INVESTIGATING TRANSLATION EQUIVALENT PRIMING: THE IMPACT OF TASK, ITEM, AND INDIVIDUAL DIFFERENCES

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

ENİS OĞUZ

IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF DOCTOR OF PHILOSOPHY
IN
THE DEPARTMENT OF ENGLISH LANGUAGE TEACHING

SEPTEMBER 2023

Approval of the thesis:

INVESTIGATING TRANSLATION EQUIVALENT PRIMING: THE IMPACT OF TASK, ITEM, AND INDIVIDUAL DIFFERENCES

submitted by **ENİS OĞUZ** in partial fulfillment of the requirements for the degree of **Doctor of Philosophy in English Language Teaching, the Graduate School of Social Sciences of Middle East Technical University** by,

Prof. Dr. Sadettin KİRAZCI
Dean
Graduate School of Social Sciences _____

Prof. Dr. Nurten BİRLİK
Head of Department
Department of Foreign Language Education _____

Prof. Dr. Bilal KIRKICI
Supervisor
Department of Foreign Language Education _____

Examining Committee Members:

Prof. Dr. Martina GRAČANIN YÜKSEK (Head of the Examining Committee)
Middle East Technical University
Department of Foreign Language Education _____

Prof. Dr. Bilal KIRKICI (Supervisor)
Middle East Technical University
Department of Foreign Language Education _____

Prof. Dr. Özgür AYDIN
Ankara University
Department of Linguistics _____

Assoc. Prof. Dr. Hale IŞIK GÜLER
Middle East Technical University
Department of Foreign Language Education _____

Assist. Prof. Dr. Orhan DEMİR
Başkent University
Department of Translation and Interpretation _____

I hereby declare that all information in this document has been obtained and presented in accordance with academic rules and ethical conduct. I also declare that, as required by these rules and conduct, I have fully cited and referenced all material and results that are not original to this work.

Name, Last Name: Enis OĞUZ

Signature:

ABSTRACT

INVESTIGATING TRANSLATION EQUIVALENT PRIMING: THE IMPACT OF TASK, ITEM, AND INDIVIDUAL DIFFERENCES

Oğuz, Enis
Ph.D., The Department of English Language Teaching
Supervisor: Prof. Dr. Bilal KIRKICI

September 2023, 184 pages

Bilingualism has been a longstanding focus of language research, yet many questions surrounding it still lack conclusive answers. Extensive research has attempted to reveal one such mystery by using cross-linguistic word pairs, specifically the potential interaction between the languages of a bilingual. Although cognate and false cognate pairs are common ways to carry out such an investigation, high orthographic or phonological overlap between such pairs might result in accessing L1 words directly without the need to activate their L2 counterparts. One way to overcome this limitation is to use translation equivalents, which possess high semantic similarities but little to no orthographic and phonological overlap in language pairs like English and Turkish. In this dissertation, lexical decision and semantic categorization tasks were used to investigate whether translation equivalents activate each other in the early stages of word processing. A cohort of 101 highly proficient bilinguals (Turkish-English) participated in the study. The potential effects of task type, prime duration, word frequency, and individual differences were also explored under different conditions. The results indicated that highly proficient bilinguals activate the counterparts of translation equivalents preconsciously after being exposed to these words for brief durations, and this activation was similar in both language directions. The responses

were faster when prime words had higher frequencies, the task required purely lexical decisions, or the participants were at higher L2 proficiency levels. In light of these findings, it is concluded that the differences between the processing of L1 and L2 words seem more quantitative than qualitative.

Keywords: translation priming asymmetry, task and individual differences, frequency effect, prime duration

ÖZ

ÇEVİRİ EŞDEĞERİ HAZIRLAMA ETKİSİNİ İNCELEMEK: GÖREVSEL, MADDESEL VE BİREYSEL FARKLILIKLARIN ETKİSİ

OĞUZ, Enis
Doktora, İngiliz Dili Öğretimi Bölümü
Tez Yöneticisi: Prof. Dr. Bilal KIRKICI

Eylül 2023, 184 sayfa

İki dillilik, dil araştırmalarının uzunca bir süre odağında olan bir konu olmasına rağmen hakkında kesin cevaplanmamış birçok soru vardır. Kapsamlı araştırmalar bu gizemlerden biri olan iki dilli bireylerin dilleri arasındaki olası etkileşimi diller arasında sözcük çiftleri kullanarak çözmeye çalışmışlardır. Eş asıllı ve sahte eş asıllı sözcükler böyle bir uğraş için yaygın yollar olsalar da bu sözcük çiftlerinin diller arasında gösterdiği yüksek yazımsal ve sesbilimsel benzerlikler D1 sözcüklerin D2 sözcüklere gerek kalmadan doğrudan etkinleştirilmelerine sebep olabilir. Bu sınırlamayı aşmanın bir yolu, yüksek anlamsal benzerliklerine rağmen İngilizce ve Türkçe gibi dil çiftlerinde neredeyse hiç yazımsal ve sesbilimsel benzerlik göstermeyen çeviri eşdeğerlerini kullanmaktır. Mevcut çalışmada çeviri eşdeğerlerinin sözcük işlemlemenin erken aşamalarında birbirlerini etkinleştirip etkinleştirmediğini anlamak için sözcüksel karar ve anlamsal sınıflandırma görevleri kullanılmıştır. Dil becerileri yüksek 101 Türkçe-İngilizce iki dilli birey çalışmaya katılmıştır. Görev türü, hazırlayıcı süresi, sözcük sıklığı ve bireysel farklılıkların etkileri de farklı koşullar altında incelenmiştir. Sonuçlar yüksek dil becerilerine sahip iki dilli bireylerin çeviri eşdeğerlerinden birine kısa bir süre maruz kaldıktan sonra bile bilinç öncesi

aşamalarda bu sözcüklerin diğer dildeki karşılıklarını etkinleştirdiğini ve bu etkinin her iki dil yönünde de benzer olduğunu göstermiştir. Yanıtlar, hazırlayıcı sözcükler daha yüksek sıklık değerlerine sahip olduğunda, görev daha sözcüksel kararlar gerektirdiğinde veya katılımcı daha yüksek D2 becerisine sahip olduğunda daha hızlı olmuştur. Bulgular ışığında D1 ve D2 sözcüklerin işlemlenmesi arasındaki farklılıkların nitelden çok nicel olduğu sonucuna varılabilir.

Anahtar Kelimeler: çeviri eşdeğeri hazırlama etkisi asimetrisi, görev ve bireysel farklılıklar, sıklık etkisi, hazırlayıcı süresi

To my son, Arvin

ACKNOWLEDGMENTS

I am extremely grateful to my supervisor, Prof. Dr. Bilal Kırkıcı, for introducing me to the world of psycholinguistics and showing me how to survive in it. Not only has he provided me with the motivation and guidance I needed to complete this dissertation, but he has also been my role model in both research and teaching. I want to thank him with all my heart, for all the support he has given.

The first step of my academic journey would not have been possible if it were not for Prof. Dr. Mehmet Özcan. He has always inspired me with his knowledge, attitude, and will. I owe him everything I have accomplished so far, and he owes younger generations the guidance he gave me; never give up fighting and be the light to show the way, as you always do.

The committee members have greatly contributed to this dissertation through constructive criticism and feedback. I want to thank all the members, Prof. Dr. Martina Gračanin Yüksek, Prof. Dr. Özgür Aydın, Assoc. Prof. Dr. Hale Işık Güler, and Asst. Prof. Dr. Orhan Demir.

I also owe my thanks to all faculty members of Middle East Technical University who have shown me the ways of research and quality teaching. Besides the names I have already mentioned, I want to thank Prof. Dr. Çiğdem Şağın Şimşek and Assoc. Prof. Duygu Sarısoy for all their support and guidance through my graduate studies.

My son, Arvin, has been the best thing in my life and will remain the best thing until I die. You have been my beacon of strength without whom I would have lost my way. Thank you for being the wonderful child that you are, the best I could have ever wished for.

I want to further thank my family members, especially my mom, Halime Uğuz, for being there whenever I needed them. Nurşen Duygu Sazoğlu has become like a family member throughout my research. Thank you, Duygu, for being my pillar of support in my toughest years.

No matter how far they have been, my friends have always supported me in this tough journey. My heartfelt thanks go out to my dear friends Çağdaş Delikanlı, Ozan Çağlar, Esra Ataman and Ali İlya.

I would like to express my special appreciation to Dr. Adel Chaouch-Orozco for our enriching discussions on translation priming, Asst. Prof. Sebastiaan Mathôt for his invaluable assistance with OpenSesame software, Dr. Hasibe Kahraman for her insightful ideas regarding statistical tests, and Dr. Hakan Cangır for his guidance on managing a tremendous workload. Berna Özkasap and Onur Evcen deserve special thanks for their help in participant recruitment.

As a beneficiary of the 2211-E National Scholarship Programme for PhD Students, I would like to thank the Scientific and Technological Research Council of Turkey (TÜBİTAK).

Finally, I want to memorialize Mustafa Kemal Atatürk, the visionary founder of the Modern Turkish Republic. His genius, leadership, and guidance have been a spring of inspiration, not only for me but for countless generations to come.

TABLE OF CONTENTS

PLAGIARISM iii
ABSTRACT iv
ÖZ vi
ACKNOWLEDGMENTS ix
TABLE OF CONTENTS xi
LIST OF TABLES xiv
LIST OF FIGURES xv
LIST OF ABBREVIATIONS xvii
CHAPTERS
INTRODUCTION 1
1.1. Investigating Cross-linguistic Effects in the Bilingual Mind 1
1.2. What Kinds of Similarities Cause Cross-linguistic Interaction in the Early Stages of Visual Word Processing? 3
1.3. Are L2 Words Stored as L1 Words in the Bilingual Lexicon? 6
LITERATURE REVIEW 9
2.1. The Qualitative Account Models 10
2.1.1. The Sense Model 10
2.1.2. The Revised Hierarchical Model (RHM) 14
2.1.3. The Episodic L2 Hypothesis 16
2.2. The Quantitative Account Models 19
2.2.1. The Refined Distributed Representation Model (DRM) 20
2.2.2. The Bilingual Interactive Activation Model (BIA) 22
2.2.3. The Bilingual Interactive Activation Plus Model (BIA+) 24
2.2.4. Multilink 28
2.3. Translation Equivalent Priming 31
2.3.1. Language Direction 32
2.3.2. Language Proficiency 35
2.3.3. Language Immersion 39

2.3.4. Language Dominance 43
2.3.5. Prime Duration and SOA 47
2.3.6. Task Differences 54
2.3.7. Language Script 61
2.3.8. Word Frequency 64
2.3.9. Summary of the Findings 67
THE PRESENT STUDY 69
METHODOLOGY 75
4.1. Participants 75
4.2. Tasks 76
4.2.1. Lexical Decision Task 77
4.2.2. Semantic Categorization Task 79
4.2.3. Prime Duration for Tasks 80
4.3. Materials 81
4.3.1. Word Lists 81
4.3.2. Subjective Word Frequency Scale 85
4.3.3. LexTALE 86
4.3.4. Language Questionnaire 86
4.4. Pilot Study 87
4.5. Procedure 88
RESULTS 92
5.1. Data 92
5.1.1. Data Exclusion 92
5.1.2. Data Imputation 95
5.2. Error Analyses 95
5.2.1. Descriptives 95
5.2.2. Error Rate Analysis 96
5.3. Response Time Analyses 97
5.3.1. Descriptives 97
5.3.2. Model Selection and Refining the Selected Model 100
5.3.3. Main Effects 103
5.3.4. Two-way Interactions 107
5.3.5. Three-way Interactions 114

5.3.6. Four-way Interactions 118
DISCUSSION 120
6.1. Translation Equivalent Priming 120
6.2. Task Effect 121
6.3. Translation Priming with 50-ms Prime Words 122
6.4. Translation Priming with 83-ms Prime Words 123
6.5. Individual Differences 128
6.6. Word Frequency Effects 131
6.7. Evaluating the Models of the Bilingual Lexicon 133
6.8. Conclusion 137
REFERENCES 138
A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE 148
B. INFORMED CONSENT FORM 149
C. RESPONSE TIME ANALYSIS USING LOG TRANSFORMATION 150
D. L2 (ENGLISH) EXPERIMENTAL WORDS 152
E. L1 (TURKISH) EXPERIMENTAL WORDS 153
F. L2 (ENGLISH) FILLER WORDS 154
G. L1 (TURKISH) FILLER WORDS 155
H. L2 (ENGLISH) NONWORDS 156
I. L1 (TURKISH) NONWORDS 157
J. CURRICULUM VITAE 158
K. TURKISH SUMMARY / TÜRKÇE ÖZET 163
L. THESIS PERMISSION FORM / TEZ İZİN FORMU 184

LIST OF TABLES

Table 1. *Descriptives of the participants* 76
Table 2. *A sample of the alternative prime lists created by Latin-square design* 78
Table 3. *Alternation of blocks, lists, and prime versions* 80
Table 4. *Properties of experimental lists* 84
Table 5. *Orthographic similarity for related and unrelated prime words* 85
Table 6. *Subjective frequency values for English and Turkish experimental words* .. 86
Table 7. *Timetable for the experiments* 89
Table 8. *Descriptives statistics of accuracy ratings for each task variation* 96
Table 9. *Error rate percentages for different conditions* 97
Table 10. *Descriptive statistics of response time in different conditions* 98
Table 11. *Descriptive statistics of response times for each task variation* 99
Table 12. *Evaluation of models with different measurement types* 101
Table 13. *Results of the reduced model* 102
Table 14. *Results of the reduced model (log-transformed response times).* 150

LIST OF FIGURES

Figure 1. The proportion of senses associated with L1 and L2 words 12
Figure 2. The Revised Hierarchical Model..... 14
Figure 3. Masked priming effects for translation equivalents in late-bilinguals according to the Episodic L2 Hypothesis..... 18
Figure 4. The connections between words and conceptual nodes in the bilingual lexicon..... 21
Figure 5. The Bilingual Interactive Activation Model (BIA)..... 23
Figure 6. The Bilingual Interactive Activation Plus Model (BIA+)..... 25
Figure 7. The architecture of Multilink based on Dijkstra et al. (2019)..... 29
Figure 8. Procedures of a lexical decision task combined with the masked priming paradigm..... 78
Figure 9. Procedures of a semantic categorization task combined with the masked priming paradigm..... 80
Figure 10. Response times for the experimental items..... 93
Figure 11. Distribution of response times in the final dataset..... 94
Figure 12. Histograms of transformed response times for each method..... 94
Figure 13. QQ Plots of transformed responses time for each method..... 94
Figure 14. Response times in the related and unrelated conditions..... 104
Figure 15. Response times for L1 and L2 tasks..... 105
Figure 16. Scatter plot of response times and L2 immersion scores..... 105
Figure 17. Response times for different task types..... 106
Figure 18. Response times in the 50-ms and 80-ms prime conditions..... 106
Figure 19. Scatter plot of response times and prime frequency values..... 107
Figure 20. Response times in different language directions for the related and unrelated primes..... 108
Figure 21. Response times across different L2 immersion scores in the related and unrelated conditions..... 109

Figure 22. Response times in the lexical decision tasks (ldt) and the semantic categorization tasks (sct) for the related and unrelated conditions. 109
Figure 23. The interaction between prime type and prime duration 110
Figure 24. Response times across different prime frequency values in the related and unrelated conditions 111
Figure 25. Response times across different LexTALE scores in two language directions 112
Figure 26. Response times in both tasks across different LexTALE scores 112
Figure 27. Response times across different L2 immersion scores in the 50 ms and 83 ms prime conditions 113
Figure 28. Response times across different L2 dominance scores in the 50 ms and 83 ms prime conditions 114
Figure 29. The interaction between the effects of prime type, language, and LexTALE scores on response times 115
Figure 30. The interaction between the effects of prime type, language, and prime duration on response times 116
Figure 31. Response times across different prime frequencies in the different tasks for the related and unrelated conditions 117
Figure 32. Response times across different target frequency values in the different tasks for both language directions 117
Figure 33. Response times across different prime frequency values in the related and unrelated conditions for the lexical decision tasks 118
Figure 34. Response times across different prime frequency values in the related and unrelated conditions for the semantic categorization tasks 119

LIST OF ABBREVIATIONS

AoA	Age of Onset of Acquisition
BIA	The Bilingual Interactive Activation Model
BIA+	The Bilingual Interactive Activation Plus Model
CI	Confidence Intervals
COCA	Corpus of Contemporary American English
DRM	Refined Distributed Representation Model
EEG	Electroencephalogram
ERP	Event-Related Potentials
K-NN	K-Nearest Neighbors
L1	First (Native) Language
L2	Second Language
LDT	Lexical Decision Task
LEAP-Q	Language Experience and Proficiency Questionnaire
Lev	The Levenshtein Distance
LexTALE	Lexical Test for Advanced Learners of English
LHQ	The Language History Questionnaire
ms	Milliseconds
n	Sample size
N250	Negative Waveform at around 250 msecs
N400	Negative Waveform at around 400 msecs
NLD	The Normalized Levenshtein Distance
OQPT	Oxford Quick Placement Test
OS	Orthographic Similarity
RHM	Revised Hierarchical Model
RLA	Resting Level Activations
SCT	Semantic Categorization Task
SOA	Stimulus-Onset Asynchrony
SD	Standard Deviation

Std.	Standardized
TOEIC	The Test of English for International Communication
vs.	Versus

CHAPTER 1

INTRODUCTION

Bilingualism is the ability to use more than one language (Mackey, 1962). For decades, this ability has raised many questions as to how different languages are stored and processed in the bilingual mind. The recent consensus states that words from different languages are somehow related in the lexicon as they activate each other through shared orthographic, phonological, semantic, or lexical features. While the exact nature of this activation remains unknown, investigating this phenomenon can help reveal whether the words acquired later in life through learning a second language (i.e., L2) are stored and processed like the words of the native language (i.e., L1). This is especially important since revealing the way L2 words are stored and processed can guide researchers and educators to build better models of the bilingual lexicon and create more efficient curricula for second language education.

1.1. Investigating Cross-linguistic Effects in the Bilingual Mind

Investigating the interaction between multiple languages is central to understanding the differences between L1 and L2 word representations and processing in the human mind, and the studies aimed at this investigation focus on different aspects of language processing, such as the manner of processing (production or comprehension) or the unit to be processed (sentence, word, or morpheme). As the units to be investigated get longer, it becomes more difficult to separate different sources of cross-linguistic activation from each other and from within-language effects. When bilinguals read a sentence, for example, there might be potential interactions between the lexical items, morphology, syntax, and phonology of their multiple languages. This makes it difficult to determine whether an observed effect is caused by cross-linguistic factors, strategy use, or within-language features.

One way to isolate cross-linguistic effects from other potential factors is to focus on the early stages of word comprehension. Words can be processed faster than sentences due to their size, and comprehension is faster than production; therefore, visual word recognition studies have the potential to reveal the interaction patterns between words in different languages without the involvement of other aspects such as syntax and articulation. However, confounding factors like strategy use might still have an influence on visual word recognition and interact with the effects of automatic and preconscious processes regarding cross-linguistic interaction. One line of research, *masked priming* research, can overcome this limitation by including short-duration masked primes that are consciously unrecognizable, yet affect the way words are processed. As Holcomb and Grainger state, this paradigm "... tends to limit the range of possible effects by mitigating the influence of higher cognitive processing, thus resulting in a smaller and more manageable set of effects to be reconciled" (2006, p. 14).

The masked priming paradigm involves presenting a prime for a brief duration (usually 30-80 ms) so that it is not consciously seen by participants. A prime is followed by a target, and researchers investigate whether presenting the prime alters the responses given to the presented target. In word processing studies, primes and targets are usually words or nonwords (i.e., word-like items generated in line with the phonotactic rules of the target language). Prime words are preceded by symbols such as hashtags, thus becoming "masked" from conscious recognition. Targets are usually presented in uppercase, unlike lowercase primes, to avoid a continuity effect between the target and prime. All these procedures ensure the unconscious recognition of primes and allow for an investigation of how the activation of such stimuli affects the way words are processed without the involvement of human consciousness.

This paradigm has been a common way to investigate the effects of linguistic relationships between words. To examine the influence of orthographic similarity, for example, researchers can use the words *carrot* and *cart* as prime-target pairs in a *lexical decision task (LDT)*. As the name suggests, this task requires participants to decide whether a given letter string is a real word in a specific language. Suppose that the briefly presented prime word *carrot* elicits a faster reaction for the word *cart* compared to an unrelated prime word (e.g., *heel*). The consensus states that the prime

word has facilitated the recognition of the target word because of the shared orthographic features. Just as with orthographic similarity, research using the masked priming paradigm has also focused on phonological and semantic similarities between words in the word processing literature, and the results so far have presented ample evidence for the influence of such similarities on the interaction between languages in the bilingual mind.

Another common task that has been used with the masked priming paradigm is the *semantic categorization task (SCT)*. In this task, all targets are real words in a specific language, and participants are given a category before each word set. Rather than deciding whether the given target is a real word, participants decide if the target word they see is within the given category. For example, if the word *dog* is presented under the category of *animals*, the trial requires a positive response, while the same word should be rejected under the category of *human body*. Due to its focus on categorical selection, this task is argued to involve more semantic processing compared to the lexical decision task, which relies more on lexical presentations (e.g., Xia and Andrews, 2015). Task differences, therefore, have the potential to reveal more about the nature of how cross-linguistic activation occurs.

1.2. What Kinds of Similarities Cause Cross-linguistic Interaction in the Early Stages of Visual Word Processing?

Cognates share a common origin across languages and show high degrees of orthographic (for similar scripts), phonological, and semantic overlap. Commonly referred to as *the cognate advantage*, such words are known to yield a processing advantage in early word processing; studies using behavioral measures such as lexical decision tasks (e.g., Nakayama et al., 2013) have found a facilitative priming advantage for cognates (e.g., *carbon* in English is *karbon* in Turkish) compared to non-cognate translation equivalents (e.g., *house* in English is *ev* in Turkish). Further support for this advantage comes from EEG (Electroencephalogram) research: Midgley et al. (2011) found more negative activities for L2 non-cognates compared to cognates, suggesting lower processing costs for the latter. Although one may argue that the shared representations of cognates in the bilingual mind are the reason behind the cognate advantage (e.g., Davis et al., 2010; Sánchez-Casas & García-Albea, 2005),

the findings of Peeters et al. (2013) contradict this view. In addition to presenting further evidence in favor of the cognate processing advantage by showing that cognates are processed faster than non-cognate cross-linguistic words, Peeters et al. (2013) also showed that this facilitative effect was modulated by the frequency values of words in both languages, suggesting that cognate words have separate representations for different languages in the bilingual mind. Other than the shared-representation view, it is also possible to attribute the cognate advantage to high orthographic similarities between cognate pairs. However, evidence has suggested that an explanation based on purely orthographic similarity would fail to explain the cognate advantage, let alone cross-linguistic interaction, and that there are other factors behind the more efficient processing of cognates by the bilingual mind.

The role of phonological overlap in cross-linguistic activation has been confirmed for the early stages of visual word recognition. In fact, studies with Japanese-English bilinguals have shown that cognate pairs seem to activate each other in early word processing, even in the complete absence of orthographic similarity, and the amount of this activation is modulated by the phonological overlap between cognate pairs (Nakayama et al., 2014). Testing Japanese-English bilinguals with a self-paced reading task, Allen et al. (2020) showed that the cognate advantage was still apparent in bilingual reading with cross-script languages and was affected by cognate frequency along with phonological and semantic similarities. Comparing cognate pairs with non-cognate translation equivalents, Nakayama et al. (2013) showed that Japanese-English cognate pairs led to more facilitative priming effects than non-cognate translation equivalents in lexical decision tasks combined with masked priming. In the absence of a shared script, phonological similarity was referred to as the potential explanation of this pattern since both cognate and non-cognate pairs shared conceptual similarities, but only cognate pairs had prominent phonological overlaps between pairs.

In addition to the studies conducted with Japanese-English bilinguals, other studies including different language pairs with different scripts have also supported the role of phonological similarity in cross-linguistic word activation. In a masked priming study with Russian-English bilinguals, Jouravlev et al. (2014) found that phonological overlap led to faster responses when using cross-linguistic prime-target pairs. The ERP data in the same study revealed a more detailed picture: There was also a significant

effect of orthography, but this effect diminished after around 250 ms when phonological similarity effects emerged. Similarly, the study by Peleg et al. (2020) with Arabic-Hebrew bilinguals found cross-linguistic phonological effects in a lexical decision task in the absence of orthographic and semantic overlap. Mishra and Singh (2014) conducted an eye-tracking study in which Hindu-English bilinguals listened to sentences in one language while looking at a set of words in the other language. Although the words on the screen were semantically unrelated to the words in the spoken sentence, one word was phonologically similar to the translation equivalent of a word in the sentence. In both language directions, the bilinguals focused more on phonological competitors for the translation equivalents of the spoken words. Overall, the findings of the studies using cross-script languages have supported the idea that phonological similarity is an essential factor in cross-linguistic activation, even when tasks involve visual word recognition.

Some cognate-like words seem to have etymological relationships with other words in different languages by coincidence, even though these words are semantically or etymologically unrelated. Such word pairs with high orthographic or phonological similarities are known as *false cognates*. The English word *mole* and the Turkish word *mola*, for example, have similar spellings and pronunciations but refer to entirely different concepts, with the former meaning a small dark spot on skin and the latter referring to break time. If orthographic and phonological similarities are to explain the processing advantage of cognates, then false cognates should also yield the same advantage.

This argument has been proven false, however, as although studies have found that false cognates also interact with each other in the very early stages of word processing, this effect is somewhat less prominent compared to the effects induced by "true" cognates. For example, cognates lead to more accurate answers compared to false cognates in a semantic relatedness task (Degani et al., 2018), regardless of the fact that both have highly overlapping orthographic and phonological features with their counterparts in the other language. In a similar vein, Nakayama et al. (2012) found that phonologically similar primes led to weaker priming effects compared to cognates, and this phonological priming was not affected by proficiency level or target word frequency, unlike cognate priming. The advantage of cognates over false

cognates in cross-linguistic activation shows that although orthographic and phonological similarities play important roles in this type of activation, they fail to explain the whole phenomenon.

As studies have shown that the cognate advantage involves more than orthographic and phonological similarities, should we assume such words have their specific representations in the bilingual lexicon, or is there a missing puzzle piece that we have yet to consider? In a study with Japanese-English bilinguals, Miwa et al. (2014) found effects of word frequency, phonological similarity, and semantic similarity in bilingual reading, while the cognate status of words seemed to have no effect. This finding suggests that the semantic similarities cognate pairs have can account for the advantage shown by cognates over false cognates, as the latter pairs lack semantic overlap. This, in turn, suggests that semantic similarity alone might have the potential to induce cross-linguistic activation in the bilingual lexicon.

This argument has been supported by experimental evidence. Nakayama et al. (2013) found priming effects with both cognate and non-cognate translation equivalents, showing that semantic similarity between the words of different languages can induce facilitative priming effects. Furthermore, Schoonbaert et al. (2009) showed that semantically related word pairs such as chicken-egg can induce cross-linguistic interaction in visual word recognition tasks. Taken together, these findings suggest that semantic similarity can create cross-linguistic priming effects even in the absence of phonological and orthographic similarities.

1.3. Are L2 Words Stored as L1 Words in the Bilingual Lexicon?

The evidence examined so far shows that words from different languages interact with each other when they share orthographic, phonological, or semantic similarities. However, word-related differences are only one side of the story. Bilinguals vary greatly in terms of L2 proficiency, L2 use in daily life, and age of acquisition, and for most bilinguals, L2 competencies fall behind those of L1. It is then only logical to assume that the way L1 words activate L2 words (the L1-L2 direction) might differ from the way L2 words activate L1 words (the L2-L1 direction). Word processing research has so far supported this argument, as L2 prime words produce null or less priming effects for L1 target words, while this effect is salient in the L1-L2 direction

(e.g., Chaouch-Orozco et al., 2021; Dimitropoulou et al., 2011b; Duyck & Warlop, 2009; Wang & Forster, 2015). As opposed to the general consensus about the existence of this translation asymmetry in different language directions (L1-L2 vs. L2-L1), the source of these findings has been at the center of many debates.

Some argue that the differences are due to the qualitative differences between L1 and L2 words in the bilingual lexicon. As most bilinguals acquire L2 words after acquiring L1 words, the way the brain codes L2 lexical and sub-lexical items might differ: L2 words might have different representations themselves (e.g., Xia and Andrews, 2015) or create cross-linguistic links with their L1 counterparts that are different from the links L1 words have with each other and with conceptual features in the brain (e.g., Kroll and Tokowicz, 2001). These qualitative differences, in turn, lead to differences in processing L2 words, and no matter how proficient a bilingual becomes, L2 words can never be stored or processed as L1 words in the case of acquiring L2 later. On the contrary, differences between the words of L1 and L2 might also be quantitative: Words acquired through learning a second language might be processed with less efficiency (Wang and Forster, 2015) or activate fewer conceptual features compared to L1 words (Finkbeiner et al., 2004) due to factors like language proficiency and language use. This view attributing quantitative differences between the representations and processing of L1 and L2 words naturally leads to the idea that increasing L2 proficiency and use is likely to decrease such differences.

Deciding whether L2 words are qualitatively or quantitatively different from their L1 counterparts has been a challenging task. Using cognates or false cognates in such investigations has a strong limitation: The human mind can activate the L1 counterpart directly due to the high orthographic or phonological overlap. Research has already shown that a word prime with transposed letters such as *cho**lo**cate* can facilitate the recognition of the real word, *chocolate* (Perea et al., 2008). In the same way, the bilingual mind can ignore the small differences between L1-L2 cognate pairs and take L2 primes as L1 words, as L1 words are usually acquired earlier and used more frequently by most bilinguals.

Non-cognate translation equivalents, on the other hand, can have substantial differences in terms of both orthographic and phonological features. In their most

common uses, the English word *cow* and the Turkish word *inek* both refer to the same animal, but the words have no apparent orthographic or phonological overlap. By using such pairs, the potential confounding factor of processing L2 cognate words as their L1 counterparts would be eliminated, allowing for a more focused examination of the interaction between L1 and L2 words. One might argue that semantically related cross-linguistic word pairs, such as *chicken* in English and *yumurta* (egg) in Turkish, can also be used to investigate cross-linguistic semantic influence in word processing. While this might be true, non-cognate translation equivalents share a high amount of semantic similarity, making it easier to observe semantic cross-linguistic effects. Furthermore, studies using non-cognate translation equivalents to investigate cross-linguistic interaction can reveal whether special lexical links exist between L1 and L2 translation equivalents that are used differently in different language directions (e.g., the RHM model in Section 2.1.2).

All in all, how non-cognate translation equivalents interact in the bilingual lexicon can help reveal how words of different languages are stored and processed. While the bilingual lexicon has received much-deserved attention so far, translation equivalent priming deserves further attention, especially in regard to its interaction with other potential factors. The present study aims to investigate how presenting words in one language as primes affects the activation of their non-cognate translation equivalents in the other language, along with the potential effects of L2 competencies (proficiency, immersion, and dominance), word frequency, task type, and prime duration.

CHAPTER 2

LITERATURE REVIEW

The nature of how words in multiple languages are stored and processed in the bilingual mind has been of interest in the fields of psychology, neurology, and linguistics for decades. Understanding the mechanisms involved in bilingual language processing can shed light on the interaction between mind and language and offer valuable implications for building bilingual language processing models, improving the ones that are already available, and creating better pedagogical practices. This task, however, is challenging given the complexity of language processing and the innumerable factors interacting with it.

Many models have been proposed so far to define the bilingual lexicon, each adopting a unique perspective on the issue. The inherent complexity of bilingual processing is amplified by additional factors such as task differences, language competencies, and language use patterns (e.g., McPhedran & Lupker, 2021; Nakayama et al., 2016; Wang, 2013). This, along with methodological limitations such as low study power, can explain the contradicting empirical support provided for different models in different studies; a model can explain the processes involved in bilingual processing for a specific situation but fail to do so under another circumstance. Therefore, further studies are required to test the predictions of different models and abandon/update them accordingly.

This literature review attempts to pin down the general findings of the studies regarding the interaction between two languages in word processing. Specifically, the focus is narrowed down to the investigation of non-cognate translation equivalents using the masked priming paradigm. Such pairs allow the inquiry of cross-linguistic semantic effects without the involvement of orthographic and phonological similarities, which can create additional confounding factors. Throughout the

dissertation, I used "translation equivalents" and "translation priming" to refer to "non-cognate translation equivalents" and "non-cognate translation priming," respectively. The effects and investigations of cognates and false cognates are explicitly stated.

The first two sections examine the models of the bilingual lexicon, as such models are built on many relevant word-processing studies and have specific claims about the activation of words between the languages of a bilingual. There are two main accounts of the bilingual processing models: the qualitative differences account and the quantitative differences account. The qualitative differences account proposes that the differences between L1 and L2 words are mostly qualitative in nature and do not diminish by increasing L2 competencies, especially if L2 words are acquired later in life. The quantitative differences account, on the other hand, argues that such differences are mainly quantitative and can be reduced or completely eliminated with increasing L2 competencies, such as language proficiency and language use.

The third and final section of the Literature Review focuses on the findings regarding translation equivalents and how multiple factors interact with each other in translation priming, which is also the main focus of this dissertation.

2.1. The Qualitative Account Models

The qualitative account asserts the idea that L2 words are processed and stored differently because most bilinguals acquire L2 words after L1 words; the already-existing lexicon results in qualitative changes between the words of the native language and the language that is being acquired later. I examine three qualitative models in this section: the Sense Model, the Revised Hierarchical Model (RHM), and the Episodic L2 Hypothesis. The order of the presentation also reflects a gradual increase in the strength of qualitative claims; while some may regard the Sense Model as a quantitative model, most researchers would agree that the Episodic L2 Hypothesis is a strictly qualitative model of the bilingual lexicon.

2.1.1. The Sense Model

The Sense Model is proposed by Finkbeiner et al. (2004) based on their findings in cross-linguistic and within-language tasks. The model is really similar to the refined

DRM model (The Refined Distributed Representation Model) given in the next section; however, while the refined DRM model is described as a quantitative model by their founders (Schoonbaert et al., 2009), the Sense Model is often referred to as a qualitative model (e.g., Nakayama et al., 2016). Keep in mind that different interpretations of this model might categorize it as a quantitative model as well and make it nearly identical to the refined DRM model.

Using a group of Japanese-English bilinguals, Finkbeiner et al. (2004) found robust priming effects only in the L1-L2 direction (L1 primes and L2 targets) with lexical decision tasks but in both directions with cross-linguistic semantic categorization tasks. The lack of priming effects with L2 primes and L1 targets in the lexical decision task is explained through the shared *senses* between L1 and L2 words and the utilization of these senses in different tasks.

Semantic senses refer to the associations between conceptual representations and words. Although people tend to accept translation equivalents as *equals*, some polysemic features of words are specific to that language. Finkbeiner et al. (2004) state that while *kuroi* in Japanese and *black* in English both refer to the color *black*, the English word has 21 diverse senses, some of which are language specific. Cross-linguistic priming depends on the number of shared senses that are activated in a specific task. As the representations of L1 and L2 words are qualitatively different with respect to the number of senses they activate, the so-called *translation priming asymmetry* emerges, and the L2-L1 direction results in less efficient priming.

L1 words are associated with more senses compared to L2 words, and the fewer senses that L2 words have are usually shared by their translation equivalents in L1 as well. In addition to the number of activated senses, priming size also depends on the proportion of activated senses relative to unactivated senses (Finkbeiner et al., 2004). Consequently, a good number of senses are activated when L1 primes are used in a cross-linguistic lexical decision task. As the translation equivalent of a word is mostly built on the senses that are also shared by the L1 counterpart, a strong priming effect is observed in the L1-L2 direction. In the L2-L1 direction, L2 primes activate the associated senses again, but as the number of these senses is limited for L2 words, a considerable number of senses for their translation equivalents might be left

unactivated (Figure 1). This causes less efficient or absent priming in the L2-L1 direction.

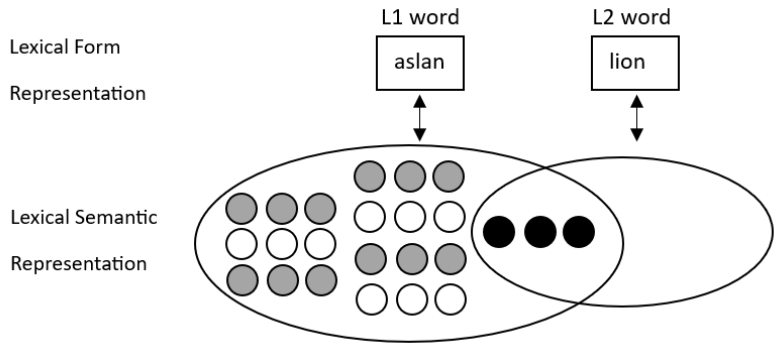


Figure 1. The proportion of senses associated with L1 and L2 words (based on Finkbeiner et al., 2004)

For L2 translation equivalent primes, the incapability of activating L1 words in a lexical decision task diminishes in a semantic categorization task. The given category for the upcoming items provides context and allows for focusing on the sense that would be useful in category choice. This narrowed focus allows L2 primes to activate the sense relevant to the given categories, and with properly selected L1-L2 translation equivalent pairs, the problem of relatively fewer activated senses by L2 words becomes irrelevant since only a single sense would be enough to make a categorical decision. This was confirmed in two semantic categorization tasks, each using translation equivalents as L2 primes for the related condition. While significant priming effects were observed for *exemplar* targets, which are words within the given category, such priming effects were absent for *non-exemplar* items, which are irrelevant words for the same category. This null effect was attributed to the mismatch between the narrowed focus and the irrelevant category of non-exemplar items. For example, when the category is *animals*, the sense activation system would be more focused on the senses related to animals. This would be helpful in processing exemplar words like *lion* in L2, as the activated senses would be sufficient to confirm the categorical match of the word, even though there are fewer of them compared to the senses of L1 words. When a non-exemplar word like *car* is processed in L2, the activated senses do not match the senses that are focused, resulting in a failure to

benefit from this category restriction. Forthwith, Finkbeiner et al. (2004) conclude that the diminishing translation priming asymmetry is a result of the restriction imposed by category when the primed target words are within that category, rather than being a result of using a more semantic-focused task.

More senses can be activated by L2 words as L2 proficiency increases. However, that would not reduce the gap in shared senses between translation equivalents; many senses are language-specific and associated with words that are acquired in different parts of a bilingual's life (Nakayama et al., 2016). This interpretation of the Sense Model places it within the qualitative models.

Further support for the model comes from within-language experiments. Words differ in the number of senses they have, even within a language. For example, the English word *head* has more senses than the English word *skull*. According to the Sense Model, if the word *head* is used for priming the target word *skull*, there is a higher chance of observing priming effects due to more activated semantic senses by the prime. However, using the word *skull* as a prime for *head* might not induce any priming effects at all, as fewer semantic senses would be activated by this prime. In order to test this assumption, Finkbeiner et al. (2004) carried out within-language tasks and observed a pattern that is in line with this proposal. Identical to the cross-linguistic findings, the prime words with more senses (e.g., head) facilitated the recognition of the target words with fewer senses (e.g., skull) in a lexical decision task, mirroring the pattern between L1 primes and L2 target words. When the prime words had fewer senses, however, there were no facilitative priming effects, similar to the results of lexical decision tasks with L2 primes and L1 targets. Further investigation of this within-language phenomenon revealed that even primes with fewer associated senses induced priming effects in semantic categorization tasks, replicating the diminishing translation priming asymmetry effects in cross-linguistic tasks. These within-language tasks then further confirmed the pattern in which the number of senses loses its dominant role in semantic categorization tasks, as long as the relevant senses are activated.

The Sense Model offers a simple yet logical explanation for the observed translation priming asymmetry in the literature (see Section 2.3.1), which refers to the reduced or

absent priming effects in the L2-L1 direction. Although the experiments in Finkbeiner et al. (2004) were well-designed to investigate language direction effects, the numbers of participants were limited, especially for the cross-linguistic tasks (between 18-20 for each task). Therefore, the lack of significant findings in the L2-L1 direction lexical decision task might have been due to low study power.

2.1.2. The Revised Hierarchical Model (RHM)

The Revised Hierarchical Model (henceforth, RHM) was originally proposed by Kroll and Stewart (1994) and then updated by Kroll and Tokowicz (2001) based on the more recent findings at the time. Unlike the Sense Model, in which each word is assumed to be connected to a number of conceptual features (senses), RHM sees word meanings as single memory units (Xia & Andrews, 2015). Although the model does not explicitly advocate a language-selective view, the formulation of two separate lexicons seems to favor this argument (Brysbaert & Duyck, 2010).

RHM suggests that bilinguals with low L2 proficiency focus more on form than on semantics in processing L2 words, and this pattern is reversed as learners become more proficient in their L2. The early reliance on form stems from creating strong lexical-level connections between L1 words and new L2 words. Conceptual representations have strong connections with L1 words, but the connections between these representations and L2 words are weaker (Figure 2). Therefore, L1 words have higher chances of involving conceptual processing, while L2 words are activated through their L1 translation equivalents, especially at lower proficiency levels.

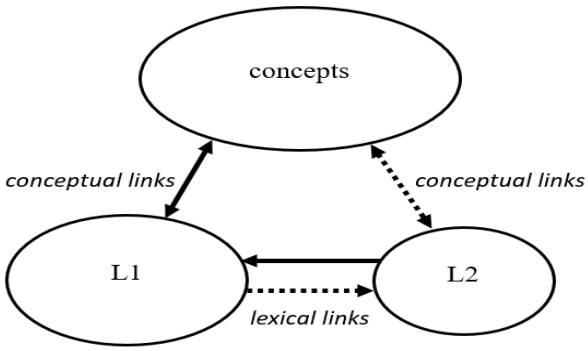


Figure 2. The Revised Hierarchical Model (based on Kroll and Tokowicz, 2001)

Vocabulary size might be another factor in different access patterns for lexicons. The L1 lexicon is usually much larger compared to the L2 lexicon, and many words in the L1 lexicon lack L2 translation equivalents. Along with the reliance on L1 in accessing L2 words, these factors lead to stronger lexical connections in the L2-L1 direction compared to the L1-L2 direction.

As a result of the varying strength of connections among the L1 lexicon, L2 lexicon, and conceptual representations, bilinguals usually process two language directions (L1-L2 and L2-L1) differently and reflect a translation priming asymmetry. While translating words from L2 into L1 is faster due to strong lexical connections starting at beginning L2 proficiency levels, L1-L2 translation is slower since it relies more on conceptual processing. The initial reliance on lexical connections between L2 and L1 words delays the development of connections between the L2 lexicon and the conceptual system. Whether proficient L2 learners can access L2 words directly through conceptual representations (like they do for L1 words) is debatable, but it is possible that the asymmetry would be reduced as L2 proficiency increases.

While the existence of the translation priming asymmetry is apparent in the literature, the direction of this asymmetry is the complete opposite of what RHM suggests. Many studies so far have shown a reduced or null priming effect in the L2-L1 direction for the early stages of word processing (e.g., Chaouch-Orozco et al., 2021; Finkbeiner et al., 2004; Jiang & Forster, 2001; Schoonbaert et al., 2009; Wang & Forster, 2015; Witzel & Forster, 2012). Brysbaert and Duyck (2010) further question the validity of RHM by referring to the following limitations: First, little evidence is available in the literature for language-selective access and separate lexicons, and L2 words have stronger associations with conceptual representations than proposed in the model. Word recognition and translation tasks are unlikely to require only simple and direct links, and such an assumption is likely to be an oversimplification. Finally, semantic features might have language-dependent features (e.g., not allowing large sister instead of big sister in the English language; see Paradis, 1997) as well as language-independent features (e.g., the concept of largeness).

Xia and Andrews (2015) offer a modification to RHM in order to keep it accurate for the recent translation priming asymmetry findings (see Section 2.3.1): Conceptual

links rather than lexical links could be behind the activation of translation equivalents. As the priming effect depends on semantic mediation, the L2-L1 direction fails to produce comparable priming effects to the L1-L2 direction due to weaker conceptual associations between the L2 lexicon and semantic representations. Similarly, Kroll et al. (2010) accept that the initial versions of the model might fail to account for some of the findings in the literature. Instead of the strict idea that L2 words are linked to their L1 counterparts through lexical links, the authors argue that the links between L2 words and concepts might be available from the beginning, but the efficiency of using these links might differ depending on the direction; the links between conceptual representations and L2 words are used more efficiently in reaching concepts through words but less efficiently in accessing words through concepts. This asymmetry was argued to account for the increased difficulty in L2 production tasks (e.g., picture naming tasks) compared to L2 comprehension tasks (e.g., lexical decision tasks). However, arguing that L2 words are difficult to access through the concept-to-word route has consequences for comprehension tasks as well. These asymmetrical links can also explain why semantic categorization tasks produce significant priming effects in both language directions: The feedback sent by concepts to L2 words might be enhanced by the activation of categorical features. Such modification also changes the strict view that L2 words usually access their meanings through their L1 translation equivalents without directly accessing the concepts themselves (Schoonbaert et al., 2009). As a result, RHM can be regarded as a quantitative account model for the bilingual mind (Xia & Andrews, 2015). One potential issue arising from this modification is its impact on L1-L2 priming effects. L1 primes are usually assumed to activate conceptual representations, and if the concept-to-word route is problematic for L2 words, then the L2-L1 direction should theoretically produce more priming effects compared to the L1-L2 direction, which contradicts the existing literature.

2.1.3. The Episodic L2 Hypothesis

The Episodic L2 Hypothesis (Jiang & Forster, 2001) draws strict lines between the representations of L1 words and L2 words in the bilingual mind. The most interesting of these proposed qualitative differences is the storage of L2 words: Bilinguals store their L2 word representations in an episodic memory, along with the traces of their L1

translation equivalents. L1 words, on the other hand, are stored in a lexical memory system.

The model was initially based on the results of five experiments carried out by Jiang and Forster (2001), each including a group of Chinese-English bilinguals (group sizes for the experiments were 26, 16, 36, 22, and 18, respectively). Although the participants were students at the University of Arizona at the time of the experiments, they had been staying in the United States for a few years (range: 1-7 years). All participants had at least a TOEFL Score of 550 or higher. The experiments were based on the idea of using translation equivalents as primes for their counterparts in the other language, thus a regular translation priming design.

In addition to lexical decision tasks, episodic recognition tasks were also used in combination with the masked priming paradigm. The episodic recognition task requires participants to study a set of specific items, namely target words that will appear in the upcoming linguistic tasks. Following the training period, the participants decide whether a presented item belongs to the study set (old) or is unfamiliar (new). The combination of the masked priming paradigm involves preceding new and old items with an equal number of related and unrelated prime words. In the investigation of non-cognate translation priming, related primes are non-cognate translation equivalents.

The results overall showed a significant priming effect for the English (L2) translation equivalent primes when they were followed by old items (L1 targets in Chinese) in the episodic recognition tasks, but such effects were absent in the same L2-L1 direction in the lexical decision tasks. Interestingly, this pattern was reversed in the opposite language direction: When Chinese (L1) translation equivalents were used as primes for English (L2) targets, the lexical decision tasks but not the episodic recognition tasks showed significant priming effects.

Jiang and Forster (2001) propose the Episodic L2 Hypothesis to explain their results. The findings regarding the L2-L1 direction are explained as follows: When L2 masked primes are activated, they can also activate the translation equivalents of their L1 translation in episodic memory. This creates L2-L1 priming effects in an episodic recognition task, as responses to such tasks are elicited from the episodic memory.

Although L2 primes in the episodic memory also activate the lexical representations of their translation equivalents in an indirect way (Figure 3), this activation requires more time and deliberate processing. Therefore, the L2-L1 direction fails to produce facilitative priming effects in a lexical decision task using short prime durations, but such effects might emerge in overt priming, which allows conscious processing of prime words.

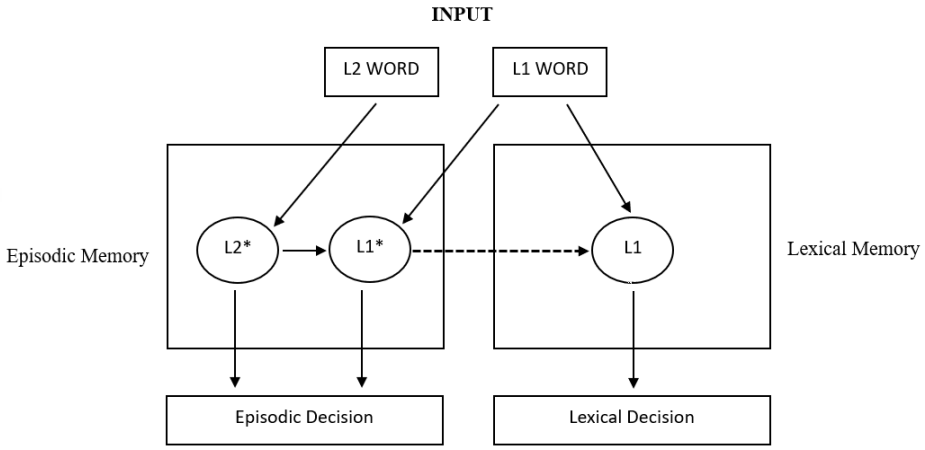


Figure 3. Masked priming effects for translation equivalents in late bilinguals according to the Episodic L2 Hypothesis (L1* and L2* represent the episodic records of L1 and L2 words)

For the L1-L2 direction, L1 prime words can activate both the traces of L1 representation in the episodic memory (recently created through studying test items) and the lexical representation in the lexical memory (Figure 3). However, the traces of L1 words (L1*) cannot activate their translation equivalents in the episodic memory since this association works in a unidirectional way (L2-L1). As a result, L1 translation equivalent primes fail to induce priming effects for L2 targets in an episodic recognition task. In a lexical decision task, L1 translation equivalent primes activate their L1 lexical representations in the lexical memory. Since lexical decisions for L2 target words are likely to be based on activity in the lexical memory, the activation of L1 primes facilitates the recognition of their L2 counterparts, producing significant priming effects in the L1-L2 direction.

The assumption that L2 words are stored in the episodic memory rather than the lexical one relies on the idea that creating lexical entries might require associating forms with

semantic features in the learning process. In L1 acquisition, words are learned through semantic connections; thus, links to semantic features are strong for L1 words. This process is different for acquiring L2 words because of two major limitations: The amount and quality of L2 input are often limited compared to L1 input, and by the time L2 is acquired (especially for late bilinguals), semantics and lexical systems have already been developed according to L1. This eliminates the necessity of establishing conceptual links while learning L2 words since these words can be understood through their translation equivalents in L1. This is a similar argument to the lexical link argument between L1 and L2 words in RHM.

The Episodic L2 Hypothesis is one of the most distinctive models in its premises: L2 words are stored in a different memory unit, and these qualitative differences are apparent when L2 words are learned later in life. This leaves little room for explanation if late bilinguals show identical translation priming patterns in both language directions. Also, L2 proficiency should contribute little to none to L2 priming because L2 words are stored in the episodic memory, not the lexical one. Any effect of L2 proficiency would then challenge the claims of the model.

It is important to keep in mind that the model is based on experiments with limited participant numbers, resulting in low study power. Also, RHM had to modify its claims regarding the absence of conceptual processing in the L2-L1 direction, as the accumulating evidence had suggested otherwise. The similar claim of the Episodic L2 Hypothesis then seems difficult to maintain against the recent findings (see Section 2.3).

2.2. The Quantitative Account Models

The quantitative account models argue that while there might be differences between the processing of L1 and L2 words, these differences can be remedied as L2 competencies increase. In a similar vein, the varying patterns observed in different language directions for different tasks and individuals can be explained by the differences between L1 and L2 competencies (Xia & Andrews, 2015).

The following section is a summary of the most influential quantitative models. One quantitative model that has been constantly updated to this date is Multilink. I start this

section by examining a simpler but well-acknowledged model, The Refined Distributed Representation Model. After that, I present the precedents of Multilink and show how the model has reached its final version gradually.

2.2.1. The Refined Distributed Representation Model (DRM)

The Refined DRM Model was originally built on the study of Duyck and Brysbaert (2004) and then updated by a more recent study by Schoonbaert et al. (2009). In this later study with Dutch-English bilinguals who were more competent in their L1, both language directions were tested along with different SOA values (i.e., the time between prime representations and target word appearance). Although prime durations were 50 ms, backward masks (50 ms and 200 ms in different experiments) were used to increase SOA and thus give participants more processing time (see Section 2.3.5). Prime-target pairs also varied among experiments: In addition to translation equivalents, semantically related cross-linguistic words were also used as prime-target pairs. Overall, the results showed more priming effects for the L1-L2 direction than the L2-L1 direction, for translation equivalents than semantically related pairs, and for a higher SOA value (250 ms) than a lower SOA value (100 ms). The null semantic priming in the L2-L1 direction at 100 ms SOA also became significant at 250 ms SOA. While there was a numerical advantage for more concrete words, this was not significant (for a more detailed examination, see Section 2.3.5).

Having decided that a model with a single processing system would better explain the findings, Schoonbaert et al. (2009) refer to the refined version of DRM (Duyck & Brysbaert, 2004), which proposes that cross-linguistic priming occurs through shared semantic/conceptual nodes between languages (Figure 4). The researchers offer additional assumptions based on the literature and their findings.

First, they propose that unbalanced bilinguals have richer semantic representations in their dominant language, and thus L1 words would activate more conceptual nodes compared to L2 words (similar to the Sense Model). Second, translation equivalents would possess more shared semantic nodes compared to semantically related words across languages. And finally, concrete words would share more semantic nodes than abstract words. Although the effect of concreteness was not significant in their study, Schoonbaert et al. (2009) underline the numerical advantage they found for more

concrete words and speculate that the effect would have been significant with more varied experimental items in terms of concreteness values.

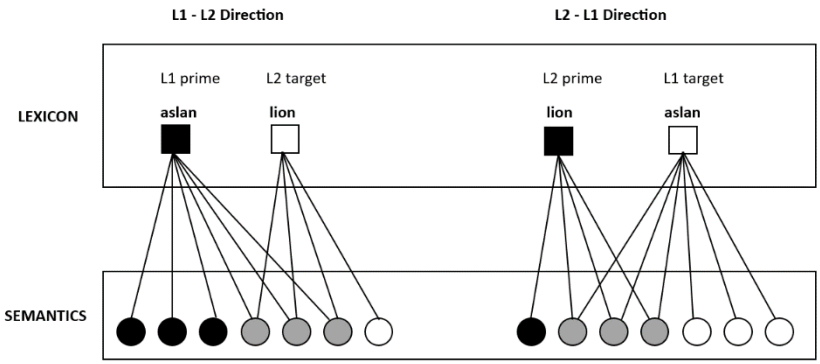


Figure 4. The connections between words and conceptual nodes in the bilingual lexicon

Figure 4 shows how words are connected to conceptual nodes in DRM. The more conceptual nodes are activated through primes, the more prominent priming effects are observed. In the L1-L2 direction, L1 words activate a large number of conceptual nodes. When translation equivalents are tested, these activated nodes constitute the majority of nodes associated with the L2 counterparts (Figure 4), thus inducing large priming effects since nearly all conceptual nodes of the target word are pre-activated. In the L2-L1 direction, L2 translation equivalent primes activate fewer nodes compared to their L1 counterparts. Since the unactivated conceptual nodes of the L1 targets are greater in number, this direction shows less prominent or null priming effects.

The DRM model and the models examined in the previous section (the qualitative account models) are all verbal models, which try to explain phenomena by merely giving verbal proposals and figures based on these proposals. Dijkstra et al. (2019) argue that such models are underspecified and unclear in terms of their predictions and structure, which makes it harder to interpret and test the predictions of these models. When new data contradicts the assumptions of verbal models, verbal solutions can be suggested to modify the model and seemingly overcome the problem (Dijkstra et al.,

2019). This over-flexibility is different from adaptation, which involves modifying certain aspects of the model without changing multiple fundamental assumptions.

Computational models, on the other hand, offer more clearly defined predictions that can be tested and falsified (Dijkstra et al., 2019). The simulations provided by these models can show how similar the output of a model is to the findings in the literature. Furthermore, computational models can handle complexity better and include a large variety of factors, allowing the investigation of complex phenomena in relation to the effects of multiple factors (O'Reilly & Munakata, 2000). The following subsections examine the computational models BIA and BIA+ and how their insights are inherited by the most-acknowledged computation model for the bilingual mind, Multilink.

2.2.2. The Bilingual Interactive Activation Model (BIA)

The Bilingual Interactive Activation (henceforth, BIA) Model (Dijkstra & van Heuven, 1998) is shaped mostly by the principles of the Interactive Action Model (McClelland & Rumelhart, 1981). BIA advocates the view that an input might activate lexical candidates from multiple languages, namely *language non-selective access*.

The processing of visual input starts in a bottom-up fashion as follows (Figure 5): In the feature stage, visual input is interpreted according to its orthographic features, and in the next stage, letters sharing these features are activated while letters without adequate similarity are suppressed. The activated letters then lead to the activation of word candidates from both languages in the next stage. Word candidates receiving high levels of activation might also inhibit the activation of other words that received less activation, a phenomenon known as lateral inhibition. In fact, each stage might increase or decrease the activation of potential candidates according to the information processed so far. In Figure 5, arrowheads refer to excitatory activations, and circle arrowheads refer to inhibitory connections. According to the activation levels of words in both languages, one language node over the other is selected in the language stage, and the final lexical decision is made. Figure 5 shows the stages of processing a word in the bilingual lexicon according to the BIA model.

Language nodes are particularly important in the BIA model. The activated language node attempts to inhibit all word nodes in the other language through a top-down

process. In this way, language nodes serve as a language filter. This suppression might not indicate a full inhibition, as even strongly pre-activated language nodes might not fully prevent the recognition of words in other languages. Context activation can also affect these language nodes, and this activation, which is from the outside of the word recognition system, might explain top-down effects in word recognition.

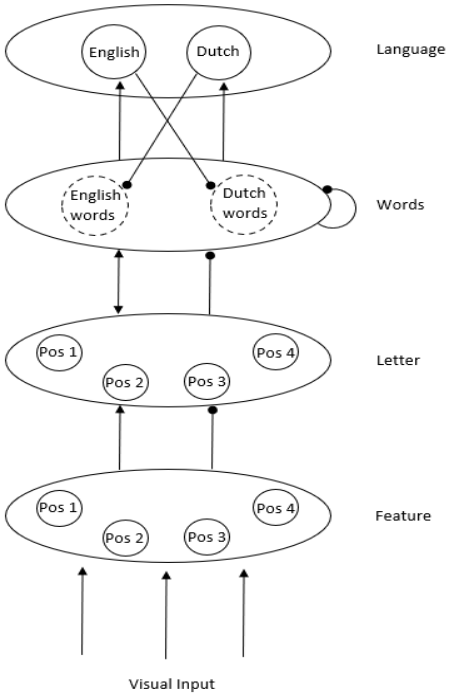


Figure 5. The Bilingual Interactive Activation Model (BIA) based on Dijkstra and van Heuven (1998)

Language switching costs can be explained through these language nodes; activating a specific language node (e.g., English) would decrease the activation threshold of all subsequent words in the same language while suppressing the words in other languages (e.g., Turkish). Similarly, priming effects across languages should lead to inhibition effects or at least less effective priming effects compared to priming effects within languages. The proposed inhibitory effect of language nodes is strongly related to language proficiency; higher L2 proficiency should result in greater inhibitory effects. This also means that a monolingual person would not have this inhibitory effect at all: A person with complete ignorance of an L2 should show facilitative priming for L2 primes that are orthographically similar to L1 targets, as such primes

would enhance the activation of orthographic features and letters without activating any orthographic competitors from other languages. This is contradictory to the findings of Bijeljac-Babic et al. (1997), in which monolinguals showed no facilitative or inhibitory priming effects with L2 primes that were orthographically similar to L1 targets.

In addition to the contradictory finding of Bijeljac-Babic et al. (1997), there are several other limitations regarding the BIA model (Dijkstra & van Heuven, 2002). First, the model did not include semantic and phonological representations, and because of this, cognates and false cognates had underspecified representations. False cognates were assumed to have two different presentations with varying activation thresholds, but the assumptions regarding cognates and false cognates were difficult to test without semantic and phonological representations. The lack of semantic and phonological representations made it impossible to simulate translation priming effects as well. In addition, the role of context, task-specific processes, and the potential interactions between task demands and word recognition were not well explained. Finally, there were concerns about the accuracy of consecutive item effects and language switch effects. Such drawbacks of the model led to an update of the characteristics and an updated version of the initial model.

2.2.3. The Bilingual Interactive Activation Plus Model (BIA+)

The Bilingual Interactive Activation Plus (henceforth BIA+) model (Dijkstra & van Heuven, 2002) similarly offers a single language-non-selective lexicon like its precedent. Although this updated model refers to phonological and semantic representations and their effects on word processing, these are not included in the computational model due to difficulty in modeling. Figure 6 shows how visual input activates the relevant word(s) in the bilingual mind.

In this model, the activation of words in the bilingual mind is strongly related to factors like proficiency, recency of activation, and subjective frequency, as they determine the resting activation levels for words. These activation levels are the thresholds for lexical candidates to become active. Once orthographically similar lexical candidates are activated through input, the stimulation spreads to associated semantic and phonological representations (Figure 6). Orthographic overlap between input and

lexical candidates is of vital importance, and languages using different scripts might lead to the activation of a rather smaller set of lexical candidates due to limited orthographic similarity. Although the potential differences between visual word recognition and audio word recognition are accepted, the BIA+ model proposes non-selective access for both visual and auditory input, at least in the early stages of word recognition.

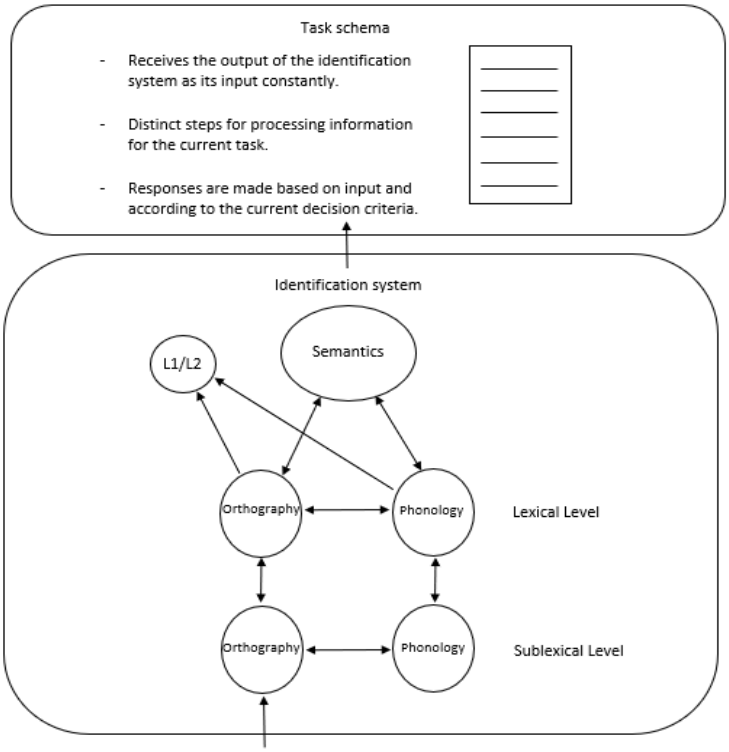


Figure 6. The Bilingual Interactive Activation Plus Model (BIA+) based on Dijkstra and van Heuven (2002)

As seen in Figure 6, BIA+ relies on two different systems for explaining word activation. The first system is *the word identification system*, which is integrated into a large language user system. Within this large system, sub-systems such as a sentence parser and language production system interact with the word identification system. This suggests that semantic and syntactic context information might also affect the automatic word identification process. The word identification system handles word recognition, and after this is done, this system becomes stable again as a result of finishing evaluating different lexical candidates. Word identification, syntactic, and

semantic effects are all regarded as language non-selective, which suggests cross-linguistic priming effects between L1 and L2.

Different from its precedent, a separate task/decision system is added, which is based on the Inhibitory Control Model of Green (1998), and the inhibitive role of language nodes in the previous model is taken over by this new system. BIA+ proposes an automated and preconscious word identification process followed by a more attention-sensitive decision-making process carried out by the task/decision system. This latter process is also prone to contextual factors and affects the results of the word identification system just before giving a response within a task. The task/decision system takes the output of the word identification system as input and compares the activation levels of lexical candidates with task specifications to arrive at a decision. Although different task demands might modulate the output of the word identification system, there is a common word identification pattern that is resilient to task demands; however, rushing to make a decision might result in using partial information from the word identification system and giving a response before the word identification system finishes its job completely. The way the task/decision system acts is modulated by factors such as the chance of making an error, the desired accuracy/speed balance, and the necessity to ignore candidates from a certain language. This system can even use other information, such as participant expectations or guesses based on item list characteristics. The relative effect of different types of information on decisions might vary among tasks: Although phonological and articulatory information is essential in a word naming task, cross-linguistic semantic and phonological effects might be decreased or even disappear if the task requires fast responses to orthographic codes (e.g., a visual lexical decision task).

BIA+ sees false cognate and cognate effects as cross-linguistic effects stemming from mental lexicon interactions before word identification and language tag retrieval. False cognates have different representations in different languages, and multiple readings for a false cognate might be activated via input. These activated representations cannot be suppressed by a top-down process induced by the decision system, as task requirements have little to no effect on the word identification system. However, if the task includes target words from a single language, the task/decision system can modulate the way decisions are made by eliminating word candidates from other

languages. For tasks with target words from multiple languages, response times for words (especially special words like false cognates) might be increased due to factors like language switch costs and different decision criteria, as the task/decision system cannot only focus on the word candidates from a certain language. Cognates, on the other hand, share semantic, phonological, and usually orthographic similarities with their counterparts in the other language. These words might be recognized faster even when they are not fully identical in terms of phonology and orthography (although identical cognates are likely to be processed faster).

In BIA, the interaction between non-cognate translation equivalents can be explained through semantic similarity. Both lexical and sub-lexical orthographic representations activate their corresponding semantic and phonological representations, and this may lead to facilitative priming effects between prime-target pairs like non-cognate translation equivalents. The subsequent activations of semantic and phonological features might be more delayed in L2, a phenomenon known as *the temporal delay assumption*, due to factors like relatively lower subjective frequencies for L2 words. As a result, L2 primes might be processed with less efficiency in cross-linguistic tasks. This asymmetry should again decrease with L2 proficiency since factors like subjective frequency between languages tend to become similar with increasing proficiency. Although this might be taken as an alternative explanation to the translation priming asymmetry phenomenon referred to in the RHM model (see above), the BIA+ model does not present clear-cut predictions about translation effects and cross-linguistic semantic activation. The model does not include lexical-semantic representations, and thus, it cannot be used to simulate non-cognate translation priming effects due to this limitation.

The task/decision system in BIA can account for the findings of more priming effects in a semantic categorization task (see the Sense Model subsection); since this system adjusts the way words are processed according to the given task, more focus can be allocated to semantic features in a semantic categorization task. This advantage can become prominent in translation equivalent priming, as this effect depends on semantic similarity. However, this cannot be simulated as well due to the underspecifications of the model.

Multilink tries to overcome these limitations by building a new model based on the insights gained from the BIA + and RHM models. The reason behind this combination rather than adopting the latter model lies within the limitations of verbal models such as RHM and DRM. As mentioned above at the end of Section 2.2.1, these models usually present vague predictions that can easily be modified to avoid accumulating contradicting evidence (Dijkstra et al., 2019). Such resistance to falsification makes verbal models long-lasting but vague and underspecified. Multilink, as a computational model, aims to present testable and falsifiable predictions that would allow the modification or rejection of the proposed model.

2.2.4. Multilink

Multilink (Dijkstra et al., 2019) is the final adaptation of the BIA model and sustains the idea of non-selective language access. A written input activates orthographic representations, which in turn activate associated semantic representations and phonological representations, respectively. All those activation stages occur in a language-nonselective way. The name is a reference to the *multiple* links that exist among representations for modeling the word retrieval process. In addition to the core architecture and representational units, Multilink includes activation functions and parameter options, which allow adjusting simulations for different purposes.

Multilink inherits the task/decision system from the previous model, BIA+. The updated decision system now allows adjusting simulations according to different tasks (e.g., lexical decision tasks). L2 proficiency level can also be adjusted by altering resting level activations (RLA) for words. The decision system checks the decision criteria for the specific task against current activations in orthographic, phonological, and semantic representations, and the best candidate is selected. This selection might not be merely based on activation levels since the decision system can also check the language of an input or output and other task criteria.

Multilink proposes a highly interactive model: Orthographic representations, language nodes, semantic representations, and phonological representations are all interactive in a bidirectional way (Figure 7). Retrieving a word involves multiple steps, and nodes are constantly updated for their activation levels based on the information from different sources (e.g., semantics) in each step. A single input usually activates

multiple candidates due to orthographic similarity; word activation depends on the subjective frequency and the orthographic similarity a lexical candidate has with the current input. The activated candidates might receive further activation in the following steps (from phonological or semantic representations), or their activation level might decay as a result of receiving no further activation. Without further activation, word candidates return to their resting level activations gradually.

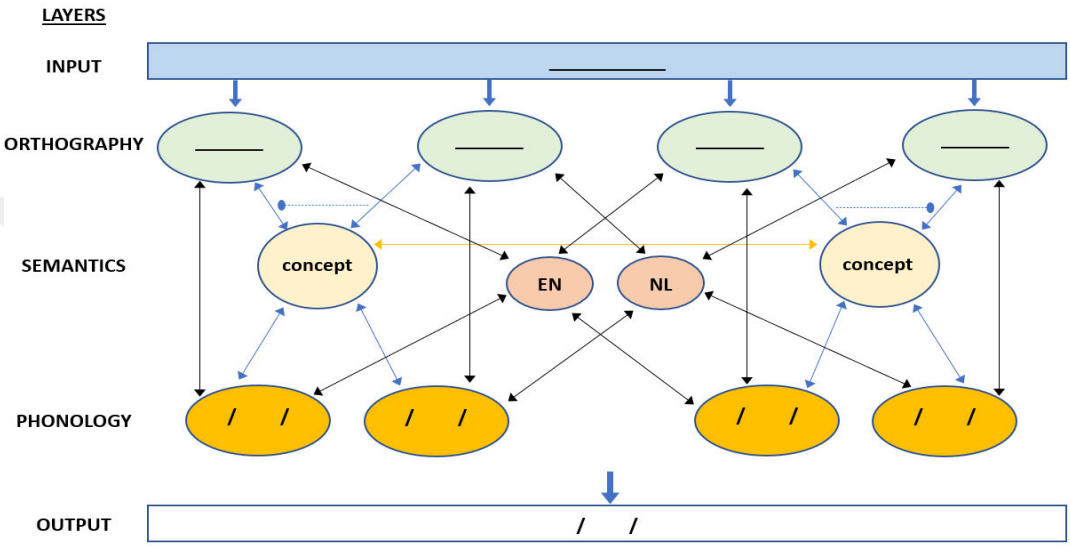


Figure 7. The architecture of Multilink based on Dijkstra et al. (2019)

In Figure 7 above, input is shown by a blue underscore, orthographic representations by green underscores, semantic representations by "concept" labels, and phonological representations by slashes. When multiple orthographic units activate the same semantic representation (e.g., cognates), only half of the activation level by the second node is considered (shown by the dashed lines). The output is strongly related to the decision system, which is underspecified in the figure. Slashes in the input layer suggest that the output might or might not share the language of the input (e.g., translation tasks). The phenomenon of lateral inhibition, in which strongly activated representations inhibit the activation of less activated candidates, is zero by default in the model, unlike BIA. Multilink cautiously proposes that lexical competition occurs in selecting a response and not in word recognition; thus, lexical candidates receiving above-threshold activation levels are all evaluated in the decision system.

The involvement of semantic representations sets the difference between processing cognates and false cognates. For both cognates and false cognates, orthographic inputs activate their orthographic neighbors (for the same-script languages). This activation also spreads to phonological neighbors and semantically similar lexical items in processing cognates. Groot (2011) proposed three reasons for cognate advantage: orthographic similarity, shared semantics/morphosemantics, and the activation of phonological representations due to shared semantics. Multilink adds a fourth component to that list: orthographic neighbors activating their related phonological representations. When the orthographic representations of lexical items are activated, this activation spreads to similar phonological representations in the same language; when orthographic neighbors are activated in the target language, these neighbors also activate phonological representations. Therefore, phonological representations receive activations from both shared semantics and activated orthographic neighbors. These two proposals indicate substantially different processing stages for false cognates. For Groot (2011), false cognates should only facilitate word recognition by virtue of visual similarity. Since phonological representations are activated through shared semantics, they would not be affected even if the presentations of false cognates in two languages had phonological overlap. For Multilink, phonological similarity still affects the word recognition process for false cognates through orthographic similarity, although this effect might be less prominent compared to cognates, which activate the phonological representations through both semantic and orthographic overlap.

One of the biggest limitations of Multilink's precedents, BIA and the BIA+, was the lack of semantic representations. This limitation also prevented previous models from capturing the whole extent of cognate processing and explaining non-cognate translation priming. Multilink partially overcomes this limitation by adding somehow underspecified semantic representations: These are holistic units that cannot activate each other through semantic priming. Cognates share a single semantic representation between languages; however, this oversimplified feature leads to an overestimation of the cognate effect in the model, and as a straightforward solution, input activation is reduced from nodes (the dashed lines in Figure 7). Another concerning issue regarding this limitation is the accuracy of semantic equivalence between the words of different languages. Although word pairs from two languages might share rather holistic

meaning representations in early learning stages, full translation equivalence is difficult for all pairs: One word might have two different translation equivalents in another language with slightly different meanings. For example, the French words *balle* and *ballon* have slightly different meanings, but they are both translated into English as *balloon*. This rather simple view of semantic equivalence should be overcome in the future.

Despite these limitations, Multilink has several advantages over the other models. First, the highly interactive nature of the model explains the findings in the literature better and presents a better overall structure of the bilingual lexicon. Second, while maintaining explanations for the translation priming asymmetry and task-related differences given in the BIA+ model, Multilink explains how semantic activation works and how the task/decision system ensures the selection of the correct word candidate through language-membership checking. Finally, this updated computational model can actually simulate translation priming effects, allowing the model to adjust itself according to the ever-accumulating evidence or give researchers the opportunity to falsify itself by providing testable predictions and simulation results.

The next section investigates the available evidence so far regarding translation equivalent priming and how it complies with the predictions of different models. An investigation of this nature will help understand the gaps in the literature and whether the bilingual lexicon models can account for the findings.

2.3. Translation Equivalent Priming

Studies so far have presented abundant evidence in favor of semantic interaction between the words of different languages, even in the very early stages of language processing (Chaouch-Orozco et al., 2021; Dimitropoulou et al., 2011b; Duyck & Warlop, 2009; Finkbeiner et al., 2004; Jiang & Forster, 2001; Schoonbaert et al., 2009; Voga & Grainger, 2007; Wang & Forster, 2015; Witzel & Forster, 2012). Non-cognate translation equivalents seem to induce more priming effects compared to semantically related cross-language word pairs, and this was attributed to more shared conceptual nodes between translation equivalents compared to semantically related pairs (Schoonbaert et al., 2009). The stronger semantic relationships between translation

equivalents make such pairs a good way to investigate the semantic interaction between languages in early word processing.

Translation priming effects can interact with multiple factors, including but possibly not limited to language direction, language proficiency, language immersion, language dominance, prime duration or SOA, task differences, language script, and word frequency (e.g., Chaouch-Orozco et al., 2021; Lee et al., 2018; McPhedran & Lupker, 2021; Nakayama et al., 2016; Schoonbaert et al., 2009; Wang, 2013; Xia &Andrews, 2015). Nonetheless, the aforementioned challenge of numerous factors gets even more prominent when human consciousness gets involved, making it more difficult to distinguish between automated processes and consciously applied strategies. One solution to avoid the confounding factors brought by consciousness is to use the masked priming paradigm in word processing studies (see the Introduction). The following subsections investigate these factors and their potential interactions with each other in the word processing studies using the masked priming paradigm.

2.3.1. Language Direction

Subconscious processing of primes in the masked priming paradigm allows researchers to investigate the effects of rapid and automated processing of translation equivalents on responding to their counterparts in the other language. Unbalanced bilinguals, who have different levels of competence in their acquired languages, are likely to experience more processing difficulty for L2 word primes compared to L1 word primes. This limitation can result in a reduced or absent facilitation effect for the responses given for translation equivalents following their counterparts used as primes, which is called the translation priming asymmetry. The literature so far has offered abundant evidence in favor of this argument, as the non-cognate translation priming in the L2-L1 direction is found to be either absent or less effective than in the opposite direction.

There is not much debate around the efficiency of using L1 primes for L2 target words in the literature regarding translation equivalents; the evidence accumulated so far has shown a solid effect of translation priming (Dimitropoulou et al., 2011b; Duyck & Warlop, 2009; Jiang & Forster, 2001; Voga & Grainger, 2007). In fact, even unbalanced bilinguals with low L2 proficiency levels have shown prominent priming

effects for non-cognate translation equivalents in the L1-L2 direction (Dimitropoulou, 2011a). This suggests that bilinguals can activate L1 words even after very brief exposures to these words, and this activation spreads to semantic and/or lexical components that are shared by different languages (see Sections 2.1 and 2.2 above).

When L2 primes are used for L1 translation equivalent targets, the general pattern reflects a decrease in priming size or even a null effect in the masked priming studies (Chaouch-Orozco et al., 2021; Finkbeiner et al., 2004; Jiang & Forster, 2001; Schoonbaert et al., 2009; Wang & Forster, 2015; Witzel & Forster, 2012). Bilingual lexicon models have offered different explanations for these findings, such as inefficient processing of L2 primes (Dijkstra et al., 2019), few numbers of activated senses/conceptual features (Finkbeiner et al., 2004; Schoonbaert et al., 2009), or L2 words being stored in an episodic memory system (Jiang & Forster, 2001). Thus far, the exact reason behind this translation priming asymmetry remains elusive.

Further evidence for this pattern comes from EEG research. Midgley et al. (2009) used two semantic categorization tasks in different language directions with the same 36 French-English bilinguals. The participants acquired their L2 (English) at around the age of 12, and their L1 skills were reported to be higher by subjective proficiency scales (6.8 vs. 4.9 out of 7). Each experiment also included identical primes that were the same as the target words; therefore, each trial included four different prime conditions: identical primes, translation equivalents, unrelated primes within the language, and unrelated primes across the languages. Participants saw 40 experimental items per condition. The primes were presented for a 50 ms, followed by 16-ms backward masks to increase SOA (see Section 2.3.6 below). The target items appeared on the screen for 300 ms, and they were followed by a 1000-ms blank screen for giving answers and a 1500-ms fixation screen for blinking and resting. Animal names are used as filler items, and the participants were instructed to press a button whenever they saw an animal name; thus, experimental items required no overt responses.

The results showed within-language repetition effects (i.e., identical priming) and translation priming in the N250 and N400 components in the L1-L2 direction. In the opposite direction, translation priming only produced N400 effects, while within-language repetition produced both N250 and N400 effects. During the N250 time

window, the processing is regarded as purely form-based, in which letters and letter clusters are mapped onto the orthographic representations of whole words (Holcomb & Grainger, 2006). The finding of Midgley et al. (2009) contradicts this proposal, as they found a translation effect for non-cognate translation equivalents during this time window in the L1-L2 direction. This suggests that the N250 component might also reflect semantic processing. One might also argue that the observed priming effects stemmed from lexical connections rather than semantic similarity, as proposed by RHM (Kroll and Tokowicz, 2001). Midgley et al. (2009) state that as RHM proposes stronger lexical links in the L2-L1 direction, the results would have reflected larger L2-L1 priming effects in the N250 competent if the RHM model had been accurate. The findings seem to comply with Multilink, as this model is highly interactive and proposes that translation equivalents can activate each other through shared semantic representations even in the absence of orthographic overlap (see Section 2.2.4 above).

Midgley et al. (2009) also argue that L2 primes should also have been processed successfully since their effect was prominent in the N400 component; the participants, perhaps, could not process them quickly enough to reflect such effects in the N250 component, and a longer prime duration might have helped them to show N250 type priming effects. This possibility was investigated by another EEG study, which used longer prime durations with unbalanced bilinguals (see Section 2.3.6 below).

In the recent meta-analysis of Wen and van Heuven (2017), the translation priming asymmetry turned out to be significant based on the analyses of 64 lexical decision tasks combined with the masked priming paradigm; translation priming effect sizes were larger in the L1-L2 direction compared to the opposite direction (0.86 vs. 0.31 average effect size). The emergence of L2-L1 priming effects, despite their reduced efficiency compared to the L1-L2 direction, was taken as support for the view that the asymmetric translation phenomenon stems from quantitative rather than qualitative differences (Schoonbaert et al., 2009). Wen and van Heuven (2017) underlined that subjective proficiency measures might be less accurate compared to objective measures, and since only two studies provided objective measures of L2 proficiency (Dimitropoulou et al., 2011c; Nakayama et al., 2016), they were unable to measure the effect of L2 proficiency on the translation equivalent priming in their meta-analyses.

This created a severe limitation in an otherwise comprehensive meta-analysis regarding translation priming effects and left the question of whether L2 proficiency affects translation priming unanswered. The next subsection investigates the potential effects of L2 proficiency on translation equivalent priming.

2.3.2. Language Proficiency

Language proficiency has been proposed as one of the main factors behind the so-called translation priming asymmetry. Both Multilink and DRM propose that achieving native-like proficiency would eradicate the asymmetry obtained in the different language directions (see Section 2.2). The empirical evidence for this proposal comes from the masked priming studies with unbalanced and balanced bilinguals (the term *balance* refers to a similar competency in both languages). The absent or less effective priming effects were obtained in the L2-L1 directions with unbalanced bilinguals (Midgley et al., 2009; Schoonbaert et al., 2009), while the studies including bilinguals with very high levels of L2 proficiency showed symmetric priming effects in both language directions (Duyck & Warlop, 2009; Perea et al., 2008). This pattern, in which the translation priming asymmetry effect diminishes as L2 proficiency increases, has been confirmed in studies involving participant groups of varying L2 proficiency levels (e.g., Nakayama et al., 2016). The overall findings then suggest that highly proficient and balanced bilinguals can benefit from L2 primes as effectively as they benefit from L1 primes.

However, there are a few studies that have found contradictory results regarding this pattern. In one of these studies, Duyck and Warlop (2009) tested 24 unbalanced Dutch-French bilinguals who acquired their second language in an L1-dominant environment. Two prime conditions (related vs. unrelated) were created with 44 experimental items. The prime duration was 56 ms, and each prime word was followed by a backward mask of the same duration. Although the participants showed more numerical priming effects in the L1-L2 direction compared to the L2-L1 direction, the difference was not significant. This is surprising given the common finding of a significantly lower or even absent L2-L1 priming effect in unbalanced bilinguals. The authors suggest that the results indicate potential conceptual access to L2 words even at beginning levels of L2 proficiency. Nevertheless, the limited sample size of the

study might also explain the lack of statistical significance between the two language directions, despite a notable numerical difference (48 ms vs. 26 ms).

In an attempt to reveal the effect of L2 proficiency on translation priming, Dimitropoulou et al. (2011c) conducted an extensive masked priming study with different groups of varying L2 proficiency levels. The participants were unbalanced Greek- English bilinguals and were selected based on both objective (Cambridge ESOL examinations) and subjective (LEAP-Q; Marian et al., 2007) L2 proficiency measures. Three proficiency groups were created, each with 36 bilinguals who had similar ages of acquisition and language exposure amounts for their L2. The careful selection of the participants allowed the study to isolate the effect of language proficiency from potential exposure and age of acquisition effects. The prime duration was 50 ms, and there were no blank screens or backward masks to give extra processing time; target words in uppercase fonts immediately followed prime words in lowercase fonts.

Dimitropoulou et al. (2011c) created two lexical decision tasks to test both language directions by including a large pool of Greek-English translation equivalents (232 word pairs) based on the CELEX database (Baayen et al., 1996). In addition to related (translation equivalent) and unrelated primes, identical primes were also included in the design. The same two tasks were given to all three proficiency groups, with at least a three-day break between different language direction tasks. The order of the tasks for different language directions was counterbalanced: half of the participants started with the L2-L1 direction, while the other half completed the L1-L2 direction task first. The trial order was randomized.

Surprisingly, the results contradicted the general assumption that translation priming would increase in the L2-L1 direction by increasing L2 proficiency, a notion supported by quantitative account models such as DRM and Multilink. Despite the better performance of higher proficiency levels in responding to L2 targets, the amount of the masked translation priming effect remained the same across different proficiency groups. Dimitropoulou et al. (2011c) then concluded that L2 proficiency fails to modulate the amount of masked translation priming effects in unbalanced bilinguals, as all three proficiency groups in their experiment (even the low proficiency group)

showed equal L1-L2 and L2-L1 priming effects with non-cognate translation equivalents. This finding contradicts the previous studies failing to find L2-L1 translation priming effects (e.g., the LDT in Finkbeiner et al., 2004) and further supports the idea that the absence of such effects could have been due to low statistical power (see the meta-analysis of Wen and van Heuven, 2017). After all, the study of Dimitropoulou et al. (2011c) included 36 participants per group and 58 items per condition (more than 1600 observations per condition), which should provide enough statistical power in line with the suggestions of Brysbaert and Stevens (2018).

In a more recent study, Nakayama et al. (2016) carried out a lexical decision task in the L2-L1 direction with three different proficiency groups (determined by an objective L2 measure, TOEIC). The experimental items consisted of 60 non-cognate translation equivalents. Primes appeared for 60 ms, and targets followed the prime words without the intervention of any backward masks or blank screens. In the first experiment, 36 highly proficient Japanese-English unbalanced bilinguals completed the task and reflected a significant 10 ms translation priming effect with non-cognate translation equivalents in the L2-L1 direction. In the second experiment, the L2 proficiency of participants was even higher, and Japanese target words were selected from low-frequency words while English prime words were of high frequency. Nakayama et al. (2016) hypothesized that the conceptual activation induced by English prime words would show a more prominent facilitation for the low-frequency Japanese targets that have low resting activation levels. The amount of priming obtained in this experiment was 22 ms; this was a huge increase in the L2-L1 direction priming effects that was either caused by increased L2 proficiency or the manipulation of word frequencies. Furthermore, better L2 proficiency scores showed larger L2-L1 proficiency effects. In the last experiment, 34 Japanese-English bilinguals with relatively lower proficiency levels completed the same task with the items from Experiment 1. This time, however, the participants failed to show any significant L2-L1 priming effects.

Nakayama et al. (2016) interpreted their results within the framework of BIA+. As proposed in the model, L2 primes might have been processed more efficiently and rapidly with increasing L2 proficiency, which allows L2 words to acquire higher resting activation levels and thus become easier to activate. Thereupon, L2 words

could have been activated at the conceptual level by even weaker bottom-up input. In the absence of such efficient L2 word processing, however, the conceptual representations are not fully activated, leading to null results in the literature for the L2-L1 direction.

The apparent contradictory results of this study to the study of Dimitropoulou et al. (2011c) are explained through two potential reasons: First, the proficiency levels of the groups in the earlier study might be similar to each other, as all three groups responded to L2 target words in similar response times (671 ms vs. 699 ms) and showed similar priming effects in the L1-L2 direction (28-31 ms). Nakayama et al. (2016) argue that L1-L2 non-cognate priming should have been more for the bilinguals with lower L2 proficiency, based on the first experiment in Nakayama et al. (2013). Second, while the participants in Dimitropoulou et al. (2011c) were matched in terms of L2 age of acquisition, the participants in Nakayama et al. (2016) had more variation in that component.

Nakayama et al. (2016) also speculated that while L2 proficiency was not a significant factor in the early activation stages of L2 lexico-semantic features, L2 immersion might have been the potential factor behind the asymmetric effects found in the literature. To test this argument with their dataset, the researchers ran further analyses by using L2 immersion and L2 proficiency as independent variables. The results of these analyses indicated that L2 proficiency was the main factor behind the null L2-L1 priming effects in the LDT, while L2 age of acquisition was not a significant factor. Therefore, Nakayama et al. (2016) conclude that the previous null results in the L2-L1 direction with translation equivalents could have been due to L2 proficiency levels, word characteristics (e.g., length and frequency), and insufficient statistical power.

While these limitations might be the true reasons behind the absence of L2-L1 priming in some studies, the last reason mentioned, low statistical power, could also be true for Nakayama et al. (2016) as well. The study included only 34-46 participants for each experiment, and 60 experimental items were used for two different conditions. Such limitations make it harder to pin down the effects of L2 proficiency and to conclude whether L2 age of acquisition influences translation priming. The next subsection

investigates this latter possibility by investigating potential L2 immersion effects on translation equivalent priming.

2.3.3. Language Immersion

Language immersion is usually associated with the age of acquisition and the number of years a language has been used, but it might also refer to the number of years lived in an L2 environment. If I were to calculate L2 immersion based on this latter argument, I would have to label the bilinguals in the current study as *not immersed*. However, although these bilinguals had been living in their L1 country for years at the time of the study, they had had many opportunities to engage in interactions using their L2 and had been exposed to quality L2 input since they were studying English Language Teaching. Similarly, McPhedran and Lupker (2021) argue that such a calculation of L2 immersion based on the years spent in an L2 environment might be misleading and that the time spent in social interactions using L2 would be a better measure of immersion. While their argument seems logical, this language-use-based definition of L2 immersion overlaps with the L2 dominance interpretation adopted in the current study (see the next section). Therefore, I adopted the definition of L2 immersion stated in LHQ 3.0 (Li et al., 2020): Language immersion can be measured through the age of acquisition for different language components and the number of years spent using these components.

Even when a proficiency test refers to two people as having the same L2 proficiency, the starting age and manner of acquisition might also be a differentiating factor in word and overall language processing. Early or simultaneous bilinguals are usually exposed to L2 through authentic input starting at an early age and thus acquire their languages in a natural setting. Other bilinguals usually have limited opportunities for native-like language exposure and usually acquire their second language in a classroom setting at a later age. This difference, which is mostly ignored in bilingual lexicon models, might also affect word processing and priming patterns. Şafak (2015) argues that the acquisition process of an L2 may influence the processing of L2 words; differences in complex word processing have been observed between bilinguals who acquired their L2 in a classroom setting (Diependaele et al., 2011) and bilinguals who acquired it through exposure to native input (Jacob et al., 2018; Kırkıcı & Clahsen, 2013). It is no

surprise that the same difference is considered a potential factor in translation equivalent priming. Even without being exposed to authentic input from infancy, the age at which different language components are acquired and the years spent using each of them might still modulate translation priming effects.

The age of acquisition might alter the organization of the bilingual lexicon. Dimitropoulou et al. (2011c) argue that the role of L2 immersion affects the functional segregation of a bilingual's languages rather than the ease of lexical access. As low-proficiency L2 bilinguals show similar lexico-semantic priming effects to native speakers in pure L2 tasks (e.g., Diependaele et al., 2011), the researchers argue that cross-linguistic activation might be more costly than lexico-semantic activation within a single language. Dimitropoulou et al. (2011c) further refer to their findings of more identical priming than translation equivalent priming to support this claim. As late L2 learners mostly rely on L1 translations while acquiring L2 words, this could have also created more dependence on L1 word activation in using L2 words (e.g., Kroll & Stewart, 1994; Sunderman & Kroll, 2006). Early bilinguals acquire their L2 before the semantic system and L1 lexicon are completely organized, so L2 words would be similar to L1 words in this system. Referring to Perea et al. (2008), they showed how early bilinguals show similar semantic priming effects both across languages and within the same language. Furthermore, Duñabeitia, et al. (2010a) reported symmetric masked translation priming effects in their EEG study with simultaneous bilinguals. According to Dimitropoulou et al. (2011c), early bilinguals learn L2 words without referring to their L1 counterparts, and thus the activation of translation equivalents is based on similar semantic features rather than lexical connections. This proposal is supported by Duñabeitia et al. (2010a), as they found only N400 activation with translation equivalents that is usually associated with semantic activation (for a contradictory finding, see Midgley et al., 2009).

Contrary to this acquisition-age-based view, Malt and Sloman (2003) argue that the conceptual representations of L2 words are affected by exposure to L2, not the age of L2 acquisition. In their study with 68 L2 English bilinguals with different L1s, naming and typicality patterns for objects differed for L2 users and native speakers. However, the bilinguals who had spent more time in an L2 context showed more similar patterns to native speakers, although they still showed variance despite their long years of

exposure to L2 in an L2-speaking context. Malt and Sloman (2003) concluded that language exposure, rather than a critical age, was a significant factor in acquiring native-like conceptual representations, and the quality and amount of this exposure mattered since the years of formal L2 instruction failed to explain as much variety as the years spent in an immersed L2 environment. This proposal requires further confirmation as the participants in the study had a large variety of L1 backgrounds, and the variation in their ages of L2 acquisition was not given.

Whether due to the qualitative difference of L2 word presentations or the efficiency of language segregation, age of acquisition seems to play a role in translation equivalent priming. In one of the few studies finding symmetrical translation priming effects for both directions, Duñabeitia et al. (2010b) conducted two masked priming lexical decision tasks in both language directions with 32 simultaneous Spanish-Basque bilinguals. The experimental items had an equal number of cognate and non-cognate translation equivalents, and although the concreteness scores were kept similar, cognate pairs had far more positional letter overlap with their counterparts in both language direction lists (55.7 and 56.9%) than non-cognate pairs (9.0 vs. 8.6%). The participants completed each task (L1-L2 and L2-L1) on a different day and in a pseudo-randomized order to avoid any task-order effects. The results showed that cognate pairs induced more priming effects compared to non-cognate pairs, and this priming advantage can be attributed either to the shared lexical presentation of cognate pairs or to the higher overlap they had. In a further analysis, Duñabeitia et al. (2010b) confirmed the latter assumption, as the priming effects were increased by higher orthographic overlap.

The most interesting finding of the study was the significant priming effects for non-cognate translation equivalents in both language directions without statistically meaningful differences (Spanish-Basque: 20 ms, Basque:Spanish: 16 ms). Despite using a short prime duration (47 ms) without any backward masks, the participants could process the primes in both languages with similar efficiency. Cognate pairs showed a numerical advantage in Spanish-Basque direction, and Duñabeitia et al. (2010b) argued that the overall slower responses for Basque targets allowed Spanish related primes to induce more priming effects due to increased response time. Although the Basque language was the medium of instruction at all academic levels

for the participants, the researchers stated that the participants were exposed to written Spanish more as a result of the higher percentage of written Spanish materials (e.g., books, newspapers) in their context.

The results were in line with BIA+ (and Multilink): Non-cognate pairs might induce priming effects through shared conceptual representations, while cognates show an advantage over them as they are also boosted by the activation of shared orthographic features. Duñabeitia et al. (2010b) argue that their findings of symmetrical translation priming in both directions contradict the predictions of the Sense Model, which proposes that translation equivalents are qualitatively different from each other as each counterpart (but mostly L1 counterparts) possesses language-specific senses, resulting in the translation priming asymmetry.

However, simultaneous bilinguals might share more senses between translation equivalents as they are exposed to both languages starting from infancy. While the finding of symmetrical priming effects in Duñabeitia et al. (2010b) is of uttermost interest, the reason behind the lack of translation priming asymmetry is unclear. The bilinguals in the study had acquired both languages at early ages and had received authentic and abundant input for both languages starting from infancy. Since the development of the L1 lexicon could not be completed in infancy, such early exposure to both languages might have created identical L1 and L2 lexicons. The claims of the Sense Model would have been strongly rejected only if such symmetrical effects had been found with sequential bilinguals.

This possibility was later tested in a recent study in which Chaouch-Orozco et al. (2021) conducted a similar masked priming experiment with 60 Spanish-English sequential bilinguals. In this study, however, the bilinguals acquired their L2 later, around the age of 9 (SD: 2,9), despite having been immersed in an L2 speaking environment at the time of the experiment (at least 5 years) and having a long history of L2 exposure/use (12 years; SD: 6,4). The language proficiency of the participants was measured by the Oxford Quick Placement Test (QPT, 2001). Both language directions were tested with a 60-ms prime duration using 50 translation equivalents.

In spite of similar numerical values for the priming effects in both language directions, only the L1-L2 direction showed significant priming effects. L2 proficiency could

account for some of the variation in the responses for low-frequent L2 words, as the bilinguals with lower L2 proficiency reacted slower to these items in the related condition. This was taken as an indicator that only bilinguals with higher L2 proficiency could benefit from L1 primes while responding to less-frequent L2 words. Chaouch-Orozco et al. (2021) underline that conclusive claims were not possible due to the lack of variance in the L2 proficiency scores of their participants and that such an extensive investigation would require bilinguals who vary a lot in their L2 proficiency.

Despite the absence of significant priming effects in the L2-L1 direction, language exposure/use emerged as a more prominent factor in the size of numerical priming; the observed priming effects increased for the bilinguals with more L2 exposure and L2 use indices. Without denying the role of L2 proficiency, Chaouch-Orozco et al. (2021) suggest that language use/exposure plays a more prominent role in explaining their results.

As discussed above, L2 age of acquisition might be the reason behind the null L2-L1 priming in Chaouch-Orozco et al. (2021) versus the symmetrical translation priming in Duñabeitia et al. (2010b). Although both bilingual groups had been exposed to quality L2 input in great amounts, only the bilinguals in the latter study acquired both their languages as infants. While both studies might have suffered from limited study power (limited number of items in Chaouch-Orozco et al. and numerous experimental conditions in Duñabeitia et al.), the contradicting findings still underline the importance of separating the definition of L2 immersion (AoA and years of use) from active language use, which is defined as L2 dominance in the current dissertation. In the following subsection, I investigate the effects of L2 dominance on translation equivalent priming.

2.3.4. Language Dominance

L2 immersion has been defined in varied ways in the literature, and some of these definitions overlap with the definitions offered for L2 dominance. Although using a scale explicitly referring to itself as a measurement of language dominance, Chaouch-Orozco et al. (2021) preferred the term *active language exposure/use* as they believe that bilinguals who are exposed to L2 through school education in their L1 contexts

for the majority of their lives would be wrongly labeled as L2 dominant if they moved to a country where L2 was dominant, even though the time they spent in this L2 context would be limited. Besides the time spent in an L2 context, L2 proficiency is also important in determining L2 dominance. A bilingual who has low L2 proficiency might live in an L2 context for years and engage in many conversations using their L2, but at the same time, this person might sustain limited competency in L2. Labeling this bilingual as L2 dominant would also be misleading, as the context and topics such a person uses in their L2 might be limited despite the quantity of L2 interactions. The participants in the current dissertation, on the other hand, had been living in their home country for years but had high L2 proficiency and had been using their L2 proficiently in interactions. Acknowledging the importance of both language proficiency and use in describing language dominance, I define language dominance as a combination of the relative use and proficiency of a certain language in daily life. This is in line with LHQ 3.0 (Li et al., 2020), as it calculates the language dominance score based on the self-reported time spent using each language component in a day along with the self-reported language proficiency.

The absence of translation priming in the L2-L1 direction in Chaouch-Orozco et al. (2021) raises the question of whether the acquisition of an L2 after infancy might have been behind such null effects and whether the absence of a symmetrical L1-L2 dominance would result in similar null effects in the L2-L1 direction. The masked priming study of Wang (2013) offers an answer to this question by including two different bilingual populations: English-dominant Chinese-English bilinguals and balanced Chinese-English bilinguals. All participants reported similar L2 proficiency ratings for language components, with the exception of writing skills for the English-dominant group. As for L2 age of acquisition, the English-dominant group reported that they had acquired their L2 around the age of five, while the majority of the balanced group reported that they either had acquired their L2 around the age of four or acquired both languages as their native languages. The results showed that while the balanced bilinguals showed significant translation priming effects in both language directions, the English-dominant bilinguals showed only L1-L2 (the English-Chinese direction) priming effects. Wang (2013) emphasized the difficulty of differentiating language proficiency from language exposure, as the latter increases the former.

Language dominance, which was defined as the ratio of use and proficiency of known languages based on Dunn and Fox Tree (2009), was argued to be a better indicator of translation priming patterns than language proficiency.

Wang (2013) argues that RHM and BIA+ could not explain the findings as such models assume shared semantic representations for specific word pairs like translation equivalents, while in fact, translation equivalents only overlap to a certain extent in terms of meaning. Instead, the Sense Model is argued to have a better explanation for the findings: Rather than relying on a shared semantic representation system, this model proposes that translation equivalents share some *senses* (see Section 2.1.1). Since the words in the dominant language usually have more senses, the priming effect is increased when the prime is given in that language. Following this line of reasoning, balanced bilinguals showed similar priming patterns in both directions because of the similar number of senses associated with the words of both languages.

All in all, Wang (2013) argues that only balanced bilinguals who have had enough opportunities to acquire and use their languages develop more balanced lexical presentations, especially in terms of semantics. This allows bilinguals to process primes in both their languages with similar efficiency, thus inducing similar translation priming effects in both language directions. As the bilinguals in their study acquired both of their languages at very early ages and the balanced group had acquired their L2 even earlier, the potential effect of L2 age of acquisition remains elusive. In spite of these interesting results and claims, it is important to underline that the study lacked statistical power as each group included 20 participants and the tasks included 40 experimental items for each condition (related vs. unrelated conditions).

One of the most interesting arguments in literature is perhaps the dominance shift between a bilingual's languages. Using two groups of Spanish-English bilinguals, Basnight-Brown and Altarriba (2007) conducted one unmasked and one masked priming study. The groups were really specific in that both of them reported better L2 (English) skills for writing, speaking, and spoken comprehension than L1 (Spanish). Using 100 ms unmasked primes, Basnight-Brown and Altarriba (2007) found asymmetrical translation priming effects with the first group, but surprisingly, the L2-L1 direction induced more priming effects for both semantically-related pairs and

translation equivalent pairs. Using the same procedure and materials with masked primes this time, the second group showed symmetrical translation priming effects in both language directions but no semantic priming in either direction.

The findings were taken as evidence for the shift of the dominant language; the bilinguals in the study used their L2 to such an extent that it became their dominant language. Using masked priming decreases the visibility of primes, and since the primes were less visible in the second experiment with the inclusion of masks, semantic priming effects might have been decreased. This also suggests that the greater L2-L1 priming in the first experiment compared to the opposite direction might stem from increased semantic activation in the dominant language.

Referring to the Sense Model, Basnight-Brown and Altarriba (2007) suggest that although L1 primes might normally activate more senses for L2 words than the opposite direction, early acquisition of both languages might allow the development of numerous senses in a bilingual's languages and lead to better retrieval of semantic and conceptual information associated with L2 words. They argue that age of acquisition, along with language dominance and proficiency, should be taken into account in designing translation equivalent studies.

One additional item that should be added to that factor list is prime duration. Basnight-Brown and Altarriba (2007) used 100 ms primes, which are longer than the usual prime durations (30-80 ms) used for unconscious processing. This longer duration might have induced conscious processing of the prime words in their study and resulted in a different pattern than what would have been observed if shorter prime words were used. Confounding factors like limited samples, item size and characteristics, and individual differences have already painted a blurry picture of how language proficiency, immersion, and dominance affect translation equivalent priming in the literature. Using different prime durations, or SOAs (stimulus-onset asynchronies), further contributes to the blurriness of the results obtained so far. The next subsection investigates whether using different prime durations or SOAs modulates translation priming effects.

2.3.5. Prime Duration and SOA

Different experimental manipulations can influence how words in different languages interact with each other. One common manipulation in the masked priming paradigm is stimulus-onset asynchrony (SOA), which refers to the time between the presentation of the prime and the presentation of the target. Along with using longer prime durations, using backward masks or blank screens after primes are common ways to increase SOA and give participants longer times to process primes before seeing target words.

Nakayama et al. (2016) argue that testing the effects of longer prime duration on translation equivalent priming can help test the claims of the BIA+ model against the Episodic L2 Hypothesis. Recall that BIA+ (and more recently, Multilink) would interpret the absence of L2-L1 priming with regards to the lower resting activation L2 words have. With longer prime durations, bilinguals would have more time to process and activate L2 words, thus showing more priming effects in the L2-L1 direction. According to the Episodic L2 Hypothesis, increasing the activation level of L2 words, which are stored in episodic memory, would still result in null priming effects in the L2-L1 direction, as the priming effects observed in this task are related to the activation of the lexical representations in the lexical memory system. The Episodic L2 Hypothesis then proposes that these differences are qualitative and could not be eliminated with increased SOA or prime duration, while BIA+ (and Multilink) argues that the differences between L1 and L2 words are mostly quantitative in nature and can be compensated for by increased lexical activation through longer prime durations.

In an extensive study to reveal the role of SOA in translation priming, Schoonbaert et al. (2009) carried out four different experiments, each including around 60 unique Dutch-English unbalanced bilinguals. The participants in all four experiments had similar language backgrounds and had acquired their L2 at school around the age of 12. The first two experiments tested translation priming in different directions and with different SOAs (100 ms and 250 ms, 50 ms prime durations for both). The second pair of experiments adopted the same design but used semantically related cross-linguistic

words instead of translation equivalents in an attempt to investigate cross-linguistic semantic priming.

The results showed that longer SOAs increased the observed priming effects in all experiments, and there were no effects of concreteness. The only absent priming effect, semantic priming in the L1-L2 direction with a 100 ms SOA, also became significant when the SOA was increased to 250 ms. Overall, the boosting effect of increased SOA was prominent in all experiments. The primes induced more facilitative effects in the L1-L2 direction than the L2-L1 direction and with the translation equivalent pairs than the semantically related pairs. The observed translation priming asymmetry was also more prominent for translation equivalents compared to semantically related pairs.

Since the patterns observed were similar between conditions, Schoonbaert et al. (2009) concluded that there were quantitative differences between the processing of L1 and L2 words, as well as between translation equivalents and semantically related pairs. The researchers rejected the existence of lexical connections between languages (as opposed to RHM) and argued that priming effects observed between translation equivalents and cross-linguistic semantic pairs were due to conceptual mediation. The findings were used to propose a refined version of the Distributed Representation Model (see Section 2.2.1).

The potential effects of prime duration and SOA are further investigated in EEG studies. Although Midgley et al. (2009) failed to find L2-L1 priming effects with 50-ms primes in the 250-ms time window, they argued that longer prime durations would make such priming more prominent and detectable in the early stages of word processing, in line with BIA+. Testing this argument in another EEG study, Schoonbaert et al. (2011) used 100 ms prime durations with lexical decision tasks for both language directions. Twenty English-French bilinguals, who had acquired their L2 at around the age of 12 (average: 11.85 years; SD = 2.67), participated in the study. In addition to 100-ms primes, 20-ms backward masks were also used to increase SOA up to 120 ms.

Confirming the predictions of Midgley et al. (2009) and the BIA+ model, L2-L1 priming effects were observed when the prime duration was longer (100 ms). Schoonbaert et al. (2011) argued that this showed the differences between processing

L1 and L2 words (e.g., translation priming asymmetry) stem from quantitative differences rather than qualitative ones. In line with the BIA+ model, L2 exposure is argued to affect L2 word processing speed due to these quantitative differences, as the bilinguals who had been exposed to L2 for a long time showed priming effects in both language directions. Despite the emergence of the L2-L1 translation effects, however, the translation priming asymmetry was still apparent as the opposite direction produced larger priming effects (70 ms vs. 24 ms).

The data regarding brain activity reveals more about the patterns of priming effects in both language directions. L1-L2 priming produced longer N400 activation compared to the opposite direction, possibly due to a latency shift created by the slower processing of L2 words. Interestingly, L2-L1 priming effects were more spread and stronger in the N250 component compared to L1-L2 priming effects, which contradicted the finding of Midgley et al. (2009). Schoonbaert et al. (2011) proposed two potential explanations. First, translation priming effects might diminish as SOA increases, similar to how identity priming effects decrease with increasing SOA (Holcomb & Grainger, 2007). Referring to the reset mechanism proposed by Holcomb and Grainger (2007), the researchers argue that words might be suppressed along with their translation equivalents to activate new upcoming words, unlike semantic representations that are needed for sentence-level integration. The second explanation is based on the premises of RHM: Semantic links might be stronger in L1 words. This would allow L1-L2 translation priming effects to involve more semantic activation, while L2-L1 activation mostly relies on direct lexical connections. In line with Holcomb and Grainger (2007), L1-L2 priming effects must be most apparent in the 400-ms time window due to more involved semantic activation, while the opposite direction must induce such effects in the 250-ms time window, as the L2-L1 direction is associated with direct lexical associations. The reason why Midgley et al. (2009) failed to find the same pattern might have been related to the shorter prime duration they used; activating L1 words through the associate links of L2 primes might require more time, thus a longer SOA.

Finally, Schoonbaert et al. (2011) conclude that increased L2 proficiency and longer prime durations would produce the same effect, as they both allow bilinguals to process L2 prime words more efficiently in a limited amount of time. Considering the

already complex relationship between L2 proficiency, immersion, and dominance, testing this hypothesis would require a thoroughly controlled experiment.

One prominent study showing how SOA duration can be a crucial element in translation priming was carried out by Lee et al. (2018) with unbalanced Korean-English bilinguals. Two experiments investigated translation priming effects in the L2-L1 direction but with different SOA values: 150-ms SOA (50 ms primes followed by 100 ms blank screens) and 60-ms SOA (50 ms primes followed by 10 ms blank screens). The participants for both experiments (30 in the first, 43 in the second) had low L2 proficiency and had acquired their L2 rather late (after the age of 10).

The L2-L1 priming effects were observed only with 150-ms SOA (Experiment 1), as 60-ms SOA failed to induce any facilitation in this direction. Lee et al. (2018) argued that the null finding in the L2-L1 direction with a shorter SOA in their study and in the literature stems from the insufficient time provided for processing L2 primes. The study was crucial in showing that L2-L1 translation priming was possible with unbalanced bilinguals whose languages use different scripts. The results were taken as evidence in favor of the BIA+ model: L2 words have low resting activation levels, and short SOAs might fail to activate them when L2 proficiency is low. Increasing SOA in such experiments, therefore, helps the activation of L2 prime words.

Lee et al. (2018) also referred to the refined DRM (Schoonbaert et al., 2009) and suggested that the findings fit within this model as well; giving participants more processing time for L2 words might have allowed them to activate more shared semantic nodes between translation equivalents and thus induced facilitative priming effects. On the other hand, the findings were argued to contradict the models that argue in favor of qualitative differences between translation priming in two language directions. The Sense Model proposes that L2 words have fewer senses to activate, so increasing SOA would not help go beyond these limited available senses. Similarly, the Episodic L2 Hypothesis refers to episodic memory in which L2 words are processed, while a lexical memory system is responsible for processing L1 words. Since L1 words and L2 words are processed in different memory systems, giving more processing time would not alter the processing pattern.

Increasing prime duration (or SOA) might make prime words more detectable and thus increase the activation of such words. Finkbeiner (2005) proposes that L2-L1 priming effects in masked priming tasks might depend on some awareness of primes, as including a 50-ms blank screen between primes and targets resulted in the emergence of such effects in their study; the inclusion of the blank screen was thought to make the participants more aware of primes. Investigating whether prime awareness is behind the so-called translation priming asymmetry, Wang and Forster (2015) compared 36 Chinese-English bilinguals to 18 native speakers of English. The unbalanced bilinguals in the study were highly proficient in their L2 (English), had acquired it through formal education in China, and had spent at least 1.5 years in the USA at the time of the study. The masked priming paradigm was used with both semantic discrimination tasks and lexical decision tasks.

In a semantic discrimination task combined with the masked priming paradigm, participants first see a fixation point followed by a prime, which is the common way of presenting primes. Following the prime word, they see two options as their targets and need to decide which option is semantically related to the prime word. Unlike most other masked priming tasks, in which primes are meant to be hidden and obscure, this task encourages participants to pay attention to primes. Even though the primes might not be consciously seen, their presentation might allow participants to choose the correct option if such priming was to activate the semantic features of the prime word. Wang and Forster (2015) used various prime conditions in the same task along with a backward mask of 150 ms, and the primes were semantically related to one of the given options in the same language. The bilinguals gave more accurate answers in their L1 for all prime durations; however, the difference between the efficiency of L1 and L2 primes started to vanish when the primes were presented for 80 ms and 90 ms durations. The native speakers, who were tested in their native language only, showed an increasing accuracy level with increasing prime durations as well, although they outperformed bilinguals in each prime duration. When both groups were compared in terms of performance in L1, they showed a similar pattern. Wang and Forster (2015) argued that bilinguals process L2 primes less efficiently and automatically compared to native speakers, and this limitation might have been remedied by giving them more time to process prime words.

To test this hypothesis, Wang and Forster (2015) used two masked priming lexical decision tasks in different language directions, using the same pool of bilinguals. They used an 80-ms prime duration without any backward masks and tested 60 translation equivalents in each direction. Surprisingly, the bilinguals showed prominent priming effects in the L1-L2 direction but no effects in the L2-L1 direction, despite the 80-ms prime duration. It was argued that the absence of L2-L1 priming is not due to the relatively lower awareness of L2 primes compared to L1 primes. While the bilinguals showed increasing performance with increasing prime duration in the semantic discrimination tasks (same-language primes and targets), their failure to do so in the lexical decision tasks (cross-language primes and targets) raised the question of whether cross-linguistic priming might depend on different mechanisms.

Alternatively, Wang and Forster (2015) also accept the possibility that translation priming is a prospective process in which the activation of prime words in turn affects their translation equivalents in the other language and makes them recognized faster. Such an automatic system would depend more on reading proficiency than prime duration, so increasing prime duration would not actually help in cross-linguistic priming. This explanation is in line with the findings of Midgley et al. (2009), as L1-L2 translation priming effects were prominent both in the N250 and N400 time windows, indicating that the semantic activation induced by L1 primes also altered the activation of form-level representations in L2 word recognition.

One unanswered question in the study was related to the different activation patterns for increased prime duration in different tasks. By referring to the Sense Model, Wang and Forster (2015) speculated that although L2 primes might be processed successfully in different tasks, the amount of priming might depend on the activated senses of the target word, which was argued to be more in semantic categorization than lexical decision tasks (e.g., Finkbeiner et al., 2004). The other explanation was offered within the premises of the Episodic L2 Hypothesis; L2 words might be stored in the episodic memory system rather than the lexical memory system, and unless the targets presented also exist in the episodic memory, L2 primes cannot induce priming effects. Wang and Forster (2015) warned, however, that both models were limited as they are: The Sense Model could not explain the emergence of L1-L1 priming in an episodic recognition memory task as this task also lacks categorical features, just as the lexical

decision task does. The episodic L2 hypothesis, on the other hand, could not explain translation priming in the L2-L1 direction.

Although the concerns regarding the models are legitimate, the controversy regarding the potential effects of prime duration and SOA cannot easily be eliminated with the findings of Wang and Forster (2015). A severe limitation of their study was the limited sample size. Although their study power might have allowed L1-L2 priming effects to emerge, it could have been insufficient for the L2-L1 direction, which is known to have a smaller effect size (e.g., Schoonbaert et al., 2009; Wen & van Heuven, 2017). A second potential limitation concerning this study was the different presentation procedures of primes in the different tasks; Wang and Forster (2015) included a backward mask in their semantic discrimination task, which increased SOA and gave the participants more processing time. The absence of this backward mask in the lexical decision tasks might have caused the L2-L2 priming effects to be null.

Further support for this argument comes from the extensive meta-analyses of Wen and van Heuven (2017), who examined 64 translation priming studies and concluded that SOA value was a significant variable in the observed priming effects in the literature. One might argue that regardless of prime duration, SOA determines the efficiency of processing L2 primes. Recall that Lee et al. (2018) found no priming effects in the L2-L1 direction when 10 ms blank screens were used after 50 ms, but such effects emerged when the duration of the blank screen was increased to 100 ms. Similarly, although Schoonbaert et al. (2009) obtained significant L2-L1 priming effects with two different SOA values, even the smaller SOA value was 100 ms in their study. The follow-up study using EEG by Schoonbaert et al. (2011) used a longer prime duration, but again the SOA value was 120 (100 ms primes were followed by 20 ms backward masks).

The overall pattern suggests that increasing SOA would give bilinguals more time to process primes, which is especially helpful in processing L2 words. The findings so far have indicated that 100 ms might be enough for processing L2 words. However, it is also important to keep in mind that most studies so far have suffered from several limitations, the most prominent being limited sample sizes. It is, therefore, unclear whether increasing prime duration but keeping it under 100 ms (to ensure unconscious

processing) would affect the patterns obtained in translation equivalent priming in both language directions.

Investigating how priming effects are modulated in different tasks can confirm or disprove the premises of different models. Different SOA values can also result in different effects on different tasks (Finkbeiner, 2005). The next subsection investigates potential task differences in translation equivalent priming effects.

2.3.6. Task Differences

Task type is referred to as a potential factor influencing cross-linguistic interaction. As discussed in Section 2.2, Multilink proposes a task/decision system that tunes word processing according to tasks and their demands, even in the early word processing stages. The Episodic L2 Hypothesis proposes that L2 primes would facilitate the recognition of their L1 translation equivalents in episodic memory tasks and not in lexical decision tasks, as L2 word representations are stored in the episodic memory system (see Section 2.1 above). The Sense Model also accepts that different tasks might modulate translation priming effects; for example, a semantic categorization task might prioritize the evaluation of categorical features and show different results than a lexical decision task for unbalanced bilinguals. Considering the varying claims of models regarding task differences, the nature of translation priming can only be fully understood by investigating how different tasks modulate this effect.

Although the Sense Model (Finkbeiner et al., 2004) proposes that translation asymmetry diminishes in semantic categorization tasks, this claim is challenged by the findings of Xia and Andrews (2015). In the first experiment of this more recent masked priming study, 37 unbalanced Chinese-English bilinguals completed lexical decision and semantic categorization tasks in both language directions. The participants had started acquiring their L2 around the age of 10 and had learned it for an average of 9 years during their formal school education in China. All participants had been exposed to authentic L2 input as they had been accommodated in Australia for at least a year (3 years on average).

The bilinguals first completed the semantic categorization task, in which both exemplars and non-exemplar items were primed. The task also included within-

language identity priming, but the targets were from a single language within a block; therefore, the participants saw all target words in a single language before responding to the target words in the other language. The primes appeared on the screen for 50 ms and followed by 150-ms backward masks. The results showed a clear translation priming asymmetry and an absence of L2-L1 priming effects for non-exemplars. This latter result is in line with the predictions of the Sense Model; since non-exemplars do not benefit from category filtering in a semantic categorization task, they are responded to more like target words in a lexical decision task, thus showing no priming effects in the L2-L1 direction. The observed translation priming asymmetry, however, contradicts the Sense Model. The model proposes a larger translation priming asymmetry for non-exemplars, but on the contrary, the results showed a numerically smaller asymmetry for non-exemplars in different language directions (88 vs. 55 ms).

Using the same materials and participants, Xia and Andrews (2015) carried out a lexical decision task in both language directions. Identical primes were again included, along with translation equivalent related primes. While the bilinguals showed apparent priming effects in the L1-L2 direction and for L1-L1 identical primes, such effects were absent in the L2-L1 direction and for L2-L2 identical primes.

Having speculated that the translation priming asymmetry observed for their exemplars in the semantic categorization task might have been due to target frequency, Xia and Andrews (2015) carried out a second pair of tasks with items of higher frequency. Thirty-two unbalanced Chinese-English bilinguals with a similar language background completed both a semantic categorization task and a lexical decision task. The semantic categorization task resulted in a similar pattern with similar priming values, as there was no L2-L1 priming for non-exemplar items. A further analysis showed that target frequency was an insignificant factor in the observed priming effects. In the lexical decision task, L2-L1 priming and the effect of target word frequency were again absent, but L2-L2 identical primes induced significant priming effects this time.

In light of the findings, Xia and Andrews (2015) argue that although the semantic categorization task induced more translation priming effects in the L2-L1 direction compared to the lexical decision task, the translation priming asymmetry still emerges

in both tasks. The null L2-L1 priming for non-exemplars suggests that the L2-L1 priming in the semantic categorization task is observed only with exemplar items.

The findings failed to confirm the category filtering mechanism proposed by the Sense Model; the observed translation priming asymmetry was not boosted for non-exemplar items. Interestingly, only exemplar items produced L2-L2 (identical) priming effects in the first experiment, but this effect was apparent for both exemplar and non-exemplar items in the second experiment with target words of higher frequency. However, L2-L1 priming was still absent for non-exemplars in this latter experiment, further supporting the idea that L2-L1 priming is not directly related to the strength of L2-L2 priming.

As an alternative explanation to category filtering, Xia and Andrews (2015) state that processing a translation equivalent in a masked priming task might allow semantics to provide feedback for lexical form representations, thus creating a facilitative priming effect. When category cues are used, such as the ones in a semantic categorization task, semantic features can be pre-activated and the semantic feedback created by primes can be boosted. This in turn enhances the activation of the lexical representation of the target item, given that it is in a semantically relevant category as the prime word. As L2 words are often argued to have weaker lexical representations, such a boost might compensate for this limitation and increase the processing efficiency of such words. In the absence of this boost, however, lexical decision tasks usually fail to induce L2-Ll priming effects.

This idea can be supported by the findings of the EGG research. As discussed in Section 2.3.5 above, the N250 time window in an EEG task seems to be unaffected when short prime words are used (e.g., Midgley et al., 2009). As this time window is argued to reflect the processes in which pre-lexical orthographic units are mapped on words (e.g., Grainger & Holcomb, 2009), the absence of L2-L1 priming might have been due to inefficient processing of brief and masked L2 primes. The N400 component, on the other hand, is argued to involve associating semantic features with lexical forms. Following this line of reasoning, L2-L2 priming emerges at the N250 component as identical primes share both form and semantic overlap. When L2 prime words are presented, the processing of these primes might not be efficient enough at

this component to provide feedback for the lexical presentations of L1 translation equivalents. Further support for this argument comes from Schoonbaert et al. (2011), who used 100-ms primes with 20-ms backward masks and found prominent L2-L1 priming effects for non-cognate translation equivalents at the N250 component.

In light of these findings, the following assumptions can be made: Semantic representations might provide feedback for lexical form representations when primed by semantically related words like translation equivalents. Although this feedback can help the activation of lexical forms when prime words are in L1, L2 prime words might fail to do so due to their less efficient processing, especially in shorter prime durations. A semantic categorization task might help with this semantic feedback since it provides additional categorial cues, which can boost the activation of semantic features. Similarly, using longer SOAs might give sufficient time to provide enough semantic feedback for lexical forms and thus induce significant translation priming effects in the L2-L1 direction (e.g., Schoonbaert et al., 2011). As proposed by Schoonbaert et al. (2009), a semantically mediated route can explain the so-called translation priming asymmetry; while this route is more efficient in the L1-L2 direction, it is more task-dependent and inefficient in the opposite direction, often failing to induce L2-L1 priming effects unless more time is given to process prime words.

All things considered, the results of Xia and Andrews (2015) show that the Sense Model successfully predicted stronger L2-L1 priming for the exemplar items in semantic categorization tasks compared to lexical decision tasks and the necessity of identical priming in an L2 for L2-L1 priming. Activating categorical features in an SCT seems to enhance the activation of semantic features and allow better feedback from semantics to the form representations of lexical items. The more efficient activation of lexical forms is especially important for observing priming effects in the L2-L1 direction since L2 primes usually fail to provide enough semantic feedback to induce such priming effects. However, the results failed to confirm a category filter as the translation priming asymmetry was still apparent in SCTs and did not increase for non-exemplar items.

In a more recent study with a large pool of 103 bilingual participants, McPhedran and Lupker (2021) investigated the possible task effects on translation priming along with its potential interactions with L2 competency. The Chinese-English bilinguals in the study were born in China but had been living in Canada for some time (Average years: 2.92, ranging from 0 - 21). Each participant completed both a lexical decision task and a semantic categorization task in the L2-L1 direction in a pseudo-randomized order. In both experiments, 50-ms prime words were followed by 150-ms backward masks, identical to the procedure of Finkbeiner et al. (2004). For the semantic categorization task, target words appeared twice in the same experiment, once as an exemplar in a category block (e.g., the word *cow* in the category of *animals*) and a second time as a non-exemplar in another category block (e.g., the word *cow* in the category of *house items*), similar to the design in Finkbeiner (2004).

McPhedran and Lupker (2021) argue that although using standardized L2 proficiency measures can show a general correlation between L2-L1 translation priming effects in lexical decision tasks (e.g., Nakayama et al., 2016), such studies failed to determine whether some specific sub-skills of L2 proficiency influence such priming effects rather than the overall L2 proficiency. In an attempt to overcome this limitation, they created ExPrime scores using the Language Experience and Proficiency Questionnaire (LEAP-Q; Marian et al., 2007) and the average priming values in their data for each participant (see McPhedran & Lupker, 2021).

Replicating the previous studies, the findings showed an absence of overall priming effects in the L2-L1 direction in the lexical decision task, while the same direction induced significant priming effects in the semantic categorization task. Furthermore, the results showed a very interesting interaction between the task type and L2 competency; although the observed L2-L1 priming interacted with L2 competency in both lexical decision and semantic categorization tasks, the significant components of L2 measurement were different in each task for this influence. Specifically, the translation priming effects were greater in the lexical decision task when the bilinguals had higher reading and writing scores and better comprehension of the spoken language in their L2. On the other hand, the priming effect in the semantic categorization task was enhanced by the fluency of speaking and listening as well as the frequent use of L2. McPhedran and Lupker (2021) warned, however, that L2 skills

were based on self-assessment in their study, and further studies should include objective measurement tools for L2 proficiency and perhaps compare these with self-ratings in terms of their accuracy in predicting translation priming patterns.

McPhedran and Lupker (2021) suggest that the findings are in line with Multilink. Despite the same general processing proposed for both lexical decision tasks and semantic categorization tasks in this model, the task/decision system can make necessary adjustments according to task requirements. In a lexical decision task, the decision of whether a given string is a real word can be made by the activation level of lexical-orthographic representations, while the activity of semantic representations can be the main factor in deciding a word's category in a semantic categorization task. This explanation can explain why the proficiency levels of L2 reading and writing are important factors in the L2-L1 translation priming when a lexical decision task is used, as such measures are likely to be related to the efficiency of the word processing system in activating lexico-orthographic representations. Bilinguals with higher L2 reading and writing scores can activate the representations of lexical-orthographic units in their L2 as a result of their more frequent use of these features and more exposure to L2 orthography. As for the semantic categorization task, richer semantic representations can refer to more activation that prime words can create in semantic features, which are essential in making categorical decisions. McPhedran and Lupker (2021) argue that cultural immersion, that is, immersion in an L2 context, can determine the amount of exposure, use, and conceptual depth of L2 words. Since L2 proficiency cannot predict the conceptual development of an L2 (e.g., Malt & Sloman, 2003), standard L2 proficiency scores might be insufficient to explain the L2-L1 priming patterns in a semantic categorization task.

A second factor modulating task effects could be the categorical cues given in a semantic categorization task. In line with Xia and Andrews (2015), McPhedran and Lupker (2021) suggest that telling participants to make choices according to a single category might allow them to activate exemplars in this category and produce larger priming effects. Such a strategy could not be adopted in a lexical decision task, as this task cannot provide the necessary information to narrow down potential target words. Pre-activation of these semantic features can also explain why the participants showed L2-L1 priming effects only with exemplar items.

Note that although the amount of L2-L1 priming in the lexical decision task was higher for the participants who reported higher speaking, reading, and writing skills in their L2 (English), these participants also reported lower reading and writing skills in their L1 (Chinese). Similarly, the priming effect was higher in the semantic categorization task for the bilinguals who reported more daily English use, more speaking ability in English, or lower writing, reading, and speaking skills in Chinese. This raises the question of whether language dominance might have been a significant factor in the results (see Section 2.3.4 above).

Overall, studies have presented ample evidence in favor of task effects in translation equivalent priming. However, distinguishing these effects from other potential factors involved in such priming is challenging, as L2 language competency seems to interact with potential task effects. It is difficult to pin down which language-related measures interact with which tasks since measuring and even defining language proficiency, immersion, and dominance is beyond a simple task. The definition of L2 immersion in McPhedran and Lupker (2021), for example, is closer to my definition of L2 dominance.

Another potential limitation in comparing different studies is language script. Some bilinguals use the same script for their acquired languages, while others use different scripts. Unbalanced bilinguals with a different script have shown significant priming effects in a semantic categorization task in the L2-L1 direction (Finkbeiner et al., 2004; Xia & Andrews, 2015). This is taken as evidence that such bilinguals can process L2 prime words efficiently enough to activate conceptual features, and if the null effects in lexical decision tasks are due to inefficient processing of L2 primes, such primes would not have induced significant priming effects in semantic categorization tasks (Nakayama et al., 2016). Despite processing L2 primes, failing to show facilitative effects in lexical decision tasks might be related to the failure to activate lexical-orthographical representations, especially if the two languages of a bilingual use different scripts. The next subsection investigates the potential effect of having different language scripts on translation equivalent priming.

2.3.7. Language Script

The writing systems of a bilingual's languages might be an additional factor in translation priming, as different writing systems might drastically decrease the orthographic similarities between translation equivalents. Different scripts might also prevent the development of lexical links between L1 and L2 lexicons, assigning an essential role to conceptual mediation between a bilingual's acquired languages (Xia & Andrews, 2015). There are two sides to arguments about the potential effect of using the same script languages for translation priming. On one side, it is argued that since reading a word activates orthographically similar candidates as well, a bilingual might activate more candidates upon reading a word if their two languages use the same script, some of which may be in the wrong target language. This competition brings an extra cost for inhibiting the competing words, thus resulting in a processing disadvantage (e.g., Gollan et al., 1997; Nakayama et al., 2018). The other side sees having the same script in cross-linguistic tasks as an advantage since recognizing a word in one language activates the relevant script and thus facilitates the recognition of words written in that script, even if they are in another language (e.g., McPhedran & Lupker, 2021). Such an advantage is especially useful in activating lexical-orthographic representations and might explain why some studies found null priming effects in the L2-L1 direction with lexical tasks and not with semantic-feature-oriented semantic categorization tasks (e.g., Finkbeiner et al., 2004).

The effect of using the same script is usually investigated with a focus on L2-L1 priming since translation priming effects diminish or disappear in that direction. In their study with unbalanced Japanese-English bilinguals who had low L2 proficiency, Nakayama et al. (2016) failed to find a translation priming effect in the L2-L1 direction in a lexical decision task. Similarly, Xia and Andrews (2015) observed no L2-L1 translation equivalent priming with unbalanced Chinese-English bilinguals, even though the SOA was long (200 ms) and the participants had moderate to high L2 proficiency.

Although these findings seem to suggest that using different scripts might suppress L2-L1 priming effects in lexical decision tasks, there are also studies showing significant translation priming effects in that direction. For example, Dimitropoulou et

al. (2011c) found L2-L1 priming effects in lexical decision tasks with unbalanced Greek-English bilinguals who acquired their L2 rather late. Lee et al. (2018) found a translation priming effect in the same direction with unbalanced Korean-English bilinguals with 150 ms SOA, even though they were low-proficient L2 users. Since all four studies used cross-script languages, script-related factors seem insufficient to explain the differences between these studies.

In addition to potential limitations for these contradicting findings, such as low study power, different tasks might also interact with the effect of cross-script effects (also see Section 2.3.6). McPhedran and Lupker (2021) argue that bilinguals whose languages have different scripts might fail to benefit from L2 primes in lexical decision tasks and thus show null priming effects in the L2-L1 direction, as priming effects in a lexical decision task are argued to depend more on the activation of orthographic representations. However, the studies with contradictory findings above all used lexical decision tasks; therefore, the controversy cannot be merely attributed to task effects.

Another reason for the divergent results might be different first languages. Lee et al. (2018) argue that L1 influence might be the reason behind the divergent results, referring to the study of Wang et al. (2003). In this 2003 study, Wang and colleagues showed that Korean-English bilinguals were better at a phoneme deletion task in L2 compared to Chinese-English bilinguals, and this was attributed to the higher degree of similarity between Korean and English writing systems as opposed to Chinese and English. Similarly, some scripts might resemble each other more. Nakayama et al. (2018) underline that the Greek and English alphabets possess apparent similarities between their corresponding letters, which might have contributed to the emergence of L2-L1 priming effects in Dimitropoulou et al. (2011c). They further argue that this priming effect might depend on L2 proficiency when two writing systems are substantially different, such as English and Japanese, as form-level information in L2 might be processed more efficiently by highly proficient bilinguals (see Section 2.3.2).

The effect of language script can also be modulated by language direction. As mentioned above, L2-L1 processing might be more challenging for different-script

language pairs due to the potential difficulty in processing L2 form (Nakayama et al., 2018). The inefficient processing of form would in turn result in less efficient conceptual activation, failing to show priming effects in the L2-L1 direction. The difference between scripts, however, can bring a processing advantage in the L1-L2 direction; words in a bilingual's two languages would have different orthographic representations, and processing L1 primes usually causes activating many word candidates due to its high efficiency. When language scripts are different, there are fewer potential candidates in word processing as cross-linguistic orthographic activation is out of the picture (Nakayama et al. 2018).

The results of one recent study contradict the idea that L2-L1 priming is more likely when the two languages share the same scripts and are more similar to each other in different aspects. Testing the bilinguals of two typologically similar languages that use the same script, Chaouch-Orozco et al. (2021) found significant translation priming effects with proficient English-Spanish bilinguals in the L1-L2 direction but not in the opposite, L2-L1, direction. As English and Spanish translation pairs share considerable orthographic and phonological similarities, the item number for this study was limited due to this limitation. Therefore, a different language that is typologically different and has dissimilar translation equivalents in terms of spelling and phonology might be useful in investigating translation priming effects in L2 English bilinguals. It is then crucial to investigate translation equivalent priming across different language pairs, as such findings can help reveal what other cross-linguistic features play a role in semantic interaction between languages.

As has been discussed so far, the different findings for translation priming are mostly attributed to the activation of words; semantic features and lexical-orthographic representations of words might be activated differently in accordance with different language competencies, SOA values, tasks, scripts, and L1s. More generally, one significant factor in the overall activation of both L1 and L2 words is their frequency values (Miwa et al., 2014). The next subsection investigates whether the frequency of targets or primes can affect translation priming effects in either language direction.

2.3.8. Word Frequency

Word frequency is known to affect word processing in almost every language-related task (Brysbaert et al., 2018; Chee et al., 2003; Monaghan et al., 2017). Chaouch-Orozco et al. (2021) underline that although word frequency has been regarded as a significant predictor of lexical access speed for L1 and L2 words (e.g., Brysbaert et al., 2017; Brysbaert et al., 2018; Diependaele et al., 2013), it has been mostly ignored in translation priming studies and was not even included in the meta-analysis of Wen and van Heuven (2017) regarding translation priming. This is especially concerning as frequency effects have been found to be larger in L2 reading for bilinguals (Cop et al., 2015).

In an attempt to investigate word-frequency related effects on translation equivalent priming, Nakayama et al. (2018) conducted a masked priming lexical decision task with 40 highly proficient Japanese-English bilinguals. In the task, English prime words appeared on the screen for 47 ms and were followed by 23 ms backward masks before Japanese target words appeared. One potential outcome was the relationship between prime frequency and the amount of L2-L1 priming: If L2 words of higher frequency were to be processed faster, this might have allowed a better activation of the conceptual features that are shared by translation equivalents, thus inducing more priming effects. A second investigation of the study was the potential effect of target frequency. As words of lower frequency were likely to receive slower responses, this extra time could have allowed bilinguals to either process L2 primes completely or employ a more strategic use of primes due to target difficulty. In addition to the significance of priming effects, the effects of frequency on both responses and prime sizes were investigated using a distributional analysis.

The results showed significant L2-L1 translation priming effects for non-cognate translation equivalents, replicating Nakayama et al. (2016). Interestingly, however, the frequency of prime words had no effect on priming effects in general. Despite the absence of prime frequency effects on priming sizes, the target words primed by low-frequency primes received slower responses. This indicates that the frequency of primes might have an effect on overall responses. As for target frequency, the priming effects were similar for the majority of the items; therefore, the researchers failed to

provide strong evidence for their argument regarding the target frequency effect as well.

Nonetheless, Nakayama et al. (2018) found a significant interaction between prime condition and frequency values, as frequency effects differed between the related and unrelated prime conditions in their study. Highly frequent words seemed to mitigate target frequency effects in the related condition; when target words were of higher frequency, they received faster responses in both related and unrelated conditions, making the response time difference between these conditions too small to become significant. Although priming was argued to work, the emergence of the target frequency effects in the unrelated condition seemed to remedy this and result in similar response times for both related and unrelated conditions. When target words had lower frequency values, on the other hand, they received slower responses in the unrelated condition but not in the related condition, thus inducing priming effects between the related and unrelated conditions.

The absence of target frequency effects in the presence of prime words of very high frequency is explained as follows: Since these prime words are processed really quickly, they might activate L1 representations of the processed L2 primes in an extremely efficient way, perhaps to their full extent. Such efficient processing would also occupy little of the processing power that is allocated for target words. When prime words are translation equivalents, the L1 representations of these primes would be the target words themselves, and since these presentations would be activated beforehand, target word frequency would not matter. In the unrelated condition, however, the activated prime word and its translation equivalent would be irrelevant to the following target word, allowing the low frequency of target words to affect overall word processing and resulting in slower responses.

Nakayama et al. (2018) argue that conceptual features of prime processing might continue even after the target word is presented. When primes are not processed efficiently (e.g., due to their low frequency), the processing of the target word would be slower, resulting in slower response times. The visual word recognition system might reset the processing when the target word appears and presents a sufficient perceptual mismatch with the preceding prime word. This reset is likely to be limited

to form-level features and might not affect the processing of conceptual features. Therefore, while presenting the target word might reset the form processing of a prime, conceptual processing might continue (Forster, 2013). If the form processing of the prime does not reach a critical threshold when the target word is presented (due to a short SOA, low proficiency, or low frequency), the efficiency of conceptual processing and thus translation priming might be harmed. This idea overall attributes the absence of L2-L1 priming to the inefficient processing of form-level features for L2 primes, which in turn fails to activate conceptual features. This inefficiency would be even greater when two languages have different scripts, as form processing would be more challenging in L2.

In the study of Chaouch-Orozco et al. (2021), the potential effects of word frequency on translation priming were investigated with Spanish-English bilinguals (see Section 2.3.4 for a more detailed review of this study). L2 target words received slower responses when they were of lower frequency, were preceded by unrelated primes, or were responded to by lower-proficiency bilinguals. This also suggests an interaction between word frequency and L2 proficiency effects, as only highly proficient bilinguals seemed to benefit from the related primes in the study. Chaouch-Orozco et al. (2021) argue that this finding could not be attributed to the absence of knowledge for L2 target words as the accuracy rates were similar for the bilinguals with low and high L2 proficiencies (96% vs. 97%). Given that the prime words were in L1 in that direction, the inefficiency of processing primes must be out of question as well; if language attrition was to play a role, this effect would have been more prominent for the bilinguals who had higher L2 proficiencies and L2 exposure/use values. Chaouch-Orozco et al. (2021) encourage further studies to investigate this significant interaction, as their design and results prevented them from reaching conclusive findings.

Even if one aims to investigate the role of frequency in translation equivalent priming, measuring a word's frequency can be more complicated than it seems, especially for L2 words. While corpora are the most common way to measure a word's frequency, they might not be accurate for different populations. Referring to corpora for frequency values might be problematic, especially for L2 frequencies, as such measures refer to all learners as a homogeneous group and provide a single frequency value for a single

word (Brysbaert et al., 2018; Chaouch-Orozco et al., 2021). Different L2 populations might differ in their L2 immersion, dominance, and proficiency, thus seeing different L2 words with different word frequencies. One way to overcome this potential limitation might be subjective frequency ratings, which are argued to have more accuracy, especially when it comes to low-frequency L2 words (Chen & Dong, 2019). This is especially important considering the prominent effect of word frequency on word processing.

The role of word frequency in translation priming is mostly unclear due to the limited number of studies and the difficulty of measuring a word's frequency accurately for different populations, in particular L2 learners. Further studies should pay more attention to this role as well as investigate whether corpus values can provide an accurate measure of word frequency compared to subjective frequency values.

2.3.9. Summary of the Findings

In summary, language direction is argued to affect the size or even the emergence of translation priming effects. The L2-L1 direction produced either less or absent priming effects compared to the L1-L2 direction in many studies.

Although some argue that this language direction asymmetry could diminish by increasing L2 competencies, no consensus exists among scholars on which specific L2 competency plays an essential role: While increasing L2 proficiency might close the gap in the translation priming effects between language directions, L2 dominance might also be the main factor behind the difference.

The qualitative account argues that unless bilinguals acquire their L2 in infancy, the observed differences will remain as they are. In this regard, it is assumed that L2 immersion or L2 onset of age of acquisition plays a crucial role in symmetrical translation priming effects.

Longer prime duration or SOA is also argued to help L2-L1 priming effects emerge. As bilinguals would have more time to process L2 primes or could activate them with more efficiency due to longer exposure, the efficiency of L2 prime processing might catch up with the efficiency of L1 prime processing.

Task effect is proposed as another factor influencing translation priming and translation priming asymmetry: Semantic categorization tasks are referred to as including more semantic processing or allowing category filtering, thus inducing more powerful and symmetrical translation priming effects in both language directions.

Language script can be another potential influence on translation equivalent priming. As stated in Section 2.3.7, there are two opposing views on the effect of having the same writing system for both acquired languages as a bilingual: one arguing that the activation of similar-script features might facilitate the activation of the relevant word in the other language, other stating that such an activation of similar features would activate more competitors, thus resulting in a more difficult decision process and slower answers.

Finally, the effect of word frequency has been largely ignored in the translation priming literature, which is unfortunate since this variable has been frequently referred to as an essential factor in word processing. The study by Nakayama et al. (2018) reveals little about the relationship between translation priming and word frequency because it is not possible to compare their results with different language pairs and participant groups due to the lack of studies investigating the phenomenon.

CHAPTER 3

THE PRESENT STUDY

As the aforementioned literature review reveals, the limitations of earlier studies have resulted in contradictory results for translation equivalent priming and, thus, in a failure to explain the potential influence of many factors such as script differences, L2 measurements (proficiency, immersion, and dominance), task type, prime duration, and word frequency. Furthermore, the picture of how these factors interact with each other is even more blurry since earlier studies have usually included only one or two of these factors in their designs. In addition to confirming such effects, the relative contributions and interactions of these factors also need further investigation. By including the same participants in each task to avoid confounding between-subject factors, the present study offers novel contributions to the literature by investigating the effects of these factors on translation priming, as well as their interaction with each other.

To the best of my knowledge, no study has so far investigated the semantic interaction between Turkish and English with Turkish-English bilinguals in the early stages of word processing. As earlier studies with other language pairs have suggested, semantic similarity alone can induce interaction between a bilingual's two languages, even in the absence of orthographic and phonological similarities. Controlling these latter similarities might be tricky for languages such as English, Spanish, and French, as translation equivalents in these languages usually possess high amounts of orthographic and phonological similarity. This usually results in either experimental items that have more than just semantic similarity between translation equivalents or a careful selection of experimental words that results in fewer translation equivalents than required for sufficient statistical power. In this respect, Turkish is a perfect candidate to investigate the so-called semantic interaction between Turkish and

English in the bilingual lexicon, as non-cognate translation equivalents in the Turkish language usually have little or no orthographic and phonological similarities with their counterparts in English. This allows for the inclusion of a good number of translation equivalent pairs to successfully investigate the influence of semantic similarity between languages in the early stages of word processing. In addition, such an investigation would reveal whether L2-L1 priming emerges in the word processing of Turkish-English bilinguals, whose native language uses the same script as their L2 but is typologically distinct at the same time.

As for the effect of L2 immersion and dominance on translation priming, most Turkish-English bilinguals acquire L2 English in a classroom setting without engaging in conversations in L2-dominant environments. L2 English bilinguals in Europe usually have the opportunity to use their L2 English in social interactions, unlike bilinguals living in the Middle East and Asian countries. As using an L2 in social interactions more frequently is associated with a better priming effect in semantic categorization tasks (McPhedran & Lupker, 2021), it is unclear whether bilinguals who acquired their L2 predominantly in the classroom would react differently in two different tasks, that is, lexical decision tasks and semantic categorization tasks in the present study. The Language History Questionnaire (LHQ) Version 3.0 (Li et al., 2020) was used to collect information about the participants' language acquisition, use, and exposure. In an attempt to investigate the role of L2 immersion, the variation in the age of acquisition was examined to determine whether it resulted in different priming effects in the tasks. Similarly, the amount of input and language use in daily life were taken as independent factors to see if L2 dominance had an influence on translation equivalent priming.

Investigating the effect of L2 proficiency on translation priming and its interaction with other factors was another goal of the present study. In accordance with the claims of Multilink, studies so far have shown that translation equivalent priming might occur or increase its efficiency depending on L2 proficiency, especially in the L2-L1 direction (e.g., Chaouch-Orozco et al., 2021; Duyck & Warlop, 2009). On the other hand, RHM (at least the initial versions) proposes that L1 and L2 words establish strong lexical connections even at the beginning proficiency levels, which suggests a powerful translation priming effect in the L2-L1 direction as well. Furthermore,

whether the translation priming asymmetry would diminish in highly proficient bilinguals is still unclear due to contradictory findings (e.g., Dimitropoulou et al., 2011c; Nakayama et al., 2016). Such claims are investigated in the current design by measuring L2 proficiency with both objective (LexTALE; Lemhöfer & Broersma, 2012) and subjective (LHQ 3.0; Li et al., 2020) measurement tools. As McPhedran and Lupker (2021) underlined the importance of using objective measurements of L2 proficiency tools and comparing their efficiency with subjective measurements, I investigated whether two types of measurements could account for a similar amount of variance in participant responses.

Multilink underlines the importance of subjective frequency, but it is quite difficult to define what it is. Although it might be correlated with language proficiency, language exposure and use are assumed to be better indicators of subjective frequency (Chaouch-Orozco et al., 2021). Therefore, self-rated frequencies were collected from the participants after they completed all the experiments. The explanatory power of these self-ratings for reaction times was compared to corpus frequency ratings in mixed-model analyses.

In line with the proposal of a task/decision system in Multilink, the studies discussed above have shown that different task demands can also modulate translation priming effects (e.g., McPhedran & Lupker, 2021; Xia & Andrews, 2015). As a result of contradicting findings, however, there is still too much to explore regarding the nature of this task effect. If the translation priming asymmetry disappears in semantic categorization tasks, this might indicate that the Sense Model was right in claiming that bilinguals only focus on categorical features in these tasks and show similar performances in both language directions due to this limited focus. Such a finding would also support the existence of a task/decision system in word processing. Moreover, observing more priming effects in the L2-L1 direction in semantic categorization tasks and not in lexical decision tasks might show that the categorical and conceptual properties of L2 words can effectively activate L1 words. This finding might also be taken against the RHM model, which argues that the links between L2 words and conceptual representations are weaker compared to L1 words. In this study, the same word lists and participants were included in each task to test potential differences between lexical decision tasks and semantic categorization tasks. This

way, the potential differences found between two tasks (LDT and SCT) could be safely attributed to task-related differences rather than item-related or subject-related differences.

Another manipulation employed in the study design was prime duration. Although Wen and van Heuven (2017) failed to find a significant effect of prime duration in their meta-analyses (the effect of SOA duration was significant), most studies in their analysis had used similar prime durations. Eddy and Holcomb (2010) suggested that increased prime durations for picture primes were likely to increase in-depth processing. More in-depth processing might result in higher activation levels and thus more priming if the finding regarding picture primes was applicable to word primes as well. In line with this reasoning, Wang and Forster (2015) propose that prime duration might determine the degree of semantic activation in different-script L1s and L2s. Also, although Turkish and English both use the same script, the two languages also have essential differences, such as syllable structure and orthographic depth. Therefore, this study investigated how prime duration modulated translation priming effects in a language pair that was typologically different despite using the same alphabet. Different task types (LDT and SCT) with different prime durations (50 ms vs. 83 ms) were included to investigate the potential interactions between these factors. Reduced or absent priming effects with the shorter prime duration (50 ms) in the L2-L1 direction and not with the longer prime duration (83 ms) would indicate that L2 words take more time to be activated. If this asymmetry diminished in SCT, the findings would support the arguments of the Sense Model (Finkbeiner et al., 2004).

Finally, it is essential to test the reliability of all the models mentioned above and verify or falsify their claims. Examining different factors and their interactions with the same sample group and the same items could provide valuable insights into the current models and theories. Comparing the claims of the models with the findings of this study had the potential to reveal the limitations of these models and offer a better understanding of bilingual word processing. Improving the models at hand or developing better ones is not only crucial for psycholinguistics studies; all fields interested in language and how it is processed can benefit from such developments.

The following hypotheses were preregistered on the Open Science Framework before the commencement of any data collection. The full preregistration report can be accessed using the following link: https://osf.io/c3gmf

1) In line with earlier research, a pattern of language non-selective access was expected: The words in one language were expected to activate their translation equivalents even in the very early stages of word processing. The hypothesis was that the participants would give faster answers when targets were preceded by related primes (translation equivalents).

2) A translation priming asymmetry was anticipated even with highly proficient Turkish-English bilinguals: the L1-L2 direction was expected to produce more priming effects than the L2-L1 direction.

3) Task differences were hypothesized to result in different response times and different priming effect patterns, in line with the proposal of a task/decision system in the Multilink model. In the lexical decision task, a participant just needs to decide whether a given set of strings is a real word by accessing the available lexical representations. In the semantic categorization task, however, participants need to determine the category of a word as well. This difference was expected to cause slower responses for semantic categorization tasks.

4) As for the potential differences in the priming patterns mentioned above, the semantic categorization task was anticipated to show more prominent priming effects as it required semantic classification, and the primes used in the study were translation equivalents (which were highly semantically related). This hypothesis was in line with Finkbeiner et al. (2004) and Xia and Andrews (2015), who found stronger L2-L1 priming effects in the semantic categorization tasks.

5) Although a reduced translation priming asymmetry was suggested by Finkbeiner et al. (2004) for semantic categorization tasks, Xia and Andrews (2015) failed to confirm this proposal. Therefore, this study had no directional hypothesis for this argument.

6) The higher prime duration (83 ms[1]) was expected to induce more priming effects in both tasks compared to the lower prime duration (50 ms); longer exposure to the prime word was hypothesized to increase the activation of prime words (and thus target words through semantic activation) in the related condition (as prime-target pairs were translation equivalents in this condition).

7) Words rated as more frequent (subjective frequency ratings) or that had higher corpus frequency ratings were expected to receive faster responses, in line with earlier research. Due to the potentially faster activation of L2 words of higher frequencies, L2 primes that had higher frequency values were anticipated to induce more priming effects. However, since the participants in the present study were highly proficient, this effect could also be insignificant; after a certain threshold, the higher frequency might stop facilitating word activation.

8) L2 proficiency was measured through LexTALE and the Language History Questionnaire (LHQ 3.0). While the variation in this measure is likely to affect L2 word processing and priming effects for the related primes in L2, the participants in the present study had similar L2 proficiency ratings. Although higher L2 proficiency was expected to result in faster responses for L2 words and higher priming effects for the L2-L1 direction, a lack of considerable variance in language proficiency ratings was also acknowledged as an influence that could prevent this effect from becoming significant in the analyses.

9) Language background data was collected using the Language History Questionnaire (LHQ 3.0). It was hypothesized that higher language use and more native input reported in the questionnaire might predict more priming effects in the L2-L1 direction and faster responses for L2 target words in both tasks.

[1] As stated in the preregistration report, the initial plan was to use 40 ms and 70 ms prime durations. However, the final prime durations of the experiments were (3 x 16.67 = 50.01 ms) and 83 ms (5x 16.67= 83.35 ms) due to the screen specifications of the laptop used in the study.

CHAPTER 4

METHODOLOGY

In this section, I explain the methodology of the current dissertation. In the *Participants* section, I describe the sample group used in the current study. In the *Experiments* section, I define the nature of the tasks conducted, namely the lexical decision task (LDT) and semantic categorization task (SCT), along with the masked priming paradigm. In the *Materials* section, I describe the materials used to collect data and explain the reasons behind their selection. In the *Procedure* section, I provide the steps taken while carrying out the study. And finally, in the *Pilot Study* section, I present the outlines of the initial pilot studies and the changes I made after these pilots.

4.1. Participants

The sample of the study included 101 university students from the English Language Teaching Department of Middle East Technical University (57 Females, Age average: 19.5). The participants were Turkish-English bilinguals (L1 Turkish) and had been exposed to L2 input daily as the department's medium of instruction is English. No participants reported any learning disabilities or learning disorders, and they all had normal (or corrected-to-normal) vision. Two participants did not complete the second experiment and the language history questionnaire, and one of these two participants also did not complete the subjective frequency scale. After excluding them, the final sample pool included 99 participants in total. Table 1 shows the individual measures regarding the participants.

The majority of the participants in the sample pool acquired their L2 after infancy (Table 1) through formal school education in their L1 environment. However, as they were all undergraduate students in the English Language Teaching Department, they had been using English excessively in the last year, both in class discussions and

activities and in assignments in which they needed to read and write in their L2. This high use of L2 along with high L2 proficiency differentiated them from other undergraduate students in Türkiye, who usually have limited chances to improve and use their L2, as most Turkish universities adopt Turkish as their medium of instruction.

Table 1
Descriptives of the participants

Descriptives	Mean (SD)
Age	19.5 (1.53)
L2 (AoA)	8.30 (3.51)
LexTALE Score	75.9 (10.4)
L2 Proficiency	77.7 (10.3)
L2 Immersion	51.4 (14.6)
L2 Dominance	48.9 (8.52)

Note. AoA: Age of Onset of Acquisition. LexTALE is a lexical performance test intended for L2 learners. L2 measures were calculated according to the answers given to the Language History Questionnaire: L2 proficiency scores were based on self-rated L2 language skills, L2 immersion scores on self-reported AoA and years of L2 use, and L2 dominance on self-reported proficiency and the amount of daily L2 use. See Sections 4.3.3 and 4.3.4 for more information.

4.2. Tasks

In this study, I used lexical decision and semantic categorization tasks with the masked priming paradigm. The use of short-duration primes provided valuable insights regarding the preconscious processing of cross-linguistic prime words and the effects of such processing on the recognition of a subsequent translation equivalent in another language.

The masked priming paradigm is based on the idea that presenting primes (e.g., words in LDT) for a short duration eliminates conscious processing and strategy use for that item (Feldman et al., 2012; Forster & Davis, 1984; Rastle et al., 2004). Such experiments are then used to investigate the effects of primes on automatized and preconscious processes. In the masked priming paradigm, primes and targets have specific kinds of relations between them, and these relations are manipulated to see

whether they affect word processing. I manipulated the semantic similarity of prime-target pairs by using translation equivalents as related primes (cow for its translation equivalent, *inek*). Another common practice in masked priming experiments is to use a baseline for comparison, such as unrelated primes. These primes have little or no orthographic, phonological, semantic, or categorical overlap with the target words. For unrelated primes, I used translation equivalents of different words, such as cow for *yıldız* (star).

A third type of prime, namely identical primes, can also be used in masked priming studies to test whether the primes are effective. These primes are identical copies of the upcoming target words (e.g., *lion – LION*). Since studies so far have presented abundant evidence for the effect of these primes (e.g., Frost et al., 1997), I decided not to include them in the current design. Including one more prime type would require many more participants to sustain the same power level, and failing to recruit that many participants would decrease the study power (Brysbaert, 2019, 2020; Brysbaert & Stevens, 2018). In addition, identical primes would be in the same language as the targets, which is not the pattern for the cross-linguistic unrelated and related primes selected for the current study. Comparing the prime-target pairs that induced a language switch to the pairs without such switching might have affected the results.

4.2.1. Lexical Decision Task

In a typical visual lexical decision task, participants are asked to decide whether a given string of letters is a real word in the language of interest. When this task is combined with the masked priming paradigm, a fixation point is shown in the middle of the screen to make participants focus on where primes and targets will be shown. After that, a set of symbols (e.g., hashtags) are presented to mask the upcoming prime. Following this mask, the prime is presented immediately for a brief moment (usually between 30 and 80 ms). In some cases, another mask is presented to give additional processing time after the prime (i.e., a backward mask). Next, a target word appears on the screen. Participants are usually asked to press a specific button to decide if the target is a word in a particular language and to press another button if it is not. Failing to give a response for a certain amount of time also counts as the wrong response.

Figure 8 shows the general procedures of a lexical decision task combined with the masked priming paradigm.



Figure 8. Procedures of a LDT combined with the masked priming paradigm

I designed two lexical decision tasks, each for one language direction. In the L1-L2 direction, Turkish prime words preceded English target words. In the L2-L1 direction, the prime words and the target words from the other experiment changed places: Turkish target words followed English prime words. Using these two tasks, I created two different versions of each language direction task by alternating the prime duration. In summary, I used four lexical decision tasks: L2-L1 direction with 50-ms primes, L2-L1 direction with 83-ms primes, L1-L2 direction with 50-ms primes, and L1-L2 direction with 83-ms primes. The items and procedures for the two language directions and two prime durations were kept constant to create identical experiments so that I could investigate potential language direction and prime duration effects.

A Latin-square design is used to create two different experiment lists to alternate experimental primes and unrelated primes for targets in each masked priming experiment (Table 2). Each participant saw only one of these four lists in a single task and completed blocks in two language directions (the L1-L2 and L2-L1 directions). The list used in a task is excluded and not used for that session.

Table 2
A sample of the alternative prime lists created by Latin-square design

	Exp. Word 1	Exp. Word 2	Exp. Word 3	Exp. Word 4
L1-L2 Primes (List A)	inek (*cow*)	araba (*car*)	zürafa (*giraffe*)	erik (*plum*)
L1-L2 Primes (List B)	masa (*table*)	tilki (*fox*)	tarak (*brush*)	aslan (*lion*)
Target words	cow	fox	giraffe	lion

4.2.2. Semantic Categorization Task

The semantic categorization task is similar to the lexical decision task, but with two essential differences: First, different semantic categories are presented in blocks (animals, food, body parts, house items, nature, and buildings; Appendices D and E), and second, participants need to decide whether the target word belongs to the category of that block. In Figure 9, the block is in the semantic category of *animals*, and the task is to press a specific key button if the target word belongs to that category. The words belonging to the given category are called exemplars. If participants decide that the given target word does not belong to the current category, they need to press another button. These words that are outside of the given category are called non-exemplars. Adopting the masked priming paradigm, I used the same procedures for presenting primes and targets (Figure 9).

When the masked priming paradigm is combined with a semantic categorization task, it is possible to prime both exemplar and non-exemplar items. In the design of this study, however, this would have posed certain disadvantages. I used related primes for only real words in the LDTs, and in each list, half of these primes were related (translation equivalents). This accounted for a total of 25% of all primes. Since I used the same number of items and the same experimental words for both the SCTs and LDTs, my options were either decreasing the number of related primes for exemplar items or having twice as many related primes in the semantic categorization task in order to investigate the priming effects for non-exemplar items. Otherwise, the equal number of primed experimental items could have made the comparison of these two tasks more difficult. Xia and Andrews (2015) state that pre-existing categories boost the activation of exemplar items in a semantic categorization task and that non-exemplar items do not benefit from such a boost; therefore, priming non-exemplar items in a semantic categorization task is identical to priming experimental items in a lexical decision task. In accordance with this argument, priming non-exemplar items would have given us a similar pattern to the primed experimental items in the lexical decision tasks while making the comparison of the two tasks unreliable. Therefore, I used related primes only for the exemplar items in the semantic categorization tasks.

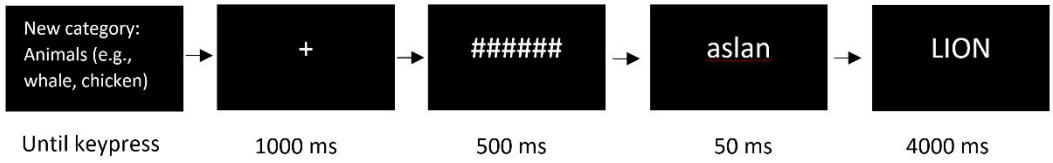


Figure 9. Procedures of a SCT combined with the masked priming paradigm

The same lists and procedures used in the lexical decision tasks were used for the semantic categorization tasks. The order of different tasks (SCT and LDT) and language directions (L1-L2 and L2-L1) was alternated among participants to avoid any potential order effects. Table 3 shows an example of this presentation.

Table 3
Alternation of blocks, lists, and prime versions

Participant	Block 1		Block 2	
Part 1	Turkish LDT- List 1- prime 1	English LDT - List 2- prime 1	Turkish SCT - List 3- prime 1	English SCT - List 4 - prime 1
Part 2	English SCT- List 2 - prime 1	Turkish SCT - List 3 - prime 1	English LDT - List 4 - prime 1	Turkish LDT - List 1 - prime 1
Part 3	English LDT - List 4 - prime 1	Turkish LDT - List 1 - prime 1	English SCT - List 2 - prime 1	Turkish SCT - List 3 - prime 1
Part 4	English SCT- List 3 - prime 1	Turkish SCT - List 4 - prime 1	English LDT- List 1 - prime 1	Turkish LDT - List 2 - prime 1
Part 5	Turkish LDT- List 1- prime 2	English LDT - List 2- prime 2	Turkish SCT - List 3- prime 2	English SCT - List 4 - prime 2
Part 6	English SCT- List 2 - prime 2	Turkish SCT - List 3 - prime 2	English LDT - List 4 - prime 2	Turkish LDT - List 1 - prime 2
Part 7	English LDT - List 4 - prime 2	Turkish LDT - List 1 - prime 2	English SCT - List 2 - prime 2	Turkish SCT - List 3 - prime 2
Part 8	English SCT- List 3 - prime 2	Turkish SCT - List 4 - prime 2	English LDT- List 1 - prime 2	Turkish LDT - List 2 - prime 2

Note. Prime 1 and prime 2 refer to alternative related and unrelated prime distributions

4.2.3. Prime Duration for Tasks

Prime duration is the duration a prime appears on the screen, while SOA value refers to the time given for a participant to process the given prime. In the masked priming paradigm, primes are presented for a brief duration, usually between 30-80 ms. Although people usually fail to recognize such primes consciously, their responses to upcoming words are altered, and they show priming effects in some conditions (e.g.,

Feldman et al., 2012; Forster & Davis, 1984; Rastle et al., 2004). Increasing prime duration is one way to increase SOA, but some studies use backward masks or blanks to increase this time even more (e.g., Lee et al., 2018; Schoonbaert et al., 2011). In the current design, I decided to manipulate prime duration to see whether longer exposure to prime words would modulate translation equivalent priming effects. I created two versions of each task by alternating the prime duration: 50 ms and 83 ms[2]**.** The reason behind this was to test the lower limit of the prime duration usually used in the masked priming paradigm against the upper limit[3]**.** Half of the participants in the current study took the tasks with 50-ms prime durations first, and the other half completed the long prime duration versions in the first step of data collection. After about a month, each participant completed the other version in the second stage of data collection. This allowed me to test the same participants with the same tasks and items while only manipulating prime duration and avoiding many potential confounding factors associated with between-item and between-subject effects.

4.3. Materials

4.3.1. Word Lists

As the participants were to complete all four tasks in a single session, I created four different experimental lists. This way, each task used a single list, and the participants saw a target or its translation equivalent only once in a single session. This was vital since seeing an item twice or seeing its translation equivalent in the same session might have altered the word processing patterns and the semantic interaction between languages. Both lexical decision tasks and semantic categorization tasks used the same words with different item orders. All real words were selected from concrete entities since concreteness is likely to play a role in word processing (Tokowicz & Kroll, 2007). In addition, I tried to select highly frequent words to lose as little data as

[2] Although I designed the experiments with 40-ms and 70-ms prime durations in the beginning, the laptop I used for the experiments had a 60 Hz monitor. Thus, the tasks in the current study used around 50 ms (3 x 16.67= 50.01 ms) and 83 ms (5x 16.67= 83.35 ms) prime durations.

[3] Despite the existence of masked priming studies using 30-ms prime durations (e.g., Eddy & Holcomb, 2010), it could have been too short for testing translation equivalent priming, especially in the L2-L1 direction.

possible for wrong answers and to be able to use the same experiment with low-level participants in future studies.

Each list consisted of 46 experimental words and their translation equivalents (46 Turkish words and their English counterparts). I used two different corpora to select the experimental words. The Corpus of Contemporary American English (COCA; Davies, 2008) was used for selecting English words. This corpus is preferred in many studies due to its detailed search options and large database (around 1.1 billion words). For Turkish words, TS Corpus V2 (Sezer & Sever Sezer, 2013) was used due to its substantial database size (close to 500 million words).

Six semantic categories were created for the semantic categorization tasks: animals (e.g., *octopus-ahtapot*), nature (e.g., *tree-ağaç*), household items (e.g., *oven-fırın*), buildings (e.g., *pharmacy-eczane*), food (e.g., *apricot-kayısı*), and human body (e.g., *arm-kol*). I did not intend to investigate the differences between categories and merely chose these to be able to include enough experimental words in the study.

As Multilink uses underspecified and holistic semantic units, it might only provide simulations for translation equivalents with highly overlapping meanings (even though full overlap might not be possible). Keeping this in mind, this study included translation equivalents with high semantic similarity. This allowed an investigation of the claims made by Multilink.

In addition to the experimental items, which required "Yes" responses in the tasks, I also included items that would receive "No" responses. In a LDT, these "No" answers are provided with nonwords since this task requires participants to decide whether a given string is a real word. I used the Wuggy software (Keuleers & Brysbaert, 2010) to create nonwords for both Turkish and English lexical decision tasks. This software changes the letters of existing words according to phonotactic rules in a language but avoids creating already-existing words. Thus, these combined letters look like potential word candidates in that language without belonging to the language. I used experimental word lists to feed the software to create nonwords for the final lists. By doing this, nonwords had similar lengths to experimental words since the word length across lists was controlled. The created nonwords were not used in the same list with the experimental items that they had been based on.

In order to elicit “No” answers in the SCTs, I used filler words that did not belong to the given category (non-exemplars) since this task requires participants to respond “Yes” to a target word if it belongs within the given category. LexOPS package (Taylor et al., 2020) was used in R 4.2.3 (R Core Team, 2023) to select the filler words. This package takes in word lists and generates new word lists that are identical to the original ones in terms of word length and frequency. As the package was only available for the English language at that time, I used English word lists to generate fillers and then translated those items into Turkish for Turkish filler words.

In each final list, I had 46 Turkish nonwords and 46 Turkish fillers, along with 46 English nonwords and the same number of English fillers. Depending on the language (Turkish or English) and the task type (LDT or SCT), the software picked the relevant columns and showed them to the participants. For example, in the Turkish LDT, Turkish experimental words were shown along with Turkish nonwords as targets for participants to decide which ones were legitimate words in that language. In this task, English translation equivalents and some unrelated English words were used as primes. I created two columns for the primes of each task to alternate related and unrelated primes; each prime column had an equal number of related and unrelated primes for each category and in total. Similar to the way I pseudorandomized the order of tasks and language directions, the selection and presentation of prime columns in lists were also pseudorandomized and balanced. This way, each target word was primed by an equal number of related and unrelated primes (see Table 2 above).

As I needed to find a total of 184 experimental items that were concrete entities and of high frequency at the same time, I did not control the difference between the lengths of the translation equivalents and rather selected the words that were between 3-8 letters. The potential effect of having different numbers of letters between translation equivalents can be investigated in further studies.

The final lists were significantly indifferent in terms of L1 word length ($F(3, 180) = 0.25$, $p = 0.861$; Eta2 = 4.15e-03, 95% CI [0.00, 1.00]), L2 word length ($F(3,180) = 0.06$, $p = 0.981$; Eta2 = 9.74e-04, 95% CI [0.00, 1.00]), L1 word frequency ($F(3, 180) = 0.10$, $p = 0.960$; Eta2 = 1.65e-03, 95% CI [0.00, 1.00]), and L2 word frequency ($F(3, 180) = 0.03$, $p = 0.992$; Eta2 = 5.34e-04, 95% CI [0.00, 1.00]).

Table 4
Properties of experimental lists

	English Word Length (SD) Mean	Turkish Word Length (SD) Mean	English Word Frequency (SD) Mean	Turkish Word Frequency (SD) Mean
List 1	4.84 (1.18)	5.11 (1.31)	33.26 (38.49)	19.70 (26.08)
List 2	4.91 (1.23)	5.02 (1.24)	34.73 (37.04)	21.43 (32.81)
List 3	4.89 (1.27)	4.89 (1.09)	32.77 (35.57)	22.41 (29.05)
List 4	4.96 (1.33)	4.96 (1.33)	32.71 (29.84)	20.06 (25.78)

Note. All frequencies are per million words.

I ran three ANOVAs to examine whether orthographic similarity differed between the lists or between related and unrelated primes within the lists, each focusing on a different orthographic similarity measure. Orthographic similarity differences between prime and target words were insignificant between the lists, as shown by the Normalized Levenshtein values ($F(1,732) = 8.50e\text{-}03$, $p = 0.927$; Eta2 (partial) = 1.16e-05, 95% CI [0.00, 1.00]), the Levenshtein Distance values ($F(1, 732) = 21.46$, $p < .001$; Eta2 (partial) = 0.03, 95% CI [0.01, 1.00]), and the Orthographic Similarity values ($F(1,732) = 8.50e\text{-}03$, $p = 0.927$; Eta2 (partial) = 1.16e-05, 95% CI [0.00, 1.00]). Although the related primes had more orthographic similarity with their targets compared to the unrelated primes in the lists ($p < .001$ for all three measures), the effect sizes were small for each measure (Eta2 values were 0.04, 0.03, and 0.04 for the Normalized Levenshtein, the Levenshtein Distance and the Orthographic Similarity, respectively). I included the orthographic similarity measures in the main analyses to see if they had a main effect or interacted with priming effects. These measures were all insignificant and did not interact significantly with priming effects; therefore, I decided that the orthographic similarity difference between the related and unrelated primes had no significant effects on reaction times or priming effects. Due to their insignificance, the final analyses did not include the orthographic similarity values. Table 5 shows the results of orthographic similarity measures for different prime conditions. As can be seen in the table, the orthographic similarity scores between prime and target pairs are minimal for both the related and unrelated conditions in the current design.

Table 5
Orthographic similarity for related and unrelated prime words

	Average Mean (SD)	Related Mean (SD)	Unrelated Mean (SD)
NLD	0.0911 (0.121)	0.112 (0.137)	0.0699 (0.0970)
Lev	5.06 (1.09)	4.88 (1.09)	5.25 (1.06)
OS	0.0930 (0.0943)	0.111 (0.115)	0.0746 (0.0633)

Note. NLD: Normalized Levenshtein; Lev: Levenshtein Distance; OS: Orthographic Similarity

4.3.2. Subjective Word Frequency Scale

I created a subjective frequency scale for experimental words using Google Forms. On this scale, participants rated the frequency of their encounter with each experimental word using 7 points:

1. I have never seen it.
2. I might have seen it.
3. About once a month.
4. About once a week.
5. About once every two or three days.
6. About once a day.
7. About a few times a day.

The purpose of collecting subjective frequency data was to compare it with corpus values and investigate whether one would be proven superior in explaining response times or translation equivalent priming. Since the participants in the current study mostly acquired their L2 in a classroom setting, corpus values might not have reflected an accurate estimation of their word encounter frequencies. Although Chen and Dong (2019) refer to using English corpora for L2 English users as an accurate measurement for high frequency words, similar to the words I used in the current study, they carried out their study with a small sample of Chinese-English bilinguals.

Table 6
Subjective frequency values for English and Turkish experimental words

Target Subjective Frequency	English (n=18400)	Turkish (n=18400)	Overall (n=36800)
Mean (SD)	4.15 (1.49)	4.31 (1.57)	4.23 (1.53)
Median [Min, Max]	4.00 [1.00, 7.00]	4.00 [1.00, 7.00]	4.00 [1.00, 7.00]
Missing	236 (1.3%)	304 (1.7%)	540 (1.5%)

4.3.3. LexTALE

As studies suggested L2 proficiency as a modulating factor in translation equivalent priming (e.g., Nakayama, 2016), I used the Lexical Test for Advanced Learners of English, or LexTALE (Lemhöfer & Broersma, 2012), as an objective measurement of L2 English proficiency. In this short test, participants complete a lexical decision task in English, and the test predicts the English proficiency of participants by examining the given answers and their response times. Despite its short duration and practical application, the scores of this test were found to be correlated with the longer and more detailed Oxford Quick Placement Test (QPT, 2001).

4.3.4. Language Questionnaire

I used the Language History Questionnaire version 3 (LHQ 3.0; Li et al., 2020) to collect data regarding the language use and competencies of the participants. This online data collection tool uses a simple web interface to elicit answers and provides aggregated scores for language proficiency, language immersion, and language dominance.

It has been discussed above that participants' language learning contexts can also have an effect on cross-linguistic interactions in addition to their second language proficiency (e.g., Nakayama et al., 2012). Furthermore, McPhedran and Lupker (2021) suggested that comparing objective measures of L2 proficiency to self-ratings might prove useful in determining which measurement was better at predicting translation equivalent priming. In addition, the participants included in the study acquired their L2 mostly in a classroom setting. LHQ allowed me to calculate an L2 immersion score

based on the age of onset of acquisition and years of L2 use of the participants; therefore, I was able to investigate whether the variance in language immersion could predict response times or priming effects. Although I could not recruit two different groups greatly varying in their manner of L2 acquisition, the language immersion score differences among the participants could also provide valuable information regarding the effect of L2 immersion on translation equivalent priming.

One final score of interest measured by LHQ in the current study was language dominance. This score is based on self-reported proficiency and the time spent on different language components (e.g., writing). Basnight-Brown and Altarriba (2007) argue that using L2 abundantly might alter the language dominance of bilinguals, making L2 as dominant as L1 or even more dominant. It was then intriguing to investigate whether the bilinguals in the current study, who had been using their L2 excessively during their undergraduate studies, would show similar translation priming patterns to balanced bilinguals.

4.4. Pilot Study

Two pilot studies were carried out: one with five participants and the other with four participants. The participants were recruited from the School of Foreign Languages at Middle East Technical University. Before the pilots, they were asked to mention any problems or shortcomings with the experiment and its procedures. According to the feedback, I made some minor changes to items, procedures, and instructions.

Some participants thought that a few non-exemplar words could belong to the category they appear in (e.g., the non-exemplar word *cage* in the human body category could refer to the *rib cage* as well, making it an exemplar). Similarly, some participants referred to certain exemplar words as not belonging to their category (e.g., *salt* in the *food category*). Seeing that the categorization I chose might differ from what participants thought, I created a Likert-scale that allowed me to investigate the appropriateness of a word for a specific category in the eyes of young Turkish-English bilinguals. Eighteen participants (different from the ones who participated in the main experiment) completed the scale. I also asked the participants which category names would best suit two specific categories since two participants in the pilot mentioned

that the available names for these categories could be misleading. All in all, I replaced 4 experimental items and 2 nonwords, changed the category of 9 non-exemplar words, and renamed two categories for the semantic categorization tasks according to the participant feedback.

In the initial trial design, I only had practice trials for Turkish tasks, thinking that they would be sufficient to understand the tasks. After the pilots, I also added practice parts for the English tasks, as one participant mentioned that it would be helpful. I also changed the names of the tasks that appear before the actual tasks: Rather than the titles "Lexical Decision Task" and "Semantic Categorization Task", I used informative titles such as "Does the word belong to the given category?" and "Is the given word real in this language?". Some participants suspected that some of the nonwords could be real words that had been taken from old English or old Turkish; therefore, I also altered the way I explained the task procedures, and the instructions made clear that the words used in the study were taken from Modern English and Turkish. Finally, I added two exemplars to the title of each category to make it clearer, such as "Animals (e.g., chicken and whale)."

The results of the pilots showed very high accuracy for all tasks. The participants gave correct answers 91.6% of the time for English tasks, 97.1% of the time for Turkish tasks, 94.8% of the time for lexical decision tasks, and 93.9% of the time for semantic categorization tasks.

4.5. Procedure

The participants used the Appointlet website to reserve time slots to complete their experiments. In the first step, 51 participants took the 50-ms version, and the remaining 50 participants took the 83-ms version. Each participant completed two experiment sessions, each of which included the same four tasks with different prime durations (English and Turkish versions of LDTs and SCTs). Different language directions for the same task followed each other, so that the participants completed the task in two different languages subsequently. After about a month (30.6 days on average), the participants completed the experiment again with the other prime duration. Table 7 shows this procedure.

Table 7
Timetable for the experiments

	1st Data Collection Step	2nd Data Collection Step
Group 1	83 ms primes	50 ms primes
Group 2	50 ms primes	83 ms primes

I used the latest stable version (3.3.12) of OpenSesame (Mathôt et al., 2012) available at that time to create experiments. Each participant was given a random ID, and the script I created used the last digit of these IDs for pseudorandomization. Since there were 8 possible orders (see Table 3), I used the numbers between 0-7 to generate ID numbers. In this way, the presentation order of the tasks (LDT and SCT), language directions (L1-L2 direction and L2-L1 direction), and related primes were evenly distributed among participants. After the task was determined, OpenSesame software picked one of the four lists and used the relevant columns for that task and language direction. For example, if the selected task was a Turkish LDT, the software used English primes (either prime column 1 or 2, depending on the participant ID), Turkish target words, and Turkish nonwords in the order provided in that list. After the task was completed, the selected list was eliminated for that experiment; therefore, each participant saw a list only once in an experimental session. As the first task is a lexical decision task in this example, the following task would also be a lexical decision task (English version).

A 15-inch Lenovo Laptop (60 Hz screen) and a Logitech F310 gamepad were used to carry out all experimental sessions. At the beginning of the experiments, the Participant ID was entered for that participant, and the tasks and procedures were explained along with the information screens on the laptop screen. The participants were told to respond as fast and accurately as possible, be careful of task and category changes, and keep focused on the task at all times. The button settings for the dominant hand were done by each participant at the beginning of the experiment: A prompt screen asked the participant to press the right-back button if they were right-handed or the left-back button if they were left-handed. Each participant completed a practice session, which included practice trials for all four tasks. Although the experiments were carried out in a silent lab room without visual distractions, all participants were

offered earplugs after the practice part to avoid any potential noise from outside. They were also told that they could rest for a while when the prompts indicated a short break or a task change. Once the participant started the experiment, no further explanations or help was offered until the experiment was done; the participants followed screen prompts to complete each task and take short breaks. In the LDTs, the participants used their dominant hands for "Yes" answers and their nondominant hands for "No" answers (92 trials per task). In SCTs, the participants were given a category at the beginning of each category list and were asked to use their dominant hands to give "Yes" answers if the word on the screen belonged to that category and "No" answers if it did not (6 categories and 92 trials per task). After a task was finished, a prompt screen showed the upcoming task. The participants were able to rest during these screens as well.

One experimental session took approximately 30 minutes for each participant (4 tasks and 368 trials per experimental session). At the end of each day, the experiment data was uploaded to the Open Science Framework and stored in a folder named after the date of that day. All 101 participants completed the experiment in the first round.

After their first experiment, the participants were asked to complete LexTALE in the lab using their mobile phones. Since LHQ is a long questionnaire that takes about half an hour to complete, they were provided with their unique access codes for the questionnaire and told to complete it within a week. They were also reminded to use their participant IDs in the questionnaire so their language background data could be matched with other collected data.

After about a month, the participants were invited to complete the second experiment, and they made appointments using the Appointlet website again. Each participant was told that there should be at least a 25-day break between their first and second experiments. This time, 99 participants completed the second round, following the same procedures.

After the second round of the main experiments, the participants were told to complete the Subjective Word Frequency Scale using Google Docs. Since measuring subjective word frequency requires no time-sensitive measurement, this scale was completed by

the participants in their free time. They were told to pay attention to each frequency rating, as the accuracy of their answers was of the utmost importance.

Possible between-subject confounding factors were avoided by keeping the same participants for the two experimental sessions. As only two participants dropped out of the study in the second part, this strategy was highly successful. A limitation of this design might be the retest effect, which is caused by item and procedure familiarity when the same participant is given the same experiment. Pluck (2020) found that the test-retest effect was not significant when a lexical decision task was repeated after a one-month interval. Therefore, I put about a one-month interval between the experiments for each participant to avoid this potentially confounding factor.

CHAPTER 5

RESULTS

5.1. Data

The collected data was examined through various methods prior to analyses. The next two subsections explain the exclusion of certain data points and the imputation of missing data to maintain high statistical power.

5.1.1. Data Exclusion

I used R 4.2.3 (R Core Team, 2023) to analyze the data. After excluding nonwords and fillers (non-exemplars in the SCTs), the experimental item data had 36800 data points. Two participants were removed as they had not taken the second experiment and had not completed the Language History Questionnaire (Participants 135 and 200). The number of data points after this was 36432.

I have checked the accuracy of the answers for each item in both task types (lexical decision task and semantic categorization task). As stated in the preregistration report, I removed nine items that had error rates over 40% in the semantic categorization tasks (8 items: scale, dock, plum, fig, mill, squash, picture, and tray) and the lexical decision tasks (1 item: pot). Rather than removing the items that were responded to with low accuracy from the relevant task, I removed them from the whole dataset to keep the items the same between the tasks so that between-task comparisons would be more reliable. Similarly, I also removed the translation equivalents of these items, as not knowing an item or failing to categorize it correctly would also be problematic when this item is used as the prime. After excluding these items, the final data points were 34650.

Finally, I check the distribution of response times to detect outliers (as stated in the preregistration of the current study). First, I removed 19 answers that were under 200 ms as they were likely to be accidental key presses. Then, I removed 18 answers that took longer than 5 seconds. Figure 10 shows the distribution of the remaining 34613 data points.

I examined the distribution of the remaining answers to identify outlier responses (Figure 10). Having decided that the majority of the answers were under 2000 ms, I excluded answers above that duration (292 answers). The final number for the data points was 34321 (Figure 11), and the excluded responses were less than 1% of all data points in this exclusion stage (0.94%).

As declared in the preregistration report, I tried different normalization methods and examined the results to find out which method gave the best result. The Order Norm transformation method (Peterson & Cavanaugh, 2020) applied by the BestNormalize package (Peterson, 2021) gave the most normal distribution (Figures 12 and 13); therefore, I used this transformation for the response time data (Raw values are used in the tables and figures). The final model for the response times gave similar results with the log transformation, which is a more traditional data transformation method (Appendix C).

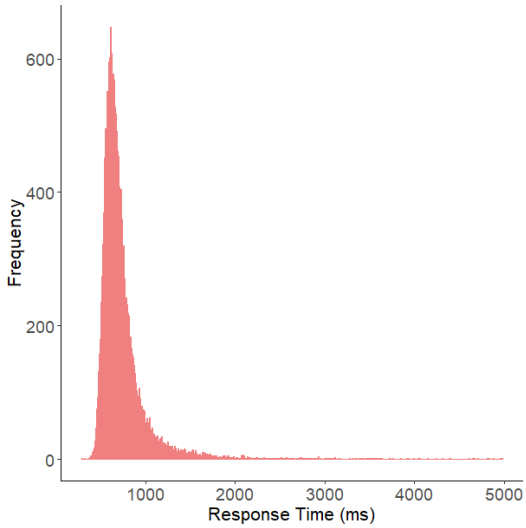


Figure 10. Response times for the experimental items (between 200 ms and 5000 ms)

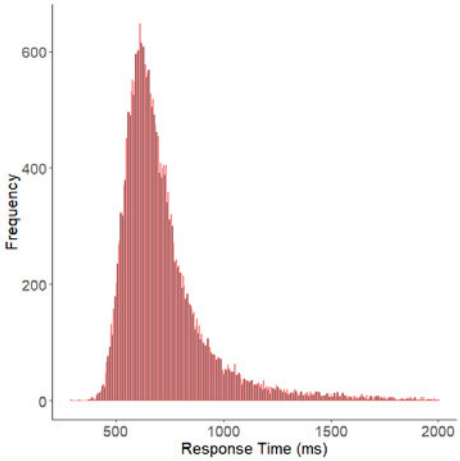


Figure 11. Distribution of response times in the final dataset (between 200 ms and 2000 ms)

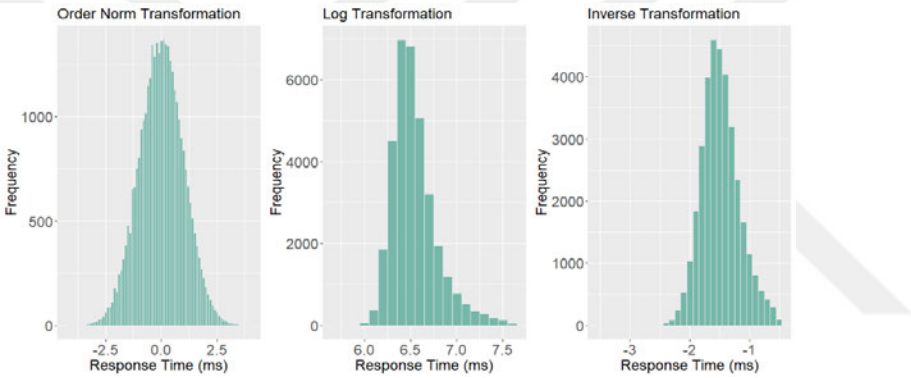


Figure 12. Histograms of transformed response times for each method (Order Norm transformation, log transformation, and inverse transformation)

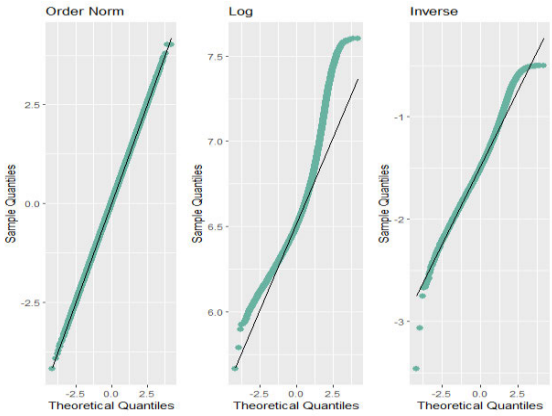


Figure 13. QQ Plots of transformed response times for each method (Order Norm transformation, log transformation, and inverse transformation)

5.1.2. Data Imputation

After the two pilot studies, four experimental items were replaced, and some of them were used as unrelated primes since their frequency values and lengths were matched with the remaining experimental items. As I included only the final experimental items in the Subjective Frequency Questionnaire (since these items were used as unrelated primes as well), the frequency values of these excluded items were not measured despite their use as unrelated primes in the main experiments. In addition, some participants skipped a few items on the scale without rating their frequencies, as well as some questions in LHQ. In the end, the final data had 1.297% missing values for Prime Subjective Frequency, 0.977% missing values for Target Subject Frequency, 1.01% missing values for L2 Dominance, and 5.05% missing values for L2 Immersion. Although the missing data was negligible, data imputation would prevent losing statistical power since mixed-effects models exclude any rows with missing data cells; therefore, I imputed the missing data.

Data imputation can be handled through several methods, including the traditional ones based on mean or median values. K-Nearest Neighbors (K-NN) is a more complex method that considers the nearest neighbor values of the missing values and uses their means to replace these missing values. This method is shown to outperform other methods (Jadhav et al., 2019) and to be highly accurate, especially for data with complex structures (Murti et al., 2019). Therefore, the missing data was imputed using the K-NN method in the caret package (Kuhn, 2008).

5.2. Error Analyses

5.2.1. Descriptives

Table 8 shows the accuracy of each task variation along with different prime conditions. Overall, related prime conditions resulted in numerically more accurate answers compared to unrelated prime conditions, and this effect was more apparent in the SCTs. The participants in this study were less likely to give correct answers in this latter task type as well. The prime duration of tasks seems to have no effect on the accuracy of answers.

Table 8
Descriptive statistics of accuracy ratings for each task variation

Task	Accuracy	L1 (50 ms)	L2 (50 ms)	L1 (83 ms)	L2 (83 ms)
Lexical Decision Task	Related Condition	0.98	0.97	0.99	0.98
	Unrelated Condition	0.98	0.97	0.98	0.97
	Overall	0.98	0.97	0.98	0.97
Semantic Categorization Task	Related Condition	0.96	0.92	0.97	0.93
	Unrelated Condition	0.94	0.91	0.95	0.90
	Overall	0.95	0.92	0.96	0.92

5.2.2. Error Rate Analysis

Interactions were not included in the error analyses for two reasons: First, including the interactions between different independent variables prevented the model from converging, despite hours of processing to finish the analysis. Second, the wrong answers in the final data set constituted a small portion of the answers (0.3%), making it difficult to sustain reliability when interactions were also considered. Table 9 shows the error rates for different prime types, languages, tasks, and prime durations.

I used a logistic mixed model (estimated using ML and Nelder-Mead optimizer) to predict the pattern of correct answers along with the independent variables of Prime Type, Task, Language, Prime Duration, L2 Proficiency (LexTALE), L2 Immersion, L2 Dominance, Prime Frequency, and Target Frequency. The random effects were Participant ID, Prime ID, and Target ID. The total explanatory power of the model was 0.38, and the marginal value that was limited to the fixed effects was 0.07.

Table 9
Error rate percentages for different conditions (ldt: lexical decision task, sct: semantic categorization task)

	Wrong Answers (n=1128)	Correct Answers (n=33193)
Prime Type		
related	434 (38.5%)	16729 (50.4%)
unrelated	694 (61.5%)	16464 (49.6%)
Language		
english	676 (59.9%)	16446 (49.5%)
turkish	452 (40.1%)	16747 (50.5%)
Task		
ldt	320 (28.4%)	16888 (50.9%)
sct	808 (71.6%)	16305 (49.1%)
Prime Duration		
50	589 (52.2%)	16568 (49.9%)
83	539 (47.8%)	16625 (50.1%)

There were three significant independent factors, Prime Type ($p < .001$; Std. beta = 0.52, 95% CI [0.40, 0.65]), Task ($p < .001$; Std. beta = -1.03, 95% CI [-1.16, -0.90]), and Language ($p = 0.004$; Std. beta = -0.41, 95% CI [-0.69, -0.14]). The participants gave more accurate answers when the target words were preceded by the related primes (translation equivalents) rather than the unrelated primes, when the task was a lexical decision task rather than a semantic categorization task, and when the target words were in Turkish rather than in English.

5.3. Response Time Analyses

5.3.1. Descriptives

The wrong answers in the dataset were removed after the error rate analysis, and the remaining final dataset of correct responses had 33193 data points. Descriptive statistics regarding response times and priming are given in Tables 10 and 11. Table

10 presents the overall values for the main effects (language direction, task, and prime durations), while Table 11 shows the values for each variation of the tasks.

Table 10

Descriptive statistics of response time in different conditions

	L2-L1 Direction (English primes- Turkish targets)			L1-L2 Direction (Turkish primes -English targets)		
	Unrelated (n=8313)	Related (n=8434)	Priming	Unrelated (n=8151)	Related (n=8295)	Priming
Mean (SD)	708 (201)	680 (184)	**28**	747 (213)	714 (199)	**33**
Median (Min, Max)	658 [380, 2000]	637 [363, 1980]	-	693 [289, 2000]	661 [386, 1980]	-
	Lexical Decision Task			Semantic Categorization Task		
	Unrelated (n=8421)	Related (n=8467)	Priming	Unrelated (n=8043)	Related (n=8262)	Priming
Mean (SD)	695 (189)	671 (171)	**24**	762 (221)	722 (209)	**40**
Median (Min, Max)	651 [289, 2000]	632 [363, 1980]	-	707 [404, 2000]	668 [386, 1980]	-
	50 ms Prime Duration			83 ms Prime Duration		
	Unrelated (n=8229)	Related (n=8339)	Priming	Unrelated (n=8235)	Related (n=8390)	Priming
Mean (SD)	714 (202)	695 (193)	**19**	741 (213)	698 (192)	**43**
Median (Min, Max)	665 [289, 2000]	646 [363, 1980]	-	688 [326, 2000]	650 [386, 1980]	-

As Table 10 shows, numerically larger priming effects were observed in the L1-L2 direction compared to the L2-L1 direction, in the SCTs compared to the LDTs, and with the longer prime duration (83 ms) compared to the shorter prime duration (50 ms).

The investigation of each task variation presents a more detailed picture of the results (Table 11). The LDTs in both language directions resulted in similar priming effects when the prime duration was shorter (12 vs. 14 ms), but this small difference increased in favor of the L1-L2 direction with a longer prime duration (27 vs. 42 ms). Therefore, while the priming effect in the L2-L1 direction had more than doubled (12 ms to 27 ms) by increasing prime duration in the LDTs, the same effect in the L1-L2 direction had more than tripled (14 ms to 42 ms) as a result of using longer prime durations in the same tasks.

Table 11

Descriptive statistics of response times for each task variation

Task	Response Time (ms)	L2-L1 (50 ms)	L1-L2 (50 ms)	L2-L1 (83 ms)	L1-L2 (83 ms)
Lexical Decision Task	Related Condition Mean (SD)	648 (157)	689 (183)	661 (165)	687 (174)
	Unrelated Condition Mean (SD)	660 (165)	703 (185)	688 (191)	729 (205)
	Priming Mean	**12**	**14**	**27**	**42**
Semantic Categorization Task	Related Condition Mean (SD)	703 (202)	741 (214)	708 (200)	739 (216)
	Unrelated Condition Mean (SD)	733 (217)	765 (223)	753 (215)	797 (226)
	Priming Mean	**30**	**24**	**45**	**58**

The semantic categorization tasks produced more numerical priming effects in all language directions and prime conditions (Table 11). Although the pattern of more

priming effects in the L1-L2 direction emerged again with the longer prime duration (58 ms in the L1-L2 direction and 45 ms in the L2-L1 direction), this pattern was reversed with the 50-ms prime duration (24 ms in the L1-L2 direction and 30 ms in the L2-L1 direction).

Keep in mind that numerical differences might not be statistically significant and thus meaningful all the time. The following subsections show the steps of building a mixed-effects model to investigate statistical differences and the results of the final model.

5.3.2. Model Selection and Refining the Selected Model

Numerical differences might be misleading, as some of these differences can be insignificant in statistical tests. In this subsection, I analyze the effect of the pre-selected independent variables on response times along with potential interactions.

LHQ scores were multiplied by 100 for a better understanding of these scores in relation to LexTALE scores, which were also out of 100. To create a composite score of L2 proficiency, I took 50% of LexTALE scores and 50% of L2 subjective proficiency scores calculated with LHQ 3.0.

As I had two measurements for word frequency (Corpus vs. Subjective) and three for L2 proficiency (LexTALE vs. Subjective vs. Composite), the initial models were created by alternating these variables and measuring their AIC values[4]. I fitted six linear mixed models in order to predict response times with Prime Type (related vs. unrelated), Task (LDT vs. SCT), Language (L1 vs. L2), Prime Duration (50 ms vs. 83 ms), L2 proficiency (LexTALE, Subjective or Composite), L2 Dominance, L2 Immersion, Target Frequency (Corpus or Subjective), and Prime Frequency (Corpus or Subjective). In addition to these main effects, the interactions between Prime Type, Task, Language, and Prime Duration were included in the analysis (Prime Type * Task * Language * Prime Duration). As one of my aims was to investigate relationships

[4] The Akaike (1974) information criterion (AIC) is a score that indicates how well the model of interest fits the given data. It is common to compare the AIC values of different models to choose the model that best fits the data at hand, especially when the true models are referred to as complex, and the models created based on data are referred to as simplifications of these complex models (Vrieze, 2012). The lower the value, the more the model can explain the variation in the data, making it a better fit.

between these main variables and other measurements (LexTALE, L2 Dominance, L2 Immersion, Target Corpus Frequency, and Prime Corpus), I added each of these later measurements to this base interaction formula in a different line. The AIC and R2 values of the models are given in Table 12.

Table 12
Evaluation of models with different measurement types

L2 Proficiency	LexTALE		Subjective L2 Prof.		Composite L2 Prof.	
Word Frequency	Subjective Word Fre.	Corpus Word Fre.	Subjective Word Fre.	Corpus Word Fre.	Subjective Word Fre.	Corpus Word Fre.
AIC	81926	81921	81996	81995	81937	81935
Marginalized R2	0.080	0.081	0.076	0.078	0.080	0.078

I picked the model with the lowest AIC value and highest marginalized R2 value, that is, the model using LexTALE for L2 proficiency and corpus values for word frequencies. The full model was:

lmer(Response_Time ~ Prime_Type + Task + Language + Prime_Duration + L2_Proficiency + L2_Dominance + L2_Immersion+ Target_Frequency + Prime_Frequency + Task*Language*Prime_Duration *Prime Type

+ Task*Language*Prime_Duration *Prime Type*L2_Proficiency

+ Task*Language*Prime_Duration *Prime Type* L2_Immersion

+ Task*Language*Prime_Duration *Prime Type* L2 Dominance

+ Task*Language*Prime_Duration *Prime Type*Target_Frequency

+ Task*Language*Prime_Duration *Prime Type*Prime_Frequency

+ (1 | Participant_ID) + (1 | Prime_ID) + (1 | Target_ID)

, data = dataexp, REML = FALSE)

In the next step, I used the step function of the lmerTest package (Kuznetsova et al., 2017) to refine my model. A Likelihood Ratio Test showed that the reduced model did not differ from the full model; therefore, I used the reduced model (df=61, Chiq=64.118, p=0.368). The results of the linear mixed model using this reduced formula are given in Table 13.

Table 13
Results of the reduced model

	Response Time		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	0.00	-0.08 – 0.09	0.966
Prime Type	-0.19	-0.21 – -0.17	**<0.001**
Task	0.33	0.31 – 0.35	**<0.001**
Language	0.24	0.17 – 0.30	**<0.001**
Prime Duration	0.09	0.08 – 0.11	**<0.001**
LexTALE	-0.06	-0.14 – 0.02	0.144
L2 Dominance	-0.03	-0.11 – 0.05	0.455
L2 Immersion	-0.09	-0.17 – -0.02	**0.015**
Target Corpus Frequency	0.02	-0.01 – 0.05	0.230
Prime Corpus Frequency	-0.02	-0.04 – -0.01	**0.003**
Task × Language	-0.03	-0.07 – 0.00	0.072
Task × Prime Duration	-0.02	-0.05 – 0.02	0.354
Language × Prime Duration	-0.02	-0.06 – 0.01	0.182
Prime Type × Task	-0.12	-0.15 – -0.08	**<0.001**
Prime Type × Language	-0.05	-0.09 – -0.01	**0.006**
Prime Type × Prime Duration	-0.12	-0.16 – -0.09	**<0.001**
Task × LexTALE	-0.03	-0.05 – -0.01	**0.001**
Language × LexTALE	-0.09	-0.11 – -0.08	**<0.001**
Prime Type × LexTALE	0.00	-0.02 – 0.02	0.967
Prime Duration × L2 Immersion	-0.02	-0.04 – -0.00	**0.015**
Prime Type × L2 Immersion	-0.03	-0.04 – -0.01	**0.006**

Table 13 (continued)

Prime Duration × L2 Domination	0.04	0.02 – 0.06	<0.001
Task × Target Corpus Frequency	0.01	-0.00 – 0.03	0.145
Language × Target Corpus Frequency	-0.06	-0.12 – 0.00	0.052
Task × Prime Corpus Frequency	0.02	-0.00 – 0.04	0.064
Prime Duration × Prime Corpus Frequency	-0.00	-0.02 – 0.02	0.890
Prime Type × Prime Corpus Frequency	-0.03	-0.06 – -0.00	**0.035**
Prime Type × Task × Prime Duration1	-0.06	-0.13 – 0.01	0.098
Prime Type × Language × Prime Duration1	-0.08	-0.15 – -0.01	**0.028**
(Prime Type × Language) × LexTALE	0.04	0.00 – 0.07	**0.030**
(Task × Language) × Target Corpus Frequency	-0.05	-0.09 – -0.02	**0.005**
(Task × Prime Duration)× Prime Corpus Frequency	0.01	-0.03 – 0.04	0.707
(Prime Type × Task) × Prime Corpus Frequency	0.06	0.02 – 0.09	**0.002**
(Prime Type × Prime Duration) × Prime Corpus Frequency	0.01	-0.03 – 0.05	0.579
(Prime Type × Task ×Prime Duration) × Prime Corpus Frequency	0.07	0.00 – 0.14	**0.040**
Random Effects			
σ	0.66		
$\tau_{00\ Prime_ID}$	0.01		
$\tau_{00\ Target\ ID}$	0.08		
$\tau_{00\ Participant\ ID}$	0.16		
ICC	0.27		
$N_{Participant_ID}$	99		
N_{Prime_ID}	371		
$N_{Target\ ID}$	350		
Observations	33193		
Marginal R^2 / Conditional R^2	0.80 / 0.328		

5.3.3. Main Effects

I used the report package (Makowski et al., 2023) to report the results of the analysis and to calculate the effect sizes. 95% Confidence Intervals (CIs) were computed for

the model. The conditional R2 referring to the total explanatory power of the model was 0.33, while the marginal R2 that shows the explanatory power of the fixed effects only was 0.08. The main effects of LexTALE, L2 Dominance, and Target Corpus Frequency were not statistically significant. Each significant main effect and interaction is given below, following the same order as in Table 13.

5.3.3.1. Prime Type

Prime Type (related vs. unrelated) had a significant effect on response times (beta =-0.19, 95% CI [-0.21, -0.17], t(33154) = -21.04, p < .001; Std. beta = -0.19, 95% CI [-0.21, -0.18]). The participants responded faster when the target words were preceded by related primes, that is, translation equivalents. Figure 14 shows the differences between response times in the related and unrelated conditions.

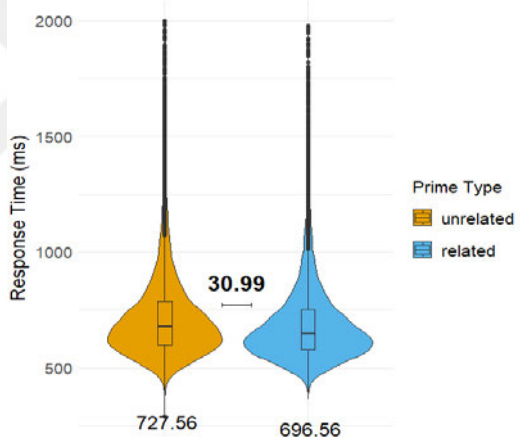


Figure 14. Response times in the related and unrelated conditions (The difference is given in bold font)

5.3.3.2. Language

Language was another significant independent variable for response times (beta = 0.24, 95% CI [0.17, 0.30], t(33154) = 7.28, p < .001; Std. beta = 0.24, 95% CI [0.18, 0.30]). The target items in L1 tasks were responded to faster compared to the target items in L2 tasks; therefore, the participants were faster to make lexical and categorical

decisions in their native language. Figure 15 shows the response times for both languages.

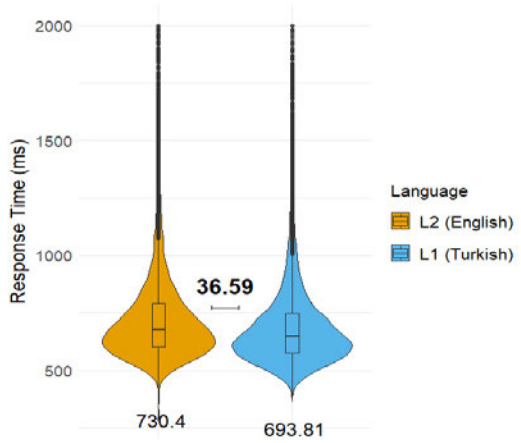


Figure 15. Response times for L1 and L2 tasks (The difference is given in bold font)

5.3.3.3. L2 Immersion

The effect of L2 Immersion was statistically significant (beta =0.09, 95% CI [-0.17, -0.02], t(33154) = -2.43, p = 0.015; Std. beta = -0.09, 95% CI [-0.17, -0.02]). The participants with higher L2 immersion scores responded faster than the participants with relatively lower L2 immersion scores. Figure 16 shows how response times decrease with increasing L2 immersion scores.

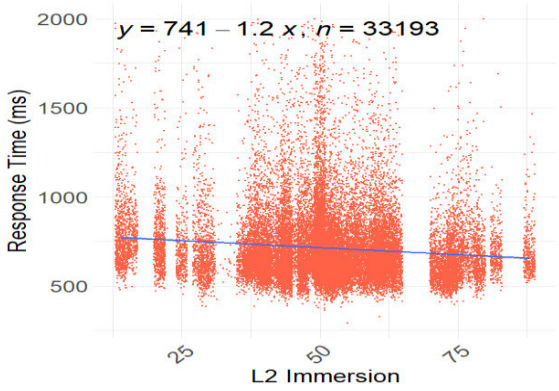


Figure 16. Scatter plot of response times and L2 immersion scores (The formula is given in bold; n refers to the number of data points)

5.3.3.4. Task

Task type (LDT vs. SCT) had a significant effect on response times (beta = 0.33, 95% CI [0.31, 0.35], t(33154) = 36.93, p < .001; Std. beta = 0.34, 95% CI [0.32, 0.35]). The participants gave faster responses to the lexical decision tasks compared to the semantic categorization tasks. Figure 17 shows the response times for different task types.

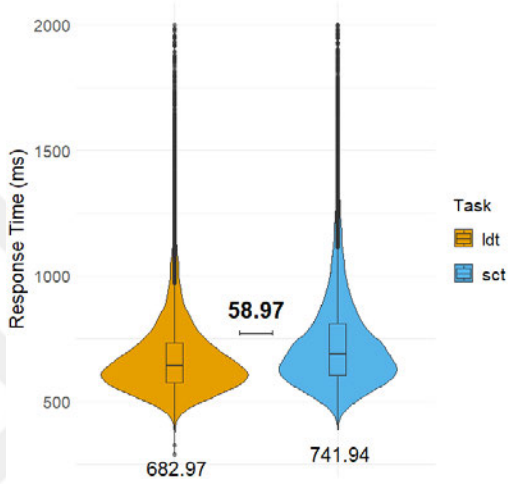


Figure 17. Response times for different task types (The difference is given in bold font)

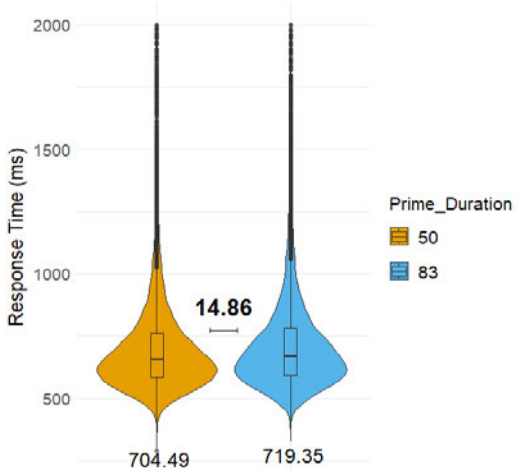


Figure 18. Response times in the 50-ms and 80-ms prime conditions (The difference is given in bold font)

5.3.3.5. Prime Duration

Prime Duration had a significant effect on response times (beta= 0.09, 95% CI [0.08, 0.11], t(33154) = 10.38, p < .001; Std. beta = 0.09, 95% CI [0.08, 0.11]). The participants reacted slower when the prime duration was longer (83 ms) compared to when it was shorter (50 ms). Figure 18 shows the difference between response times for the targets primed by longer (83 ms) and shorter (50 ms) prime durations.

5.3.3.6. Prime Corpus Frequency

Prime Frequency (Corpus values) had a significant effect on response times (beta = -0.02, 95% CI [-0.04, -0.008], t(33154) = -2.99, p = 0.003; Std. beta = -0.02, 95% CI [-0.04, -0.008]). The participants reacted faster when the prime words had higher corpus frequency values. Figure 19 shows how response times decreased with increasing prime frequency values.

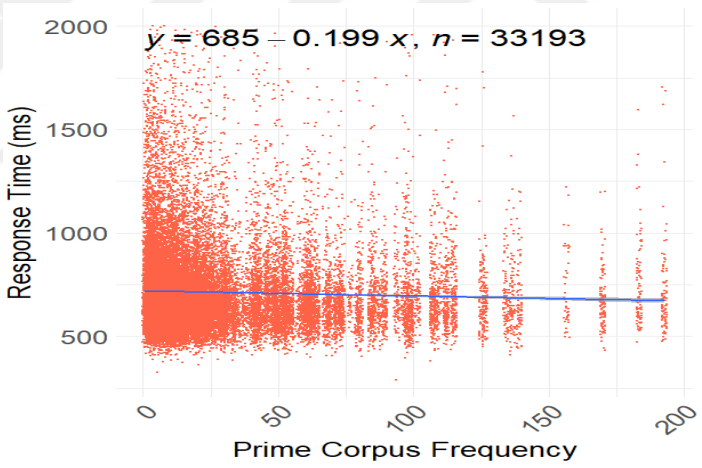


Figure 19. Scatter plot of response times and prime frequency values (The formula is given in bold; n refers to the number of data points)

5.3.4. Two-way Interactions

In this subsection, I present the significant two-way interactions in the response time analysis. The order of the interactions is the same as the order of Table 13. Interactions that were not statistically significant were not included in this subsection.

5.3.4.1. Prime Type x Language

Prime Type and Language interacted significantly with each other (beta = -0.05, 95% CI [-0.09, -0.01], t(33154) = -2.73, p = 0.006; Std. beta = -0.05, 95% CI [-0.09, -0.01]). The L1-L2 direction (L1 primes and L2 targets) produced larger priming effects than the L2-L1 direction (L2 primes and L1 targets). Figure 20 shows the priming effects that emerged in both language directions.

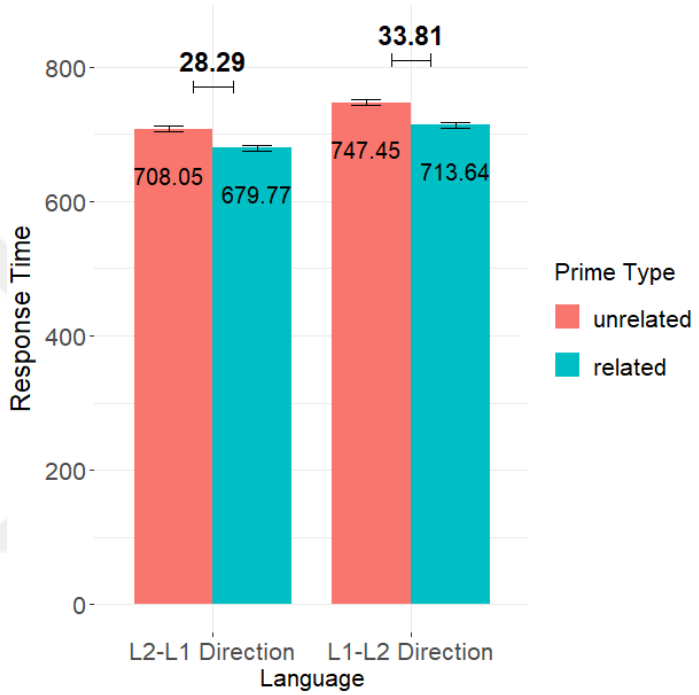


Figure 20. Response times in different language directions for the related and unrelated primes (The sizes of priming effects are given in bold font)

5.3.4.2. Prime Type x L2 Immersion

Prime Type and L2 Immersion had a significant interaction in explaining the response times of the participants (beta = -0.03, 95% CI [-0.04, -0.007], t(33154) = -2.77, p = 0.006; Std. beta = -0.03, 95% CI [-0.04, -0.007]). Although higher L2 immersion scores predicted faster responses in the unrelated condition as well, this facilitation effect was more pronounced when the target words were preceded by their translation equivalents (i.e., the related condition). Figure 21 shows how L2 Immersion scores correlated with response times in the related and unrelated conditions.

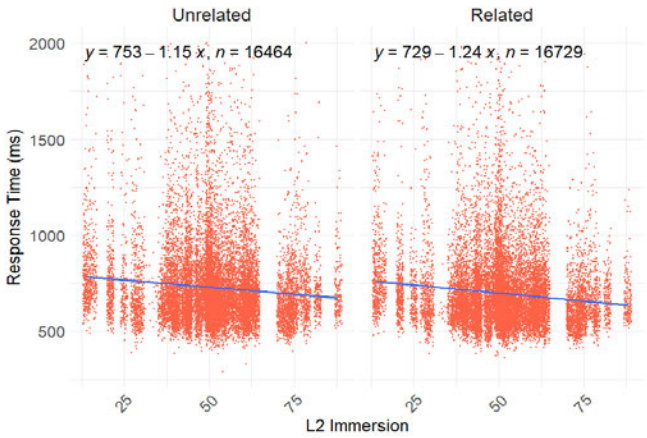


Figure 21. Response times across different L2 immersion scores in the related and unrelated conditions (The formulas are given at the top; n refers to the number of data points)

5.3.4.3. Prime Type x Task

The interaction between Prime Type and Task Type was significant (beta = -0.12, 95% CI [-0.15, -0.08], t(33154) = -6.42, p < .001; Std. beta = -0.12, 95% CI [-0.15, -0.08]). The semantic categorization tasks induced significantly more priming effects compared to the lexical decision tasks. Figure 22 shows the response times for the related and unrelated conditions in both tasks.

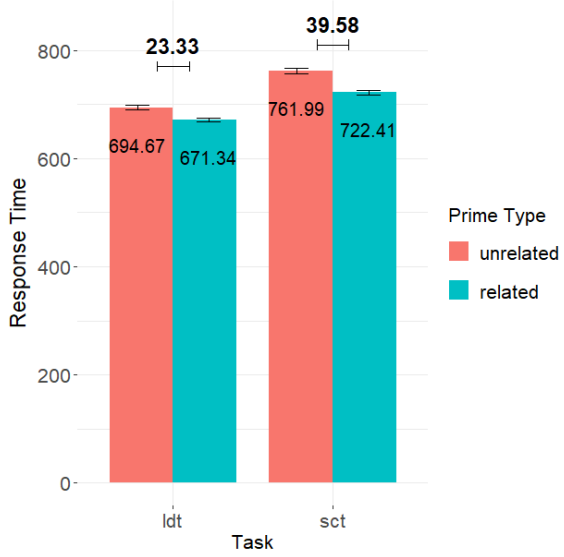


Figure 22. Response times in the lexical decision tasks (ldt) and the semantic categorization tasks (sct) for the related and unrelated conditions. (Priming effects are given in bold font)

5.3.4.4. Prime Type x Prime Duration

The interaction between Prime Type and Prime Duration was significant (beta = -0.12, 95% CI [-0.16, -0.09], t(33154) = -6.84, p < .001; Std. beta = -0.12, 95% CI [-0.16, -0.09]). The average priming effect in the 50-ms prime condition was more than doubled in the 83-ms prime condition. Figure 23 shows the interaction between Prime Type and Prime Duration.

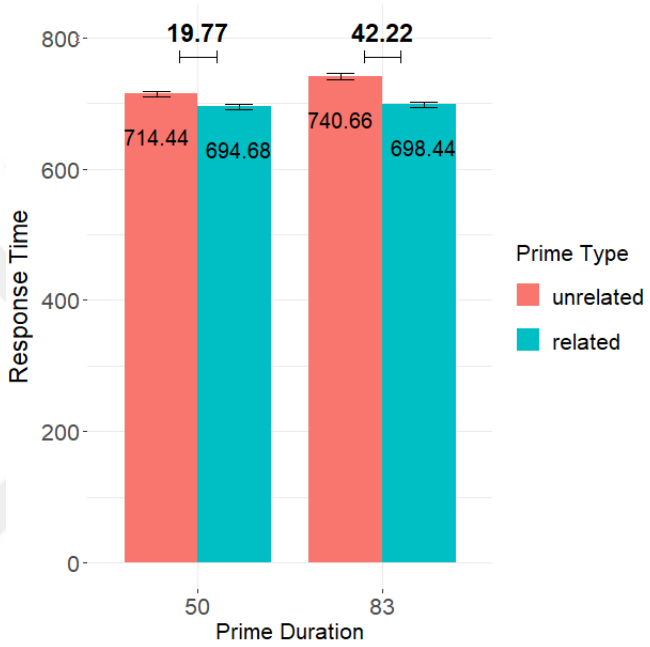


Figure 23. The interaction between prime type and prime duration (The differences are given in bold font)

5.3.4.5. Prime Type x Prime Corpus Frequency

Another two-way interaction in explaining the response times was between Prime Type and Prime Frequency (beta = -0.03, 95% CI [-0.06, -0.002], t(33154) = -2.11, p = 0.035; Std. beta = -0.03, 95% CI[-0.06, -0.002]). In the unrelated condition, prime frequencies had a small and neglectable effect. However, this effect was almost quadrupled in the related condition, and higher frequency values were correlated with faster response times. Figure 24 shows how response times were modulated by prime frequency values in the related and unrelated conditions.

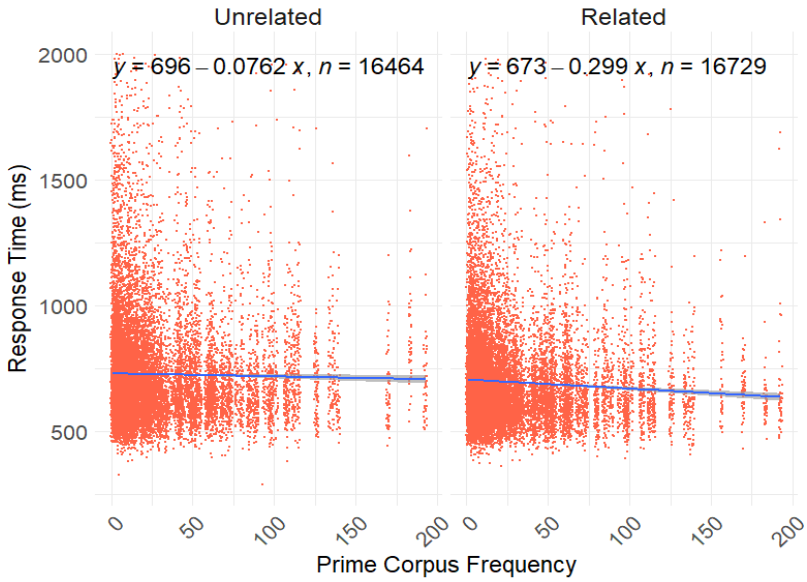


Figure 24. Response times across different prime frequency values in the related and unrelated conditions (The formulas are given at the top; n refers to the number of data points)

5.3.4.6. Language x LexTALE

Language and LexTALE scores interacted significantly in predicting response times (beta = -0.09, 95% CI [-0.11, -0.08], t(33154) = -10.57, p < .001; Std. beta =-0.10, 95% CI [-0.11, -0.08]). The increasing LexTALE scores dramatically decreased the response times in the English Tasks (the L1-L2 direction), while this effect was less prominent in the other direction (i.e., the L2-L1 direction). Figure 25 shows how response times decreased with increasing LexTALE scores for both language directions.

5.3.4.7. Task x LexTALE

The interaction between Task type and LexTALE scores was significant (beta= -0.03, 95% CI [-0.05, -0.01], t(33154) = -3.30, p < .001; Std. beta = -0.03, 95% CI [-0.05, -0.01]). The higher LexTALE scores predicted faster answers in the lexical decision tasks, but this effect was more prominent in the semantic categorization tasks, as higher LexTALE scores decreased response times in that later task even more. Figure 26 shows the interaction between the tasks and LexTALE scores in explaining response times.

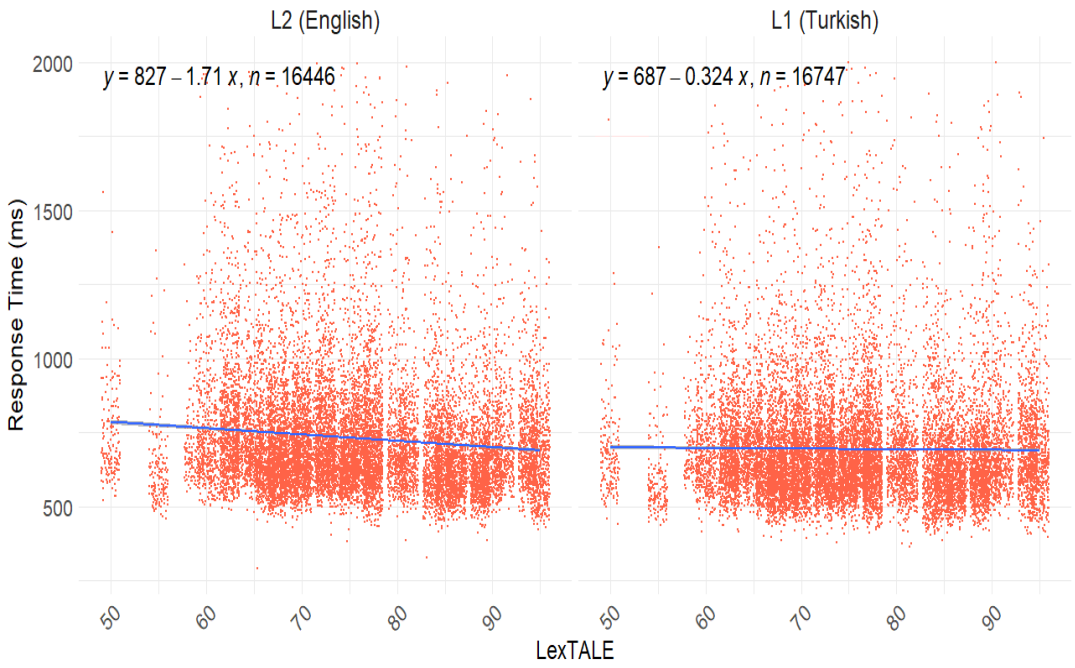


Figure 25. Response times across different LexTALE scores in two language directions (The formulas are given at the top; n refers to the number of data points)

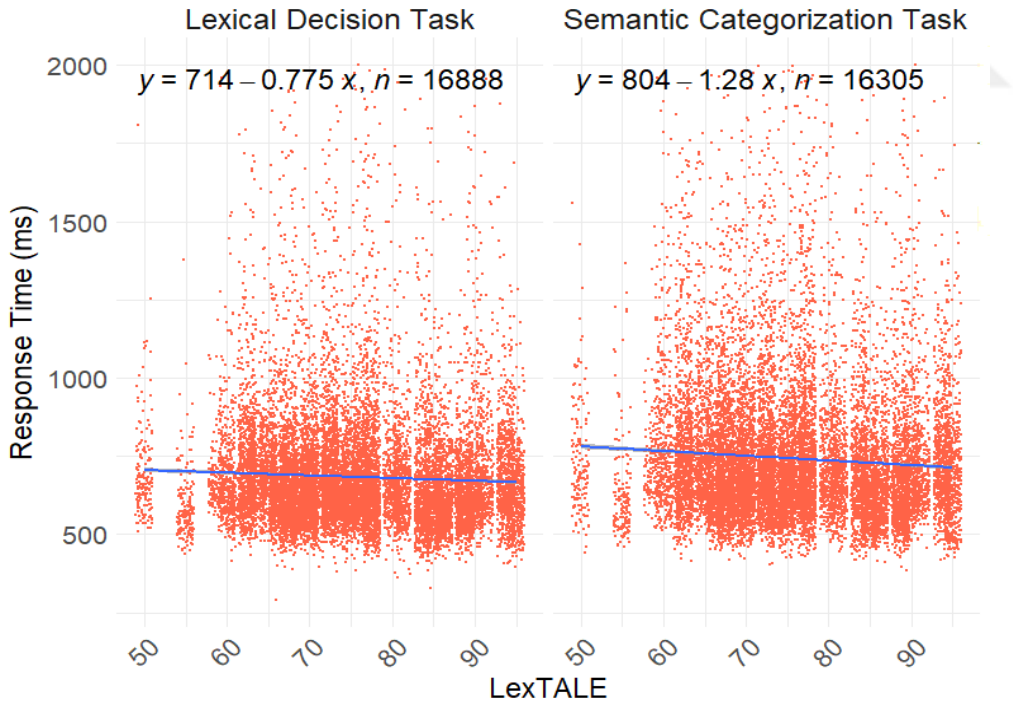


Figure 26. Response times in both tasks across different LexTALE scores (The formula is given in bold; n refers to the number of data points)

5.3.4.8. Prime Duration x L2 Immersion

Prime Duration and L2 Immersion interacted significantly in explaining response times (beta = -0.02, 95% CI [-0.04, -0.004], t(33154) = -2.43, p = 0.015; Std. beta = -0.02, 95% CI [-0.04, -0.004]). Higher L2 Immersion scores were correlated with even faster answers in the 83-ms prime condition compared to the 50-ms prime condition. Figure 27 shows how prime duration modulated the effect of L2 Immersion on response times.

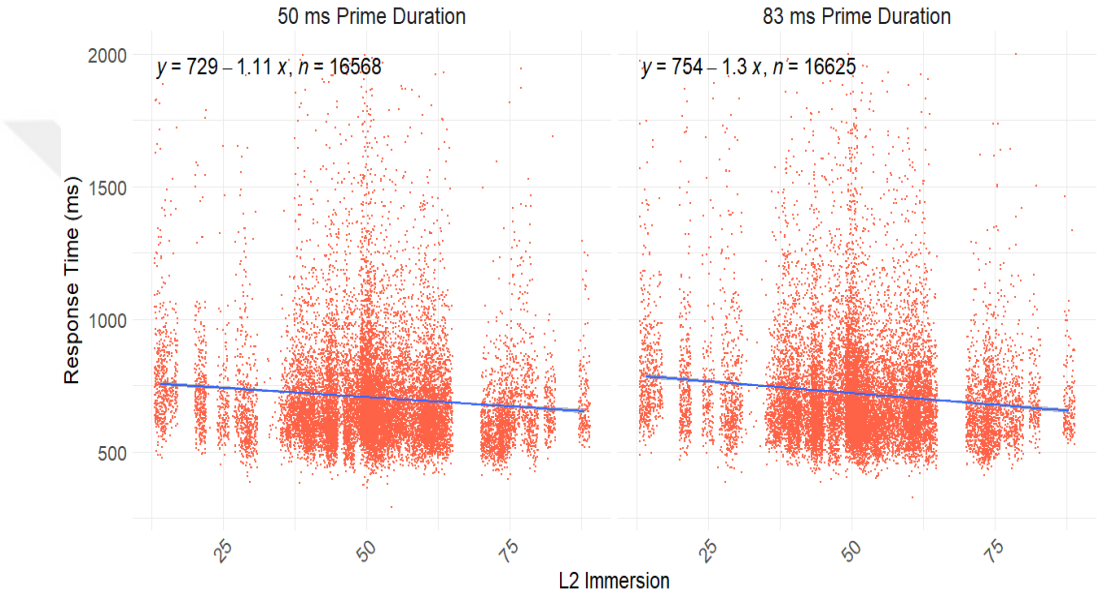


Figure 27. Response times across different L2 immersion scores in the 50 ms and 83 ms prime conditions (The formulas are given at the top; n refers to the number of data points)

5.3.4.9. Prime Duration x L2 Dominance

There was a significant interaction between Prime Duration and L2 dominance on response times (beta = 0.04, 95% CI [0.02, 0.06], t(33154) = 4.30, p < .001; Std. beta = 0.04, 95% CI [0.02, 0.06]). The higher L2 dominance scores predicted faster responses in the 50-ms prime condition, while this effect decreased when the primes were presented for a longer duration (83 ms). Figure 28 shows how L2 dominance affected response times when the prime duration was shorter compared to when it was longer.

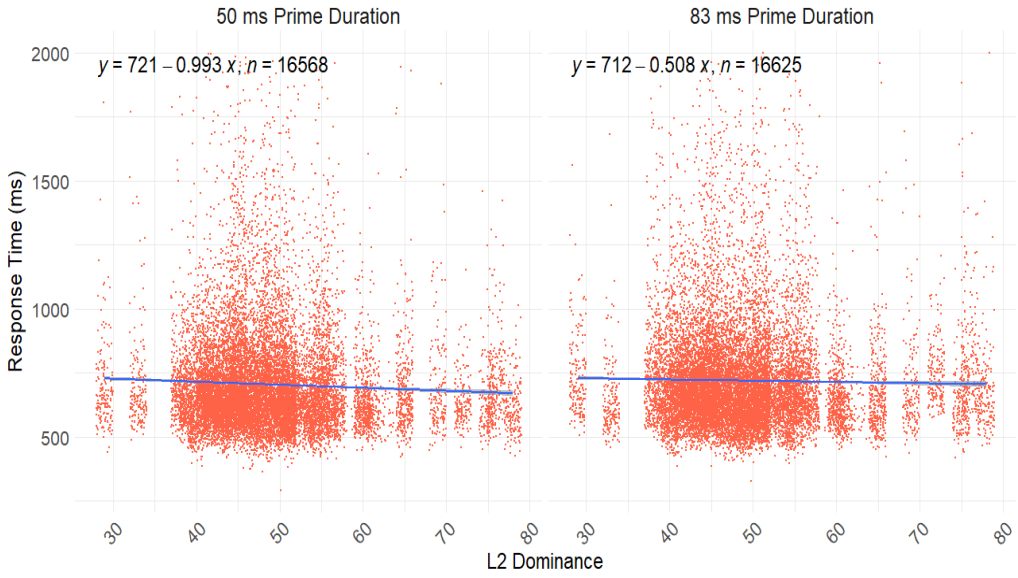


Figure 28. Response times across different L2 dominance scores in the 50 ms and 83 ms prime conditions (The formulas are given at the top; n refers to the number of data points)

5.3.5. Three-way Interactions

In this subsection, I present the significant three-way interactions in the response time analysis. The order of the interactions is the same as the order of Table 13. Interactions that were not statistically significant are not included in this subsection.

5.3.5.1. Prime Type x Language x LexTALE

Prime Type, Language, and LexTALE scores had a significant interaction effect on response times (beta = 0.04, 95% CI [0.004, 0.07], t(33154) = 2.17, p = 0.030; Std. beta = 0.04, 95% CI [0.004, 0.07]). In the Turkish (L1) tasks, higher LexTALE scores were correlated with quicker responses in the related condition than in the unrelated condition. The amount of facilitation by higher LexTALE scores is increased in the English tasks, and the previous pattern is reversed; increasing LexTALE scores seemed to decrease response times even more in the unrelated condition compared to the related conditions in the L1-L2 direction, when the target words were in English. Figure 29 shows this three-way interaction.

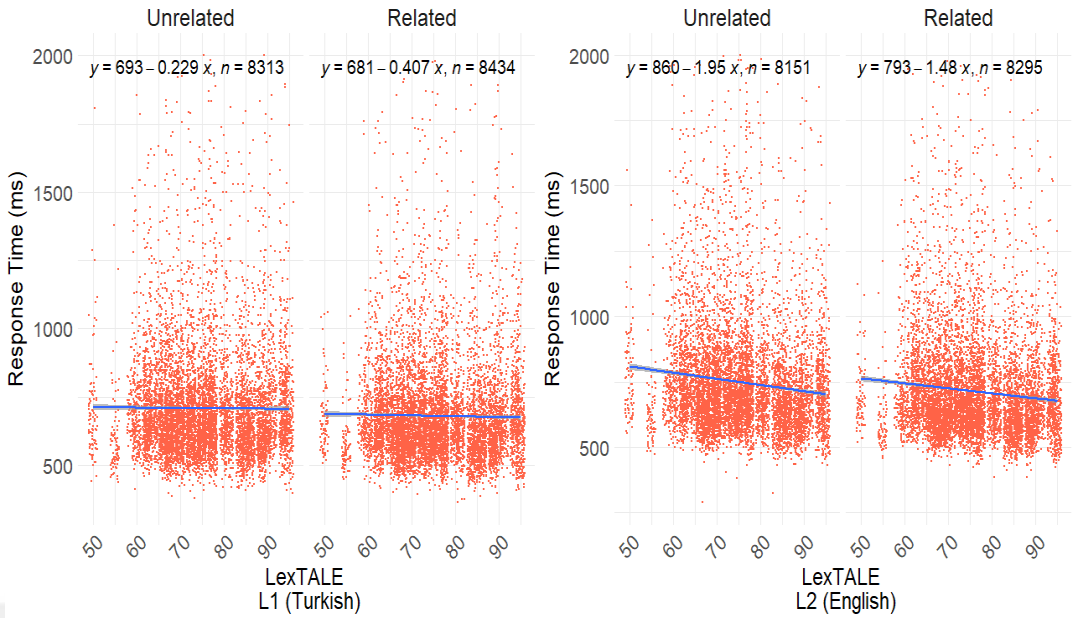


Figure 29. The interaction between the effects of prime type, language, and LexTALE scores on response times (The formulas are given at the top; n refers to the number of data points)

5.3.5.2. Prime Type x Language x Prime Duration

In explaining the response times, the effects of Prime Type, Language, and Prime Duration interacted significantly with each other (beta = -0.08, 95% CI [-0.15, -0.009], t(33154) = -2.20, p = 0.028; Std. beta = -0.08, 95% CI [-0.15, -0.009]). In the 50-ms prime condition, both the L1-L2 and L2-L1 directions produced comparable priming effects. This pattern was different in the 83-ms prime condition: the L1-L2 direction resulted in a larger priming effect size compared to the L2-L1 direction (49.11 vs. 35.63). At a closer look at the pattern, increased prime duration seemed to increase the response times given for the unrelated condition; the response times for the related primes are comparable in both 50-ms and 83-ms prime conditions (674.94 vs. 684.56 and 714.74 vs. 712.55 for the L2-L1 and L1-L2 directions, respectively). However, the response times were increased for the unrelated primes when the prime duration was longer, and this effect was even more prominent in the L1-L2 direction (695.83 vs. 720.2 and 733.32 vs. 761.65 for the L2-L1 and L1-L2 directions, respectively). Figure 30 shows this interaction.

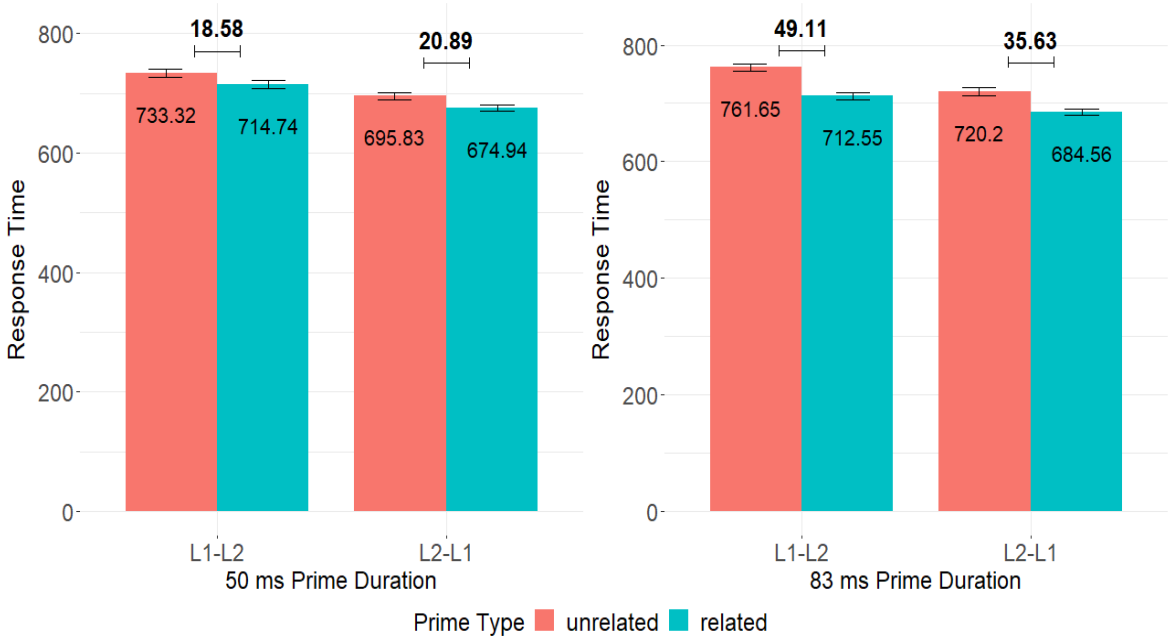


Figure 30. The interaction between the effects of prime type, language, and prime duration on response times (The priming effects are given in bold font)

5.3.5.3. Prime Type x Task x Prime Corpus Frequency

Another three-way interaction observed within the model was between the effects of Prime Type, Task, and Prime Frequency (beta = 0.06, 95% CI [0.02, 0.09], t(33154) = 3.13, p= 0.002; Std. beta = 0.06, 95% CI [0.02, 0.09]). In the lexical decision tasks, the primes with higher frequencies (corpus values) received faster answers only in the related condition. Although this facilitation effect of prime frequency was less prominent in the semantic categorization tasks, it was also apparent in the unrelated condition with less efficiency compared to the related condition. Figure 31 shows these patterns.

5.3.5.4. Task x Language x Target Corpus Frequency

The effects of Task, Language, and Target Frequency (Corpus values) interacted significantly (beta = -0.05, 95% CI [-0.09, -0.02], t(33154) = -2.81, p = 0.005; Std. beta = -0.05, 95% CI [-0.09, -0.02]). In the lexical decision tasks, target frequency values had little effect on response times. In the semantic categorization tasks, however, different language directions showed opposite patterns: higher target word frequencies were correlated with slower responses in the Turkish tasks (the L2-L1

direction), while such frequencies seemed to be related to quicker responses in the English tasks (the L1-L2 direction). Figure 32 shows the interaction between these factors.

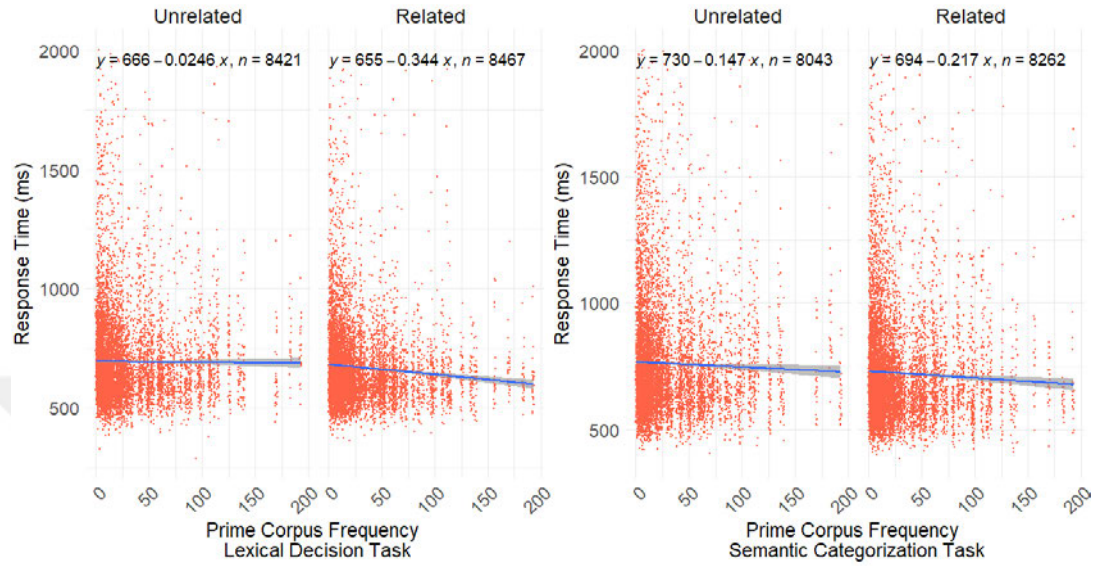


Figure 31. Response times across different prime frequencies in the different tasks for the related and unrelated conditions (The formulas are given at the top; n refers to the number of data points)

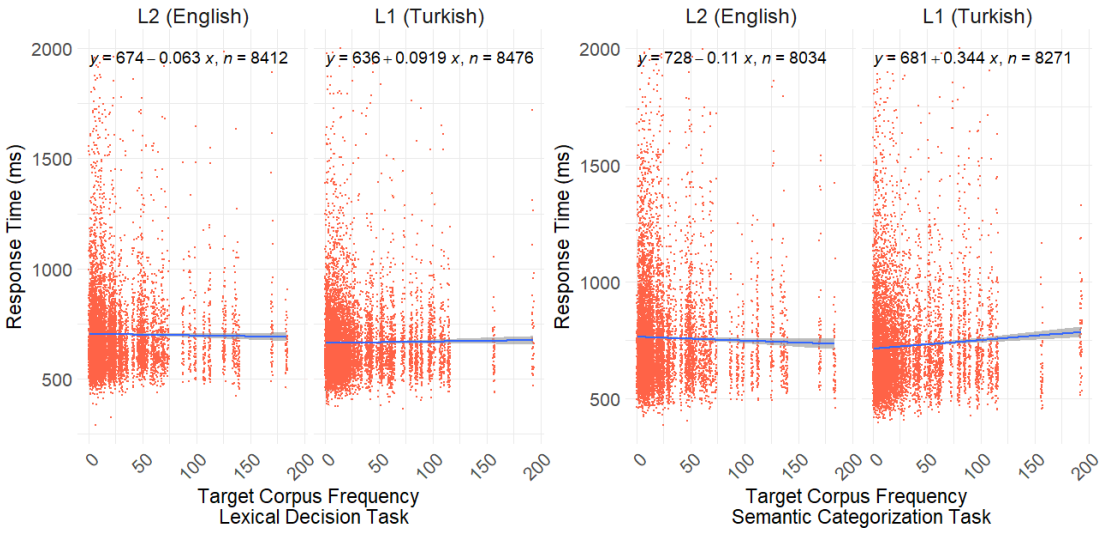


Figure 32. Response times across different target frequency values in the different tasks for both language directions (The formulas are given at the top; n refers to the number of data points)

5.3.6. Four-way Interactions

In this subsection, I present the only significant four-way interaction in the response time analysis. Although the final dataset for correct responses had a massive number of data points (33193), a four-way interaction is extremely complex and might be difficult to interpret. Therefore, the interaction in this section should be approached with caution.

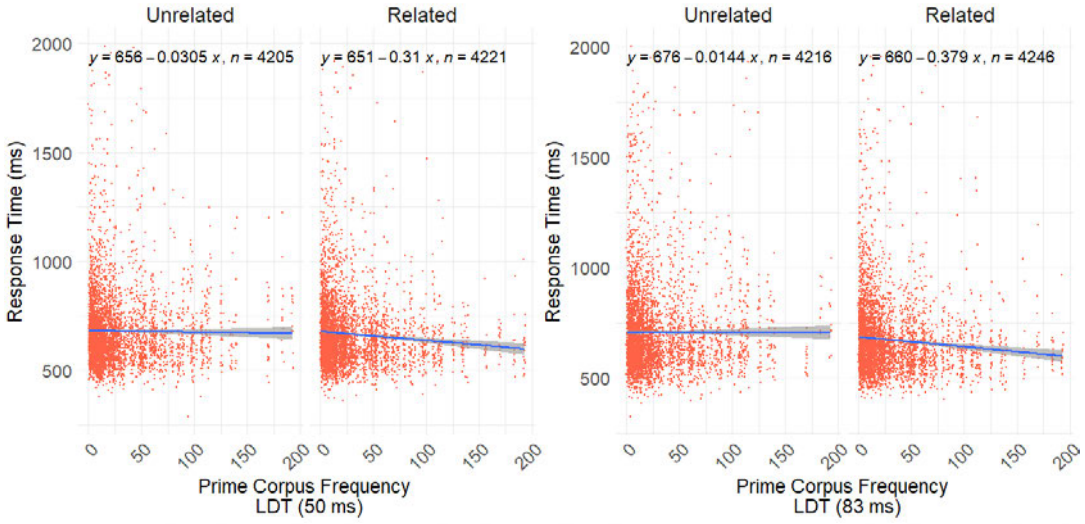


Figure 33. Response times across different prime frequency values in the related and unrelated conditions for the lexical decision tasks (The formulas are given at the top; n refers to the number of data points)

5.3.6.1. Prime Type x Task x Prime Duration x Prime Corpus Frequency

The only significant four-way interaction in the final reduced model was between the effects of Prime Type, Task, Prime Duration, and Prime Frequency (beta = 0.07, 95% CI [0.003, 0.14], t(33154) = 2.06, p = 0.040; Std. beta = 0.07, 95% CI [0.003, 0.15]). In the lexical decision tasks, Prime Frequency (Corpus values) seemed to have a similar effect with 50-ms and 83-ms primes: The higher prime frequencies were correlated with quicker responses in the related conditions, while this facilitative effect was negligible in the unrelated conditions. In the semantic categorization tasks, prime duration changed the patterns observed for the related and unrelated conditions. Similar to the pattern in the lexical decision tasks, the increasing prime frequency was

correlated with lower response times in the related condition when the prime duration was 50 ms, and this effect was negligible in the unrelated condition. When the primes were presented for 83 ms, however, the pattern of decreasing response times by increasing prime frequency was apparent in both the related and unrelated conditions. In fact, the facilitative effect was more prominent in the unrelated condition. Figures 33 and 34 present the patterns of this four-way interaction.

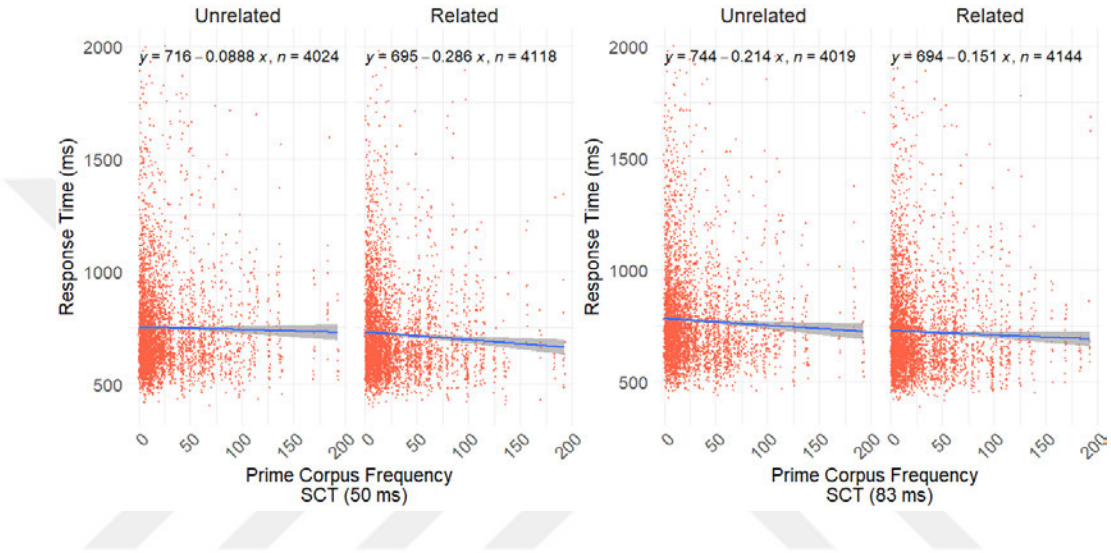


Figure 34. Response times across different prime frequency values in the related and unrelated conditions for the semantic categorization tasks (The formulas are given at the top; n refers to the number of data points)

CHAPTER 6

DISCUSSION

In an attempt to reveal how the languages of a bilingual interact with each other in the early stages of word processing, I recruited a large sample of 101 highly proficient bilinguals and carried out two experimental sessions with the same participants, each including four different tasks. Using the masked priming paradigm in combination with the lexical decision and semantic categorization tasks, the present study investigated the effects of processing translation equivalents preconsciously on the response times for the counterparts of these words in the other language. In addition to language direction (L1-L2 and L2-L1) and task-related differences (different task types and prime durations), I also examined the effects of individual differences (L2 proficiency, L2 immersion, and L2 dominance) and item-related differences (prime word and target word frequencies) as independent factors. The results of the mixed-effects model provided valuable insights into the bilingual mind by providing reliable findings with high study power.

6.1. Translation Equivalent Priming

The most profound and important findings of the current dissertation are related to translation equivalent priming. The use of translation equivalents as primes (the related condition) decreased response times significantly (Figure 14). In addition, the error rate analysis showed that the bilinguals in the current study made more mistakes when target words were preceded by unrelated primes (Table 9); therefore, related prime words helped participants reach the correct answer. These results, which are based on dozens of thousands of observations, present compelling evidence that the languages of a bilingual can interact with each other in the early and preconscious stages of word processing, even in the absence of orthographic and phonological similarity. What makes this translation equivalent priming effect that has already been common in the

literature (e.g., Voga & Grainger, 2007) interesting is its interactions with other potential factors in the current design.

The translation priming effect was prominent in both the L1-L2 direction and the L2-L1 direction. The bilinguals in the current study showed large priming effects for translation equivalent targets when these targets were preceded by brief presentations of their counterparts in the other language (Figure 14). Despite the high L2 proficiency level, response times were slower for L2 (English) target words compared to L1 (Turkish) target words in general (Figure 15). Although this tendency might present only weak evidence in favor of word processing differences between L1 and L2 as language-related factors can also modulate reading speed (Trauzettel-Klosinski & Dietz, 2012), the significant interaction between prime type and language seems to suggest that the efficiency of translation equivalent priming is different between language directions; the highly proficient bilinguals showed larger priming effects in the L1-L2 direction, that is, when L2 targets followed L1 primes (Figure 20). This rather small (5.52 ms) but significant difference between different language directions might be taken as evidence for better prime processing efficiency in a bilingual's native language, which is tempting given my similar prediction in the pre-registration report and the abundant evidence in the literature showing the same pattern (Chaouch-Orozco et al., 2021; Finkbeiner et al., 2004; Jiang & Forster, 2001; Schoonbaert et al., 2009; Wang & Forster, 2015; Witzel & Forster, 2012). However, a careful examination of this pattern and its interactions with prime duration reveals a different story: The bilinguals showed symmetrical priming effects in the 50-ms prime duration for both language directions, but the priming effect was asymmetrical in the 83-ms prime duration.

6.2. Task Effect

The task effect was a prominent factor in the response times. Semantic categorization tasks received more wrong answers, and this pattern was even more apparent in the L1-L2 direction. The bilinguals might have experienced greater difficulty in evaluating the categorical features of the target and comparing them with the given category in semantic categorization tasks compared to simply deciding whether the given string of letters was a real word, especially in their L2 (Table 8). As predicted in the pre-

registration report, the semantic categorization tasks elicited slower responses and induced larger translation priming effects in both language directions. These findings raise the question of whether different mechanisms or procedures are involved in cross-linguistic priming when using different tasks (Wang & Forster, 2015). As both language directions produced large and comparable priming effects in the present study, the reason why semantic categorization tasks elicit more priming effects should then be associated with the nature of this task rather than a failure to process prime words in L2 lexical decision tasks; as suggested in Multilink, the task/decision system can adjust word processing patterns in accordance with the task at hand (McPhedran & Lupker, 2021), resulting in more semantic activation in semantic categorization tasks due to a more semantic focus.

Pre-activation of categorical cues is an alternative argument for the boosted translation priming effects in the semantic categorization task (Xia & Andrews, 2015). The prompts at the beginning of each set show a category, which might pre-activate categorical cues or exemplars. This semantic boost might in turn help the activation of words, resulting in more prominent priming effects. Since lexical decision tasks lack this boost, priming effects could be less apparent in such tasks. Semantic feedback for lexical form representations is argued to help L2-L1 priming effects emerge since L2 words have weaker lexical representations. The results challenge this latter idea of weaker L2 lexical representations, at least for bilinguals similar to the sample pool in the current study, as even the lexical decision task in the L2-L1 direction produced significant priming effects with both prime durations.

The effect of using different tasks interacted with prime type, prime duration, language direction, and word frequency. These interactions are thoroughly examined in the subsections below.

6.3. Translation Priming with 50-ms Prime Words

In the 50-ms prime condition, both language directions produced similar translation equivalent priming sizes (20.89 ms in the L2-L1 direction, 18.58 ms in the L1-L2 direction), showing a pattern of symmetrical priming effects (Figure 30). This suggests that highly proficient bilinguals can benefit from semantic similarity with similar efficiency in both language directions when translation equivalent pairs are used as

prime-target pairs, in line with Duyck and Warlop (2009) and Perea et al. (2008). This result is even more striking considering that the current design did not include any blank screens or backward masks to provide extra processing time, making the SOA value equal to prime duration (50 ms SOA in the 50-ms prime condition). Remember that Schoonbaert et al. (2011) and Lee et al. (2018) could only find L2-L1 translation priming either when the prime duration was 100 ms or the SOA value was 150 ms. The findings obtained in the 50-ms prime condition challenge the argument that L2-L1 translation priming effects can only emerge when bilinguals are given more processing time through long prime durations or extended SOA values.

The languages of the bilinguals in the current study had the same script. This similarity might have also helped process the forms of L2 primes with the same efficiency as L1 primes (Nakayama et al., 2018), leading to symmetrical priming effects in the 50-ms prime condition. The effect of using the same-script in the current design can be revealed more clearly after further studies with a similar design and cross-script language pairs are carried out.

6.4. Translation Priming with 83-ms Prime Words

Regardless of language direction (L1-L2 or L2-L1), the longer prime duration increased the size of the priming effects (Figure 18). Interestingly, the longer exposure to prime words seems to have little effect in the related condition; when the prime words were related (translation equivalents), the bilinguals responded with average means of 698.68 ms and 698.44 ms in the 50-ms and 83-ms prime conditions, respectively. Therefore, the longer prime duration did not increase the efficiency of prime word activation. The real effect of the longer prime duration, and thus the reason behind the difference between priming effect sizes, was its inhibitory effect in the unrelated condition; when the prime duration was increased to 83 ms, the average response time in the unrelated condition increased from 714.44 ms to 740.66 ms. This 26 ms difference in the unrelated condition increased the magnitude of the priming effects for the tasks with the longer (83 ms) prime duration (Figure 23).

When language direction is also considered along with prime type and prime duration, the pattern of symmetrical translation priming obtained with the 50-ms primes changes. In the longer prime duration (83 ms), the L1-L2 direction received a close

average of response times for the related primes (714.74 ms vs. 712.55 ms), while the average difference was a little more in the L2-L1 direction (674.94 ms vs. 684.56 ms). A closer look at the response times of different tasks shows that this effect was more prominent in the lexical decision tasks; in the related conditions of these tasks, more prime duration led to significantly slower responses in the L2-L1 direction (648 ms vs. 661 ms). If this 13 ms delay for the related condition had not emerged with the 83-ms primes, the amount of priming obtained in both language directions would have been similar in the lexical decision tasks (42 ms in the L1-L2 direction, 40 ms in the L2-L1 direction). For the semantic categorization tasks in the L2-L1 direction, the responses in the 83-ms prime condition were again slower, but the average difference was only 5 ms and not statistically significant (703 ms vs. 708 ms), despite the longer average response times in the semantic categorization tasks. This leads to the idea that increasing the prime duration of L2 primes might increase the response times given for L1 translation equivalents, especially when the tasks are based on pure lexical decisions. This finding can be further taken as evidence in favor of task-related differences and the existence of a task/decision system. I offer two arguments to explain this finding.

The first argument is based on the involvement of phonological features. Although the tasks were based on visual recognition, a task/decision system might have prioritized the activation of semantic features. When the prime duration was increased, phonological features might have been activated, as the relevant semantic and lexical features were already fully activated. The studies have shown that orthographic effects emerge earlier than phonological effects in visual word recognition, both in L1 (Grainger et al., 2006) and L2 (Jouravlev et al., 2014). Since the target-prime pairs in the experiments possessed little to no phonological similarities in the current study, this information could have been useless in both language directions and even inhibitory in L2. In the semantic categorization tasks, this inhibitory effect might have been mitigated as these tasks relied more on semantic information and the target-prime pairs possessed high semantic similarity. Alternatively, the participants might have taken longer to finish processing orthographic information in the semantic categorization tasks, leaving little time to process phonological information.

The second argument refers to a reset system in the bilingual lexicon (Holcomb & Grainger, 2007). The processing of semantics might continue after the prime word disappears and the target word appears on the screen (Nakayama et al., 2018). EEG research supports this argument, as semantic activation has been found to be activated later than form-based activation in the brain (e.g., Holcomb & Grainger, 2006). Similar to the diminishing effect of identity priming with increasing SOA (Holcomb & Grainger, 2007), activated translation equivalent pairs might be suppressed to make room for upcoming words, leaving only semantic representations to be used in sentence-level processes (Schoonbaert et al., 2011). The suppression of form-level features might be even faster when the visual word recognition system recognizes that the target word and the preceding prime have a large orthographic mismatch (Nakayama et al., 2018). With increased prime duration, form-level features might have been activated more, possibly because I chose the upper limit of prime duration for unconscious processing and the primes were almost visible (83 ms). This enhanced activation of unrelated form-level features (since prime-target pairs had no visual similarity) might have been more difficult to suppress in an L2; since the activated semantic features by the prime word indicated a similarity with the semantic features activated by the target, the orthographic mismatch might have resulted in slower response times in the related conditions of the lexical decision tasks with the longer prime duration. Relatively lower hindrance in the L2 semantic categorization tasks (13 ms vs. 5 ms) can be associated with the more semantic and less form-based focus in such tasks. Future research is required to determine whether this inhibitory effect of longer prime durations for L2 related primes stems from different processing patterns of phonological information or from more activation of the form-level features. Also, different-script languages might result in easier rejection of form-level features even with longer prime durations.

The inhibitory effect of the longer prime duration was mostly apparent in the unrelated condition. In the unrelated conditions of lexical decision tasks, both the L1-L2 direction and the L2-L1 direction received slower responses with the increased prime duration (703 to 729 vs. 660 to 688, respectively). This indicates that increasing prime duration led to a similarly slower rejection of unrelated prime words in both language directions (26 ms vs. 28 ms); a longer exposure to the target word might have activated

more competitors or form-based features of the same word, resulting in the slower response time observed in the unrelated conditions for the 83-ms primes. In line with the explanation of the reset mechanism, increased activation of form-level features might have delayed giving answers in the unrelated conditions of lexical decision tasks. This time, however, both language directions might have shown the same challenge since both form-level and semantic features contradicted the features activated by target words. Alternatively, the longer prime duration might have enhanced the activation of phonological features, slowing down the responses given to the lexical decision tasks in both language directions when the prime-target pairs were not related.

When the task was a semantic categorization task, however, the responses given after unrelated primes were affected more by the increasing prime duration in the L1-L2 direction than the L2-L1 direction (765 to 797 vs. 733 to 753, respectively). This 12-ms difference between the language directions (32 ms vs. 20 ms) cannot be attributed to the overall slower responses to L2 target words since the average response time for L2 targets was only about 5% slower. The difference between the numbers of activated senses in L1 and L2 words might explain the results; more senses can be activated in the native language depending on a number of factors, including prime duration.

More processing time given by a longer prime duration might encourage the activation of more senses in both languages, as the senses that possess weaker links with words might need more processing time or more activation. L1 words might indeed activate more senses (Wang, 2013), some of which belong to different categories, and this in turn could make the decisions in a semantic categorization task harder when the activated senses and categories are irrelevant. When prime duration is shorter, only the senses with the strongest connections to the prime word might be activated, resulting in a similar number of activated senses in both language directions. As one of my professors said during my undergraduate studies to underline how categories are strongly related to prototypes, “Some birds are birder than others” (M. Özcan, personal communication, November, 2011); the Turkish word kuş and its English translation equivalent bird might activate the same (or mostly similar) senses in brief prime durations, prioritizing the prototypes and the most common uses of the word. When prime duration is increased, however, the higher number of senses related to L1 words

might show its effect, and L1 words can activate even the senses that possess weak links to the given prime words. In the unrelated conditions of the semantic categorization tasks, activation of that many senses in L1 can activate more unrelated categories compared to L2, making it more difficult to make categorical decisions in one's native language. In the related conditions of these tasks, as the mostly activated senses (or prototypes) show correspondence with the senses activated by the target word, it might be easier to reject the senses and categories that possess weaker links to the prime word.

Such a difference in the activated senses would not make a significant difference in lexical decision tasks, as a single activated sense of the target word would be enough to decide whether a given string of letters is a real word. Alternatively, a bilingual can reach the orthographic presentation of a given target to confirm that it is a real word. In semantic categorization tasks, however, participants must compare the activated senses and their categories to the given category, which would make this task even more challenging in the case of more activation for unrelated categories. In addition, semantic categorization tasks might prioritize the activation of semantic and conceptual features more than lexical decision tasks, making this effect emerge primarily in semantic-focused tasks.

The findings regarding prime type and prime duration in lexical decision and semantic categorization tasks can be summarized as follows: The shorter prime duration resulted in symmetrical priming effects in both language directions and both tasks, while the longer prime duration interacted with these factors. In the lexical decision tasks with an 83-ms prime duration, the participants gave slower answers after related L2 primes, probably due to the involvement of more phonological processing or form-based features. In the semantic categorization tasks with an 83-ms prime duration, the participants gave slower answers after unrelated L1 and L2 prime words, but this inhibitory effect was stronger in the L1-L2 direction. This latter result might be related to the increased number of senses associated with each word in L1; when an unrelated word activates more senses that are also unrelated to the target word and its category, categorical decisions might become more difficult.

6.5. Individual Differences

The characteristics of the bilinguals in this study are important in determining the reasons behind the symmetrical priming effects in the 50-ms prime duration and only small differences between language directions in the 83-ms prime duration. Despite their high L2 proficiency, the majority of the participants acquired their L2 after infancy (the average AoA for L2 was 8.30), suggesting that early acquisition of an L2 during infancy is not necessary for native-like conceptual representations in L2 (Malt & Sloman, 2003) or in obtaining symmetrical translation priming effects. Cultural immersion, which is immersion in an L2 context, can influence the conceptual depth of L2 words along with the amount of L2 use and exposure (McPhedran & Lupker, 2021). As the participants were students of the English Language Teaching Department, they used their L2 (English) in conversations and writing tasks and were exposed to it through written materials and auditory input, especially in the lessons. Similar to the bilinguals in Duñabeitia et al. (2010b), who found symmetrical priming effects in both language directions, the participants in the current study were exposed to a lot of written materials in their L2 (English). In this aspect, language proficiency and dominance (or cultural immersion) seem to have an important role in symmetrical translation priming. The results contradict the view that the acquisition age of an L2 determines the organization of a bilingual's lexicon and the way L2 words are activated (e.g., Dimitropoulou et al., 2011c; Jiang & Forster, 2001) and suggest that symmetrical translation effects are possible without acquiring an L2 in infancy.

The scores of LexTALE, which were taken as an indicator of L2 proficiency, predicted faster answers in the L1-L2 direction, that is, when the target words were presented in L2 (1.71 ms faster with each LexTALE score). The effect was also apparent in the opposite direction, although with lesser efficiency (0.32 ms faster with each LexTALE score). This suggests that higher L2 proficiency enhanced the efficiency of processing L2 primes (the L2-L1 direction) that were presented for brief durations, but when L2 words were presented as targets, the facilitative effect increased even more as the bilinguals had much more time for processing target words. L2 proficiency scores interacted with the prime type as well and modulated the observed priming effects. In the L1-L2 direction (Figure 29), the bilinguals benefited from higher L2 proficiency scores more in the unrelated condition (1.95 ms faster responses per each LexTALE

score) compared to the related condition (1.48 ms faster responses per each LexTALE score). However, such a difference between prime types might have stemmed from the overall slower responses given in the unrelated conditions of the tasks; when the answers are slower, a facilitative effect might seem bigger numerically but remain the same size in percentage. The effect of having a higher L2 proficiency showed a reversed pattern in the L2-L1 direction. The bilinguals with higher L2 proficiency responded faster in the unrelated condition (0.229 ms faster for each LexTALE score), but this facilitative effect was even more prominent in the related condition (0.407 ms faster for each LexTALE Score). Unlike the difference in the L1-L2 direction that could be explained by the slower answers in the unrelated conditions in general, the more L2 proficiency had a bigger facilitative effect on response times in the related condition, in which the answers were already faster in general. It is likely that the bilinguals might have activated the semantic features of L2 primes better with increasing L2 proficiency, resulting in more facilitation when responding to related L1 translation equivalents, which possessed high semantic overlap.

L2 proficiency also interacted with the type of task used, further supporting the argument for a task/decision system. Although higher LexTALE scores were associated with faster answers in the lexical decision tasks, the amount of facilitation was increased in the semantic categorization tasks (Figure 26). Regardless of the language direction, the participants with higher L2 proficiency scores might have used the task decision/system more efficiently, resulting in overall faster responses. Since the task/decision system is likely to play a more crucial role in the semantic categorization task (making categorical comparisons and decisions), this facilitative effect might increase in such tasks.

As opposed to the proposal that increased SOA or prime duration would have the same effect as increased L2 proficiency (Schoonbaert et al., 2011), the results of the current study showed that two manipulations have different outcomes, at least for highly proficient bilinguals using their L2 frequently. Increasing prime duration increased the processing times, especially in the unrelated conditions of tasks, while increased L2 proficiency predicted faster answers in different prime conditions. Similar to the sample pool of Chaouch-Orozco et al. (2021), however, the variation of L2 proficiency was low for the participants in the current study, and only one objective measurement

of L2 proficiency (LexTALE) was used. This limitation should be overcome in future studies by including participants with more varied L2 proficiencies and measuring L2 competencies through more extensive tests. Confirming the concerns of McPhedran and Lupker (2021), the objective measurement of L2 proficiency (LexTALE) explained the response times better than the subjective measurement (LHQ) in the current study, showing the importance of measuring L2 competencies through objective measurement tools in future research.

Another individual measure, L2 immersion, is usually associated with the efficiency of processing L2 primes and, thus, with translation priming in the L2-L1 direction. However, higher L2 immersion scores predicted faster answers regardless of language direction, suggesting that acquiring an L2 earlier might increase the lexical performance of a bilingual in both languages (Figure 16). Although this effect seemed slightly more prominent in the 83-ms prime condition (Figure 27), overall responses were also slower in this longer prime duration as well. The argument for enhanced lexical performance is further supported by the interaction between L2 immersion and prime type (Figure 21). The bilinguals with higher L2 immersion scores responded faster in the unrelated condition (1.15 ms faster per L2 immersion score), and this effect was a little more powerful in the related condition (1.24 ms faster per L2 immersion score). This finding indicates that bilinguals with higher L2 immersion scores might associate the semantic features of translation equivalent pairs more effectively, probably due to using the task/decision system better. It is important to remember, however, that L2 immersion scores were based on questionnaire answers, which were completed by the participants on their own without any guidance. Although the questionnaire items were self-explanatory, some of the participants in the present study might have had different interpretations of the age of onset of acquisition for their L2 or paid less attention to the questionnaire than required. This limitation can be overcome in future studies by collecting such information through interviews or providing guidance while participants are completing such questionnaires.

One final goal of the present study regarding individual differences was to investigate the potential influence of L2 dominance on translation priming. L2 dominance scores predicted slightly faster response times, and this effect was more apparent in the 50-

ms prime condition (Figure 28). More frequent use of L2 was associated with higher L2 dominance scores, and this more frequent use might have resulted in more efficient overall lexical access, especially when the prime duration was shorter. In longer prime durations, however, the involvement of confounding factors (e.g., the activation of phonological features or less-frequent senses) might have mitigated this facilitative effect.

The scores of L2 dominance failed to become significant factors in other analyses; the absence of significant main effects or further interactions regarding L2 dominance might be related to the lack of variance in the language use and proficiency of the participants in the current study. As discussed in Section 2.3.4, language dominance is also related to the ability to use language in a proficient way. Possessing a basic variety of an L2 and engaging in conversations with this limited ability should not be regarded as the L2 being the dominant language, regardless of how much it is used. The bilinguals in the current study had high levels of L2 proficiency and used their L2 in conversations and studying in a similar way, as they were all undergraduate students in the same department. This homogeneity might have prevented L2 dominance from emerging as a significant factor in more analyses. Similar to how a bilingual's weaker language can become the dominant one through increased L2 use and proficiency (Basnight-Brown & Altarriba, 2007), the bilinguals in the current study might have reached a state of balanced bilingualism in which both their languages had similar dominance. In addition, the limitation in collecting L2 dominance scores through self-completed questionnaires might have resulted in noisy data, as was the case with the L2 immersion scores mentioned above.

6.6. Word Frequency Effects

Item-related differences, namely prime and target frequencies in the current study, were also significant factors in the obtained results. This is especially important since the effect of word frequency has been mostly neglected in translation priming research (Chaouch-Orozco et al., 2021). Prime frequency interacted with task type, prime type, and prime duration (Figure 33). Higher prime frequencies predicted faster responses for the related conditions in all tasks and prime durations; therefore, primes with higher frequency values induced more priming effects in the tasks regardless of the language

direction, contradicting the null finding of Nakayama et al. (2018). When the prime duration was 83 ms in the semantic categorization tasks, higher prime frequencies decreased the response times in both related and unrelated conditions. Although increased prime duration might have activated extra senses that are unrelated to the target word in the unrelated condition and caused an extra delay in the response times, as discussed above, the higher frequency of the prime words seemed to alleviate this inhibition effect that was mostly apparent in the unrelated condition of the 83-ms semantic categorization tasks. In other words, due to the limited time to process prime words, higher prime frequency might have prevented the activation of some unrelated senses by prioritizing the activation of the most common uses, reducing the difficulty of making categorical decisions in the unrelated conditions of semantic categorization tasks.

Target word frequency had negligible influence on the response times in the lexical decision tasks. In the semantic categorization tasks, however, target frequency affected different language directions with opposite patterns, regardless of the prime type. When the highly proficient bilinguals saw an L2 target word with a higher frequency, their response times decreased, in line with previous research showing faster response times with increasing word frequency (e.g., Diependaele et al., 2013). This can be attributed to the faster activation of the target word along with its categorical features and thus the faster decision of whether it belongs to a certain category. On the contrary, L1 target words with higher frequency values received slower answers compared to L1 target words with relatively lower frequency values. In line with the explanation I provided before, a longer prime duration can result in activating more senses, even the ones that have weaker links to the given prime word (especially in L1). As opposed to the briefly presented prime words, target words remained on the screen until a response was given. This extended processing time might have eliminated the need for prioritizing common uses, as it allowed more thorough processing compared to prime words. Therefore, highly frequent target words might have activated all the relevant senses associated with them. Similar to how 83-ms L1 primes increased the response times in the unrelated condition of the semantic categorization task, L1 target words of higher frequency might have activated more senses and different categorical cues, potentially making categorical decisions more challenging.

6.7. Evaluating the Models of the Bilingual Lexicon

The findings should be discussed within the assumptions of the bilingual lexicon models. Quantitative models refer to the differences between L1 and L2 word presentations and processing as quantitative, indicating that they can disappear by increasing L2 competencies (e.g., Dijkstra & van Heuven, 2002; Dijkstra et al., 2019; Schoonbaert et al., 2009). Therefore, such accounts can better account for the symmetrical translation priming in the 50-ms prime condition and the little differences between language directions in the 83-ms prime condition.

As mentioned above, the observed differences between the tasks can be explained by the task/decision system in Multilink. This system might have prioritized the activation of semantic units in the semantic categorization tasks and thus resulted in more translation priming due to the high semantic overlap between prime-target pairs. Multilink predicts symmetrical priming effects in both language directions as a result of increasing L2 proficiency and L2 use. As bilinguals use their L2 more, their proficiency increases and the resting levels of lexical features change, leading to easier activation of L2 words. These assumptions align well with the current results; the highly proficient bilinguals in the current study had been using their L2 daily in their departments for various assignments and discussions, showing a high level of L2 use. The results cautiously suggest that increasing L2 competencies (proficiency, immersion, and dominance) can also improve the efficiency of the task/decision system.

Multilink, however, has one limitation that prevents it from explaining the whole nature of semantic interaction between languages in the bilingual mind: Its holistic and underspecified semantic units oversimplify the complex semantic features and interactions. As acknowledged by the creators of Multilink, even translation equivalents may not fully correspond to each other in terms of semantics between languages (Dijkstra et al., 2019). As a result, while the proposal of a task/decision system and changing resting levels for words seem accurate for the bilingual mind, the way words are represented with semantic and conceptual features must be enriched in the model to account for the recent findings, including the ones in the current study.

Another quantitative model, DRM, can offer a more detailed picture regarding the role of semantic features in translation equivalent priming. The shared conceptual features, which are increased in number by higher L2 proficiency, might be the main reason behind observing a semantic facilitation effect of translation equivalents. Throughout the discussion section, I have referred to senses associated with words in the lexicon in accordance with the Sense Model. In fact, the concept of senses I used in my arguments can easily be replaced by the conceptual features in Multilink or DRM. L1 words might be associated with more conceptual features, but the resting levels of conceptual features might vary. Factors like increased prime duration might allow the activation of conceptual features with weaker links to the prime word, resulting in the observed results in the current study.

However, as discussed in Section 2.2.1, verbal models such as DRM have strong limitations, including but not limited to the inability to provide simulations to test their assumptions and the seemingly accurate solutions offered by additional verbal proposals, which make it impossible to falsify such models. In that sense, enriching semantic/conceptual features in Multilink can allow the model to account for translation and semantic priming and provide a more reliable and testable model of the bilingual mind at the same time.

The findings might be more difficult to explain within the qualitative models, as they argue that the languages in the bilingual mind have qualitative differences, and these are resilient to change even at high L2 proficiency levels. The Sense Model, for example, is also based on the idea of shared conceptual features (senses) between the words of different languages. One interpretation of the Sense Model is that although increasing L2 proficiency might increase the efficiency of the sense activation for L2 words, the gap between L1 and L2 words in terms of shared senses will remain constant; many senses are specific to certain languages since they were encoded in different times and different situations (Nakayama et al., 2016). This view is difficult to maintain as the difference in translation priming between two language directions was absent with 50-ms primes and small with 83-ms primes. Another proposal of the Sense Model is the diminishing translation priming asymmetry in the semantic categorization tasks: In the lexical decision tasks, translation priming effects might be absent or less prominent in the L2-L1 direction compared to the other direction, but

this translation priming asymmetry should diminish in the semantic categorization tasks. The findings of the current study present counterevidence to this argument as both tasks produced significant translation priming effects in both language directions, and although the priming was larger in the semantic categorization tasks compared to the lexical decision tasks (Figure 22), language direction did not modulate this interaction.

The initial version of RHM, which can be regarded as a qualitative model, argues that lexical links are formed between translation equivalents, and these links are used in the L2-L1 direction rather than the conceptual links that are used in the L1-L2 direction. The proposal of direct activation for L1 words through lexical links (without the need for conceptual processing) has been challenged by the findings of null or reduced translation priming in the L2-L1 direction (e.g., Chaouch-Orozco et al., 2021). The current findings similarly challenged this proposal; both language directions induced comparable priming effects, contrary to the exception of a direction activation pattern without the need for using conceptual features in the L2-L1 direction. Furthermore, if L2 words had direct lexical links with their L1 translation equivalents as RHM suggested, the increased prime duration would not have increased the processing time of the related primes in the L2-L1 direction of the lexical decision task; quite the opposite, the activation of lexical links would have been even easier in the 83-ms prime condition if the priming effects had depended on direct lexical links in the L2-L1 direction. Similarly, the longer prime duration would not have resulted in the increased processing time observed for the unrelated prime conditions in all L2-L1 tasks. Instead, this language direction showed similar processing patterns and priming effects to the L1-L2 direction, indicating small quantitative differences between the processing of the two language directions.

Rather than the argument of stronger lexical links between L1 words and conceptual features, L1 words might have more conceptual features attached to them, but these extra conceptual features might require extra semantic activation to become activated, as discussed above. One might argue that the Sense model proposes direct lexical activation for the beginning proficiency levels and that this direct route loses its dominance as L2 proficiency increases. Although this interpretation might account for the current findings by referring to the L2-L1 processing of highly proficient bilinguals

as mainly conceptual-based, the accumulating evidence showing the absence of L2-L1 priming effects with lower proficiency levels disproves this idea (e.g., Witzel & Forster, 2012).

A more recent interpretation of RHM rejects simple lexical links that ignore language-dependent and language-independent semantic features (Brysbaert and Duyck, 2010) and adopts the idea of different efficiency levels of L2 conceptual processing in different directions (Kroll et al., 2010). In the latter argument, L2 words might be used efficiently to reach relevant concepts, but accessing L2 words through activated concepts is more challenging. Such modifications to the model would place it within quantitative models (Xia & Andrews, 2015).

However, even if the argument of direct lexical links is replaced with conceptual links that work more efficiently in the L2 words-concepts direction, the model still fails to account for the findings of more L1-L2 priming in the literature. In the L1-L2 direction, L1 words presumably activate conceptual features, which in turn activate L2 translation equivalents. If conceptual features were slower to activate L2 words, L2 words would activate conceptual features more efficiently in the L2-L1 direction and produce larger priming effects, which is contradictory to the current findings and the findings in the literature (e.g., Chaouch-Orozco et al., 2021; Jiang & Forster, 2001; Schoonbaert et al., 2009). Therefore, both the initial and recent versions of RHM cannot explain the accumulating evidence so far, including the results of the current study.

The Episodic L2 Hypothesis, the most qualitative model there is for the bilingual mind, fails to explain the translation equivalent patterns in this study, even with its updated version (Section 2.1.3). The model states that sequential bilinguals acquire their L2s after their L1s, when their semantic and lexical systems are already shaped in line with L1. According to the model, this causes L2 words to be stored in the episodic memory rather than the lexical memory. For this reason, L2 primes fail to induce priming effects for their L1 translation equivalents in lexical decision tasks, no matter how high a bilingual's L2 proficiency is. The majority of the bilinguals in the current study had acquired their L2s later in childhood, but the results still showed a prominent L2-L1 priming effect in the lexical decision tasks. Furthermore, the amount of this priming

effect was similar to the priming effect observed in the L1-L2 direction. These findings, which are based on strong evidence, strongly challenge the claims of the Episodic L2 Hypothesis.

6.8. Conclusion

In summary, the highly proficient bilinguals in the current study showed symmetrical translation priming effects with the 50-ms primes and comparable translation priming effects with the 83-ms primes, indicating quantitative differences between processing L1 and L2 words in the bilingual mind. L2 proficiency predicted faster responses in L2 and modulated priming effects, in addition to decreasing the response times more in the semantic categorization tasks than the lexical decision tasks. While the higher L2 immersion and L2 dominance scores reduced response times in general, it is important to consider the lack of variance in these two subjectively measured indices and the potential limitations of collecting data through self-completed questionnaires before reaching conclusions in the current study. Prime frequency interacted with prime type, resulting in a general pattern of enhanced priming effects with higher frequency values. Finally, target frequency showed opposing patterns in the semantic categorization tasks for different language directions. Higher frequency values predicted faster answers when the targets were presented in L2 and slower answers when they were presented in L1, which might have been related to the activation of different categories related to highly frequent L1 words. The findings indicate quantitative differences between the languages of a bilingual that can be remedied with increasing L2 competencies (e.g., L2 proficiency and dominance), even when these languages were not acquired simultaneously during infancy. Multilink, a computational model of the bilingual lexicon, can account for the current findings if it is to enrich the representations of its semantic/conceptual features and interactions. As the L2 words were selected from highly frequent words in the current design, future studies can replicate the same experiments using the same items but with lower L2 proficiency levels. This would help reveal the developmental map of translation equivalent priming and provide a better understanding of how the models of the bilingual mind should be structured.

REFERENCES

Akaike, H. (1974). A New Look at the Statistical Model Identification. In E. Parzen, K. Tanabe, & G. Kitagawa (Eds.), *Springer Series in Statistics, Perspectives in Statistics, 0172-7397. Selected Papers of Hirotugu Akaike* (pp. 215–222). Springer New York. https://doi.org/10.1007/978-1-4612-1694-0_16

Allen, D., Conklin, K., & Miwa, K. (2020). Cross-linguistic lexical effects in different-script bilingual reading are modulated by task. *International Journal of Bilingualism*, 136700692094397. https://doi.org/10.1177/1367006920943974

Baayen, R. H [R. H.], Piepenbrock, R., & Gulikers, L. (1996). *The CELEX Lexical Database (CD-ROM)*. University of Pennsylvania. https://pure.mpg.de/pubman/faces/ViewItemOverviewPage.jsp?itemId=item_2339741

Basnight-Brown, D. M., & Altarriba, J. (2007). Differences in semantic and translation priming across languages: The role of language direction and language dominance. *Memory & Cognition*, *35*(5), 953–965. https://doi.org/10.3758/BF03193468

Bijeljac-Babic, R., Biardeau, A., & Grainger, J. (1997). Masked orthographic priming in bilingual word recognition. *Memory & Cognition*, *25*(4), 447–457. https://doi.org/10.3758/BF03201121

Brysbaert, M. (2019). How Many Participants Do We Have to Include in Properly Powered Experiments? A Tutorial of Power Analysis with Reference Tables. *Journal of Cognition*, *2*(1), 16. https://doi.org/10.5334/joc.72

Brysbaert, M. (2020). Power considerations in bilingualism research: Time to step up our game. *Bilingualism: Language and Cognition*, 1–6. https://doi.org/10.1017/S1366728920000437

Brysbaert, M., & Duyck, W. (2010). Is it time to leave behind the Revised Hierarchical Model of bilingual language processing after fifteen years of service? *Bilingualism: Language and Cognition*, *13*(3), 359–371. https://doi.org/10.1017/S1366728909990344

Brysbaert, M., Lagrou, E., & Stevens, M. (2017). Visual word recognition in a second language: A test of the lexical entrenchment hypothesis with lexical decision times. *Bilingualism: Language and Cognition, 20*(3), 530-548. doi:10.1017/S1366728916000353

Brysbaert, M., Mandera, P., & Keuleers, E. (2018). The Word Frequency Effect in Word Processing: An Updated Review. *Current Directions in Psychological Science, 27*(1), 45–50. https://doi.org/10.1177/0963721417727521

Brysbaert, M., & Stevens, M. (2018). Power Analysis and Effect Size in Mixed Effects Models: A Tutorial. *Journal of Cognition*, *1*(1), 9. https://doi.org/10.5334/joc.10

Chaouch-Orozco, A., González Alonso, J., & Rothman, J. (2021). Individual differences in bilingual word recognition: The role of experiential factors and word frequency in cross-language lexical priming. *Applied Psycholinguistics*, *42*(2), 447–474. https://doi.org/10.1017/S014271642000082X

Chee, M. W., Westphal, C., Goh, J., Graham, S., & Song, A. W. (2003). Word frequency and subsequent memory effects studied using event-related fMRI. *NeuroImage, 20*(2), 1042-1051. https://doi.org/10.1016/S1053-8119(03)00335-5

Chen, X., & Dong, Y. (2019). Evaluating objective and subjective frequency measures in L2 lexical processing. *Lingua*, *230*, 102738. https://doi.org/10.1016/j.lingua.2019.102738

Cop, U., Keuleers, E., Drieghe, D., & Duyck, W. (2015). Frequency effects in monolingual and bilingual natural reading. *Psychonomic bulletin & review*, *22*, 1216-1234 https://doi.org/10.3758/s13423-015-0819-2

Davies, M. (2008). The corpus of contemporary American English (COCA). https://www.english-corpora.org/coca/

Davis, C., Sánchez-Casas, R., García-Albea, J. E., Guasch, M., Molero, M., & Ferré, P. (2010). Masked translation priming: Varying language experience and word type with Spanish–English bilinguals. *Bilingualism: Language and Cognition, 13*(2), 137-155. https://doi.org/10.1017/S1366728909990393

Degani, T., Prior, A., & Hajajra, W. (2018). Cross-language semantic influences in different script bilinguals. *Bilingualism: Language and Cognition*, *21*(4), 782–804. https://doi.org/10.1017/S1366728917000311

Diependaele, K., Duñabeitia, J. A., Morris, J., & Keuleers, E. (2011). Fast morphological effects in first and second language word recognition. *Journal of Memory and Language*, *64*(4), 344–358. https://doi.org/10.1016/j.jml.2011.01.003

Diependaele, K., Lemhöfer, K., & Brysbaert, M. (2013). The word frequency effect in first- and second-language word recognition: A lexical entrenchment account. *Quarterly Journal of Experimental Psychology*, *66*(5), 843–863. https://doi.org/10.1080/17470218.2012.720994

Dijkstra, T., & van Heuven, W. J. B. (1998). The BIA model and bilingual word recognition. *Localist Connectionist Approaches to Human Cognition*, 189–225.

Dijkstra, T., & Van Heuven, W. J. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and cognition*, *5*(3), 175-197. https://doi.org/10.1017/S1366728902003012

Dijkstra, T., Wahl, A., Buytenhuijs, F., van HALEM, N., Al-Jibouri, Z., Korte, M. de, & Rekké, S. (2019). Multilink: a computational model for bilingual word recognition and word translation. *Bilingualism: Language and Cognition*, *22*(04), 657–679. https://doi.org/10.1017/S1366728918000287

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011a). Masked translation priming effects with low proficient bilinguals. *Memory & Cognition*, *39*(2), 260–275. https://doi.org/10.3758/s13421-010-0004-9

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011b). Phonology by itself: Masked phonological priming effects with and without orthographic overlap. *Journal of Cognitive Psychology*, *23*(2), 185–203. https://doi.org/10.1080/20445911.2011.477811

Dimitropoulou, M., Duñabeitia, J. A., & Carreiras, M. (2011c). Two words, one meaning: Evidence of automatic co-activation of translation equivalents. *Frontiers in Psychology*, *2*, 188. https://doi.org/10.3389/fpsyg.2011.00188

Dunn, A., & Fox Tree, J. (2009). A quick, gradient Bilingual Dominance Scale. *Bilingualism: Language and Cognition, 12*(3), 273-289. https://doi:10.1017/S1366728909990113

Duñabeitia, J. A., Dimitropoulou, M., Uribe-Etxebarria, O., Laka, I., & Carreiras, M. (2010a). Electrophysiological correlates of the masked translation priming effect with highly proficient simultaneous bilinguals. *Brain Research*, *1359*, 142–154. https://doi.org/10.1016/j.brainres.2010.08.066

Duñabeitia, J. A., Perea, M., & Carreiras, M. (2010b). Masked translation priming effects with highly proficient simultaneous bilinguals. *Experimental Psychology*, *57*(2), 98–107. https://doi.org/10.1027/1618-3169/a000013

Duyck, W., & Brysbaert, M. (2004). Forward and backward number translation requires conceptual mediation in both balanced and unbalanced bilinguals. *Journal of Experimental Psychology. Human Perception and Performance*, *30*(5), 889–906. https://doi.org/10.1037/0096-1523.30.5.889

Duyck, W., & Warlop, N. (2009). Translation priming between the native language and a second language: New evidence from Dutch-French bilinguals. *Experimental Psychology*, *56*(3), 173–179. https://doi.org/10.1027/1618-3169.56.3.173

Eddy, M. D., & Holcomb, P. J. (2010). The temporal dynamics of masked repetition picture priming effects: Manipulations of stimulus-onset asynchrony (SOA) and prime duration. *Brain Research, 1340*, 24-39. https://doi:10.1016/j.brainres.2010.04.024

Feldman, L. B., Kostić, A., Gvozdenović, V., O'Connor, P. A., & Moscoso del Prado Martín, F. (2012). Semantic similarity influences early morphological priming in Serbian: A challenge to form-then-meaning accounts of word recognition. *Psychonomic bulletin & review, 19*, 668-676. https://doi.org/10.3758/s13423-012-0250-x

Finkbeiner, M., Forster, K., Nicol, J., & Nakamura, K. (2004). The role of polysemy in masked semantic and translation priming. *Journal of Memory and Language*, *51*(1), 1–22. https://doi.org/10.1016/j.jml.2004.01.004

Finkbeiner, M. (2005). Task-dependent L2-L1 translation priming: An investigation of the separate memory systems account. In *Proceedings of the 4th International Symposium on Bilingualism* (pp. 741-750). Somerville, MA: Cascadilla Press.

Forster, K.I. (2013). How many words can we read at once? More intervenor effects in masked priming. *Journal of Memory and Language, 69*, 563–573. https://doi.org/10.3758/s13428-020-01387-3

Forster, K. I., & Davis, C. (1984). Repetition priming and frequency attenuation in lexical access. Journal of Experimental Psychology: Learning, *Memory, and Cognition*, *10*(4), 680–698. https://doi.org/10.1037/0278-7393.10.4.680

Frost, R., Forster, K. I., & Deutsch, A. (1997). What can we learn from the morphology of Hebrew? A masked-priming investigation of morphological representation. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 23*(4), 829–856. https://doi.org/10.1037/0278-7393.23.4.829

Gollan, T. H., Forster, K. I., & Frost, R. (1997). Translation priming with different scripts: Masked priming with cognates and noncognates in Hebrew–English bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*(5), 1122–1139. https://doi.org/10.1037/0278-7393.23.5.1122

Grainger, J., & Holcomb, P. J. (2009). Watching the Word Go by: On the Time-course of Component Processes in Visual Word Recognition. *Language and Linguistics Compass, 3*(1), 128-156. https://doi.org/10.1111/j.1749-818X.2008.00121.x

Grainger, J., Kiyonaga, K., & Holcomb, P. J. (2006). The time course of orthographic and phonological code activation. *Psychological science, 17*(12), 1021-1026. https://doi.org/10.1111/j.1467-9280.2006.01821.x

Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. *Bilingualism: Language and Cognition, 1*(2), 67–81. https://doi.org/10.1017/S1366728998000133

Groot, A. M. B. de. (2011). *Language and cognition in bilinguals and multilinguals: An introduction*. Psychology Press. https://doi.org/10.4324/9780203841228

Holcomb, P. J., & Grainger, J. (2006). On the time course of visual word recognition: An event-related potential investigation using masked repetition priming. *Journal of Cognitive Neuroscience, 18*(10), 1631–1643. https://doi.org/10.1162/jocn.2006.18.10.1631

Holcomb, P.J., & Grainger, J. (2007). Exploring the temporal dynamics of visual word recognition in the masked repetition priming paradigm using event-related potentials. *Brain Research, 1180*, 39-58. https://doi.org/10.1016/j.brainres.2007.06.110

Jacob, G., Heyer, V., & Veríssimo, J. (2018). Aiming at the same target: A masked priming study directly comparing derivation and inflection in the second language. *International Journal of Bilingualism*, *22*(6), 619-637. https://doi.org/10.1177/1367006916688333

Jadhav, A., Pramod, D., & Ramanathan, K. (2019). Comparison of performance of data imputation methods for numeric dataset. *Applied Artificial Intelligence*, *33*(10), 913-933. https://doi.org/10.1080/08839514.2019.1637138

Jouravlev, O., Lupker, S. J., & Jared, D. (2014). Cross-language phonological activation: Evidence from masked onset priming and ERPs. *Brain and language*, *134*, 11-22. https://doi.org/10.1016/j.bandl.2014.04.003

Jiang, N., & Forster, K. I. (2001). Cross-Language Priming Asymmetries in Lexical Decision and Episodic Recognition. *Journal of Memory and Language*, *44*(1), 32–51. https://doi.org/10.1006/jmla.2000.2737

Jouravlev, O., Lupker, S. J., & Jared, D. (2014). Cross-language phonological activation: Evidence from masked onset priming and ERPs. *Brain and Language*, *134*, 11–22. https://doi.org/10.1016/j.bandl.2014.04.003

Keuleers, E., & Brysbaert, M. (2010). Wuggy: A multilingual pseudoword generator. *Behavior research methods*, *42*, 627-633. https://doi.org/10.3758/BRM.42.3.627

Kırkıcı, B., & Clahsen, H. (2013). Inflection and derivation in native and non-native language processing: Masked priming experiments on Turkish. *Bilingualism: Language and Cognition*, *16*(4), 776-791. https://doi.org/10.1017/S1366728912000648

Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory representations. *Journal of Memory and Language*, *33*(2), 149–174. https://doi.org/10.1006/jmla.1994.1008

Kroll, J. F., & Tokowicz, N. (2001). The development of conceptual representation for words in a second language. In Nicol J. (Ed.), *One Mind, Two Languages: Bilingual Language Processing*, *2*, 49–71.

Kroll, J. F., van Hell, J. G., Tokowicz, N., & Green, D. W. (2010). The Revised Hierarchical Model: A critical review and assessment. *Bilingualism: Language and Cognition*, *13*(3), 373–381. https://doi.org/10.1017/S136672891000009X

Kuhn, M. (2008). Building predictive models in R using the caret package. *Journal of statistical software*, *28*, 1-26. https://doi.org/10.18637/jss.v028.i05

Kuznetsova, A., Brockhoff, P. B., & Christensen, R. H. (2017). lmerTest package: tests in linear mixed effects models. *Journal of statistical software*, *82*, 1-26. https://doi.org/10.18637/jss.v082.i13

Lee, Y., Jang, E., & Choi, W. (2018). L2-L1 Translation Priming Effects in a Lexical Decision Task: Evidence From Low Proficient Korean-English Bilinguals. *Frontiers in Psychology*, *9*, 267. https://doi.org/10.3389/fpsyg.2018.00267

Lemhöfer, K., & Broersma, M. (2012). Introducing LexTALE: A quick and valid lexical test for advanced learners of English. *Behavior research methods*, *44*, 325-343. https://doi.org/10.3758/s13428-011-0146-0

Li, P., Zhang, F., Yu, A., & Zhao, X. (2020). Language History Questionnaire (LHQ3): An enhanced tool for assessing multilingual experience. *Bilingualism: Language and Cognition*, *23*(5), 938-944. https://doi.org/10.1017/S1366728918001153

Mackey, W. F. (1962). The description of bilingualism. *Canadian Journal of Linguistics/Revue canadienne de linguistique*, *7*(2), 51-85. https://doi.org/10.1017/S0008413100019393

Makowski D, Lüdecke D, Patil I, Thériault R, Ben-Shachar M, Wiernik B (2023). Automated Results Reporting as a Practical Tool to Improve Reproducibility and Methodological Best Practices Adoption. *CRAN*. https://easystats.github.io/report/.

Malt, B. C., & Sloman, S. A. (2003). Linguistic diversity and object naming by non-native speakers of English. *Bilingualism: Language and Cognition*, *6*(1), 47–67. https://doi.org/10.1017/S1366728903001020

Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing language profiles in bilinguals and multilinguals. *Journal of Speech, Language, and Hearing Research : JSLHR*, *50*(4), 940–967. https://doi.org/10.1044/1092-4388(2007/067)

Mathôt, S., Schreij, D., & Theeuwes, J. (2012). OpenSesame: An open-source, graphical experiment builder for the social sciences. *Behavior research methods*, *44*, 314-324. https://doi.org/10.3758/s13428-011-0168-7

McClelland, J. L., & Rumelhart, D. E. (1981). An interactive activation model of context effects in letter perception: I. An account of basic findings. *Psychological Review*, *88*(5), 375. https://doi.org/10.1037/0033-295X.88.5.375

McPhedran, M. J., & Lupker, S. J. (2021). L2-L1 noncognate masked translation priming as a task-specific phenomenon. *Bilingualism: Language and Cognition*, *24*(3), 507–523. https://doi.org/10.1017/S1366728920000504

Midgley, K. J., Holcomb, P. J., & Grainger, J. (2009). Masked repetition and translation priming in second language learners: A window on the time-course of form and meaning activation using erps. *Psychophysiology*, *46*(3), 551–565. https://doi.org/10.1111/j.1469-8986.2009.00784.x

Midgley, K. J., Holcomb, P. J., & Grainger, J. (2011). Effects of cognate status on word comprehension in second language learners: An ERP investigation. *Journal of Cognitive Neuroscience*, *23*(7), 1634–1647. https://doi.org/10.1162/jocn.2010.21463

Mishra, R. K., & Singh, N. (2014). Language non-selective activation of orthography during spoken word processing in Hindi–English sequential bilinguals: an eye tracking visual world study. *Reading and Writing*, *27*(1), 129–151. https://doi.org/10.1007/s11145-013-9436-5

Miwa, K., Dijkstra, T. O., Bolger, P., & Baayen, R. H [R. Harald] (2014). Reading English with Japanese in mind: Effects of frequency, phonology, and meaning in different-script bilinguals. *Bilingualism: Language and Cognition*, *17*(3), 445–463. https://doi.org/10.1017/S1366728913000576

Monaghan, P., Chang, Y.N., Welbourne, S., & Brysbaert, M. (2017). Exploring the relations between word frequency, language exposure, and bilingualism in a computational model of reading. *Journal of Memory and Language, 93*, 1–21. https://doi.org/10.1016/j.jml.2016.08.003

Murti, M. P., Pujianto, U., Wibawa, A. P., & Akbar, M. I. (2019). K-Nearest Neighbor (K-NN) based Missing Data Imputation. In *2019 5th International Conference on Science in Information Technology (ICSITech)*. https://doi: 10.1109/ICSITech46713.2019.8987530

Nakayama, M., Ida, K., & Lupker, S. J. (2016). Cross-script L2-L1 noncognate translation priming in lexical decision depends on L2 proficiency: Evidence from Japanese–English bilinguals. *Bilingualism: Language and Cognition*, *19*(5), 1001–1022. https://doi.org/10.1017/S1366728915000462

Nakayama, M., Lupker, S. J., & Itaguchi, Y. (2018). An examination of L2-L1 noncognate translation priming in the lexical decision task: Insights from distributional and frequency-based analyses. *Bilingualism: Language and cognition, 21*(2), 265-277. https://doi.org/10.1017/S1366728917000013

Nakayama, M., Sears, C. R., Hino, Y., & Lupker, S. J. (2012). Cross-script phonological priming for Japanese-English bilinguals: Evidence for integrated phonological representations. *Language and Cognitive Processes*, *27*(10), 1563–1583. https://doi.org/10.1080/01690965.2011.606669

Nakayama, M., Sears, C. R., Hino, Y., & Lupker, S. J. (2013). Masked translation priming with Japanese–English bilinguals: Interactions between cognate status, target frequency and L2 proficiency. *Journal of Cognitive Psychology*, *25*(8), 949–981. https://doi.org/10.1080/20445911.2013.839560

Nakayama, M., Verdonschot, R. G., Sears, C. R., & Lupker, S. J. (2014). The masked cognate translation priming effect for different-script bilinguals is modulated by the phonological similarity of cognate words: Further support for the phonological account. *Journal of Cognitive Psychology*, *26*(7), 714–724. https://doi.org/10.1080/20445911.2014.953167

O'Reilly, R., & Munakata, Y. (2000). *Computational explorations in cognitive neuroscience: Understanding the mind by simulating the brain*. MIT press. https://doi.org/10.7551/mitpress/2014.001.0001

Paradis M. (1997). The cognitive neuropsychology of bilingualism. In De Groot A. M. B., Kroll J. F. (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 331–354). Erlbaum.

Peterson, R. A. (2021). Finding Optimal Normalizing Transformations via best Normalize. *R Journal, 13*(1). https://doi.org/10.1080/02664763.2019.1630372

Peterson, R. A., & Cavanaugh, J. E. (2020). Ordered quantile normalization: a semiparametric transformation built for the cross-validation era. *Journal of applied statistics*, *47*(13-15), 2312–2327. https://doi.org/10.1080/02664763.2019.1630372

Peeters, D., Dijkstra, T [Ton], & Grainger, J. (2013). The representation and processing of identical cognates by late bilinguals: RT and ERP effects. *Journal of Memory and Language*, *68*(4), 315–332. https://doi.org/10.1016/j.jml.2012.12.003

Peleg, O., Degani, T., Raziq, M., & Taha, N. (2020). Cross-lingual phonological effects in different-script bilingual visual-word recognition. *Second Language Research*, *36*(4), 653–690. https://doi.org/10.1177/0267658319827052

Perea, M., Duñabeitia, J. A., & Carreiras, M. (2008). Transposed-letter priming effects for close versus distant transpositions. *Experimental Psychology*, *55*(6), 384–393. https://doi.org/10.1027/1618-3169.55.6.384

Pluck, G. (2020). A lexical decision task to measure crystallized-verbal ability in Spanish. *Revista Latinoamericana De Psicología*, *52*. https://doi.org/10.14349/rlp.2020.v52.1

Quick Placement Test. (2001). Oxford: Oxford University Press.

R Core Team (2023). R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria. https://www.R-project.org/

Rastle, K., Davis, M.H. & New, B. (2004) The broth in my brother's brothel: Morpho-orthographic segmentation in visual word recognition. *Psychonomic Bulletin & Review 11*, 1090–1098. https://doi.org/10.3758/BF03196742

Sánchez-Casas, R., & García-Albea, J. E. (2005). The representation of cognate and noncognate words in bilingual memory. *Handbook of bilingualism: Psycholinguistic approaches*, 226-250.

Sezer, T., & Sever Sezer, B. (2013). TS corpus: Herkes için Türkçe derlem. In *Proceedings of the 27th Turkish National Linguistics Conference*, pp. 217–225.

Schoonbaert, S., Duyck, W., Brysbaert, M., & Hartsuiker, R. J. (2009). Semantic and translation priming from a first language to a second and back: Making sense of the findings. *Memory & Cognition*, *37*(5), 569–586. https://doi.org/10.3758/MC.37.5.569

Schoonbaert, S., Holcomb, P. J., Grainger, J., & Hartsuiker, R. J. (2011). Testing asymmetries in noncognate translation priming: Evidence from RTs and ERPs. *Psychophysiology*, *48*(1), 74–81. https://doi.org/10.1111/j.1469-8986.2010.01048.x

Sunderman, G., & Kroll, J. F. (2006). First language activation during second language lexical processing: An investigation of lexical form, meaning, and grammatical class. *Studies in second language acquisition, 28*(3), 387-422. https://doi.org/10.1017/S0272263106060177

Şafak, D. F. (2015). Morphological processing of inflected and derived words in L1 Turkish and L2 English (Master's thesis, Middle East Technical University).

Taylor, J. E., Beith, A., & Sereno, S. C. (2020). LexOPS: An R package and user interface for the controlled generation of word stimuli. *Behavior Research Methods, 52*, 2372-2382. https://doi.org/10.3758/s13428-020-01389-1

Trauzettel-Klosinski, S., & Dietz, K. (2012). Standardized assessment of reading performance: The New International Reading Speed Texts IReST. *Investigative Ophthalmology & Visual Science*, *53*(9), 5452–5461. https://doi.org/10.1167/iovs.11-8284

Tokowicz, N., & Kroll, J. F. (2007). Number of meanings and concreteness: Consequences of ambiguity within and across languages. *Language and Cognitive Processes, 22*(5), 727-779. https://doi.org/10.1080/01690960601057068

Voga, M., & Grainger, J. (2007). Cognate status and cross-script translation priming. *Memory & cognition, 35*, 938-952. https://doi.org/10.3758/BF03193467

Vrieze, S. I. (2012). Model selection and psychological theory: A discussion of the differences between the Akaike information criterion (AIC) and the Bayesian information criterion (BIC). *Psychological Methods*, *17*(2), 228–243. https://doi.org/10.1037/a0027127

Wang, M., Koda, K., & Perfetti, C. A. (2003). Alphabetic and nonalphabetic L1 effects in English word identification: A comparison of Korean and Chinese English L2 learners. *Cognition*, *87*(2), 129–149. https://doi.org/10.1016/s0010-0277(02)00232-9

Wang, X. I., & Forster, K. (2015). Is translation priming asymmetry due to partial awareness of the prime? *Bilingualism: Language and Cognition*, *18*(4), 657–669. https://doi.org/10.1017/S1366728914000650

Wang, X. (2013). Language dominance in translation priming: Evidence from balanced and unbalanced Chinese-English bilinguals. *Quarterly Journal of Experimental Psychology (2006)*, *66*(4), 727–743. https://doi.org/10.1080/17470218.2012.716072

Wen, Y., & van Heuven, W. J. B. (2017). Non-cognate translation priming in masked priming lexical decision experiments: A meta-analysis. *Psychonomic Bulletin & Review*, *24*(3), 879–886. https://doi.org/10.3758/s13423-016-1151-1

Witzel, N. O., & Forster, K. I. (2012). How L2 words are stored: The episodic L2 hypothesis. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *38*(6), 1608–1621. https://doi.org/10.1037/a0028072

Xia, V., & Andrews, S. (2015). Masked translation priming asymmetry in Chinese-English bilinguals: Making sense of the Sense Model. *Quarterly Journal of Experimental Psychology (2006)*, *68*(2), 294–325. https://doi.org/10.1080/17470218.2014.944195

APPENDICES

A. APPROVAL OF THE METU HUMAN SUBJECTS ETHICS COMMITTEE

UYGULAMALI ETİK ARAŞTIRMA MERKEZİ
APPLIED ETHICS RESEARCH CENTER

DUMLUPINAR BULVARI 06800
ÇANKAYA ANKARA/TURKEY
T: +90 312 210 22 91
F: +90 312 210 79 59
ueam@metu.edu.tr
www.ueam.metu.edu.tr

ORTA DOĞU TEKNİK ÜNİVERSİTESİ
MIDDLE EAST TECHNICAL UNIVERSITY

Sayı: 28620816 /

15 ŞUBAT 2022

Konu : Değerlendirme Sonucu

Gönderen: ODTÜ İnsan Araştırmaları Etik Kurulu (İAEK)

İlgi : İnsan Araştırmaları Etik Kurulu Başvurusu

Sayın Bilal KIRKICI

Danışmanlığını yürüttüğünüz Enis OĞUZ'un "Diller Arası Anlamsal Örtüşmelerin İki Dilli Zihinde İşlemlenmesi: Türkçe-İngilizce İki Dilli Zihinsel Sözlük Örneği" başlıklı araştırmanız İnsan Araştırmaları Etik Kurulu tarafından uygun görülmüş ve **0100-ODTUİAEK-2022** protokol numarası ile onaylanmıştır.

Saygılarımızla bilgilerinize sunarız.

[redacted]
Prof.Dr. Mine MISIRLISOY
İAEK Başkan

B. INFORMED CONSENT FORM

Bu çalışma araştırmacılar Prof. Dr. Bilal Kırkıcı ve doktora öğrencisi Enis OĞUZ tarafından yürütülmektedir. Bu form sizi araştırma koşulları hakkında bilgilendirmek için hazırlanmıştır.

Çalışmanın Amacı Nedir?

Çalışma çift dilli üniversite öğrencilerinin her iki dildeki kelime işlemleme örüntüleri ile ilgili bilgi toplamayı amaçlamaktadır. Farklı deney türlerinin ve deney değişkenlerinin bu örüntülemeye olan etkisi de incelenmek istenmektedir.

Bize Nasıl Yardımcı Olmanızı İsteyeceğiz?

Çalışmada her biri 30 dakika civarında sürecek 2 deney aralıklarla 2 farklı günde yapılacaktır. Bu deneylerin ardından katılımcılar kısa bir anket ve ölçek doldurarak çalışmayı tamamlayacaklardır. Pandemi sebebiyle bu veri toplama süreci çevrimiçi de yapılabilir.

Katılımınızla ilgili bilmeniz gerekenler:

Bu çalışmaya katılmak tamamen gönüllülük esasına dayalıdır. Herhangi bir yaptırıma veya cezaya maruz kalmadan çalışmaya katılmayı reddedebilir veya çalışmayı bırakabilirsiniz. Araştırma esnasında cevap vermek istemediğiniz sorular olursa boş bırakabilirsiniz.

Katılımcıların isimleri bağımsız bir listede toplanacaktır ve veri toplama işlemi tamamen tamamlandıktan sonra bu liste silinecektir. Araştırmaya katılanların kimlik bilgileri tamamen gizli tutulacak, her katılımcıya rastgele oluşturulacak bir katılımcı numarası verildikten sonra veriler açık bilim prensipleri gereği çevrimiçi ulaşıma açık hale getirilecektir. Bu araştırmanın sonuçları bilimsel ve profesyonel yayınlarda veya eğitim amaçlı kullanılabilir, fakat katılımcıların kimliği gizli tutulacaktır.

Riskler:

Bu araştırmanın, ister fiziksel ister psikolojik olsun, herhangi bir riski yoktur. Yukarıda da belirtildiği gibi, herhangi bir ceza olmadan çalışmayı bırakabilirsiniz. Toplanan verilerin ve kimlik bilgilerinizin eşleştirilmeyeceğinin de garantisini veriyoruz. Bu çalışmadaki bilgiler, bilimsel yayınlarda kullanılabilir, fakat katılımcıların kimliği kesinlikle gizli tutulacaktır.

Araştırmayla ilgili daha fazla bilgi almak isterseniz:

Çalışmayla ilgili iletmek istediğiniz soru ve yorumlarınızı araştırmacılara [redacted] adresinden ulaştırabilirsiniz.

Yukarıdaki bilgileri okudum ve bu çalışmaya tamamen gönüllü olarak katılıyorum.

İsim Soyad Tarih İmza

C. RESPONSE TIME ANALYSIS USING LOG TRANSFORMATION

Table 14
Results of the reduced model (log-transformed response times)

	Response Time		
Predictors	*Estimates*	*CI*	*p*
(Intercept)	6.54	6.52 – 6.56	**<0.001**
Prime Type1	-0.04	-0.05 – -0.04	**<0.001**
Task1	0.08	0.07 – 0.08	**<0.001**
Language1	0.05	0.03 – 0.07	**<0.001**
Prime Duration1	0.02	0.02 – 0.02	**<0.001**
LexTALE	-0.01	-0.03 – 0.00	0.141
L2 Dominance	-0.00	-0.02 – 0.01	0.609
L2 Immersion	-0.02	-0.04 – -0.01	**0.006**
Target Corpus Frequency	0.00	-0.00 – 0.01	0.336
Prime Corpus Frequency	-0.01	-0.01 – -0.00	**0.006**
Task1 × Language1	-0.00	-0.01 – 0.01	0.640
Task1 × Prime Duration1	-0.00	-0.01 – 0.01	0.442
Language1 × Prime Duration1	-0.00	-0.01 – 0.01	0.442
Prime Type1 × Task1	-0.02	-0.03 – -0.01	**<0.001**
Prime Type1 × Language1	-0.01	-0.02 – -0.00	**0.012**
Prime Type1 × Prime Duration1	-0.03	-0.04 – -0.02	**<0.001**
Task1 × LexTALE	-0.01	-0.01 – -0.01	**<0.001**
Language1 × LexTALE	-0.02	-0.03 – -0.02	**<0.001**
Prime Type1 × LexTALE	0.00	-0.00 – 0.01	0.442
Prime Duration1 × L2 Immersion	-0.01	-0.01 – -0.00	**0.002**
Prime Type1 × L2 Immersion	-0.00	-0.01 – -0.00	**0.041**
Prime Duration1 × L2 Dominance	0.01	0.00 – 0.01	**<0.001**

Table 14 (continued)

Task1 × Target Corpus Frequency	0.00	-0.00 – 0.01	0.194
Language1 × Target Corpus Frequency	-0.01	-0.03 – 0.00	0.057
Task1 × Prime Frequency	0.00	-0.00 – 0.01	0.148
Prime Duration1 × Prime Corpus Frequency	-0.00	-0.00 – 0.00	0.810
Prime Type1 × Prime Corpus Frequency	-0.01	-0.01 – 0.00	0.090
Prime Type1 × Task1 ×Prime Duration1	-0.01	-0.03 – 0.01	0.329
Prime Type1 × Language1 × Prime Duration1	-0.02	-0.04 – -0.00	**0.024**
(Prime Type1 × Language1) × LexTALE	0.01	0.00 – 0.02	**0.033**
(Task1 × Language1) × Target Corpus Frequency	-0.02	-0.02 – -0.01	**0.001**
(Task1 × Prime Duration1) × Prime Frequency	-0.00	-0.01 – 0.01	0.960
(Prime Type1 × Task1) × Prime Frequency	0.01	0.00 – 0.02	**0.003**
(Prime Type1 × Prime Duration1) × Prime Frequency	0.00	-0.01 – 0.01	0.429
(Prime Type1 × Task1 ×Prime Duration1) × Prime Fre.	0.02	-0.00 – 0.03	0.053

Random Effects

σ^2	0.04
$\tau_{00\ Prime_ID}$	0.00
$\tau_{00\ Target_ID}$	0.00
$\tau_{00\ Participant\ ID}$	0.01
ICC	0.23
$N_{\ Participant_ID}$	99
$N_{\ Prime_ID}$	371
$N_{\ Target_ID}$	350
Observations	33193
Marginal R^2 / Conditional R^2	0.072 / 0.283

D. L2 (ENGLISH) EXPERIMENTAL WORDS

camel	mouse	carrot	ear	napkin	thunder
worm	apple	rice	arm	scale	tornado
octopus	garlic	cheek	blood	sink	lake
tiger	apricot	neck	remote	basket	rain
bull	spinach	nail	rug	island	mountain
spider	onion	kidney	fork	snow	town
parrot	cherry	tongue	oven	tree	bridge
dolphin	bean	chest	brush	sky	dorm
giraffe	grape	hair	plate	fog	pub
cat	banana	nose	picture	cave	store
frog	cabbage	heart	bed	plant	tomb
deer	cheese	tooth	mirror	leaf	mill
monkey	jam	ankle	spoon	hill	temple
duck	olive	eye	comb	storm	tower
bat	pickle	finger	iron	forest	village
lion	pear	bone	bottle	coast	pharmacy
sheep	fig	brain	bowl	wind	factory
elephant	steak	knee	couch	rock	mosque
snake	squash	lip	tray	valley	statue
crow	peach	waist	shelf	earth	palace
bear	plum	chin	sponge	sun	fountain
dog	soup	elbow	pan	cloud	mansion
goat	corn	heel	towel	beach	church
wolf	bread	shoulder	grill	star	pool
rabbit	egg	foot	chair	river	prison
cow	lettuce	mouth	pillow	grass	wall
donkey	honey	palm	cup	sand	castle
bee	melon	skin	carpet	flower	dock
fox	orange	beard	curtain	ocean	farm
ant	tomato	leg	pot	stone	
eagle	candy	stomach	knife	desert	

E. L1 (TURKISH) EXPERIMENTAL WORDS

deve	fare	havuç	kulak	peçete	yıldırım
solucan	elma	pirinç	kol	tartı	hortum
ahtapot	sarımsak	yanak	kan	lavabo	göl
kaplan	kayısı	boyun	kumanda	sepet	yağmur
boğa	ıspanak	tırnak	kilim	ada	dağ
örümcek	soğan	böbrek	çatal	kar	kasaba
papağan	kiraz	dil	fırın	ağaç	köprü
yunus	bezelye	göğüs	fırça	gök	yurt
zürafa	üzüm	saç	tabak	sis	bar
kedi	muz	burun	resim	mağara	mağaza
kurbağa	lahana	kalp	yatak	bitki	mezar
ceylan	peynir	diş	ayna	yaprak	değirmen
maymun	reçel	bilek	kaşık	tepe	tapınak
ördek	zeytin	göz	tarak	fırtına	kule
yarasa	turşu	parmak	ütü	orman	köy
aslan	armut	kemik	şişe	kıyı	eczane
koyun	incir	beyin	kase	rüzgar	fabrika
fil	biftek	diz	kanepe	kaya	cami
yılan	kabak	dudak	tepsi	vadi	heykel
karga	şeftali	bel	raf	toprak	saray
ayı	erik	çene	sünger	güneş	çeşme
köpek	çorba	dirsek	tava	bulut	konak
keçi	mısır	topuk	havlu	sahil	kilise
kurt	ekmek	omuz	ızgara	yıldız	havuz
tavşan	yumurta	ayak	sandalye	nehir	hapis
inek	marul	ağız	yastık	çimen	duvar
eşek	bal	avuç	kupa	kum	kale
arı	kavun	deri	halı	çiçek	rıhtım
tilki	portakal	sakal	perde	okyanus	çiftlik
karınca	domates	bacak	çanak	taş	
kartal	şeker	mide	bıçak	çöl	

F. L2 (ENGLISH) FILLER WORDS

hook	dungeon	litter	gun	drum	stick
rope	bill	compass	vaccine	table	stamp
bullet	anchor	coat	aunt	hammer	ink
medicine	money	ticket	sign	punch	purse
throne	coin	cannon	wire	shield	paper
belt	door	page	bucket	shirt	stage
gold	letter	phone	silver	puppet	ladder
trophy	pen	pin	needle	lock	kick
crown	student	pink	cane	woman	plane
torch	skull	dragon	bag	glue	purple
glass	child	truck	calendar	green	fist
hat	candle	fuel	pocket	witch	wing
steel	pearl	black	wheel	horn	path
triangle	poison	ship	daughter	dust	blue
tent	pipe	white	cape	mustard	priest
shoe	button	planet	elevator	box	umbrella
staple	medal	gym	zoo	ring	book
cotton	brick	rifle	luggage	spear	skate
brown	dice	toy	ice	coal	chess
cable	fire	muffin	car	glove	sword
silk	wallet	biscuit	seat	chain	sock
bike	ball	razor	lantern	circle	broom
key	chalk	mail	street	wood	violin
map	hole	desk	vomit	bow	father
king	dress	feather	scar	sister	seed
coffin	cage	salt	monk	kite	poet
gray	fence	mom	sweat	bell	boy
nurse	flag	skirt	square	baby	fur
monster	wool	girl	uncle	wound	air
brake	engine	pill	red	device	
cough	axe	gate	road	whistle	

G. L1 (TURKISH) FILLER WORDS

kanca	zindan	çöp	silah	davul	sopa
halat	fatura	pusula	aşı	masa	damga
kurşun	çapa	palto	teyze	çekiç	mürekkep
ilaç	dosya	bilet	işaret	vinç	tarla
taht	para	çuval	tel	kalkan	kağıt
kemer	tavan	sayfa	kova	gömlek	sahne
altın	mektup	telefon	gümüş	kukla	merdiven
akü	kalem	raptiye	iğne	kilit	tekme
taç	kavanoz	pembe	baston	kadın	uçak
meşale	bardak	ejderha	çanta	silgi	mor
cam	çocuk	kamyon	takvim	yeşil	yumruk
şapka	mum	benzin	cep	cadı	kanat
demir	inci	siyah	tekerlek	boynuz	yol
adaptör	zehir	gemi	kravat	toz	mavi
çadır	sakız	beyaz	pelerin	hardal	papaz
saz	düğme	gezegen	asansör	kutu	şemsiye
zımba	pijama	jeton	lastik	yüzük	kitap
pamuk	tuğla	tüfek	bagaj	mızrak	paten
kahve	zar	kibrit	buz	kömür	satranç
kablo	ateş	cetvel	araba	hoparlör	kılıç
ipek	cüzdan	bisküvi	tüp	zincir	çorap
bisiklet	top	jilet	fener	daire	ceket
anahtar	tebeşir	posta	sokak	tahta	keman
harita	yama	sıra	kaldırım	yay	baba
kral	elbise	tüy	yara	abla	tohum
tabut	kafes	tuz	rahip	küpe	şair
gri	çit	anne	ter	çan	erkek
hemşire	bayrak	etek	kare	bebek	kürk
canavar	yün	kız	dayı	pantolon	hava
fren	motor	hap	kırmızı	cihaz	
öksürük	balta	kapı	dozer	düdük	

H. L2 (ENGLISH) NONWORDS

mearl	lenner	brabet	roo	moif	desuce
groy	rord	ruttan	poad	wirge	swoge
woor	goif	mrag	rurtet	streeg	seef
coimin	sipt	gilm	govan	poshel	bux
shaspe	rullat	ferse	edapater	reat	pumque
toze	kitn	codlass	tagro	pivver	poal
pind	nurch	spigon	rire	baj	fuv
bigh	chosly	smip	tuggack	linterg	bew
sivicine	cabton	ruefin	ild	gleat	woupe
kec	maj	skign	ryd	swue	glond
anblar	menep	moz	jotit	lalmer	pugue
birt	cunbre	piud	drield	squang	biek
shei	menfler	digh	ruppit	urwhe	beke
gheel	bewn	palp	gach	bleel	kack
crorl	skure	fjone	auge	cagy	chach
moipon	chauk	bauk	hoch	wiud	stase
shupent	rajir	founter	theen	biy	sood
qen	cunjon	maut	cuj	clisgre	awd
brant	piy	homp	shurt	sode	staud
brorl	tiy	wollel	prar	taquer	brear
chign	dreve	flell	snum	usthulla	breem
caclo	pitn	blall	durb	fimb	sless
coth	brire	siwhe	geadle	riud	chue
har	bisciel	thite	tign	frane	pasp
rungept	giel	wiel	jacrine	fadmer	miet
hooh	lyrter	ridal	caif	knate	raner
glard	bym	arx	loif	prieve	kiud
throrb	fere	derg	calannir	cigter	bidcle
stianfla	engack	coar	putch	nuherac	ilt
tolve	cahl	hirtet	cact	niotun	
coubt	trurn	gug	darchler	stise	

I. L1 (TURKISH) NONWORDS

enyi	melvup	yesegan	restik	cafip	zipaz
yri	çalet	duğde	bizer	rası	kırıh
bavak	arton	bemrak	kica	mukak	tocem
sabot	icuk	kıv	kason	nep	kubo
zülba	kutvun	rit	avanmir	yüp	moh
kazati	drel	çuyola	bafa	güsüz	küvür
sanuz	hetgice	ehnerva	til	garta	cürk
sisunlet	alu	hevi	bajad	cenar	yüy
iles	gatuk	nefvel	buh	rer	molav
anaycer	paresa	edak	kungızı	sülbi	yoperlor
pibü	dofda	arve	kalcurum	çekaf	badla
nadora	şum	gefbe	kakvan	maşe	kinep
paz	dulep	zağ	kebla	galu	çun
deter	kecar	sasga	kagi	tenuklek	mekre
tuç	marvak	teligin	tefbe	bebır	zirgir
reher	tecezar	yop	bolfuz	katal	davha
kavarül	limet	züy	yevel	ernuk	savta
kalul	puyal	gista	alase	büdök	pada
puen	nevtiye	paba	güslek	çurav	sakve
kasge	kührit	rüsdan	rata	dapa	mofrak
çobek	etvime	kafek	dapel	vemdire	vetet
kafro	pap	sizaj	tüz	guvruk	samralt
vata	tübla	mücek	ıvta	hüyük	tahi
napya	benhüvi	besız	ıcarar	uhar	vol
lirdan	bevcin	yüf	adü	merbifan	paur
kayva	pöp	higada	bazgon	catin	pafıt
cüm	jeyin	bayya	kurit	çafaz	kıhe
tapt	asez	dıka	tayfim	anra	taica
avapyör	tosor	panlo	vint	küza	mürerzap
segala	kapos	mitet	nekeyin	kebon	
örsüyüp	kavkon	solav	franat	mupa	

J. CURRICULUM VITAE

Enis Oğuz

EDUCATION

2018 – 2023

PhD: English Language Teaching (Linguistics Track)

Middle East Technical University | Turkey

Supervisor: Prof. Dr. Bilal Kırkıcı

Thesis Title: Investigating Translation Equivalent Priming: The Impact of Task, Item, and Individual Differences

2015 – 2018

MSc: English Language Teaching

Middle East Technical University | Turkey

Supervisor: Prof. Dr. Bilal Kırkıcı

Thesis Title: Morphological Processing in Developing Readers: A Psycholinguistic Study on Turkish Primary School Children

2013 – 2013

BSc (Erasmus Programme): English Philology

Krosno State College| Poland

2010 – 2014

BSc: English Language Teaching

Mehmet Akif Ersoy University | Turkey

CERTIFICATES & TRAINING

2022 – 2023

Instructor Training Program | Middle East Technical University (face-to-face)

2021

TESOL | Arizona State University (160 hours, online)

2021

Data Analysis with R | Duke University (160 hours, online)

2021

R Programming | John Hopkins University (75 hours, online)

AWARDS AND HONORS

2021

Course Performance Award (PhD) | Middle East Technical University

2017

Course Performance Award (MSc) | Middle East Technical University

2014

Valedictorian (BSc) | Mehmet Akif Ersoy University

SCHOLARSHIPS

2018 – 2023

PhD | 2211-E National PhD Scholarship

2015 – 2018

MSc | TÜBİTAK 2210 -A National MSc/MA Scholarship

EMPLOYMENT HISTORY

2022 – Present

Instructor | Middle East Technical University, Turkey

- English Language Instructor
- Researcher at the Research and Development Unit
- Coordinator at the Academic Foreign Language Support Project

2019 – 2022

Instructor | Istanbul University, Turkey

- English Language Instructor
- Pearson PTE Center Test Administrator

2015 – 2019

Teacher | Ministry of National Education, Turkey

- English Language Teacher
- Worked at primary and secondary schools

2014 – 2014

Research Assistant | Bartın University, Turkey

PUBLICATIONS

Oğuz, E. G., & Özge, D. (2020). A Developmental Study of Turkish Connectives. *Dilbilim Arastirmalari Dergisi, 31*(1).

Oğuz, E., & Kırkıcı, B. (2022). The processing of morphologically complex words by developing readers of Turkish: a masked priming study. *Reading and Writing,* 1-28.

Cangır, H., Uzun, K., Can, T., K. Küllü, Oğuz, E., & Kaya, Ö. F. (2023). Learner Corpus Research and Natural Language Processing. In Özer, Ö. & Yükselir, C. (Eds.) *Teaching in Online and Blended Learning Environments* (pp. 13–31). Nobel Academic Publishing.

WORKSHOPS & SEMINAR PRESENTATIONS

Oğuz, E., Bir, E., Cangır, Uzun, K., Can, T. Kullu, K. & Kaya, Ö.F. (2022, June 17-19). *Learner Corpus Research and Natural Language Processing in Detecting L2 Writing Performance* [Poster Presentation] . METU ELT Convention 2022, Ankara, Turkey

Cangır, H., Uzun, K., Can, T., Oğuz, E. & Kaya, Ö.F. (2022, May 16-18*). Common Lexical Errors and the Possible Effect of L1 Turkish* [Paper Presentation]. 12th International ELT Research Conference, Çanakkale, Turkey

Cangır, H., Uzun, K., Can, T., Kullu, K., Oğuz, E., Şimşek, İ.M. & Kaya, Ö.F. (2022). *Öğrenen Derlemi ve Doğal Dil İşleme Araçlarının D2 İngilizce Yazma Becerisini Tespit Etmede Kullanımı* . Ankara Üniversitesi Yabancı Diller Yüksekokulu 20. Yıl (Türkiye'de Yabancı Dil Öğretimi), Ankara, Turkey

Kırkıcı, B., Ataman, E., Çağlar, O. C., Oğuz, E., Demir, O., & Çelikkol, N., (2021, August 2-4). *Farklı açılardan biçimbilimsel işlemleme* [Paper Presentation]. 20th International Conference on Turkish Linguistics (ICTL), Eskişehir, Turkey

Oğuz, E., & Kırkıcı, B., (2018, May 3-4). *İlkokul Çocuklarında Biçimbilimsel İşlemleme* [Paper Presentation]. 32. Ulusal Dilbilim Kurultayı, İzmir, Turkey

SKILLS

Software

R programming	★★★★☆
R Studio	★★★★★
Jamovi	★★★★★
Jasp	★★★★★
SPSS	★★★★★
MAXQDA	★★★★☆
Visual Studio Code	★★★★☆
Excel	★★★★★
Open Sesame	★★★★★
PsychoPy	★★★★★
Google Docs	★★★★★

Designing Research & Data Analysis

Extensively experienced at:

- designing online and offline experiments
- collecting quantitative and qualitative data
- using Open Science tools such as Open Science Framework
- quantitative analysis (e.g., Mixed-Effects Models, Bayesian Analysis)
- qualitative analysis (e.g., Content Analysis, Discourse Analysis)
- data visualization (e.g., using R to create unique graphs)

Teaching

Highly skilled in:

- teaching all age groups and skill levels
- teaching both face-to-face and online classes
- preparing high quality lesson materials
- supporting learning with additional tools (online and offline) and materials
- teaching most recent and accurate information available

REFERENCES

Prof. Dr. Bilal Kırkıcı

Prof. Dr. Martina Gračanin Yüksek

Prof. Dr. Çiğdem Sağın Şimşek

K. TURKISH SUMMARY / TÜRKÇE ÖZET

İki dilli (ya da *çok dilli*) tanımlaması birden fazla dili kullanma yeteneğine sahip kişiler için kullanılan bir terimdir (Mackey, 1962). Son yıllarda dil işlemleme ile ilgili literatürde iki dilli kişilerin bildiği diller arasında bir etkileşim olduğu ve bu etkileşimin yazımsal, sesbilimsel, anlamsal ya da sözcüksel benzerliklerden dolayı oluştuğuna dair genel bir fikir birliği vardır. Bu etkileşimin tam olarak nasıl oluştuğu bilinmezken, bu konudaki araştırmalar yaşamın daha geç aşamalarında öğrenilen ikinci dildeki sözcüklerin anadildekilerden farklı bir şekilde depolandığı ya da işlemlendiği argümanlarının (örn. Jiang & Forster, 2001) geçerliliği konusunda kanıt sunabilir. Farklı dillerdeki sözcükler arasındaki etkileşimi dil işlemlemenin birçok aşamasında gözlemlemek mümkün olmakla birlikte çok erken bilinç öncesi aşamalarda bile etkilerinin görüldüğüne dair bulgular vardır (örn. Chaouch-Orozco vd., 2021). Bu çalışmanın temel amacı, bilinen diller arasındaki anlamsal yakınlığın dil işlemlemenin erken aşamalarındaki bilinç öncesi aşamalarda oluştuğu düşünülen diller arası etkileşimle olan muhtemel ilişkisinin Türkçe-İngilizce çeviri eşdeğerleri (ing. translation equivalents) kullanılarak araştırılmasıdır.

Anadildeki (D1) ve ikinci dildeki (D2) sözcüklerin olası etkileşimin incelenmesi bu sözcüklerin zihinsel sözlükte depolanması ve işlenmesinin anlaşılması açısından çok önemlidir ve bu konuda yapılan araştırmalar dil işlemlemenin farklı türlerine odaklanmışlardır (anlama ve konuşma gibi). İşlemlenecek dilsel yapıların uzunluğu arttıkça diller arası olası etkilerin diğer dil işlemleme ile ilgili olan etkilerden ayırt edilmesi zorlaşır. Bu noktada sözcük işlemlenmesinin incelenmesi bu olası kirletici etkenlerin azaltılması açısından etkin bir yöntemdir. Ancak sözcük algılama çalışmalarında bile bilinçli strateji kullanımı deneylerde verilen cevap örüntülerini etkileyebilir. Bu sebeple bilinç öncesi aşamaları incelemek için farklı yöntemler kullanılması gerekmektedir.

Bilinç öncesi aşamaları incelemek için kullanılacak deneylerde, uyarıcıların katılımcılar tarafından bilinçli bir şekilde fark edilmemesi ve bununla beraber bu

uyarıcılara verilen tepkilerin de bir şekilde gözlemlenebilmesi gerekmektedir. Bu bakımdan, bir dilin başka bir dildeki anlamsal, sesbilimsel ya da yazımsal benzerini bilinçdışı bir şekilde etkinleştirmesini araştırmak için maskelenmiş hazırlama (ing. masked priming) paradigması etkili bir yöntemdir. Bu deneysel paradigmada, katılımcıların bilinçli olarak işlemleyemeyeceği kadar kısa süreli (örn. 50 milisaniye) gösterilen hazırlayıcı sözcükler kullanıldığından, bilinçli ve stratejik işlemleme devre dışı kalmış olur (örn. Feldman vd., 2012; Forster & Davis, 1984; Rastle vd., 2004). Söz konusu paradigmanın temelinde yüksek bilişsel işlemleme devre dışı bırakılarak daha az ve kontrol edilebilir etkilerin incelenebilmesi düşüncesi vardır (Holcomb & Grainger, 2006). Karmaşık sözcüklerin işlemlenmesini konu alan çalışmalarda sıklıkla kullanılan maskelenmiş hazırlama paradigmasında hazırlayıcı sözcüklere ek olarak, bu sözcüklerden hemen sonra gösterilen hedef sözcükler kullanılmaktadır. Bu hedef sözcükler, hazırlayıcı ile ilgili olduğunda (örn. kapıcı-KAPI) ilgisiz hedef sözcüklere (örn. zürafa-KAPI) göre daha hızlı tepki sürelerine yol açıyorsa, hazırlayıcının hedef sözcüğün işlemlemesini kolaylaştırdığı sonucuna varılır. Bu etki, hazırlama etkisi (ing. priming effect) olarak tanımlanır.

Diller arası etkileşimi incelemek adına literatürdeki birçok çalışma diller arasındaki çeşitli sözcüksel benzerlikleri (örn. anlamsal, biçimbilimsel ve sesbilimsel) manipüle ederek, hazırlayıcı sözcüklerin hedef sözcükler üzerindeki etkilerine odaklanmıştır. Örneğin, sözcüksel karar testi kullanılarak uygulanmış bir maskelenmiş hazırlama deneyinde, hazırlayıcı olarak İngilizce *sport* sözcüğü sunulduktan sonra Türkçe karşılığı olan *spor* hedef sözcük olarak gösterilebilir. Eğer ilgili hazırlayıcı olan sport sözcüğü ilgisiz bir hazırlayıcıya kıyasla (örn. plane) hedef sözcük olan spor sözcüğüne verilen tepki süresini kısaltıyorsa, eş asıllı (ing. cognate) sözcüğün önce verilmesinin bir hazırlayıcı etkisi oluşturduğu ve iki dil arasında etkileşime yol açtığı sonucuna varılabilir. Diller arası çalışmalardaki hazırlayıcı ve hedef sözcük çiftleri, yazımsal, sesbilimsel ve anlamsam benzerlikler taşıyabileceği gibi (örn. İngilizcedeki *house* ve Almancadaki *haus* gibi aynı alfabeyi kullanan dillerdeki eş asıllı sözcükler), bu benzerliklerden ikisini ya da sadece birini de taşıyabilirler (örn. Türkçedeki *kayısı* ve İngilizcedeki *apricot* gibi çeviri eşdeğerleri).

Eş asıllı sözcüklerin diller arasında erken sözcük işlemleme aşamalarında bile hazırlama etkisi oluşturdukları yaygın olarak rapor edilen bir sonuçtur (örn. Nakayama

vd., 2013, Midgley vd., 2011). Yazımsal benzerlik, özellikle okuma tabanlı deneylerde eş asıllı sözcük çiftleri arasındaki hazırlama etkisi için akla gelen ilk açıklamadır. Ancak sadece yazımsal benzerlik bu kolaylaştırma etkisini açıklamada yetersiz kalmaktadır: Sahte eş asıllı (ing. false cognate) sözcük çiftleri yazımsal benzerlik taşımalarına rağmen, bu sözcük çiftlerine verilen yanıtlar eş asıllı sözcük çiftlerine oranla daha yüksek hata oranlarına sahiptir (Degani vd., 2018). Üstelik Japonca ve İngilizce gibi farklı alfabeleri kullanan diller arasındaki eş asıllı sözcüklerin de birbirlerinin fark edilmesini kolaylaştırdıkları görülmüştür (örn. Allen vd., 2020). Bu bulgular, diller arası sözcük etkileşiminde yazımsal benzerlikten fazlası olduğunu ortaya koymaktadır.

Sesbilimsel benzerlik diller arası etkileşimde etkili olan diğer bir unsurdur ve görsel sözcük işlemleme görevlerinde bile (örn. görsel sözcüksel karar testi) etkisini görmek mümkündür (örn. Jouravlev vd., 2014; Peleg vd., 2020; Mishra & Singh, 2014). Allen vd.'nin (2020) bulgularının yanında, Nakayama vd. (2014) de aynı alfabeyi paylaşmayan diller arasındaki eş asıllı sözcük çiftlerindeki sesbilimsel benzerlik düzeyinin hazırlama etkisini değiştirdiklerini gözlemlemiştir. Bunun yanı sıra ardışık sunulan farklı dillerdeki sözcükler anlamsal benzerlik olmadan sadece sesbilimsel bir benzerlik taşıyorsa, bu kolaylaştırıcı hazırlama etkisi anlamsal olarak da benzerlik gösteren eş asıllı sözcüklere oranla daha az olmaktadır (Nakayama vd., 2012). Bunun, sesbilimsel benzerlik yanında anlamsal benzerliğin de diller arası etkileşimde etkili olduğunu gösterdiği iddia edilebilir.

Yazımsal, sesbilimsel ve anlamsal benzerliklerin bir arada olduğu iki dildeki sözcük çiftlerinin bu tür çalışmalarda kullanılması modeller arasında ayrım yapmayı zorlaştırmaktadır; bulunan etkilerin hangi benzerlik dolayısıyla elde edildiğinin ortaya çıkarılması bu tür deneysel sözcükler ile pek mümkün değildir. Dahası, yazımsal ve sesbilimsel benzerliklerin fazla olması, hazırlayıcı olarak gösterilen D2 sözcüğün D1 eşdeğeri olarak algılanmasına neden olabilir; dolayısıyla bulunan sonuçlar diller arası bir etkileşimden ziyade sadece yazımsal ya da sesbilimsel benzerlik kaynaklı olabilir. Bu sebepten, iki dildeki sözcüklerden sadece anlamsal yakınlığı bulunan çeviri eşdeğerlerinin (örn. İngilizce *apricot* ve Türkçe *kayısı*) incelenmesi, diller arası etkileşimin incelenmesi açısından büyük önem arz etmektedir. Anlamsal benzerliğin iki dil arasındaki sözcüklerin etkileşimine katkısından halihazırda yukarıda verilen

çalışmalarda bahsedilmiştir (Allen vd., 2020; Nakayama vd., 2012). Ancak, sadece anlamsal yakınlığı bulunan çeviri eşdeğerlerinin detaylı bir şekilde incelenmesi, yazımsal ya da sesbilimsel bir yakınlığın yokluğunda diller arası etkileşimin sözcük işlemlemenin erken aşamalarında olup olmadığının araştırılması açısından kilit bir rol oynamaktadır.

Çeviri eşdeğerlerinin bilinç öncesi aşamalarda birbirlerini etkileştirdiği konusunda bulgular olsa da bu etkinleştirmenin doğası ile ilgili birçok farklı sonuç ve çıkarım vardır. Bu farklı yaklaşımlar iki dilli zihinsel sözlüğü açıklamak için farklı modellerin oluşturulmasını da beraberinde getirmiştir. Bu modellerin genel olarak nitel görüşlü ve nicel görüşlü olarak ayrılması mümkündür. Nitel modeller arasında Algısal Model (ing. The Sense Model; Finkbeiner et al., 2004), Düzenlenmiş Dizisel Model (İng. The Revised Hierarchical Model; Kroll & Tokowicz, 2001) ve Olaylara Dayalı D2 Hipotezi (ing. The Episodic L2 Hypothesis; Jiang & Forster, 2001) gösterilebilir. Bu modeller genel olarak D1 ve D2 sözcüklerinin eğer dillerin ikisi de bebeklik ya da erken çocukluk döneminde edinilmemişse farklı şekilde işlemlenip depolandıklarını savunurlar. İki dilli bireylerin ikinci dil yeterliklerini geliştirmeleri ya da ikinci dillerini sıklıkla kullanmaları bu farkı ortadan kaldırmaya yetmeyecektir. Öte yandan söz konusu modellerin nitel görüşlerindeki keskinlik de modeller arasında değişebilir. Örneğin, Algısal Model bazı araştırmacılar tarafından ufak güncellemeler ile nicel bir model olarak değerlendirilebilirken (Xia & Andrews, 2015), Olaylara Dayalı D2 Hipotezi yapısı gereği son derece katı nitel açıklamalara bağlıdır.

Nicel görüş çatısı altında İyileştirilmiş Dağıtılmış Temsil Modeli (ing. The Refined Distributed Representation Model; Duyck & Brysbaert, 2004; Schoonbaert et al., 2009), İki Dilli Karşılıklı Etkinleştirme Modeli (ing. The Bilingual Interactive Activation Model; Dijkstra & van Heuven, 1998), İki Dilli Karşılıklı Etkinleştirme Artı Modeli (ing. The Bilingual Interactive Activation Plus Model; Dijkstra & van Heuven, 2002) ve Çoklu Bağlantı Model (ing. Multilink; Dijkstra et al., 2019) sayılabilir. Bu modellerin ortak noktası iki dilli bireylerin D2 yeterlikleri ve kullanım sıklıklarını arttırdıkları takdirde D1 ve D2 sözcükleri depolamaları ve işlemlemelerine dair diller arası farklılıkların azalacağı iddialarıdır. Nitel ve nicel görüşler arasındaki bu temel fark şimdiye kadar birçok araştırmanın da konusu olmuştur.

Literatürde çeviri eşdeğerlerinin etkileşimi ile ilgili çalışmaların sonuçlarını farklı alt başlıklar altında toplamak mümkündür. Sonuçlardan ve çıkarımlardan bir kısmı nitel modelleri, diğerleri ise nice modelleri destekler nitelikte olduğu için iki dilli kişilerin sözcük işlemlemelerindeki diller arası farklılıklar hakkında kesin yargılara varılamamıştır.

Dil yönü

Çeviri eşdeğerlerinin hazırlama etkisi ile ilgili en net sonuçlardan biri çalışmaların genellikle D1-D2 yönünde çeviri eşdeğerleri için hazırlama etkisi bulurlarken, D2-D1 yönünde bu etkinin daha az ya da hiç olmamasıdır (örn. Chaouch-Orozco vd., 2021; Jiang & Forster, 2001; Schoonbaert vd., 2009; Wang & Forster, 2015). Bu olaya dil yönü asimetrisi (ing. language direction asymmetry) denilmektedir. Anlamsal benzerliğin sözcük işlemlemede diller arasında oluşturduğu hazırlama etkisinin ve dil yönleri arasında görülen dil yönü asimetrisi etkisinin doğaların daha iyi anlaşılmaları için bunların olası diğer etkenlerle beraber incelenmesi gerekmektedir. Özellikle incelenen dillerin yazım sistemleri, katılımcıların dil seviyeleri ve kullanımları, D2 edinme yaşı, sözcük sıklığı, farklı görev türleri ve hazırlayıcı süresi gibi olası etkenlerin bu etkilerle etkileşim halinde olduğuna dair bulgular ve hipotezler vardır. Bunların kapsayıcı çalışmalar oluşturarak bir arada incelenmesi ise diller arası etkileşim hakkında daha fazla bilgi edinmek için elzemdir.

Dil yeterliği

D2 yeterliği dil yönü asimetrisine ve diller arası anlamsal etkileşime etkisi olduğu düşünülen diğer bir etkendir. Yüksek D2 dil yeterliğine sahip iki dilli katılımcılar ile yapılan çalışmalar D2-D1 yönünde de kolaylaştırıcı bir hazırlama etkisi bulmuştur (örn. Nakayama vd., 2016). Görülen etkinin büyüklüğünün de yine aynı şekilde D2 yeterliği ile ilişkili olduğu tartışılmaktadır (Nakayama vd., 2012). D2 yeterliğinin hem çeviri eşdeğeri hazırlama etkisi üzerine etkisi hem de dil yönü asimetrisi ile olan ilişkisinin incelenmesi iki dilli zihinsel modellerin savlarını araştırmak açısından oldukça önemlidir.

Dil banyosu

Dil banyosunu farklı şekillerde tanımlamak mümkün olsa da mevcut çalışma D2 öğrenilmeye başlanılan yaş ve bu yaştan sonra her bir D2 bileşeninin kullanıldığı toplam yıla dayanan bir tanım tercih etmiştir. Bu tanım Dil Geçmişi Anketinde (Li et al., 2020) hesaplanan D2 Dil Banyosu puanının hesaplanma şekli ile de uyumludur. İki dilli bireylerin bebeklikten sonra D1 seviyeleri iyice arttığından, bu süreçte edinilen D1 sözcüklerin zihinsel sözlükte sonradan öğrenilecek D2 sözcüklerden daha farklı depolandığı ve işlemlendiği görüşü yaygın bir görüştür (örn. Dimitropoulou et al., 2011c). Söz konusu görüş nitel modellerin temel savlarından biri olmakla beraber bebeklik ya da erken çocukluk sonrası D2 edinen kişilerin D2 yeterliklerini ne kadar arttırırlarsa arttırsınlar anadildeki sözcükler gibi D2 sözcükleri işlemleyemeyecekleri çıkarımının da temel noktalarından biridir.

Dil baskınlığı

Literatürde dil baskınlığı ilgili de çeşitli tanımlamalar bulmak mümkündür. Dil Geçmişi Anketinin (Li et al., 2020) tanımıyla uyumlu olarak, mevcut çalışmada Dil Baskınlığı iki dilli kişilerin her bir dillerini göreceli olarak günlük hayatta kullanma süreleri ve bu dildeki yeterliklerinin bir birleşimi olarak görülmüştür. Wang (2013) bu değişkenin dil yeterliliğine göre çeviri eşdeğeri hazırlama etkisini daha iyi açıklayabileceğini ve iki dil yönünde de benzer hazırlama etkisi gösterme noktasında kilit bir rol oynadığını öne sürmüştür.

Hazırlayıcı Süresi ve UBD değeri

Aynı görev kullanılsa bile farklı deneysel düzenlemeler farklı diller arası etkileşim örüntülerine yol açabilir. Bu düzenlemelerden biri de hazırlayıcının gösterilme süresini belirleyen uyarıcı başlama desenkronizasyonudur (UBD; ing. stimulus-onset asynchrony, SOA). Lijewska ve Chmiel (2015) İngilizce hazırlayıcı sözcükler (D2) ve Korece hedef sözcükler (D1) kullandıkları çeviri eşdeğerleri çalışmalarında hem 60 ms UBD için hem de 150 ms UBD için anlamlı hazırlama etkileri bulmalarına rağmen, D2-D1 yönünde sadece 150 ms UBD deneyinde anlamlı bir çeviri hazırlama etkisi (ing. translation priming) bulmuşlardır. Buna ek olarak, Wen ve van Heuven (2017) maskelenmiş hazırlama paradigması ile yapılan çeviri eşdeğeri çalışmaları üzerine

olan meta-analizlerinde, UBD değeri literatürde gözlemlenen hazırlama etkilerinde anlamlı bir değişken olarak ortaya çıkmıştır. Bu sebeplerle farklı görevlerin olduğu gibi alternatif görev düzenlemelerinin de diller arası etkileşimde oynayabileceği potansiyel rolün göz önünde bulundurulması ve diğer olası etkilerle (görev türü gibi) olan etkileşimi daha detaylı incelenmesi gerektiği ortaya koyulmuştur.

Görev Türü

Görev türü diller arası etkileşime etkisi olduğu düşünülen bir başka etkendir. Çoklu Bağlantı Modelinin öne sürdüğü görev/karar sisteminin işi farklı görev ve taleplere göre sözcük işlemleme aşamalarını en baştan itibaren düzenlemektir. Kuramsal olarak öne sürülen bu iddianın deneysel desteğini literatürde maskelenmiş hazırlama paradigması ile farklı görev türleri kullanan çalışmalarda bulmak mümkündür. Finkbeiner vd. (2004), eğer çeviri eşdeğerleri anlamsal sınıflandırma görevinde test edilirse dil yönü asimetrisinin sözcüksel karar görevine göre daha az olacağını iddia etmiştir. Bu iddianın dayanağı ise ilk görev türünde sadece sınıfsal niteliklerin değerlendirilmesi hipotezidir. Xia ve Andrews (2015) D2-D1 yönünde yaptıkları deneylerde anlamsal sınıflandırma görevinde sözcüksel karar testine göre daha fazla hazırlama etkisi gözlemlemişlerdir, ancak dil yönü asimetrisinde bir azalma bulamamışlardır. Bu çalışmalarda bulunan sonuçlar diller arası etkileşim için sözcük işlemlemenin erken aşamalarında bile bir görev türü etkisini gösterirken, çelişen iddialar ve bulgular bu etkinin doğasını anlamayı mümkün kılmamıştır. Dolayısıyla görev türü etkisinin diller arası anlamsal etkinleşme ile ilişkisini inceleyen başka çalışmalara ihtiyaç olduğu görülmüştür.

Yazım sistemleri

Dillerin yazım sistemleri diller arası etkileşimde etkili olabilir. Alfabe ve tipoloji olarak birbirinden uzak dillerde bile (örn. Japonca ve İngilizce), maskelenmiş hazırlama paradigması ile yapılan deneylerde kullanılan çeviri eşdeğerleri hazırlama etkisi göstermişlerdir (örn. Nakayama vd., 2013). Bu, anlamsal örtüşmenin diller arasında bilinç öncesi bir etkileşime neden olduğu tezini desteklemektedir. Söz konusu anlamsal örtüşmeye atfedilen hazırlama etkisinin aynı alfabeyi kullanan dillerdeki durumunun incelenmesi ise dikkatle yaklaşılması gereken bir konudur. Farklı yazım sistemlerine sahip iki dile sahip bir iki dilli kişinin bu dillerden birinde gördüğü bir

sözcük hedef dilde yazımsal olarak benzer olan birden fazla adayı etkinleştirmeyeceği için, sadece anlamsal benzerlik taşıyan hedef sözcüğe daha kolay ulaşılabilir (örn. Gollan et al., 1997; Nakayama et al. 2018). Öte yandan, aynı yazım sistemini kullanan diller arasında da aynı yazım sisteminin etkinleştirilmesi bir avantaj sağlayabilir (örn. McPhedran & Lupker, 2021). Bu konuda daha kesin sonuçlar için özellikle aynı yazım sistemini kullanan dilleri bilen iki dilli bireylerle yapılan çalışmaların sayısı arttırılmalı ve bunlar farklı yazım sistemleri kullanan dilleri konuşan iki dilli bireylerle yapılan çalışmalarla karşılaştırılmalıdır. Literatürdeki aynı alfabeyi kullanan diller ile yapılan çalışmaların önemli bir kısmında İngilizceyi ikinci dil olarak edinen iki dilli bireylerin anadilleri de İngilizceye sözcüksel benzerlik bakımından yakındır; örneğin Chaouch-Orozco vd. (2021) Türkçe gibi yazımsal derinlik açısından saydam olan diğer bir dil olan İspanyolca anadilli ve İngilizce ikinci dilli bireylerle yaptığı çalışmada çeviri eşdeğerleri için D1- D2 yönünde hazırlama etkisi bulmuştur, ancak İspanyolca sözcüklerin çoğunun İngilizce sözcüklere olan yazımsal ve sesbilimsel benzerlikleri sebebiyle deneylere seçilen sözcük çiftlerinin sayısı kısıtlı kalmıştır. O halde, bu konudaki Japonca ve Korece çalışmaların ikinci dili İngilizce olan bireylerle yapıldığı da göz önüne alındığında, İngilizce ile aynı yazım sistemini kullanan ve çeviri eşdeğerleri arasında yaygın yazımsal ve sesbilimsel benzerlikler olmayan diller ile daha fazla çalışma yapılması, söz konusu diller arası etkileşim ile yazım sistemi farklılıkları arasında bir ilişki olup olmadığının incelenmesi açısından oldukça önemlidir.

Sözcük sıklığı

Dili edinme şekliyle ve bağlamıyla ilgili olan bir diğer konu ise sözcük sıklığıdır. Bu değişkenin sözcük işlemlere ile ilgili görevlerde etkisinin olduğu literatürde sık karşılaşılan bir bulgudur (Brysbaert vd., 2018; Chee vd., 2003; Monaghan vd., 2017). Ancak sözcük sıklığının çeviri eşdeğeri hazırlama etkisi ile olan ilişkisi literatürde detaylı araştırılmamış bir konu olarak kalmıştır (Chaouch-Orozco et al., 2021). Böyle bir çalışmada sözcük sıklıklarına karar vermek özellikle D2 sözcükler için kolay olmayabilir. Yüksek sıklıktaki D2 sözcükler için derlemler doğru tahminler sunabilse de, düşük sıklıktaki sözcükler için derlemlerden ziyade öznel sıklık değerlendirmeleri nispeten daha gerçeğe yakın sonuçlar verebilmektedir (Chen & Dong, 2019). Maskelenmiş hazırlama deneyi kullanan çalışmalarda ise genelde bu iki yöntemden

biri tercih edilmektedir. Bu sebeple, derlem sıklık değerleri ve öznel sıklık değerlerinin hangisinin hazırlama etkisini daha iyi açıkladığı cevapsız kalmış önemli sorulardan biri olduğu görülmüştür.

MEVCUT ÇALIŞMA

Literatür incelendiğinde gözlemlenen eksiklikler mevcut çalışmanın gerekliliğini ortaya koymaktadır; dil yönü, ikinci dil ile ilgili ölçümler (dil yeterliği, dil banyosu, dil baskınlığı), görev farklılıkları (farklı görevler, UBD süresi), sözcük sıklığı, dillerin yazım sistemleri gibi diller arası anlamsal etkileşime etki edebilecek muhtemel etkenlerle ilgili çalışmalar çelişkileri ortadan kaldırmada ve güvenilir sonuçlar sunmada yetersizdir. Dahası, genellikle ayrı çalışmalarda incelenen bu etkenlerin birbirleri arasındaki potansiyel ilişkileri ile ilgili pek az şey bilinmektedir. Mevcut çalışma bu etkilerin ve aralarındaki olası etkileşimin diller arası etkileşimde olan rolleri hakkında literatüre için eşsiz katkılar sunmak için yapılmıştır.

Çalışmanın hipotezleri hiçbir veri toplanmadan oluşturularak Open Science Framework (OSF) uygulamasında kaydedilmiştir. Aşağıda sıralanan hipotezlerin tam raporuna ulaşmak için burada verilen internet adresi kullanılabilir: https://osf.io/c3gmf

1) Önceki çalışmalarla paralel olarak, bir dildeki sözcüklerin diğer dildeki çeviri eş değerlerini sözcük işlemlemenin çok erken aşamalarında (bilinç öncesi aşamalarda) etkinleştirecekleri düşünülmüştür. Bu hipotez katılımcıların alakalı hazırlayıcılardan (çeviri eşdeğerleri) sonra gelen hedef sözcüklere daha hızlı cevap vereceklerini öngörmüştür.

2) Katılımcılar yüksek dil becerilerine sahip Türkçe-İngilizce iki dilli kişiler olmalarına rağmen bir dil yönü asimetrisi beklenmiştir: D1-D2 yönünde diğer yöne nazaran daha fazla hazırlayıcı etkisi öngörülmüştür.

3) Görev farklılıklarının (Sözcüksel Karar Görevi ve Anlamsal Sınıflandırma Görevi) farklı cevap sürelerine ve hazırlama etkisi örüntülerine sebep olacakları düşünülmüştür. Bu hipotez Çoklu Bağlantı Modelinin görev/karar sistemi savı ile de uyumludur. Sözcüksel karar görevinde katılımcıların verilen hedeflerin söz konusu dilde gerçek sözcükler olup olmadıklarına karar vermeleri beklenir ve bu da mevcut sözcüksel temsillere ulaşarak yapılabilir. Anlamsal sınıflandırma görevinde ise

katılımcıların ulaştıkları sözcüksel temsillerin sınıfları ile ilgili de yargıda bulunmaları gerekmektedir. Bu sebepten anlamsal sınıflandırma görevlerindeki cevapların sözcüksel karar görevlerine nazaran daha yavaş olacakları düşünülmüştür.

4) Yine görev farklılıkları ile ilgili yukarda bahsedilen farklı hazırlama etkisi örüntülerinin anlamsal sınıflandırma görevlerinde daha fazla hazırlama etkisi oluşmasına sebep olacağı öngörülmüştür. Buna sebep söz konusu görevin anlamsal sınıflandırma gereğinin görevi daha anlamsal nitelik odaklı yapması ve mevcut çalışmada hazırlayıcı-hedef çiftleri arasında yüksek anlamsal benzerlikler olmasıdır (çeviri eşdeğerleri oldukları için). Bu hipotez önceki çalışmalarla uyumludur (Finkbeiner vd., 2004; Xia & Andrews, 2015).

5) Daha önce çeviri eşdeğeri hazırlama asimetrisinin anlamsal sınıflandırma görevlerinde azalacağı iddia edilse de (Finkbeiner vd., 2004), daha sonra Xia ve Andrews (2015) tarafından yapılan bir çalışma bu iddiayı doğrulayamamıştır. Bu sebepten mevcut çalışma bu iddia ile ilgili belli bir yönde hipotez ortaya koymamaktadır.

6) Daha uzun hazırlayıcı süresinin (83 ms) daha kısa hazırlayıcı süresine (50 ms) oranla daha fazla hazırlama etkisi oluşturacağı öngörülmüştür; alakalı hazırlayıcı sözcüğe daha uzun süre maruz kalmanın sözcüğün etkinleşme gücünü arttıracağı düşünülmüştür.

7) Önceki çalışmalara paralel olarak öznel olarak daha sık görüldüğü belirtilen ya da daha yüksek derlem sıklık değerine sahip sözcüklerin daha hızlı cevaplar alacağı düşünülmüştür. Özellikle yüksek sıklık değerlerine sahip D2 sözcüklerinin daha hızlı etkinleştirilmelerinin daha fazla hazırlayıcı etkisi oluşturabileceği öngörülmüştür. Ancak yine de mevcut çalışmadaki katılımcıların ikinci dil yeterlikleri son derece yüksek olduğundan, bu etkinin belli bir sınırdan sonra gücünü kaybedebileceği ve analizlerde anlamlı çıkmayacağı ihtimali de olduğu kabul edilmiştir.

8) D2 yeterliği LexTALE ve Dil Geçmişi Anketi (v3) kullanılarak ölçülmüştür. D2 yeterliğinin D2 sözcüklerini işlemleme ve hazırlayıcı etkisi üzerinde etkisi olması beklenmesine rağmen, katılımcılarının yüksek D2 yeterlikleri ve bu skorlardaki

farklılık eksikliğinin yine söz konusu bağımsız değişkenin analizlerde anlamlı bulunmasının önüne geçebileceği kabul edilmiştir.

9) Dil geçmişi anketi (v3) ile toplanan dil banyosu ve dil baskınlığı değerlerinin yükseldikçe her iki görevde de D2 hedefler için daha hızlı cevaplar ve D2 hazırlayıcı kullanılan görevlerde ise daha fazla hazırlama etkisi oluşturabilecekleri öngörülmüştür.

YÖNTEM

Katılımcılar

Çalışmaya İngilizce Dili Eğitimi fakültesinde öğrenim gören 101 tane Orta Doğu Teknik Üniversitesi öğrencisi dahil edilmiştir (57 Kadın, Yaş Ortalaması: 19.5) Katılımcılar anadili Türkçe olan Türkçe-İngilizce iki dilli kişilerdi. Yüksek D2 yeterliklerinin yanı sıra fakültelerinin öğretim dili İngilizce olması sebebiyle yüksek oranda günlük D2 girdisine maruz kalmışlardı. İki katılımcının ikinci deney ve Dil Geçmişi Anketi'ne katılmaması ile birlikte çalışmadaki son katılımcı sayısı 99 olmuştur.

Görevler

Çalışmada iki dil yönü (İngilizce-Türkçe ve Türkçe-İngilizce) iki farklı görev ile (sözcüksel karar görevi ve anlamsal sınıflandırma görevi) ile sınanmıştır. Anlamsal sınıflandırma ve sözcüksel karar görevlerinde katılımcıya en başta hedef sözcüklerin hangi dilde verileceği söylenmiş ve tek bir görevde hedef sözcükler için sadece bir dil kullanılmıştır. Sözcüksel karar görevlerinde katılımcılar karşılarına gelen hedeflerin belirtilen dilde gerçek bir sözcük olup olmadığına karar vermek için iki ayrı tuş kullanmışlardır ("Evet ve "Hayır" tuşu). Örneğin Türkçe görevinde hedef olarak gelen *masa* sözcüğü belirtilen dilde gerçek bir sözcük olduğu için evet cevabı gerektirmiş, *yeju* olmayan sözcüğü ise aynı dilde gerçek bir sözcük olmadığı için hayır cevabı gerektirmiştir. Anlamsal sınıflandırma görevlerinde ise ekranda bir sınıf belirmiş ve katılımcılar ardından gelen sözcüklerin bu sınıfa dahil olup olmadığına yine "Evet" ve "Hayır" tuşları ile karar vermişlerdir. Örneğin hayvan sınıfında hedef olarak gelen *aslan* sözcüğü evet cevabı gerektirmişken, aynı sınıfta gelen *marul* sözcüğü hayır cevabını gerekmiştir.

Maskelenmiş hazırlama paradigması (örn. Feldman vd., 2012; Forster & Davis, 1984; Rastle vd., 2004) ile birlikte kullanılan sözcüksel karar görevleri ve anlamsal sınıflandırma görevlerinin alakalı koşullarında hedef sözcüklerinin çeviri eşdeğerleri kısa süreli hazırlayıcı olacak kullanılmışlardır. Bu hazırlayıcılar bilinçli olarak fark edilmeyecek kadar kısa süreli oldukları ve bilinç öncesi süreçlerde sözcükleri etkinleştirdikleri daha önceki çalışmalarda birçok kez gösterildiği için, sözcüklerin bilinç öncesi sözcük işlemleme aşamaları sırasında çeviri eşdeğerlerini etkinleştirip etkileştirmedikleri ve hangi dil yönünde bu söz konusu etkinin daha kuvvetli (ya da eşit) olduğu konusunda bulgular edinilmesini sağlamışlardır.

UBD değeri hedef sözcükten önce gösterilecek hazırlayıcının ekranda kalma süresini belirtir. Aynı görevlerin farklı versiyonları arasındaki tek fark UBD süresi olmuştur (50 ms ve 83 ms). Maskelenmiş hazırlama deneylerinde katılımcıların 30-80 ms arasındaki hazırlayıcıları genelde bilinçli olarak fark etmedikleri ve hazırlama etkileri gösterdikleri gözlemlenmiştir (örn. Feldman vd., 2012; Forster & Davis, 1984; Rastle vd., 2004). İki uç noktadaki değer alınarak inceleme yapılmasının bu etkenin incelenmesi açısından en doğru yöntem olduğuna karar verilmiş, ancak 30 ms değeri D2 sözcüklerinin işlemlenebilmesi için çok düşük olabileceği düşünüldüğünden 50 ms kısa süreli UBD değeri olarak seçilmiştir. Katılımcılar rastgele iki farklı gruba bölünerek bu farklı görev versiyonlarını (50 ms ve 83 ms görevleri) değişik sıralarda almışlardır. Böylece farklı UBD sürelerine sahip görevlerin verilme sırasını her grup için farklı olmuştur. Aynı görevlerin farklı versiyonlarını tekrar aynı katılımcılara vermeden önce koyulan süre (1 ay) alıştırma ve öğeleri tanıma etkisini elemiştir (Pluck, 2020).

Materyaller

Bu görevlerde kullanılması için 4 farklı liste oluşturulmuştur. Dört tane ayrı liste oluşturulmasının sebebi toplamda 4 farklı görev olması ve tüm katılımcıların bu 4 görevi de aynı oturumda tamamlamalarıdır; bu sayede katılımcılar aynı sözcük ile ya da onun çeviri eşdeğeri ile aynı oturumda birden fazla kez karşılaşmamışlardır. Her listede 46 adet deneysel sözcük ve onların çeviri eşdeğerleri yer almıştır (örn. 46 Türkçe ve bunların çeviri eşdeğeri olan 46 İngilizce deneysel sözcük). Yine her listede 46 adet Türkçede olmayan sözcük, 46 adet İngilizcede olmayan sözcük, 46 adet

Türkçe dolgu sözcük ve 46 adet İngilizce dolgu sözcük kullanılmıştır. Başlamakta olan görevin diline ve türüne göre (sözcüksel karar ya da anlamsal sınıflandırma) ilgili sütunlar seçilerek deneyde kullanılmıştır. Her bir katılımcı 4 farklı görevi sahte rastgele şekilde almıştır; OpenSesame (Mathôt vd., 2012) yazılımı kullanılarak hazırlanan deney, katılımcı numarasına göre (son rakam) hangi görevin ve hangi dil yönünün ilk olarak sunacağını seçmiştir. Bu sayede görevlerin (sözcüksel karar ve anlamsal sınıflandırma) ve dil yönlerinin (D1-D2 ve D2-D1) sunulma şekilleri eşit olarak dağıtılmıştır. Görev belirlendikten sonra deney yine katılımcı numarasına göre bir liste seçmiş ve göreve uygun olan hedefleri ekrana getirmiştir. Örneğin, eğer görev Türkçe sözcüksel karar görevi ise seçilen listede Türkçe hedeflerin ve Türkçe dilinde olmayan sözcüklerin hazırlandığı sütunlar seçilmiştir ve sadece bilinçli olarak görülmeyecek hazırlayıcılar İngilizce olmuştur. Hazırlanan deney dosyası kullanılan listeyi elemiş, böylece sıradaki görev farklı bir liste kullanmıştır.

Deneysel sözcükler hem anlamsal sınıflandırma hem de sözcüksel karar görevlerinde kullanılacak şekilde seçilmişlerdir. Sözcük soyutluk düzeyinin sözcük işlemlemeye etkisi olabileceği için (Tokowicz & Kroll, 2007) tüm gerçek sözcükler somut nesnelerden seçilmiştir. Listeler arasındaki sözcük sıklığı ve uzunluğu gibi değerlerin (her iki dil için de) istatiksel olarak farksız olmasına dikkat edilmiştir. Deneysel hedef sözcüklere verilecek "Evet" cevapları dışında katılımcılara karar verecekleri bir ikilem sunmak için göreve uygun "Hayır" cevabı verecekleri hedefler de sunmak gerekmiştir. Bu hedefler sunulan harf dizilimlerinin gerçek sözcük olup olmadığının cevabı istenen sözcüksel karar görevinde dilde olmayan harf dizimleridir (örn. jelup Türkçe'de olmayan bir sözcüktür) ve Wuggy yazılımı (Keuleers & Brysbaert, 2010) kullanılarak her iki dil için de hazırlanmıştır. Bir liste için oluşturulması gereken dilde yer almayan sözcükler söz konusu yazılım aracılığıyla başka listeler için seçilmiş sözcükler kullanılarak üretilmiştir; bu yazılım verilen sözcüklerin belli harflerini dile uygun olarak (dilde bulunan gerçek sözcüklerin harf ve hece dizilimlerine uygun) değiştirerek dilde olmayan (ama aslında olabilecek) sözcükler üretmektedir. Bu sayede dilde yer almayan sözcüklerin türetildiği sözcükler de sıklık ve uzunluk bakımından deneysel sözcüklerle aynı olmuşlardır. Verilen gerçek sözcüklerin belli bir sınıfa ait olup olmadığının sorgulandığı anlamsal sınıflandırma görevinde ise "Hayır" cevapları verilen sınıflandırmada olmayan dolgu sözcüklerle ilişkilendirilmiştir. Anlamsal sınıflandırma görevinde kullanılacak dolgu sözcükler için R yazılımı (R Core Team,

2023) üzerinde çalışan LexOPS paketi (Taylor vd., 2020) kullanılmıştır. Bu paket verilen sözcüklere sıklık ve uzunluk gibi belirlenen kriterler açısından yakın olan başka sözcükler bulmaktadır ve mevcut çalışmada deneysel sözcüklere söz konusu değerler bakımından yakın sözcükler bulmak için kullanılmıştır. Kullanılan paket İngilizce dilinde çalıştığı için dolgu sözcükler İngilizce dilinde bulunup Türkçe çeviri eşdeğerleri de listelerin Türkçe bölümleri için kullanılmıştır.

Katılımcıların ikinci dil yeterlilikleri LexTALE kullanılarak test edilmiştir. Bu kısa sözcüksel karar görevinin sözcük fark etme ve işlemleme performanslarını ölçme sonucunda verdiği puan daha uzun ve detaylı olan Hızlı Yerleştirme Testinin (ing. Quick Placement Test; QPT, 2001) verdiği puanlarla büyük yakınlık göstermiştir (Lemhöfer & Broersma, 2012).

Katılımcılar Dil Geçmişi Anketini çevrimiçi olarak bireysel olarak tamamlamışlardır. Bu ankete verilen cevaplar öznel ikinci dil yeterliği, ikinci dil banyosu ve ikinci dil baskınlığı puanları oluşturulmasında kullanılmıştır. Dil banyosu ve dil baskınlığının olası etkilerinin araştırılmalarının yanında öznel olarak ölçülen ikinci dil yeterliği ve LexTALE aracılığı ile nesnel olarak ölçülen ikinci dil yeterliği puanlarının araştırılan diller arası etkileşimi açıklamada ne kadar etkili oldukları da karşılaştırmalı olarak incelenebilmiştir.

Çalışma için iki farklı derlem kullanılmıştır. İngilizce sözcükler için Çağdaş Amerikan İngilizcesi Derlemi (ing. Corpus of Contemporary American English, or COCA; Davies, 2008) kullanılmıştır. Bu derlem içerdiği 1.1. milyar sözcüğün yanı sıra detaylı arama seçenekleri ile de birçok çalışmada tercih edilmektedir. Türkçe sözcükler için ise TS Corpus V2 (Sezer & Sever Sezer, 2013) kullanılmıştır. Bu derlemin seçilme sebebi ise 500 milyona yakın sözcük içeriği ile araştırılacak anadildeki en çok sözcüğe sahip derlem olmasıdır. Bir diğer olası etken ise katılımcıların öznel sözcük sıklık değerleri ile derlemden alınan değerler arasındaki farktır. Katılımcılardan toplanan sözcük sıklık değerleri Google Documents (docs.google.com) üzerinden oluşturulan bir Likert ölçeği aracılığıyla toplanmıştır.

Pilot Çalışma

Toplam 9 öğrenci ile iki adet pilot çalışma yapılmış ve bu katılımcılar ana çalışmada yer almamıştır. Söz konusu çalışmalardan elde edilen veri ve katılımcı dönütleri doğrultusunda deneylerde ve uygulamalarda bazı değişikliklere gidilmiştir. Bazı katılımcıların bir takım deneysel sözcüklerin sınıflandırılmaları ile ilgili farklı fikirleri olduğu görüldüğünden dolayı ana deneylerde yer almayacak on sekiz katılımcının katıldığı bir Likert ölçeği çalışması yapılmış ve bu katılımcılara mevcut sözcüklerin belirtilen sınıflandırmalara ne kadar uydukları sorulmuştur. Pilot çalışmaların ve ölçeğin sonuçlarına göre dört adet deneysel sözcük ve iki adet dilde olmayan sözcük tamamen değiştirilmiş, dokuz adet dolgu sözcüğün ise sınıflandırılması değiştirilmiştir. Bunun yanı sıra deneyde kullanılan görev isimleri daha anlaşılır bir hale getirilmiştir: Sözcüksel karar görevi ve anlamsal sınıflandırma görevi yerine "Verilen sözcük dilde var mı?" ve "Sözcük belirtilen kategoriye uygun mu?" şeklinde daha açıklayıcı isimler tercih edilmiştir. Son olarak her bir sınıflandırma değişikliği ekranına iki adet örnek koyulmuştur (hayvanlar sınıflandırması ekranında *tavuk* ve *balina* gibi) ve alıştırma bölümünün hem İngilizce hem de Türkçe görevlerin alıştırmalarının içermesine karar verilmiştir.

Pilot çalışma sonucundaki cevaplardaki doğruluk oranı oldukça yüksek olmuştur. Katılımcılar İngilizce görevlerde %91.6, Türkçe görevlerde %97.1, sözcüksel karar görevlerinde %94.8 ve anlamsal sınıflandırma görevlerinde %93.9 doğru cevaplar vermişlerdir.

Uygulama

Katılımcıların yarısı ilk aşamada 50 ms olan görevleri diğer yarısı ise 83 ms olan görevleri tamamlamışlardır. Yaklaşık bir ay sonraki ikinci oturumda her katılımcı diğer hazırlayıcı süresine sahip görevleri tamamlamıştır. Oturumlar arasına bir ay süre konulmasının sebebi tekrar test etme etkisini ortadan kaldırmaktır (Pluck, 2020). Görevler OpenSesame programının o zamanki en güncel sürümü olan 3.3.12 versiyonu (Mathôt et al., 2012) ile hazırlanmışlardır. Her katılımcı sahte-rastgele bir şekilde sıralanan görevleri tamamlamış ve böylece görevlerin olası sıralamaları iki oturumda da birbirlerine yakın bir sayıda sunulmuştur. Katılımcılar cevaplarını bir

adet Logitech F310 oyun kolu kullanarak ve 16 inç ekrana sahip bir Lenovo dizüstü bilgisayarda gösterilen görevlere bakarak vermişlerdir.

Katılımcılar bir oturumdaki ana deneyi yaklaşık 30 dakikada tamamlamışlardır. Ana deneyin hemen sonrasında cep telefonlarını kullanarak LexTALE testini tamamlamışlardır. Dil Geçmişi Anketini ise her katılımcı boş vaktinde kişisel bilgisayarını kullanarak tamamlamıştır. Veri toplanan her günün sonunda toplanan veriler Open Science Framework üzerine o günün adını taşıyan bir klasör içine kopyalanmıştır. İkinci oturumda da görevlerini tamamlayan katılımcılardan yine boş vakitlerinde kişisel bilgisayarlarını kullanarak Sözcük Sıklık Ölçeğini tamamlamaları istenmiştir. Tüm bu süreçte sadece iki katılımcı çalışmadan ayrılmış, geri kalan 99 katılımcıdan gerekli tüm veriler toplanmıştır.

BULGULAR

Veri analiz etmede R (R Core Team, 2017) kullanılmıştır. Olmayan sözcükler ve dolgu sözcükler çıkarıldıktan sonra 36800 veri noktası kalmıştır. Çalışmadan ayrılan iki katılımcı ve uç değer olan cevaplar da çıkarıldıktan sonra 34321 veri noktası kalmış ve bu veriler kullanılarak hata analizleri yapılmıştır. Cevap süreleri için yapılacak analizler için ise yanlış cevaplar çıkartılmış ve kalan 33193 veri noktası ile analizler yapılmıştır. R içerisinde kullanılan BestNormalize paketinin (Peterson, 2021) Order Norm dönüştürme metodu (Peterson & Cavanaugh, 2020) kullanılarak cevap süreleri normalleştirilmiştir. Ayrıca Sözcük Sıklık ölçeğinde ve Dil Geçmişi Anketinde bulunan eksik cevaplar için caret paketindeki (Kuhn, 2008) K-NN (K-Nearest Neighbors) kayıp veri atama yöntemi kullanılmıştır.

Hata örüntüleri ile ilgili yapılan Lojistik Karışık Model Analizi sonuçlarında üç değişkenin yapılan hatalar üzerinde anlamlı etkileri bulunduğu görülmüştür. Katılımcılar alakalı hazırlayıcılara (çeviri eşdeğerleri) alakasız hazırlayıcılara nazaran daha doğru cevaplar vermişlerdir. Ayrıca anlamsal sınıflandırma görevlerinde ve genel olarak Türkçe görevlerde cevaplar daha yüksek doğruluk oranlarına sahip olmuştur.

Cevap süreleri ile ilgili oluşturulan Karışık Modellerin karşılaştırılması derlem sıklık değerlerinin öznel sıklık değerlerine oranla ve LexTALE ile hesaplanmış D2 yeterliklerinin Dil Geçmişi Anketi (v3) ile hazırlanmış öznek D2 yeterliklerine oranla

daha iyi açıklayıcı özelliğinin olduğunu göstermiştir. Derlem sıklık değerleri ve LexTALE sonuçlarının D2 yeterliği olarak alındığı model ise lmerTest paketi (Kuznetsova et al., 2017) kullanılarak daha sade bir hale getirilmiştir. Olasılık oranı testi sonuçları tüm değişkenleri ve etkileşimleri içeren model ile daha sade model arasında anlamlı bir fark bulamamış (df=61, Chiq=64.118, p=0.368) ve sonuç olarak sade model kullanılmıştır.

Seçilen sadeleştirilmiş Karışık Model analizi sonuçları hazırlayıcı türü ve süresi, dil yönü, dil banyosu, görev türü ve derlem sıklık değerlerinin verilen cevap süreleri üzerinde anlamlı etkileri olduğunu göstermiştir. Ayrıca çalışmadaki değişkenlerin birbirleri ile istatiksel olarak anlamlı iki yönlü, üç yönlü ve dört yönlü etkileşimler gösterdikleri gözlemlenmiştir. Bu ana etkiler ve etkileşim etkileri incelenerek çalışmaların bulguları literatürdeki bulgular doğrultusunda incelenmiştir.

GENEL SONUÇLAR

Çalışmanın sonucunda elde edilen veriler incelendiğinde Türkçe anadile sahip Türkçe-İngilizce iki dilli katılımcıların her iki dil yönünde de çeviri eşdeğeri hazırlama etkisi gösterdikleri görülmüştür; yüksek ikinci dil yeterliğine sahip katılımcılara alakalı hazırlayıcı olarak çeviri eşdeğerleri verildiğinde (örn. lion) bu hazırlayıcı, hedef sözcüğe (örn. aslan) verilen cevap sürelerini anlamlı bir şekilde kısaltmıştır. Bu etki her iki hazırlayıcı süresinde ve her iki görevde gözlemlenmiştir. Söz konusu sonuç D2-D1 yönündeki sözcüksel karar görevlerinde çeviri eşdeğerlerinin anlamlı bir hazırlama etkisi oluşturamayacağını iddia eden Olaylara Dayalı D2 Hipotezini (Jiang & Forster, 2001) yanlışlamaktadır. Genel sonuçlara bakıldığında D1-D2 yönündeki hazırlama etkisinin D2-D1 yönündeki hazırlama etkisinden az bir miktar (5.52 ms) daha fazla olduğu gözlemlenmiştir. Her ne kadar bu bulgu literatürde yaygın olarak dile getirilen (Chaouch-Orozco et al., 2021; Finkbeiner et al., 2004; Jiang & Forster, 2001; Schoonbaert et al., 2009; Wang & Forster, 2015; Witzel & Forster, 2012) ve benim hipotezlerimde belirttiğim anadilde hazırlayıcıların daha etkili işlemlendiği savını destekler gibi görünse de, kesin bir sonuca varılmadan bu etkinin diğer mevcut değişkenlerle etkileşimi de detaylı bir şekilde incelenmiştir.

Katılımcılar anlamsal sınıflandırma görevlerinde daha fazla hata yapmışlardır ve bu bulgu sözcük sınıflarının değerlendirildiği bu görevin sadece sözcüksel kararlar

verilen sözcüksel karar görevinden daha zor olacağı hipotezimi desteklemektedir. Ayrıca yine görev kaynaklı farklar noktasında hipotezlerime uygun şekilde anlamsal sınıflandırma görevlerinde verilen cevapların süreleri ve bu görevlerde gözlemlenen hazırlama etkileri sözcükler karar görevlerine oranla daha çok olmuştur. Her iki görevde de düşük hazırlayıcı süresinde dahi hazırlama etkisi gözlemlenmesi sözcüksel karar görevlerinde D2 hazırlayıcıların kısa sürelerde işlemlenemediği savını (Lee et al., 2018) yanlışlamaktadır.

Hazırlayıcı süresi ile dil yönü beraber değerlendirildiğinde çeviri eşdeğeri hazırlama etkisinin doğası ile ilgili ilginç bulgular gözlemlenmiştir. Öncelikle hazırlayıcı süresi 50 ms olduğu zaman her iki dil yönünde de benzer hazırlama etkileri gözlemlenmiş ve bunun yüksek ikinci dil yeterliğine sahip ve ikinci dillerini sık kullanan iki dilli kişilerin diller arası anlamsak benzerlikten her iki dil yönünde de benzer bir şekilde yararlanabildiklerini gösterdiği sonucuna varılmıştır (Duyck & Warlop, 2009; Perea et al. 2008). Mevcut çalışmada hazırlayıcı işlemleme süresini arttırmak için kullanılan boş ekran ya da ters maske kullanılmadığı göz önüne alındığında, bu bulgu D2-D1 yönünde hazırlama etkisi gözlemlemek için hazırlayıcı işlemlemeye uzun süreler (100 ms ve üzeri) verilmesi gerektiği savını (Schoonbaert et al., 2011) da yanlışlamaktadır.

Her iki dil yönünde de benzer çeviri eşdeğeri hazırlama etkisi gözlemlenmesi değerlendirilirken mevcut çalışmadaki katılımcıların özelliklerini de göz önünde bulundurmak oldukça önemlidir. Katılımcıların birçoğu ikinci dillerini bebeklik döneminden sonra edinmişlerdi (Ortalama D2 edinmeye başlama yaşı: 8.30), bu da dil yönü etkisinin ortadan kalkması ve her iki yönde de benzer hazırlama etkisi gözlemlenmesi için iki dilli kişilerin her iki dillerini de bebeklik döneminde edinmeleri gerektiği savını yanlışlamaktadır (Dimitropoulou vd., 2011c; Jiang & Forster, 2001). Bir D2 bağlamının içinde bulunmak, D2 kullanımı ve D2'ye maruz kalmak ile birlikte D2 sözcüklerinin kavramsal derinliklerini etkileyebilir (McPhedran & Lupker, 2021). Mevcut çalışmadaki katılımcılar yüksek D2 yeterliklerinin yanı sıra D2 dillerinin eğitim dili olarak kullanıldığı bir üniversitede okumaktaydılar. Bu yüksek D2'ye maruz kalma ve D2 kullanımı ile gelen yüksek D2 baskınlığı ve D2 yeterliğinin bu bulguların elde edilmesinde etkili olduğu düşünülebilir. Ayrıca katılımcıların iki dillerinin aynı yazı sistemini kullanması da bu gözlemlenen örüntüde etkili bir faktör

olarak düşünülüp sonraki çalışmalarda farklı dil grupları ile benzer sonuçlar elde edilip edilmediği incelenebilir.

Hazırlayıcı süresinin 83 ms olduğu görevlerde daha fazla çeviri eşdeğeri hazırlama etkisi görülmüştür ve bu defa dil yönleri arasında hazırlama etkisi açısından bir fark gözlemlenmiştir. Her ne kadar bu etkinin daha fazla hazırlama süresi ile birlikte gelebilecek daha etkili hazırlayıcı işlemlemesinden kaynaklandığı açıklaması cazip gözükse de söz konusu farkın alakasız hazırlayıcılara verilen daha yavaş cevaplardan kaynaklandığı gözlemlenmiştir. Hazırlama etkisi alakalı hazırlayıcılara (örn. lion-aslan) verilen cevaplar ile alakasız hazırlayıcılara (örn. kapı- aslan) verilen cevapların arasındaki süreyi ifade eder. Hazırlayıcı süresi 83 ms olduğunda alakalı hazırlayıcılara verilen cevap süresi 50 ms hazırlama süresinde olanlardan çok farklı değilken, alakasız hazırlayıcılara verilen süreler bu daha uzun hazırlama etkisi süresinde artmış ve bu da hazırlama etkisinin artmasına sebep olmuştur. Bu yavaşlamanın D1-D2 yönünde daha fazla olması ise bu yöndeki hazırlama etkisinin D2-D1 yönünden daha fazla olmasını sağlamıştır; ancak belirtildiği gibi bu daha güçlü hazırlama etkisi D1 alakalı hazırlayıcılarının daha etkili işlemlenmesinden ziyade D1 alakasız hazırlayıcılarının verilen cevapları daha fazla yavaşlamasından kaynaklanmaktadır.

Alakasız hazırlayıcılar 83 ms hazırlama süresi kullanan sözcükler karar görevlerinde her iki dil yönünde de benzer şekilde daha geç cevaplanmışlardır. Anlamsal özelliklerin işlemlenmesi hazırlayıcı sözcük kaybolduğunda ve hedef sözcük ekranda belirdiğinde devam ediyor olabilir (Nakayama et al., 2018). Yapı ile ilgili özelliklerin bastırılıp sadece anlamsal özelliklerin etkin bir şekilde tutulması işlemi hazırlayıcı ve hedef arasındaki yazımsal fark çok fazla olduğunda daha da hızlı olabilir (Nakayama et al., 2018). Mevcut çalışmada hazırlayıcı süresinin uzatılması yapı-temelli özelliklerin daha fazla etkinleşmesini ve hazırlayıcı-hedef arasında anlamsal bir ilişki de bulunmadığı durumlarda daha geç cevap sürelerine neden olmuş olabilir.

Anlamsal sınıflandırma görevlerinde ise alakasız hazırlayıcılara verilen daha geç cevaplar D1-D2 yönünde daha bariz bir şekilde gözlemlenmiştir. Bu dil yönü ile ilgili etki 83 ms hazırlayıcı kullanılan görevlerde D1-D2 yönünde daha fazla hazırlayıcı etkisi gözlemlenmesinin de ana sebebi olmuştur. Anlamsal sınıflandırma görevinde hazırlayıcı sürelerinin uzatılması alakasız hazırlayıcıların daha fazla alakasız algı ve

sınıflar etkinleştirmesine neden olmuş olabilir. D1 sözcüklerin daha fazla algı etkinleştirdiği savını (Wang, 2013) kabul edersek, bu geciktirici etkinin D1-D2 yönünde daha etkili olmasının sebebinin etkinleştirilen daha fazla sayıda alakasız sınıf ve bunların anlamsal sınıflandırma görevinde verilen cevaplar üzerinde engelleyici bir etki yapması olduğu iddia edilebilir.

Bireysel farklılıklar incelendiğinde D2 yeterliğine sahip katılımcıların D2 hedeflere (D1-D2 yönü) ve alakalı D2 hazırlayıcılara (D2-D1 yönü) daha hızlı cevaplar verdiği gözlemlenmiştir. Anlamsal sınıflandırma görevinde D2 yeterliğinin kolaylaştırıcı etkisinin daha fazla olduğu bulunmuş, bunun da yüksek D2 yeterliğine sahip iki dilli kişilerin Çoklu Bağlantı Model'inde iddia edilen görev/karar sistemini daha etkili kullanmış olabilecekleri ve bu sistemin anlamsal sınıflandırma görevlerinde daha etkili bir rol oynadığına işaret edebileceği düşünülmüştür. D2 dil banyosu skorlarının yükselmesiyle cevap sürelerinin kısalması bulgusu da D2 edinimine daha önce başlayan kişilerin söz konusu sistemi her iki dil yönünde de daha etkin kullandıklarını gösterebileceği sonucuna varılmıştır. D2 baskınlığı puanlarının cevap süreleri üzerinde az bir kolaylaştırıcı etkisi görülmüştür ve daha güçlü bir etki görülmemesinin muhtemel sebebinin katılımcıların D2 baskınlıkları arasında çok fazla farklılıklar olmaması olduğu düşünülmüştür. Ayrıca D2 banyosu ve D2 baskınlığı puanlarının hesaplandığı Dil Geçmişi Anketini öğrencilerin kendi başlarına tamamlamaları ve bu değerlerin öznel verilere dayanmaları da muhtemel sınırlılıklar olarak belirtilmiştir.

Hazırlayıcı sözcüklerin sıklığı arttıkça genel olarak alakalı hazırlayıcılardan sonra verilen cevap süreleri kısalmıştır ve bu durum daha önce hazırlayıcı sıklık değerleri ile ilgili anlamlı bir sonuç bulamayan Nakayama vd.'nin (2018) çalışması ile zıt düşmektedir. Hedef sözcüklerin sıklık değerleri sözcüksel karar görevlerinde genel olarak ufak bir kolaylaştırıcı etki göstermişlerdir ama anlamsal sınıflandırma görevlerinde her iki dil yönü için zıt örüntüler ortaya koymuşlardır. D1-D2 yönünde D2 hedef sözcüklerin sıklığı arttığında verilen cevap süreleri kısalmış, D2-D1 yönünde ise D1 hedef sözcüklerin sıklığı arttığında verilen cevap süreleri uzamıştır. Bu bulgunun D1 hedef sözcüklerin de sıklıkları arttıkça birden fazla sınıf etkinleştirebilecekleri ve bunun anlamsal sınıflandırma görevlerinde engelleyici bir etki yapabileceğine işaret edebileceği düşünülmüştür.

Elde edilen bulguların D1 ve D2 sözcüklerin işlemlenmesi arasında nitelden ziyade nicel farklılıklara işaret ettiği sonucunu varılmıştır. Her ne kadar özellikle farklı dillerdeki sözcüklerin anlamsal ilişkileri ve özellikleri konusunda geliştirmesi gereken çok şey olsa da Çoklu Bağlantı Modeli mevcut bulguları en iyi açıklayan model olmuştur. Gelecek çalışmalar yüksek sıklık değerlerinden seçilmiş sözcüklerin kullanılarak oluşturulduğu mevcut çalışmadaki görevleri daha düşük D2 yeterliğine sahip iki dilli katılımcılara tamamlatarak çeviri eşdeğeri hazırlama etkisinin gelişimsel olarak nasıl ilerlediğini ortaya çıkarabilir ve iki dilli zihinsel sözlük modellerinin daha fazla geliştirilmesine katkıda bulunabilirler.

L. THESIS PERMISSION FORM / TEZ İZİN FORMU

ENSTİTÜ / INSTITUTE

Fen Bilimleri Enstitüsü / Graduate School of Natural and Applied Sciences ☐

Sosyal Bilimler Enstitüsü / Graduate School of Social Sciences ☒

Uygulamalı Matematik Enstitüsü / Graduate School of Applied Mathematics ☐

Enformatik Enstitüsü / Graduate School of Informatics ☐

Deniz Bilimleri Enstitüsü / Graduate School of Marine Sciences ☐

YAZARIN / AUTHOR

Soyadı / Surname : OĞUZ

Adı / Name : Enis

Bölümü / Department : İngiliz Dili Öğretimi / English Language Teaching

TEZİN ADI / TITLE OF THE THESIS (**İngilizce** / English): INVESTIGATING TRANSLATION EQUIVALENT PRIMING: THE IMPACT OF TASK, ITEM, AND INDIVIDUAL DIFFERENCES

TEZİN TÜRÜ / DEGREE**:** **Yüksek Lisans** / Master ☐ **Doktora** / PhD ☒

1. **Tezin tamamı dünya çapında erişime açılacaktır. /** Release the entire work immediately for access worldwide. ☒
2. **Tez iki yıl süreyle erişime kapalı olacaktır.** / Secure the entire work for patent and/or proprietary purposes for a period of **two years. *** ☐
3. **Tez altı ay süreyle erişime kapalı olacaktır.** / Secure the entire work for period of **six months.** * ☐

***** *Enstitü Yönetim Kurulu kararının basılı kopyası tezle birlikte kütüphaneye teslim edilecektir. /*

A copy of the decision of the Institute Administrative Committee will be delivered to the library together with the printed thesis.

Yazarın imzası / Signature ..... **Tarih** / Date .....

(Kütüphaneye teslim ettiğiniz tarih. Elle doldurulacaktır.)

(Library submission date. Please fill out by hand.)

Tezin son sayfasıdır. / This is the last page of the thesis/dissertation.