provided the same information as that provided by the bilingual participants (i.e., age, sex, and profession) with the exception of the three elements irrelevant to them (i.e., their 12

proficiency level, the number of L2 hours used per week, and the age at which English learning started). Among the 28 participants tested, four were excluded due to their unqualified performance on the task resulting in a total of 24 participants (females = 14, males = 10) ranging from 24 years of age to 55 years of age ($M = 41.3$).

The monolinguals recruited were mostly functional monolinguals. That is, they have received some instruction in English in a certain phase of their lives, but at the time of testing, they did not recall knowing English or being able to use it in any significant manner. Resorting to functional monolinguals rather than true monolinguals was due to practicality reasons. The true monolinguals available were nearly non-educated individuals who were not competent enough to use computers. This is in line with Colomé (2001) who also recruited functional monolinguals. The Spanish participants she recruited reported no knowledge of Catalan other than the minimal contact they had with it through media outlets such as TV. Thus, the monolinguals used in the present research adequately meet the characteristics of those used by Colomé (2001) (i.e., although both groups have encountered the language being tested in one way or another, they both significantly lacked knowledge of that language).

Design and Procedure

Participants were recruited through a snowball sampling technique to take part in the present experiment. All 28 participants performed the task, however only those proven qualified ($n = 24$) were used for data analysis. The same exclusion criteria used in the main experiment was also used in the control experiment. A detailed account of the experimental design and procedure are provided in the Methods chapter. Following is a brief reminder of the main aspects of the experimental design and procedure.

The researcher personally contacted the participants by either a telephone call, a text message, or an email. Those who agreed to participate did so as volunteers. They were not paid or compensated in any manner. Furthermore, they all provided informed consent by clicking a continue tab on the laptop on which they performed the task.

Each participant was tested individually, by the researcher or a qualified individual, in a quiet isolated area in approximately 20-30 minute sessions. Each testing session consisted of six phases. First, the participant received detailed oral instructions from their interlocutor regarding the method of the task. Second, the participant studied a booklet containing the black-on-white pictures used in the task with their Arabic names written underneath them for approximately five minutes. Third, the participant read the participation information on the screen of the laptop used for testing. Fourth, the participant gave consent to be recruited in the study by pressing a continue tab on the keyboard of the laptop on which they were performing the task. Fifth, the participant went through a training session consisting of six items which followed the exact procedure as that applied in the main task. After the training session, the participant had the opportunity to ask questions or express the need for more clarification, and then she/he received feedback regarding her/his performance on the training session and whether she/he correctly understood the task strategy or not. Finally, the participant performed the task by completing all three blocks of the task. Each participant performed the task only once, and only those who completed the entire task were used for data analysis. The same apparatus used in the main experiment were also used in the control experiment.

Results and Discussion

In line with Colomé (2001), and as mentioned in the Results and Discussion chapter, the dataset was trimmed by removing observations from those trials involving the two pictures with error rates higher than 30 percent (i.e., woodpecker and ladder). The mean error rate in percent for each picture across groups is displayed in Appendix E. Participants of the monolingual group were also trimmed with the same exclusion criteria used in the main experiment. Those with an error rate higher than 30 percent were eliminated from data analysis (i.e., four participants).

The resulting dataset of monolinguals ($n = 24$) was then analyzed using analyses of variances (ANOVAs) in which, in accordance with recommendations by Clark (1973), pictures were treated as a random effect. Consequently, the between-subjects factor (F_1) contained one group (i.e., the monolingual group), whereas the within-subject factor (F_2) contained three levels: a) *yes* response-Arabic sound contained in Arabic noun describing the picture, b) *no* response-English sound contained in English noun describing the picture, and c) *no* response-sound unrelated to either Arabic or English noun describing the picture. As in the main experiment, both analyses of Error Rate and Response Time were conducted. Refer to Table 11 for the mean error rates and standard errors from the F_1 and F_2 analyses, and Table 12 for the mean response times and standard errors from the F_1 and F_2 analyses. All measures were performed at a 0.05 level of significance.

Results of the two-way analyses of variance (ANOVAs) showed no significant difference between Conditions 2 and 3 in either Error Rate or Response time. The main effect of Phoneme Type on Error Rate yielded an F-ratio of $F_1(2,48) = 1.77, p = 0.18$, $F_2(2,48) = 1.30, p = 0.28$ indicating an insignificant difference in Error Rate between

Arabic sound, English sound, and unrelated sound, a finding which is in line with the results of Colomé (2001).

Table 11

Mean Error Rates and standard errors for participant and item analyses (F₁ and F₂) - Monolingual group

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	Error Rate %	SE	Error Rate %	SE	Error Rate %	SE
F ₁	16.50	0.02	20.17	0.02	15.83	0.02
F ₂	16.00	0.02	20.08	0.03	15.72	0.02

Note: SE = Standard Error

Table 12

Mean Response Times (in milliseconds) and standard errors for participant and item analyses (F₁ and F₂) – Monolingual group

	Condition 1 Affirmative (Arabic sound)		Condition 2 Negative (English sound)		Condition 3 Negative (Unrelated sound)	
	RT	SE	RT	SE	RT	SE
F ₁	718.49	42.28	1056.82	68.92	1041.75	68.50
F ₂	776.56	32.11	1058.40	26.84	1049.99	32.50

Note: RT = Response Time; SE = Standard Error

Mean error rates obtained from the present experiment were nearly double those found in Colomé's (2001) control experiment. This can be explained in reference to the instruments used in the two experiments. In Colomé (2001), the first stimulus was a

letter, whereas in the present experiment, it was presented as a sound the participants heard. Colomé's (2001) participants had the advantage of making judgment on the basis of a visual representation rather than an auditory representation. Such an issue may have boosted their accuracy level, an element the participants of the present experiment did not have the advantage of.

Response Time differed significantly across the three conditions (i.e., Arabic sound, English sound, and unrelated sound) resulting in a significant main effect of $F_{1(2,46)} = 58.00, p = 0.000, \eta^2 = 2.53, F_{2(2,48)} = 50.58, p = 0.000, \eta^2 = 2.11$. Posthoc tests were conducted using Fisher's LSD test (Toothaker & Miller, 1996) to establish which levels for Condition were significantly different. As in the main experiment, Fisher's least significant difference (LSD) measure was chosen because of its appropriateness in dealing with three independent means, an issue which has been proven analytically (Hayter, 1986) and empirically (Seaman, Levin & Serlin, 1991).

For the F_1 factor, the LSD was 77.26 at a 0.05 alpha level of significance. Comparing the obtained LSD level to the absolute value of the differences between means, results showed a significant difference in Response Time between Condition 1 (i.e., Arabic sound contained in the Arabic word describing the picture) and Condition 2 (i.e., English sound contained in English noun describing picture), $|-338.33| > 77.26$. Condition 1 also differed in Response Time from Condition 3 (i.e., sound unrelated to either Arabic or English noun describing the picture), $|-323.26| > 77.26$. No significant difference in Response Time was found between Conditions 2 and 3, $15.07 < 77.26$.

Pertaining to the F_2 factor, the LSD value was 32.87 at a 0.05 alpha level of significance. Comparing it to the absolute value of the differences between means, results

showed a significant difference in Response Time between Condition 1 (i.e., Arabic sound contained in the Arabic word describing the picture) and Condition 2 (i.e., English sound contained in English noun describing picture), $|-281.86| > 32.87$. Condition 1 also was significantly different in Response Time from Condition 3 (i.e., sound unrelated to either Arabic or English noun describing the picture), $|-273.43| > 32.87$. No significant difference was evident between Conditions 2 and 3, $8.43 < 32.87$.

Since the significant difference pertains to the *yes* response condition, and is absent from the two *no* response conditions, it is clear that the type of answer required played a prominent role in the main effect found. Hence, an affirmative response transpiring in a more rapid manner than that of a negative response is an explanation in such a situation. Consequently, such a significant effect does not negatively affect the validity of the main experiment. The only significant difference which would have raised questions about the validity of the main experiment is the occurrence of a significant difference between Conditions 2 and 3, which is not apparent.

Mean response time of Condition 2 obtained from the present experiment was noticeably higher than that found in the condition specific to the participants' L2 in Colomé's (2001) control experiment. This can also be explained in reference to the instruments used in the two experiments. Participants of the present experiment were exposed to an auditory stimulus, which needs more time to internalize and react to than a visual stimulus.

The results obtained support the last hypothesis of the present research, "Monolingual Arabic participants are not expected to show any L2 interference in Error Rate or Response Time between Conditions 2 and 3." Thus, the L2 interference found in

the main experiment is due to the bilingualism of the participants and emerged as a result of their knowledge of the English language and its competition with their native language, Arabic.

Summary

The results confirmed that the monolingual participants' performance differed from that of the bilinguals' performance with regard to the condition in which the sound was contained in the English translation equivalent of the Arabic word for the picture. For the monolingual participants, there were no significant differences between the two *no-response* conditions in either Error Rate or Response Time. Accordingly, it can be concluded that the results obtained from the bilingual participants are due to interference from their L2.

CHAPTER VII

GENERAL DISCUSSION

The central question in the present study was how Arabic-English bilinguals process their two languages and whether their L2 is active when in a setting exclusively using their mother tongue. More specifically, the study targeted four issues. First, it aimed at associating the language processing mechanism of Arabic-English bilinguals with one of the bilingual language processing paradigms available in the field. The three paradigms of bilingual language processing are: 1) language- dependent processing (i.e., co-activation), 2) language-specific processing (i.e., separate activation), and 3) variable-dependent processing (i.e., circumstantial activation). Such association was concluded on the basis of quantitative evidence supported by qualitative findings. Second, the study aspired to compare its results with Colomé (2001). The objective of such a comparison was to examine whether the results of Colomé (2001) upheld in the present study, and to determine whether Arabic-English bilinguals and Catalan-Spanish bilinguals apply the same or different language processing mechanisms. This is especially important because, although very similar procedures were applied, the two types of bilingual categories differed at numerous levels. Taking these differences into consideration, the present

study aimed at finding justifications for the difference in the results between the two studies. Such justifications were viewed in light of affective variables discussed in theories of bilingual memory, variables such as language similarity (Coderre & Van Heuven, 2014), the language specificity of the bilingual's life domains (Grosjean, 2013), and the bilinguals' sociocultural circumstances (Giles et al., 1973). Third, the study aimed at detecting the effect of location on bilingual language processing (Grosjean, 2013) in Arabic-English bilinguals. That is, whether the language specificity of the setting in which Arabic-English bilinguals use their two languages is a variable which significantly affects their processing mechanism. This was conducted by recruiting Arabic-English bilinguals in two different locations. The first location was a native setting of the bilinguals' L1 (i.e., Saudi Arabia), whereas the second was a native setting of their L2 (i.e., the United States). This is a rather important examination since no study in the literature, as of the knowledge of the researcher to this date, has attempted to empirically study such an aspect. Finally, the study aimed at determining the variables which affect L2 activation in Arabic-English bilinguals. It accomplished this by three means: 1) theoretical observations, 2) studying relationships between experimental dependent variables and participant/item characteristics, and 3) examining Arabic-English bilinguals' personal and sociocultural circumstances and judgments.

The present chapter consists of ten sections. The first section tackles the first hypothesis of the study by overviewing L2 activation in Arabic-English bilinguals. It compares the present results with other results in the literature. Section two tackles the second and third hypotheses of the study by examining the status of location as an affective factor in Arabic-English bilinguals' language processing mechanism. Section

three examines the fourth hypothesis by discussing how L2 word frequency affects language processing in Arabic-English bilinguals. Section four compares the present results with the three theories of bilingual memory; whereas section five discusses the variables affecting language processing in Arabic-English bilinguals. The aim of sections four and five is to establish the mechanism by which Arabic-English bilinguals process their languages. Section six discusses conflicting findings in the literature and justifies differences in results. Section seven provides the limitations of the study, whereas section eight provides future directions. Following, section nine presents the importance of the findings of the study. The chapter ends with a conclusion section.

Language Processing in Arabic-English Bilinguals

(Hypothesis # 1)

Testing the first hypothesis, “Arabic-English bilinguals are expected to encounter L2 interference reflected in differences in Error Rate and Response Time between Conditions 2 and 3,” results showed that Arabic-English bilinguals experience a certain extent of L2 interference while using their mother tongue. Such a finding sets Arabic-English bilinguals within the language-independent spectrum of language processing. However, since their L2 activation level is partial, this suggests that their language-independent mechanism is not absolute.

Results which show partial L2 activation in bilinguals, are not unusual in the literature because “an inactive language influences behavior in an active language, at least when stimuli are present which can activate the supposedly inactive linguistic system” (Keatley, 1992, p. 33). As previously mentioned, this was also apparent in Colome’ (2001) which showed that although the languages of Catalan-Spanish bilinguals

are more connected than the languages of Arabic-English bilinguals, they remain separated to a certain degree.

Partial activation was also apparent in Marian, Spivey and Hirsch (2003) who found that their participants first applied a language-independent mechanism then diverted to a language-specific mechanism. Accordingly, their results signal more L2 activation at the initial levels of bilingual language processing which decreases at advanced stages. This pattern suggests that bilinguals can demonstrate partial L2 activation, a situation very similar to the findings of the present study.

Moreover, Gerard and Scarborough (1989) found that their bilingual participants mainly functioned as monolinguals when performing a monolingual task. However, the researchers found traces of common encoding processes between the two languages and some language integration at the semantic level. Accordingly, the researchers were not totally determined to one mechanism. Although, they were more prone to associate Spanish-English bilinguals with the language-specific processing mechanism, they were not totally committed to such a model because of the mixed nature of their results. A very similar pattern emerged in the present study which indicates that language processing is not necessarily applied by using one specific mechanism.

Results of the present study are in line with other studies in the literature which specifically examined language processing in Arabic-English bilinguals. For instance, Qasem and Foote (2010), found that excessive usage of the L2 weakened their bilinguals' L1. This in turn increased the level of interference they experienced. Such a finding supports the positive correlation found in the present study between the amount of L2

usage per week and error rate. It also indicates a certain level of L2 activation as in the present study.

Furthermore, the present results are in line with Coderre and Van Heuven (2014) who found that bilingual categories whose languages are highly dissimilar demonstrate less language connectedness than bilingual categories whose languages are highly similar. Likewise, when comparing the present results to Colomé (2001), one concludes that bilingual categories who speak highly similar languages exhibit more connectedness in their language processing mechanism than bilingual categories who speak highly dissimilar languages.

In addition, Saegert, Obermeyer and Kazarian (1973) found that their participants followed a language-categorization technique in their recall of bilingual word lists. This signals a language-specific mechanism. However, they also found that their bilinguals experienced language interference in the recall of the unilingual word lists. This signals a language-independent mechanism. As in the present study, such findings support the view that the two languages of Arabic-English bilinguals are not in a total state of full activation at all levels of language processing, however they demonstrate partial activation.

Location as an Affective Factor (Hypotheses # 2 and 3)

Results of the present study showed that the language specificity of the location in which Arabic-English bilinguals use their two languages has no effect on their language processing mechanism. Such results refute the second hypothesis of the study, “Arabic-English bilinguals in an English-speaking setting are expected to encounter more L2 interference reflected in differences in Error Rate and Response Time between

Conditions 2 and 3 than Arabic-English bilinguals in an Arabic-speaking setting.”

However, since results showed that Arabic-English bilinguals tested in the United States experience more L2 interference as their amount of English language use increased per week, the insignificant effect of location on language activation needs to be rethought.

The relationship found between the L2 activation of Arabic-English bilinguals in the United States and their usage of English indicates that the more an Arabic-English bilingual used English per week in its native setting, the more interference that bilingual encountered when experiencing a stimulus from their L2. This finding is in line with Grosjean’s (2013) assertion that the status of the languages of bilinguals and their language choice mechanism is affected by the location in which they are using their two languages. This usually occurs because there is a tendency to increase the amount of usage of a specific language when using it in its native setting.

Consequently, when Arabic-English bilinguals move to a country where the main language spoken is their L2, this specific location affects their choice of ‘base language’ (Grosjean, 2013). This in turn affects the level of language interference they encounter when attempting to use their native language only. Hence, location, in the present study, did show a certain level of effect on the L2 activeness in the individual performance of Arabic-English bilinguals. Such an effect somewhat intertwines the two languages and makes them more connected.

The positive correlation found between L2 interference and the amount of L2 usage per week in Group 2 partially supports the third hypothesis of the study, “For Arabic-English bilinguals, Error Rates and Response Times in Condition 2 will be related to their English language proficiency and the amount of English they use each week.”

The mere fact that such a correlation surfaced, supports the notion that language processing is extremely circumstantial and is context-dependent. This notion is supported by cases highlighted by Grosjean (2013) involving the languages of adult bilinguals which are affected by the external environment in which they use their languages. Comparing members of Group 2 (i.e., Arabic-English bilinguals tested in the United States) to MC and EP (Grosjean, 2013), one concludes that the base language of members of Group 2 is at certain times different than that of members of Group 1 (i.e., Arabic-English bilinguals tested in Saudi Arabia). This difference resonates in certain situations related to the English-speaking environment in which they are using their two languages. Accordingly, the insignificant results pertaining to the second hypothesis are considered circumstantial and are most likely due to the episodic context of the experiment, and the strong effort displayed by the researcher to conduct the experiment in a purely Arabic-speaking situation.

L2 Word Frequency as an Affective Factor (Hypothesis # 4)

A relationship emerged between the word frequency of the English noun describing the picture and L2 activation in both groups (i.e., bilinguals tested in Saudi Arabia and bilinguals tested in the United States). Accordingly, in both bilingual groups, the higher the L2 word frequency, the longer it took the participants to respond. This finding is especially interesting because it occurred in both groups, which indicates an L2 activation level even in bilinguals using their L2 in its non-native setting (i.e., bilinguals tested in Saudi Arabia). The power of this finding lays in that the participants were exposed to a speech sound (the smallest possible type of language stimuli) which had the strength of stimulating the non-target item in the minds of members of both bilingual

groups alike. This indicates that a characteristic associated with the English translation equivalents of the pictures overrides the language-specificity of the setting in which the bilinguals use their two languages. Accordingly, word frequency of usage dominates location. This finding supports the fourth hypothesis, “For Arabic-English bilinguals, Error Rate and Response Time in Condition 2 will be related to the frequency of the English translation equivalents of the Arabic word describing the picture.” This finding places Arabic-English bilinguals nearer to the language-independent spectrum of language processing.

The effect of the frequency of usage of lexical items on bilingual language processing is evident in the literature. For example, Poulisse and Bongaerts (1994) found that word frequency affects language processing. The more a word is used or experienced, the easier it is to retrieve it. Likewise, Gerard and Scarborough (1989), found that a word’s frequency of usage significantly decreased their participants’ response times. Although these two studies found a negative correlation between word frequency and response time, they do support the notion that word frequency affects language processing.

Reder et al. (2000), on the other hand, specifically supports the present study because it established a positive correlation between word frequency and language activation measured by response time. The researchers were able to determine that high-frequency words are represented in a more complicated manner in the linguistic memory of speakers. The present study supports such notions.

Fitting the Present Results within the Theories of Bilingual Memory

The current section aims at evaluating the results obtained in the present study in light of the theories of bilingual memory and the language processing models associated with them. The aim of this evaluation is to determine the paradigm in which language processing in Arabic-English bilinguals falls.

The revised hierarchy model presented by Kroll and Stewart (1994) asserts that lexical nodes of both languages as well as concepts, are active at the semantic level, however with different strengths. The strength of activation is determined by two factors, the bilingual's L2 proficiency level and her dominant language.

Examining whether L2 proficiency was an affective factor in the present study is not possible because the participants recruited were not determined as either high proficient or low proficient in their L2. Rather, in coordination with Grosjean's (1992) definition of bilingualism, they were determined as bilinguals who used their L2 regularly on a daily basis.

Nevertheless, language dominance does have the potential of being an affective factor in the present study. According to the qualitative data, the dominant language of Arabic-English bilinguals in a speech situation similar to that of the present experiment situation would be their L1 (i.e., the Arabic language). In such a case, Arabic would be more activated than English. This transpired in the present study. Yet, the occurrence of L2 interference in both Conditions 1 (i.e., Arabic sound contained in Arabic noun describing the picture) and 2 (i.e., English sound contained in English noun describing the picture) indicates that the connections between L1 lexical entries and concepts were not tremendously more activated than the connections between L2 lexical entries and

concepts. This is contradictory to the revised hierarchy model which asserts that the L1 system consistently demonstrates stronger connections with concepts than the L2 system does. Consequently, language dominance does not explain the results at hand.

Accordingly, L2 proficiency level and language dominance, proposed by the revised hierarchy model, cannot be used to explain the level of L2 activation found in the present study.

In addition, the present results can't account for notions related to the language-specific model of language processing (i.e., the preverbal message notion and the binding-by-checking mechanism). The present results can't account for the preverbal message notion (Li Heij, 2005) because the stimulus speech sounds used in the experiment were those which overlapped between the two languages. Thus, they did not contain any contextual information relevant to either language. Likewise, the binding-by-checking mechanism (Roelofs, 1998) can't account for the findings of the present study because of the noticeable occurrence of L2 interference, which indicates that the mechanism failed to detect mismatches. Accordingly, the findings of the present study do not find a place within the revised hierarchy model of bilingual memory, and the language-specific model of language processing associated with it.

The BIA+ theory (Dijkstra & Van Heuven, 2002), on the other hand, may be more successful in explaining the present findings than the previous theory for a number of reasons. First, BIA+ indicates that even though languages with different writing systems are connected, activation will be specific to the target language only, and recognition will be rapid. In relation to the present study, the theory failed with the former point but was successful with the latter. That is, although response times did not

elevate, some L2 activation did emerge. Second, BIA+ asserts that subjective frequency affects activation at the semantic and lexical levels. Such an effect explains the positive correlation found between L2 word frequency and Response Time. Finally, the BIA+ theory stresses the role of the task and its strong effect on the activation process. Since the task applied in the present study focused entirely on Arabic and was conducted by its means only, and since the task/decision system works very early on in the recognition process, this can be used to explain the short response times found.

In summary, according to the BIA+ line of thought, although the languages of Arabic-English bilinguals are connected, short response times transpired because of the task schema applied in the experiment, and the high level of differences between the two languages which increased the bilinguals' inhibitory control abilities. However, the BIA+ model does not account for the level of L2 activation found in the present study; hence, cannot be totally determined as the paradigm in which the present results fall.

According to the third line of thought in bilingual language processing, the language mode theory (Grosjean, 1997), language activation is highly sensitive to the episodic context of the speech situation and the variables surrounding it. The qualitative data suggest that the variables of the experiment (i.e., setting, participants, culture, etc.) stimulated participants to make a decision that their L2 was not needed, to deactivate it, and set Arabic as their base language. Such a tendency explains the short response times found in the present study. In addition, according to Grosjean's (1997) language mode continuum (Figure 1, p. 2), the non-target language is never totally deactivated, nor is it entirely turned off. This explains the L2 interference which emerged in the present study.

Examining the three levels of non-target language activation displayed in Grosjean's visual representation of his continuum (Figure 1, p. 2), one concludes that the left-most square does not represent L2 activation in Arabic-English bilinguals because it does not account for the amount of L2 interference apparent in the present study. Likewise, the right-most square also does not represent the level of L2 activation in the present study because of the short response times found. Consequently, the only square left is the mid-position one, which suggests that, in the present study, the Arabic language of the participants was in full activation, whereas their L2 activation was in mid-position.

In conclusion, the results of the present study indicate that the languages of Arabic-English bilinguals are connected, however partially. The emerging degree of separation between the two languages is due to the variables of the speech situation during which the participants were evaluated, one of which is linguistic and others of which are extra-linguistic. The former refers to the linguistic nature of the two languages. Arabic and English being highly different languages, apparently increased the level of separation between them, and caused the non-target language to be only partially activated. On the other hand, the extra-linguistic variables are those which emerged from the qualitative phase of the study. Such variables are discussed in the following section.

Variable-dependent Processing in Arabic-English Bilinguals

The statistical findings of the present study provided a precise scientific description of the status of the two languages of Arabic-English bilinguals when speaking in their mother tongue. However, they did not examine the possible occurrence of personal and social factors which have the potential of playing a role in the surfacing of the quantitative results, factors introduced in Grosjean's language mode theory. When

comparing the results of Colome' (2001) to the present study, it is apparent that the level of connectedness and separation between the two languages of a bilingual is determined by the variables related to the task, the two languages, and the sociolinguistic tendencies of the bilingual category.

One of the aspects which influences language use in bilinguals is the domain of life in which they are speaking. This was evident in both Sahgal (1991) and Siachitema (1991), who established the effect of domain on language choice. For instance, the youth tend to mostly use their L1 in situations where they are dealing with the elderly (e.g. grandparents) (Siachitema, 1991) but a more universal language in social gatherings that include peers from other speech communities (Sahgal, 1991). Likewise, the participants in the present study expressed a strong tendency to limit their 'language choice' (Grosjean, 2013) to Arabic in a situation such as that of the experiment. This indicates that their base language at the time of testing was set to Arabic. The choice of their base language was by no means random, but definitely affected by the variables of the experimental situation. Speaking to an Arabic speaker in the absence of non-Arabic speakers, was a strong stimulator to choose Arabic as their base language. Their decision to use Arabic was also based on a habitual element. That is, since Arabic-English bilinguals are individual bilinguals, Arabic is the main language used in their speech community, whether in a setting of their L1 or L2. Accordingly, they use Arabic by habit, whereas English is most likely used intentionally.

Furthermore, the qualitative data showed that, while in a situation such as that of the experiment, Arabic-English bilinguals acted as if they were functioning in an Arabic speaking community situation. This was also apparent with those tested in the United

States. Among the attitudes which emerged from the qualitative data is a ridged and very strong personal and sociocultural obligation to demonstrate their membership to their native speech community whenever speaking one-on-one to an Arabic speaker. Many elements apparently contributed to such an obligation. For instance, participants evidently made a personal decision to define the domain of the experiment on the basis of certain episodic issues; one of which is ‘interlocutor sensitivity’ (Paradis & Nicoladis, 2007). Since their interlocutor was very strict in using only Arabic during the experiment, this must have influenced their language processing mechanism and developed strong control abilities to inhibit their L2. This was also apparent in Grosjean (2000) when the participants opted to incorporate more of the language of their interlocutor while retelling the stories.

In addition, the participants also indirectly expressed a cultural obligation to present themselves as true Arabs. Apparently, the participants achieved this by means of ‘accommodation’ and ‘similarity- attraction’ (Giles & Powesland, 1975) to reduce the social differences between them and their recipient, which in the present case was their interlocutor. Such accommodation was also explicitly stated by participants recruited in Giles et al. (1973), who expressed a preference to accommodate their interlocutor’s language to minimize the cultural gap between them and their recipient. Their aim was to be viewed in a more socially appropriate manner, a situation quite similar to that of the present study.

Accordingly, and in reference to the mixed methods question, “How does the qualitative data help explain the results obtained from the quantitative phase of the study?” it is apparent that language processing in Arabic-English bilinguals is variable-

dependent and determined by the episodic context of the speech event. In other words, language processing in Arabic-English bilinguals is circumstantial and highly sensitive to the variables involved while speaking. This finding is not unique to the present study since several other studies have also found that language processing in bilinguals is circumstantial and variable-dependent.

For instance, Roelofs et al. (2016), asserted that their participants applied a language-specific approach in their language processing. However, this was only conditional because it was affected by the type of methodology of their experiment. They exclusively used the target language while the non-target language was totally excluded from their experiment. Thus, Roelofs et al. (2016) asserted that their results were circumstantial and had the potential of varying in different contextual conditions. The present study makes the same assertions since a similar type of methodology was employed.

Similarly, Hernandez, Bates and Avila (1996) empirically determined that language processing is quite circumstantial and rather flexible because it is extremely sensitive to the specific variables of the speaking situation. Thus, language processing can't be associated with a certain language processing approach. Rather, a bilingual fluctuates between the types of processes depending on the situation itself. Such a situation also transpired in the present study.

Moreover, Blanco-Elorrieta and Pylkkanen (2015) found that their participants' language processing was highly sensitive to the variables of the speech situation, such as script and cultural context. Their results support Grosjean's language mode theory regarding the effect of the characteristics of the speech situation on the speaker's status

on the language mode continuum. Their results also support the views of the present study in that language processing in Arabic-English bilinguals is variable-dependent.

Accordingly, one concludes that the nature of the languages of Arabic-English bilinguals and the contextual variables in which the present experiment was conducted contributed to the increased separation between the languages of Arabic-English bilinguals when compared to Catalan-Spanish bilinguals. This is supported by both the statistical results and the qualitative findings of the present study. Statistically, results showed a variation of signals, some of which indicated language connectedness and others which indicated language separation. This can only be taken as partial L2 activation. The qualitative findings expanded the understanding of the research problem by highlighting the role of the sociocultural situation of Arabic-English bilinguals and their personal judgments when they are in the process of choosing their base language. These qualitative results stress the role and effect of variables on language processing in Arabic-English bilinguals, hence place them within Grosjean's variable-dependent model of language processing. It also places them closer to the monolingual endpoint of the language mode continuum.

Conflicting Findings

Among the conflicting findings in the literature are the results of Coderre and Van Heuven (2014). In their study, the researchers found that Arabic-English bilinguals, compared to bilinguals speaking more similar languages, showed longer response times. Results of Coderre and Van Heuven (2014) cannot be compared to those of the present study because of the difference in methodology. Namely, the absence of L2 interference and the prolonged response times they found are most likely the result of a Stroop effect.

Likewise, Liepmann and Saegert (1974), found extreme connectedness in the languages of their Arabic-English bilinguals. However, when viewing their methodology, they purposely incorporated a high level of overlap of the two languages (i.e., the target language and the non-target language) in their recall experiment. In comparison, Saegert et al. (1973) applied the same procedure but with a lower level of language overlap and found that Arabic-English bilinguals demonstrated a high level of separation between their languages. Thus, one concludes that the increased incorporation of the non-target language in the procedure applied by Liepmann and Saegert (1974), is obviously a main cause of the high level of co-activation they found.

The two conflicting studies previously mentioned (Coderre & Van Heuven, 2014; Liepmann & Saegert, 1974) noticeably incorporated the non-target language in their experiments. Exposing their participants to the non-target language in the form of stimuli has evident consequences since “[i]t is plausible to assume that when speakers have to switch regularly between languages ... competition for selection often can no longer be restricted to the target language” (Roelofs et al., 2016, p. 9). Such a procedure purposefully intertwines and connects the two languages of a bilingual because the speaker is not motivated in any manner to inhibit the non-target language even if language-separation is plausible (Marian & Spivey, 2003).

Unlike the two previous experiments, results of the present experiment were not affected by the experimental procedure. First and foremost, the L2 interference found in the present study is totally original because the non-target language was excluded from the procedure and the participants were not exposed to it in any manner. Furthermore, since the monolingual experiment showed no L2 interference, the L2 interference which

surfaced in the main the experiment is due to the bilingualism of the participants and their L2 knowledge.

Limitations

The present study is limited in a number of ways. First, for practicality reasons, the participants' L2 proficiency level could not be determined by scientific means (i.e., standardized testing). Rather, a self-rating mechanism was used to establish that all participants were proficient enough in English, and that they used their L2 on a daily basis. This limitation does not affect the results of the study since the aim was not to examine L2 activation in relation to a specific proficiency level.

In addition, the present study is limited in its sampling procedure. A snowball sampling method was used rather than a random sampling method. Choosing a snowball technique was due to practicality reasons. The researcher did not have entire access to the population examined (in both locations) and needed to be connected to additional participants as the testing phase was taking place. However, this does not affect the results obtained simply because results were the same in both groups with the exception of one correlation (i.e., the positive correlation in Group 2 between errors in Condition 2 and amount of L2 usage per week). Accordingly, this rules out a quasi-experimental effect.

The study is also limited in its sound stimuli. The phonemes used in the experimental task were recorded by a phonologist in a sound-proof booth by means of sophisticated and high quality software and equipment. Nevertheless, there is still room

for human error. However, the fact that the participants did not express dissatisfaction with the sounds, justifies their appropriateness.

Finally, the study is limited by the absence of a member check mechanism in the qualitative phase. Although researchers bring biases into their studies, the interview methodology applied overcame this limitation. The researcher consistently asked for clarifications during the interview to ensure the information collected actually reflected the true intentions of the participants.

Future Directions

The present study purposefully conducted its experiment in a purely Arabic context. English did not play a role whatsoever in the procedure. The aim of applying such a method was to detect L2 activation in its original state without being intentionally stimulated. Future research can include a counter experiment in which English is the main language used to conduct the experiment. In such an experiment, the task would remain as it is, however instructions, feedback, names of pictures given to the participants, and participation information would be presented in English. In addition, such an experiment would be strengthened by creating a strong English context and examining whether L2 activation remains partially activated or becomes highly activated. The strong English context can be achieved by a number of ways. For example, it can be achieved by including an ice-breaker which involves a discussion about Las Vegas, or another technique which affects the language specificity of the speech situation in the minds of the participants. If in such an experiment, L2 activation unfolds in a stronger manner, this would further support the conclusion that language processing in Arabic-English bilinguals is circumstantial and highly sensitive to the episodic context.

Another stream of research which would add to the literature is to examine L1 interference in Arabic-English bilinguals. In such an experiment, the task would require the participants to make judgments about the English language to examine whether the Arabic language affects their judgments. If so, finding the degree to which their L1 affects their L2 would be interesting.

Finally, another interesting stream of research would be to test the effect of L2 proficiency level on the language processing of Arabic-English bilinguals by comparing low-proficiency participants to high-proficiency participants. Since the present study did not find a correlation between proficiency level and the dependent variables, such a study would be quite interesting

Importance of the Study

The present research is important for a number of reasons. First, it adds to the literature a study which examines the language processing mechanism in a bilingual category which speaks highly different languages, namely, Arabic and English. Consequently, it determines that Arabic-English bilinguals process their two languages using a variable-dependent mechanism. The study also compares its findings with Colomé (2001). Such a comparison sheds light on the effect of variables on language processing in bilinguals. As a result, the present study introduces the affective variables found and discusses their role in increasing/decreasing the level of connectedness between the languages of Arabic-English bilinguals. Such information can be used for future research. More detailed results can be obtained by building on the present study or replicating it in light of different contextual variables.

The study is also important to the sociolinguistic field. It highlights the role of sociocultural circumstances on both the conscious and subconscious decisions of Arabic-English bilinguals when using one of their two languages. Such information can help understand how language functions in communication in multilingual situations, especially in relation to Arabic-English bilinguals.

The present study can also benefit the TESL/TEFL field. The results pertaining to the individual performance of the participants (i.e., correlational analyses) can be beneficial in helping teachers enhance their teaching strategies and curricula content. For example, the fact that Error Rate correlated positively with the hours of L2 usage per week can inspire those in second/foreign language instruction to increase the actual amount of hours learners use English in the classroom. Doing so will most likely increase the level of L2 activation in the learners, speed their learning process, and improve their L2 proficiency level.

Conclusion

The present study aimed at examining L2 activation in Arabic-English bilinguals and whether it is affected by location. Results showed that location has no main effect on the L2 activation of Arabic-English bilinguals. Nevertheless, L2 interference occurred in both groups, however partially. The two correlations found also support the notion of partial L2 activation.

Results also showed that, the languages of Arabic-English bilinguals, although connected, are more separated than the Catalan-Spanish bilinguals examined in Colomé (2001). Whereas Catalan-Spanish bilinguals are closer to the bilingual endpoint of the

language mode continuum (Grosjean, 1997), Arabic-English bilinguals are closer to the monolingual endpoint. This difference in results can be attributed to a number of issues. For example, it can be attributed to the fact that Catalan and Spanish are highly similar languages, whereas Arabic and English are highly dissimilar languages. The other possible affective variables are those which transpired from the qualitative phase of the study.

A qualitative phase followed the quantitative phase. The aim of this qualitative phase was to find reasons for the separation found between the languages of Arabic-English bilinguals. Results showed that Arabic-English bilinguals are affected by the language specificity of their life domains as well as by their sociocultural circumstances. Such variables are possible causes of the elevated separation between the languages of Arabic-English bilinguals when exclusively using their mother tongue.

Furthermore, the study was also able to detect variables which contribute to language connectedness in Arabic-English bilinguals. Such variables emerged from the correlations found in the study. Namely, the study highlighted the effect of location and L2 word frequency on the increased level of L2 activeness in Arabic-English bilinguals. Accordingly, they are determined as variables which affect language processing in bilinguals.

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APPENDICES

Appendix A

A description of the population of the study

The present study was conducted in Saudi Arabia. The main language in Saudi Arabia is Arabic. The Saudi community generally uses English as a foreign language. Some institutes, such as ARAMCO, use it as an operational language. In recent years, the use of English has increased due to economic reasons. However, there is still resistance to adapt its culture; rather, it is used in a way which accommodates the social and religious beliefs and practices of the local community (Mahboob and Elyas, 2014).

Public schools teach English to students from fifth grade and continue until students graduate from high school at twelfth grade. Students take four hours of English every week. It is a mandatory subject that students need to pass in order to proceed to the next level. At the university level, scientific majors (e.g. math, chemistry, IT, etc.) and medical majors (e.g. dentistry, medicine, nursing, etc.) are taught in English. Whereas, nearly all other majors (e.g. history, business, religious studies, etc.) are taught in Arabic. However, even those which are presumably taught in English, English is not used one hundred percent. Rather, it is used mostly for issues such as formulas, calculations, and theories. Furthermore, students in such majors are required to take mandatory courses given in Arabic (i.e., three courses in religious studies and three courses in the Arabic language).

However, in recent years, middle and high class Saudis are teaching their children in high standard schools, some of which are local and others of which are international. In these schools, students are taught from first grade in two languages; such as taking two math classes, one in Arabic and another in English. People of these social classes are becoming more accommodated to using English on a personal level, and are more frequently using it with close members of their social class. However, when they are with people whom they are not very close with, or people from less advantaged social classes, they usually refrain from English and use Arabic.

Appendix B

Pictures used in the phoneme monitoring task

Sixty pictures were used in the experiment:

Backpack, Bag, Balloons, Banana, Basket, Broom, Bucket, Butterfly, Candle, Car,
Carrot, Cell-phone, Children, City, Curtains, Deer, Dolphin, Dress, Factory, Fan, Farmer,
Fingerprint, Fish, Flower, Gate, Giraffe, Gun, Jalapenos, Ladder, Library, Lightbulb,
Mountains, Mustache, Newspaper, Ostrich, Owl, Pear, Pineapple, Rabbit, Scale,
Screwdriver, Singer, Skeleton, Snake, Soldier, Square, Star, Strawberry, Table,
Telephone, Tiger, Toothbrush, Tree, Truck, Turtle, Wallet, Wheelchair, Woodpecker,
Zipper, Zucchini

Appendix C

The phoneme-monitoring task

Item Type	#	Picture	Arabic phoneme (YES)	English phoneme (NO)	Neutral phoneme (NO)
Experimental items	1	backpack	/ʃ/	/b/	/s/
	2	banana	/m/	/b/	/f/
	3	basket	/s/	/b/	/m/
	4	bucket	/s/	/b/	/n/
	5	butterfly	/f/	/b/	/k/
	6	candle	/ʃ/	/k/	/w/
	7	carrot	/dʒ/	/k/	/m/
	8	city	/m/	/s/	/l/
	9	curtains	/s/	/k/	/f/
	10	factory	/m/	/f/	/b/
	11	farmer	/m/	/f/	/s/
	12	fingerprint	/b/	/f/	/l/
	13	flower	/w/	/f/	/b/
	14	giraffe	/z/	/dʒ/	/m/
	15	ladder	/s/	/l/	/k/
	16	library	/m/	/l/	/s/
	17	mountains	/dʒ/	/m/	/f/
	18	mustache	/ʃ/	/m/	/dʒ/
	19	newspaper	/dʒ/	/n/	/m/
	20	screwdriver	/m/	/s/	/z/
	21	singer	/m/	/s/	/f/
	22	skeleton	/h/	/s/	/m/
	23	soldier	/dʒ/	/s/	/m/
	24	strawberry	/f/	/s/	/k/
	25	wallet	/m/	/w/	/s/
	26	woodpecker	/n/	/w/	/s/
	27	zipper	/s/	/z/	/m/
<hr/>					
Filler Items	#	Picture	YES	YES	NO
	28	balloons	/l/	/n/	/m/
	29	broom	/s/	/n/	/f/
	30	car	/j/	/s/	/l/
	31	cell-phone	/w/	/l/	/ʃ/
	32	children	/l/	/f/	/m/
	33	deer	/z/	/l/	/j/
	34	dolphin	/f/	/n/	/s/
	35	fish	/k/	/m/	/w/
	36	gate	/w/	/b/	/m/
	37	gun	/s/	/m/	/ð/

38	jalapenos	/l/	/f/	/m/
39	lightbulb	/b/	/l/	/dʒ/
40	ostrich	/m/	/n/	/k/
41	owl	/m/	/b/	/j/
42	pear	/m/	/k/	/f/
43	pineapple	/s/	/n/	/ʃ/
44	scale	/n/	/z/	/b/
45	snake	/b/	/n/	/z/
46	square	/b/	/m/	/n/
47	table	/l/	/w/	/n/
48	telephone	/f/	/n/	/ð/
49	tiger	/m/	/n/	/ð/
50	toothbrush	/ʃ/	/f/	/l/
51	tree	/dʒ/	/ʃ/	/m/
52	turtle	/l/	/f/	/dʒ/
53	wheelchair	/s/	/k/	/b/
54	zucchini	/s/	/k/	/f/

Training Items	#	Picture	Random reply
	55	bag	/s/ (yes)
	56	dress	/f/ (yes)
	57	fan	/ð/ (no)
	58	rabbit	/b/ (yes)
	59	star	/ʃ/ (no)
	60	truck	/m/ (no)

Appendix D

Task instructions

سوف تشاهدة صورة ثم ستستمع إلى صوت و سوف يطلب منك الإدلال بهل أن الصوت جزء من الكلمة التي ترمز اليها الصورة أم لا. في الحالات التي يكون فيها الصوت جزء من الصورة سوف الرجاء الضغط على "نعم" في اسرع وقت ممكن، أما اذا لم يكن الصوت جزء من الصورة فالرجاء الضغط على "لا" في اسرع وقت ممكن.

ستقوم باكمال ثلاث اجزاء. كل جزء يتضمن 54 عنصر. يجب الإجابة على كل عنصر خلال ثلاث ثواني. لا يمكن التوقف بين العناصر بل يمكن التوقف فقط بين الجلسات. عند اعطائك إجابة صحيحة سوف تظر كلمة "صح" على الشاشة. و اذا أجببت بإجابة خاطئة سوف تظهر كلمة "خطأ" على الشاشة. أما إذا لم تجب خلال الثلاث ثواني المتاحة سترا عبارة "انتهى الوقت" انتقل مباشرة للعنصر الذي يليه.

You will view a picture and then hear a sound. If the sound is part of the picture, you need to press 'yes' as quickly as possible; if the sound is not part of the picture, you need to press 'no' as quickly as possible. You will perform three sessions. Each session includes 54 items. You need to give a response to each item within three seconds. There are no intervals between items. Intervals are between sessions only. After giving an answer, feedback regarding your answer will appear on the screen. It will show either the word *correct*, *incorrect*, or *time out*. Once you get the feedback, immediately start working on the next item. Work as quickly as possible.

Appendix E

Mean error rate (in percent) for each picture across groups

<i>Drawing</i>	Group # 1 (Bilinguals in Saudi Arabia)	Group # 2 (Bilinguals in the United States)	Group # 3 (Monolinguals)	Overall mean
<i>Backpack</i>	80	74	64	73
<i>Banana</i>	96	94	97	96
<i>Basket</i>	82	79	68	76
<i>Bucket</i>	76	78	70	75
<i>Butterfly</i>	97	96	91	95
<i>Candle</i>	96	94	88	93
<i>Carrot</i>	95	93	97	95
<i>City</i>	80	86	75	80
<i>Curtains</i>	84	81	78	81
<i>Factory</i>	83	78	71	77
<i>Farmer</i>	76	72	74	74
<i>Fingerprint</i>	95	91	81	89
<i>Flower</i>	90	85	87	87
<i>Giraffe</i>	96	90	97	94
<i>Ladder</i>	63	60	57	60
<i>Library</i>	88	87	81	85
<i>Mountains</i>	92	92	97	94
<i>Mustache</i>	94	90	88	91
<i>Newspaper</i>	97	89	93	93
<i>Screwdriver</i>	78	75	81	78
<i>Singer</i>	81	85	75	80
<i>Skeleton</i>	87	88	84	86
<i>Soldier</i>	84	82	81	82
<i>Strawberry</i>	92	89	86	89
<i>Wallet</i>	83	80	72	78
<i>Woodpecker</i>	58	58	57	58
<i>Zipper</i>	87	81	84	84

Appendix F

Participant (interviewee) demographics – Qualitative phase

<i>Pseudonym</i>	Sex F=1 M=2	Age	Residence	Occupation	Self- rating 1-10	English hour/week	AoA
<i>Yara</i>	1	30	Riyadh	Admin. Assistant	7.5	40	11
<i>Nora</i>	1	23	Riyadh	Nurse	7.5	48	12
<i>Abdul</i>	2	45	Riyadh	General Manager (Ministry of Agriculture)	10	40	3
<i>Nasser</i>	2	39	Riyadh	Bank Operation Support	7.5	15	12
<i>Mohammad</i>	2	34	Riyadh	Bank Employee	7.5	35	12
<i>Deem</i>	1	23	Riyadh	Bach. Student/Senior (English)	7.5	45	11
<i>Faisal</i>	2	25	Ok	Bach. Student/Junior (Aviation Engineering)	7.5	55	12
<i>Mona</i>	1	33	OK	PhD student (TESL)	9	70	13
<i>Yousef</i>	2	18	OK	Bach. Freshman (Mechanical Engineering)	8	65	9
<i>Ali</i>	2	20	OK	Bach. Sophomore (Construction Technology)	7	50	15
<i>Reem</i>	1	31	OK	MA student (Finance)	8.5	140	21
<i>Maha</i>	1	18	OK	High school student	8	70	10

VITA

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