COMPARING THE TRENDS OF DEVELOPMENT IN L2 AND L1 MENTAL LEXICON

ASSOCIATIONS, VOCABULARY SIZE, AND REACTION TIME

NEDA AKBARI

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Acknowledgements

My interest in the area of word associations goes back to the day that I was browsing through the journal of *Studies in Second Language Acquisition* looking for a topic for my Master's thesis. I accidentally found the article *Comparing the L1 and L2 mental lexicon: A depth of individual word knowledge model* by Dr. Brent Wolter (2001). This paper inspired me to conduct a small-scale study for my Master's degree and continue my studies at PhD level in the areas of word associations and retrieval.

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Abstract

Words are an important component of language in second language (L2) learning since words carry meaning, and the ability to communicate occurs through the meaning of words. The current study investigated the trend of development in the L2 mental lexicon (ML) from the three dimensions of associations, vocabulary size, and reaction time. The main purposes of this study were to determine whether the L2 ML had a similar trend of development to the first language (L1) ML if the L2 was learned in similar circumstances to the L1, and whether the L2 ML could resemble the L1 ML at some age.

The participants in this study comprised the immigrant children aged 6-17 undertaking mainstream education in the L2 (English). A Word Association Task and the yes/no Lexical Decision Task were utilised in order to elicit the word associations and measure the vocabulary size and reaction time respectively.

The findings of the present study revealed a relatively similar trend of development for the L2 and L1 ML with only slight discrepancies between them. The findings also demonstrated significant similarities between the L2 and L1 ML of students aged 15-17. These findings were discussed in the broader context of children's cognitive and linguistic development. The impact of age and the environment on language learning was also explained.

Abbreviations

AoA	Age of Arrival
BNC	British National Corpus
CAE	Cambridge Certificate in Advanced English
cfg	correction for guessing formula
COCA	Corpus of Contemporary American English
DL1	Dutch as a First Language
DL2	Dutch as a Second Language
EFL	English as a Foreign Language
ESL	English as a Second Language
EVST	Eurocentres Vocabulary Size Test
IEC	Introductory English Centres
L1	First Language
L2	Second Language
LDT	Lexical Decision Task
LoE	Length of Education
LoR	Length of Residence
LPR	Language Proficiency Ratings
ML	Mental Lexicon
PPVT	Peabody Picture Vocabulary Test
SDT	Signal Detection Theory
SPSS	Statistical Package for Social Sciences
UWL	University Word List
VLT	Vocabulary Levels Test
VORST	Vocabulary Recognition Speed Test
WAT	Word Association Task
WFL	Word Family List

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Chapter 1: Introduction

1.1. Overview

The current study continues the line of studies focusing on words in second language (L2) learning. Words are the fundamental component of language and the ability to communicate occurs through the meaning of words. On the importance of words in communication, Wilkins (1972) states that "without grammar very little can be conveyed, without words nothing can be conveyed" (p. 111). Additionally, in some languages, the term used for *word* is the same term used for *speaking*.

Words also play a fundamental role in L2 learning. Schmitt (2010) emphasises the importance of words and their meaning in L2 learning by making the anecdotal statement that we see L2 learners carrying dictionaries around not grammar books. The importance of words in L2 learning is also highlighted by its correlation with different language skills such as reading comprehension, grammatical accuracy (e.g., Alderson, 2005), and fluency (e.g., Laufer & Nation, 2001; Harrington, 2006). On the significance of word knowledge and its impact on various L2 skills, Alderson (2005) states that language ability is to a large extent a function of vocabulary size.

The view that the current study has on the words is adopted from Meara (1996a). He proposed that words are connected with each other in the three dimensional network of the mental lexicon (ML). The three dimensions of the ML are:

- Vocabulary size: This refers to the number of words that the language users know.
- Organisation (associations): This reflects the fact that words in the ML are not stored in isolation rather there are semantic connections among them. The word associations inform us of the semantic connections which exist among words in the ML.
- Reaction time: This refers to the time required to retrieve the information about each word in the ML. According to Barcroft (2002), the human mind has limited cognitive resources. If many resources are given to one particular aspect of words such as their form, there are not many resources available for the other aspects of words such as their meaning. Therefore, the fast reaction time to some aspect of words frees up the cognitive resources for the other aspects. It is important to note that it is good to have a large vocabulary with strong connections among the words. However, if there is no fast reaction time to the words, the communication either fails or is difficult.

The network view of ML proposed by Meara (1996a) is in line with Aitchison's (1997, 2003) view which defines ML as an interconnected network of words. When a new word enters the ML, it affects the existing words in the ML and builds connections with them. This network view is in contrast to the two dimensional view containing the vocabulary size (breadth) and knowledge of the individual words (depth of word knowledge) without considering the connections among words (Read, 1995; Wesche & Paribakht, 1996).

1.2. Rationale and research questions

There have been very few studies in the research literature on the L2 ML which considers the ML as an interconnected network of words with three dimensions: vocabulary size, organisation (associations), and reaction time. Arguably, there remains the need to investigate the L2 ML as an interconnected network with the three dimensions and to examine the impact that each dimension has on the other. Therefore, the present study fills an important gap in research on the L2 ML by focusing on the development of the ML from the three dimensions of vocabulary size, organisation (associations), and reaction time.

Additionally, there are gaps in the studies which investigated the development of different dimensions of the ML separately. The studies which examined the organisation of ML primarily focused on the word associations of child and adult L1 rather than the word associations of child L2. Additionally, these studies are old and limited to studies of children from a few close age groups. There are also other methodological issues with these studies which are explained in detail in the literature review in Chapter 2. In contrast, the present study focuses on the development of L2 ML in terms of organisation and provides snapshots of what the L2 ML looks like at different points of its development over a longer period of time.

The studies which explored the L2 ML of adult L2 learners reported contradictory results in terms of the word associations of adult L2 learners. Some studies revealed that the L2 ML is fundamentally different from the L1 ML (e.g., Fitzpatrick, 2006). Others reported that the L2 ML is fundamentally similar to the L1 ML and the discrepancies observed between the two are quantitative (e.g., Zareva, 2007). The contradictory findings of previous research deserve further attention. The participants of previous research were adult L2 speakers with various levels of language proficiency. None of these studies provided any information on when and in what circumstances the L2 was learned. The participants, nevertheless, took language

proficiency tests before they entered university which indicates that they did not have sufficient exposure to the L2 in the L2 environment during childhood. The present study contributes to the research on the L2 ML by focusing on whether the L2 ML develops similarly to the L1 ML, and whether it resembles the L1 ML at some age if the L2 is learned in similar circumstances to the L1.

The findings of studies investigating the vocabulary size and reaction time of adult L2 learners also revealed contradictory findings. Some studies (e.g., Laufer & Nation, 2001; Harrington, 2006) reported moderate and high correlations between these two dimensions of the ML while others (e.g., Miralpeix & Meara, 2010) reported no correlation between them. The current study contributes to the research on the vocabulary size and reaction time of child and adult L2 and L1 by investigating the impact that each dimension of the ML has on the other.

Furthermore, in investigating the development of the L2 ML, two variables, the age and environment for language learning, need to be considered. The age of the language learner is a very important factor in successful language learning. Previous research has suggested that language learners who began learning the L2 earlier in life generally developed higher levels of proficiency in the L2 (e.g., Bialystok & Miller, 1999; Johnson & Newport, 1989; Oyama, 1982). Additionally, previous research has suggested that the environment in which language is learned is also crucial in successful language learning (e.g., Flege & Liu, 2001). The impact of age and the environment of the language learner on the development of the L2 ML has been neglected in research on the L2 ML. In contrast, the current study focuses on the L2 learners who learned their L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and generally by living in the L2 country.

The current study aims to investigate whether the trend of development of the L2 ML is similar to that of the L1 ML in terms of the associations, vocabulary size, and reaction time if the L2 is learned in circumstances similar to those of the L1. In this study, the term "similar circumstances" refers to learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and by living in the L2 country. The current study also aims to investigate whether the L2 ML resembles the L1 ML in terms of the associations, vocabulary size, and reaction time at some age. The main research questions are:

1) Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

2) Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

1.3. Research design

A cross-sectional study with a quantitative design was chosen in order to respond to the research questions. The participants in this study were the L2 and L1 students from three age groups of 6-7 (early primary school years), 11-12 (late primary school years), and 15-17 (late high school years). The L1 students (native speakers of English) participated as members of control groups.

A Word Association Task (WAT) was administered to elicit the word associations in the L2 and L1 ML. The WAT contained stimulus words from different word classes (nouns, verbs, and adjectives) and different frequency ranges (low and high frequencies). After a stimulus word is presented to the task taker, s/he says the first word which comes to mind. Then, the responses provided by the task takers are classified into different association categories (see section 4.5.1.1).

A yes/no Lexical Decision Task (LDT) is administered to measure the participants' vocabulary size and reaction time. The yes/no LDT contains words and pseudowords. The words are from different word classes and frequency ranges. The pseudowords are nonexisting words which look like real words and are used to control for guessing. An item (a word or a pseudoword) comes on the computer screen, and the task taker clicks *yes* if s/he knows the word and *no* if s/he does not know it. The vocabulary size is measured by the number of correct responses to the words. The reaction time is measured by the time it takes to recognise real words (see section 4.5.1.2).

1.4. Chapter overview

The current study is reported in seven chapters. Chapter 1 (Introduction) provides the introduction to the study undertaken, focusing on the importance of the current study, the

rationale, and the research questions. Additionally, this chapter presents an overview of the research design with a focus on the participants and the tasks.

Chapter 2 (Literature Review) reviews the research literature available related to the associations, vocabulary size, and reaction time of child and adult L2 and L1 from the fields of psychology, psycholinguistics, and applied linguistics. This chapter also discusses the limitations of the previous research and provides the rationale for the current study.

Chapter 3 (Word Association Task and Lexical Decision Task) introduces the two tasks utilised in the current study and the purpose of the tasks. It then reviews the development of these tasks, their construct, and similar task formats. It also provides a rationale for their use in the current study.

Chapter 4 (Research Methodology and Data Analysis) firstly focuses on the design of the current study, the ethical considerations, the participants, and the data collection procedure. It then presents the data analysis and the descriptive and statistical approaches of the current study.

Chapter 5 (Results) reports the findings of this study in response to the main research questions.

Chapter 6 (Discussion) discusses the findings of the current study in response to the two research questions. In response to the first research question, this chapter discusses the trend of development for each dimension of the L2 and L1 ML (associations, vocabulary size, and reaction time) comparing the findings of the current study with the findings of previous research and in the broader context of child cognitive and linguistic development. In response to the second research question, this chapter focuses on the similarities and differences between the L2 and L1 ML of participants of different ages. The last section of this chapter emphasises the effect of age and environment on language learning.

Chapter 7 (Conclusions) provides an overview of the research questions, methodology, and the major findings of the current study. This chapter then presents the contribution of the current study to the understanding of L2 ML and its development. The chapter also focuses on the limitations of the present study and offers suggestions for future research.

Chapter 2: Literature Review

2.1. Overview

The objective of this chapter is to provide an analytical review of the literature pertaining to the three dimensions of the mental lexicon (ML): organisation (associations), (section 2.3), vocabulary size, and reaction time (section 2.4) in child and adult second language (L2) and first language (L1).

First, this chapter focuses on the importance of age and environment in L2 learning (section 2.2). Second, it covers the theoretical background and empirical studies conducted on the word associations of child and adult L2 and L1. While the word associations of children and adults are under-researched areas, this chapter comprehensively covers the empirical studies relevant to the purposes of the present study. The following themes are covered in the second section:

- Mental lexicon and word associations (section 2.3)
- Word associations in child and adult L1 (section 2.3.1)
- Word associations in adult L2 learners (section 2.3.2)
- Word associations in child L2 (section 2.3.3)

Third, this chapter presents the theoretical background and empirical studies carried out on the vocabulary size and reaction time of child and adult L2 and L1. This section focuses on the following themes:

- Mental lexicon, vocabulary size, and reaction time to words (section 2.4)
- Vocabulary size and reaction time in child L2 and L1 (section 2.4.1)
- Vocabulary size and reaction time in adult L2 and L1 (section 2.4.2)
- Correlation between vocabulary size and reaction time (section 2.4.3)

As the studies in the second and third sections of this chapter focus on the trend of development for the word associations, vocabulary size, and reaction time, and investigate whether the L2 ML of the adult L2 resembles the L1 ML of the native speaker, the findings of these studies are important for the purposes of the present study.

The last section of this chapter identifies the gaps existing in the research literature on associations, vocabulary size, and reaction time in order to provide the rationale for the present study.

2.2. Age and the environment for language learning

There is a range of variables which play crucial roles in the L2 learning. Two of the variables crucial for the current study are age and the environment for language learning. Age is important in successful L2 learning as previous research has suggested that language learners who begin learning the L2 during the sensitive period for language learning generally develop higher levels of proficiency in the L2 specifically in the areas of morphosyntax and phonology (e.g., Bialystok & Miller, 1999; Johnson & Newport, 1989; Oyama, 1982). Opinion varies about the sensitive period for language learning. It is defined by Diller (1981) and Johnson and Newport (1989) as the period from birth to 6-7 years old and by Lenneberg (1967) and Seliger (1978) as the period from birth to puberty when the brain is most sensitive to a particular environmental stimulus, in this case language. After this period, the ability to learn a language declines gradually (Birdsong 2005). For example, Bialystok and Miller's (1999) study demonstrated a strong correlation between the age of arrival (AoA) in the L2 country and the L2 students' scores on the grammaticality judgement tests. The L2 learners who arrived in the L2 country and began learning the L2 earlier in life (younger than 15) did better than those who arrived in the L2 country and began learning the L2 at an older age (older than 15).

The impact of age of language learning on the structure of L2 ML has received little attention in the literature. Although the findings of previous research have revealed that age constrains the acquisition of L2 morphosyntax and phonology, it is not clear whether age constraints apply to the acquisition of L2 vocabulary, and consequently the structure of L2 ML, in the same way as they apply to the acquisition of L2 morphosyntax and phonology. In acquisition of vocabulary, both depth and breadth of word knowledge continue to expand throughout one's life span. This is due to the fact that the individuals' vocabulary is aligned with their conceptual knowledge. As the individuals' conceptual knowledge increases throughout their lives, the breadth and depth of vocabulary also expand. Despite that, the findings of previous research comparing the adult L2 speakers who had not learned their L2 during childhood in the L2 country and the native speakers (e.g., Fitzpatrick, 2006; Wolter, 2001) have revealed discrepancies between the structure of L2 and L1 ML. In particular, the syntagmatic and phonological associations seemed to play more dominant roles in the structure of L2 ML, while the paradigmatic association was more dominant in the structure of L1 ML (Wolter, 2001).

The environment in which language is learned also plays a crucial role in the success of L2 learning as it functions as a source of exposure to the L2. Previous research has also revealed that learning the L2 in the L2 environment is more successful than learning the L2 in a foreign language environment (e.g., Flege & Liu, 2001). Although the environment for language learning is important, there is a difference between living in an L2 environment and undertaking education in the L2. The former is referred to as the length of residence (LoR) in the L2 country, and the latter is the length of education (LoE) in the L2. The findings of previous research (e.g., Flege & Liu, 2001) have shown that living in the L2 country does not improve the L2 learners' skills specifically the morphosyntax knowledge and comprehension. The LoR in the L2 country is correlated to the L2 skills for those L2 learners who were enrolled as students during most of their stay in the L2 country.

The age and environment for language learning are two essential factors which together provide the L2 learners with a situation in which they more or less go through the same stages of formal education as the native speakers. They attend primary school and high school in the L2 country and have extensive exposure to the L2 both in and out of school. The quantity (how often they receive input and produce output in the L2) and quality (where and from whom they receive the L2 input) of their L2 input and output are closer to the quality and quantity of the native speaker input and output than those who learn their L2 in the foreign language environment.

2.3. Mental lexicon and word associations

Even though there are different theories on the way words are organised in the ML of a language user, and whether the language users who know more than one language possess more than one ML, there is a commonly accepted definition for the ML. Dijkstra (2005) states that "the mental lexicon is the database containing all words in the mind of a language user" (p. 180). Phonological, orthographic, syntactic, and semantic information about each word is also stored in the ML. Words in the ML are not stored in isolation. Rather there are stored in semantic connections. Word associations inform us of the semantic connections which exist among words in the ML. For example, there are semantic connections among the words *cat*, *dog*, *animal*, and *terrier*. *Terrier* is a kind of *dog*, and *dog* and *cat* are kinds of *animals*. This view of the ML as an interconnected network of words and connections is in line with the semantic theory that words and their meanings are understood in relation to other words. The meaning of *terrier* is understood in relation to *dog* and *animal*.

Knowledge of word associations is part of knowledge of word meaning. Knowledge of a word includes knowledge of its form, meaning, and use (Nation, 2001). Knowledge of word form involves knowledge of phonological and written aspects of the word as well as recognisable parts of the word. For example, there is a correspondence between spelling and pronunciation for the word *interested*, as it is pronounced and written in the same way. It is also made up of two morphemes, *interest* and *ed*. Knowledge of word meaning involves connecting the form of the word and its meaning(s), connecting concepts and referents, and connecting words to their associates. For example, if the word *apple* is known, the language user can connect the referent *apple* to its concept as a fruit. Knowledge of use of word includes the grammatical functions of the word, its collocations, and constraints on its use. For example, the word *interesting* is an adjective which occurs before a noun; it comes with words like *book*; and it is used in informal and semi-formal contexts. Generally, knowledge of a word starts with knowledge of its phonological form. As knowledge of a word increases, language users' grasp of its meaning(s) and use(s) increases. Additionally, individuals gain written knowledge of the word (Milton, 2013).

Word associations have been divided into three main categories: paradigmatic, syntagmatic, and phonological (clang). The paradigmatic associations exist between words which have a close semantic connection with each other (stimulus word and response). The stimulus word and response are from the same word class, for example noun, adjective, verb, or adverb and have the same grammatical function in the sentence such as *apple* and *fruit*, *hand* and *finger*, or *heavy* and *light* (see section 4.5.1.1). According to Cruse (2011), the paradigmatic associations reflect the semantic choices available at a particular structure point in a sentence as shown in the following example:

I'll have a glass of ----.
beer
wine
water
lemonade
etc. (example from Cruse, 2011)

The syntagmatic associations exist between words which sit in a phrase or sentence together. Thus, there is a sequential or collocational connection between them. Additionally, they are mostly (not always) from different word classes such as *dog* and *bark* (Wolter, 2001). The phonological (clang) associations, however, exist between words which resemble each other

phonologically, although there is no semantic connection between them such as *dog* and *bog* (Wolter, 2001).

The general assumption underlying the development of word knowledge is that as language proficiency increases, breadth and depth of word knowledge also increase. Breadth refers to the number of words that individuals know (vocabulary size). Depth of word knowledge refers to how much individuals know about each word. Depth of word knowledge has also been defined in terms of the number of associations among words. Once a meaning is attached to a word, the word develops associations with other words. The number of associations among words indicates the depth of word knowledge.

2.3.1. Word associations in child and adult L1

Most studies investigating the word associations of child and adult L1 were conducted in the 1960s and 1970s in the field of psychology. These studies provide the basis for our understanding of word associations in child L1 and the changes which occur with age. As the current study draws on different elements of each study, the research purposes, methodology, findings, and their discussions are covered. The last part of this section provides a summary of the main findings.

2.3.1.1. Brown and Berko (1960)

Brown and Berko (1960) conducted a study to investigate the word association patterns of child and adult L1 to observe the changes which occur with age in the word associations of children. This study was carried out on four groups of participants: first grade (N = 20), second grade (N = 20), and third grade (N = 20) children and adults (N = 20). The participants were given a Word Association Task (WAT), (see section 3.1) containing 36 stimulus words. There were six stimulus words representing each of the six parts of speech noted below:

a) transitive verbs (verbs which require an object e.g., *want*)
b) intransitive verbs (verbs which appear with no object e.g., *go*)
c) count nouns (nouns used for the countable things e.g., *table* and *chair*)
d) mass nouns (nouns used for the uncountable things e.g., *milk* and *water*)
e) adjectives
f) adverbs

The stimulus words utilised in this study were all high-frequency words in the speech of American primary school children. The high-frequency words were used as they revealed discrepancies between the associations of children and adults in previous research. The aural-oral method (see section 3.1) was used for the data collection and the participants' responses to the stimulus words were scored as homogeneous (paradigmatic) or heterogeneous (syntagmatic) by part of speech to the stimulus word.

The findings of this study clearly revealed that with age, the number of homogeneous responses increased. Brown and Berko (1960) stated that the responses that both children and adults provided were semantically related to the stimulus words in the WAT. The difference between child and adult responses was that the child response completed a phrase but the adult response replaced the stimulus word. For example, children gave *away, a letter, a card,* and *mail* to the stimulus word *send*. In contrast, adults gave other verbs such as *receive, get, deliver, bring,* or *fetch.* The findings of this study also revealed that the part of speech of the stimulus word caused variance in the participants' responses. Nouns are nominal as they refer to concepts and thus are subject to (easy) categorisation, while verbs, adjectives, and prepositions are relational as they commonly serve as a link between two entities. Thus, nouns are better adapted for paradigmatic associations, while verbs, adjectives, and prepositions are better adapted for syntagmatic associations.

There was also a significant interaction between age and the part of speech. The homogeneous response for count nouns and adjectives was far less affected by age compared to the other parts of speech. Both children and adults provided a similar number of homogeneous responses for count nouns and adjectives. Therefore, Brown and Berko (1960) concluded that as both children and adults have more experience with nouns and adjectives compared to the other parts of speech such as verbs and adverbs, these parts of speech elicit homogeneous responses even in children.

Both the age of the participants and the part of speech of the stimulus words were found to be determiners of the number of homogeneous responses that children and adults provided. Brown and Berko (1960) argued that as children grow older, their experience with words belonging to the same part of speech increases. Thus, children gradually organise their vocabulary into the syntactic classes called parts of speech. Nevertheless, the explanation that Brown and Berko (1960) provided for their findings has been criticised. Indeed, other research has shown that younger children (age 3-4) are able to use words appropriately

according to their word classes and match words to their parts of speech (Nelson, 1977). The explanation that with age, children organise their vocabulary into the syntactic classes has been challenged.

2.3.1.2. Ervin (1961)

Another study with a similar design was carried out by Ervin (1961) which also revealed similar findings to the Brown and Berko (1960) study. Ervin (1961) conducted her research on children of different ages in order to investigate the impact of age on the development of word associations. A total of 184 children from kindergarten (N = 23), first grade (N = 10), third grade (N = 52), and sixth grade (N = 99) took part in this study.

As in the case of the Brown and Berko (1960) study, a WAT was administered to the children to elicit the word associations. The WAT contained 46 stimulus words from various word classes such as nouns, adjectives, adverbs, and verbs. All the stimulus words were selected from the Rinsland List (1954), A Basic Vocabulary of Elementary School Children. These words were regarded as likely to be known by the youngest age group. The WAT was administered using the aural-oral method (see section 3.1) for the kindergarten and first grade students, and aural-written method (see section 3.1) for the third and sixth grade students.

The findings of Ervin's (1961) study showed that with age, the number of paradigmatic associations increased, and the number of syntagmatic and phonological associations declined. For five of the six verbs, all the prepositions, adjectives, adverbs, and pronouns, the number of paradigmatic associations increased consistently. The findings also revealed that the paradigmatic associations rose for the word classes which occur in the final position of sentences, and those which occur alone such as nouns, adjectives, intransitive verbs, adverbs, and accusative pronouns rather than the word classes which occur in the medial position of sentences.

Ervin (1961) discussed the findings of her research in terms of the contextual similarity of words. With age, children's experience with words appearing in the same position in a sentence increases. Therefore, the number of paradigmatic associations rises, and the number of syntagmatic and phonological associations declines. For example, the child learns that in order to complete the sentence *we climbed ...*, s/he can say *a hill* or *a mountain*. Therefore, the number of paradigmatic associations (*hill* and *mountain*) increases, and the number of competing syntagmatic associations drops. Ervin (1961) also pointed out that with age,

children spend more time on exercise books. The exercise books contain a large number of exercises for substituting words with their synonyms and antonyms. The widespread use of these exercises helps increase the number of paradigmatic associations that students provide.

Ervin's (1961) study is one of the most cited studies in the research on word associations of child and adult L1. The results are of importance for the current study as they revealed the types of associations in L1 children and focused on the impact of age on their word associations. In particular, Ervin (1961) presented the word associations of children in the first and sixth grades who are in the same age ranges as two of the participating groups in the current study. Nevertheless, the current study makes an important contribution to the previous research literature as it focuses also on the word associations of L2 children.

2.3.1.3. Entwisle (1966)

Entwisle (1966) investigated the effect of the frequency of the stimulus words on the word associations of children. The participants in this study were prekindergarten, kindergarten, first grade, third grade, and fifth grade students (N = 1,160), and adults (N = 200). The importance of the study is its attention to the influence of the frequency of words on the associations as well as its focus on the age of the participants and the word class of the stimulus words. Entwisle's (1966) research also reported similar findings to the Brown and Berko (1960) and Ervin (1961) studies.

Entwisle (1966) took a similar approach to Brown and Berko (1960) and Ervin (1961), and utilised a WAT to elicit associations. In contrast to those studies, the WAT used in Entwisle's (1966) study contained 96 high- and low-frequency stimulus words from various word classes of nouns, adjectives, verbs, adverbs, pronouns, and miscellaneous (prepositions, conjunctions, and an adverb). They were selected from the Kent-Rosanoff List (1910) (see section 3.1.3.1.1). The stimulus words previously used in other studies (e.g., Ervin, 1961) were also included so that the results could be compared to the previous research.

The WAT was administered to the adults using the written-written method (see section 3.1) and to the children using the aural-oral method (see section 3.1). The participants were required to provide the first word which came into their mind. The responses were classified on the basis of their word class and commonality of response (the percentage of the most popular responses provided).

Similarly to the results of previous studies, the results showed that with age, the paradigmatic associations increased (e.g., noun in response to noun, and adjective in response to adjective). Nevertheless, the number of paradigmatic responses that the college students gave to the nouns and high-frequency verbs was lower than that produced by the fifth grade students. An increase in the paradigmatic responses was observed for the categories of less common verbs, adverbs and pronouns. Entwisle (1966) emphasised the importance of word class and frequency on the children and adults' word associations. Entwisle (1966) further explained that the sharp increase in the number of paradigmatic associations for the less common verbs, adverbs, and pronouns is attributable to the fact that these word classes are in the process of consolidation for children aged 11-12, while nouns and high-frequency verbs consolidate in the ML earlier.

Additionally, comparing the responses of the fifth grade and college students, the syntagmatic associations rose for some word classes. The college students gave more verb and adjective responses to nouns than the fifth grade students. They also provided more adverb responses to the verbs. Further, the decrease in the paradigmatic associations for the nouns and high-frequency words indicated an increase in the number of syntagmatic associations. Entwisle (1966) argued that the nature of syntagmatic associations in children's responses differed from that of adults. Adults' syntagmatic associations were of a different genre.

> . . . these so-called adult syntactics are of a different genre from the early syntactics based on grammatical continuity. They are enlargements in meaning, a more flexible and richer interpretation of a concept. Thus, *bright* appears in response to *colour*, and *yellow* appears in response to *butterfly* for adults. The meaning of a word is interpreted less rigidly and the associative structure seems to be undergoing an enrichment process. (Entwisle, 1966, p. 74)

Entwisle (1966) discussed the findings concerning the sequence of development for word associations, word class, and the exposure to words (word frequency). As the associations develop, words first elicit a noun, second a syntagmatic association, third a paradigmatic association, and last a different syntagmatic association. The associations are not a function of age. Nor is it the case that 6-8 year old children provide more syntagmatic associations than older children. At any age, all these associations are available for different words. Development of the paradigmatic associations does not start for all the words in the ML at the same time either. The word class of the stimulus word affects the associations. Even within

each word class, some words develop faster than others. The rate of development is ultimately influenced by exposure to the words.

The findings of Entwisle's (1966) study are relevant and important to the current study as Entwisle focuses on the three types of associations (paradigmatic, syntagmatic, and phonological) in child L2 and L1, and the changes which occur with age in the associations. Entwisle's findings also contradicted those of previous research (Brown & Berko, 1960; Ervin, 1961) relating to syntagmatic associations. Previous research demonstrated a decline in the number of syntagmatic associations that occurs with age, but Entwisle's (1966) study showed that college students offered more syntagmatic associations than fifth grade students. The current study sheds light on syntagmatic associations in child L2 and L1 and the impact of age on the associations.

2.3.1.4. Palermo (1971)

Another study with similar research purposes and methodology to the above-mentioned studies is Palermo's (1971) study. This study also reported similar findings to previous research in terms of the paradigmatic associations. Palermo (1971) focused on the effect of age on the associations of children and employed 50 boys and 50 girls from each of the first to fourth grades in primary school. A WAT containing 95 stimulus words was administered to the children. The high-frequency stimulus words were selected from the Palermo and Jenkins List (1964) representing different word classes. It was administered using the aural-oral method (see section 3.1).

Concerning the paradigmatic associations, the findings of Palermo's (1971) study supported those of Brown and Berko's (1960), Ervin's (1961), and Entwisle's (1966) studies. With age, the number of paradigmatic responses increased. Nevertheless, the participants gave more paradigmatic responses to the nouns. The adjectives and pronouns elicited fewer, and adverbs, verbs, and prepositions elicited the fewest paradigmatic responses. Also with age, the contrast and superordinate responses rose.

Palermo (1971) linked the findings to those of her previous studies (e.g., Palermo, 1963; Palermo & Jenkins, 1963, cited in Palermo, 1971) and proposed the following development path for children's associations: With age, the number of paradigmatic associations and contrasts increases steadily from the first grade to college, and the superordinate associations rise from the first grade to sixth grade but decline thereafter. Based on the research on

children's cognitive development, the increase and decrease in the superordinate associations are due to the fact that around the age of 11-12, children understand the hierarchical organisation of language, and that understanding reveals itself in the paradigmatic associations and specifically the superordinate ones. Therefore, an increase is observed in the number of superordinate associations for children around the age of 11-12.

The strength of Palermo's (1971) research and its relevance to the present study is that it concentrated on the child L1 associations and the influence of age on children's associations. Nevertheless, it is noteworthy that Palermo (1971) separated the paradigmatic associations from the other categories such as the superordinates and contrasts. In Palermo's (1971) study, the paradigmatic associations referred to the responses with the same word class as the stimulus words like a response of noun to a noun. However, by definition, paradigmatic associations reflect the connections between words with the same word class but also close semantic relationship (see section 4.5.1.1). This includes the categories of superordinates and contrasts. Nevertheless, this separation does not affect our interpretation of Palermo's (1971) findings as in this study, the paradigmatic associations, superordinates, and contrasts increased collectively. Palermo's (1971) study therefore supports the claim that with age, the paradigmatic associations, including the superordinates and contrasts, increase.

2.3.1.5. Stolz and Tiffany (1972)

Stolz and Tiffany (1972) conducted a study with a different purpose from the previous research. Their study aimed to investigate whether the adults' responses to the unfamiliar stimulus words were similar to the children's responses to the familiar ones. The significance of this study is that it took both the frequency of the stimulus word and the familiarity of the participants with the stimulus words into account. Two hundred and twenty four undergraduate students (young adults) participated in their study. It is important to note that the participants of this study were not children rather they were young adults.

Similar to the WAT utilised in Entwisle's (1966) study which contained both high- and low-frequency words, the WAT in this study consisted of 27 frequent and 27 infrequent stimulus adjectives. A word familiarity test was also used for the 27 infrequent ones. There were five possible responses for each of the infrequent adjectives, one of which was the more frequent adjectives. The participants were asked to choose the response which was the closest to the meaning of the stimulus word.

The participants gave more paradigmatic and syntagmatic responses to the frequent words (67% paradigmatic and 25% syntagmatic) than the infrequent words (51% paradigmatic and 17% syntagmatic). In terms of the familiarity of the stimulus adjectives, the findings showed that the number of paradigmatic and syntagmatic associations was positively related to the familiarity of the stimulus words. The participants produced 43% paradigmatic and 21% syntagmatic associations to the familiar infrequent words. They gave 13% paradigmatic and 11% syntagmatic associations to the unfamiliar words. These results offered support to the hypothesis that the familiarity with and frequency of the stimulus words rather than the children's cognitive development determine their associations. Adults' responses to unfamiliar stimulus words were similar to the children's responses to familiar ones.

Stolz and Tiffany's (1972) research is important and interesting as it investigated the impact of the familiarity with and frequency of the stimulus words on the word associations. The current study also aims to discover the impact of these two variables, familiarity and frequency, on children's associations. Stolz and Tiffany' (1972) study provided evidence that the two variables affect children's word associations. Nevertheless, these findings do not necessarily indicate that the cognitive development of children and their age have no impact on the associations. In contrast, previous research (e.g., Brown & Berko, 1960; Ervin, 1961) demonstrated the impact of age on word associations and revealed that with age, the number of paradigmatic associations increased even for high-frequency words that were familiar to the children (e.g., Palermo 1971).

2.3.1.6. Summary

The findings of research investigating the associations of child and adult L1 have mostly revealed that child associations differ from adult associations. Children have a tendency to provide more syntagmatic and phonological associations, while adults produce more paradigmatic associations. For example, in Brown and Berko's (1960) study, children demonstrated a tendency towards heterogeneous by part of speech (syntagmatic) associations, but adults produced more homogeneous (paradigmatic) ones. Further, Ervin's (1961) study showed that with age, the number of paradigmatic associations increased whereas the number of syntagmatic and phonological associations declined. Therefore, the syntagmatic and phonological associations play more dominant roles in the organisation of words in child L1

ML, while the paradigmatic associations are more dominant in the organisation of words in adult L1 ML.

The increase in the number of paradigmatic associations and the decline in the number of syntagmatic and phonological associations have been explained differently in different studies. Brown and Berko (1960) argued that as children grow older, their experience with words belonging to the same part of speech increases. Thus, they organise their vocabulary into the parts of speech of the words (see section 2.3.1.1). Ervin (1961), however, discussed the results concerning the contextual similarity of words. With age, children's experience with words appearing in the same position in a sentence increases. Thus, the number of paradigmatic associations rises and the number of competing syntagmatic and phonological associations falls (see section 2.3.1.2).

The impact of word class and frequency of words on word associations was demonstrated in Entwisle's (1966) study. She argued that words first elicit a noun, second a syntagmatic association, third a paradigmatic association, and last a different syntagmatic association. Additionally, each word class has a different development, and within each word class, some words develop faster than others depending on the exposure of the individual to the words (see section 2.3.1.3). Stolz and Tiffany (1972) linked the results to the familiarity with and frequency of the stimulus words. As words become more familiar, they elicit more paradigmatic and syntagmatic associations (see section 2.3.1.5).

Even though all of the above-mentioned studies revealed that children provide more syntagmatic and phonological associations, and adults have a tendency towards paradigmatic associations, these studies presented contradictory findings for the syntagmatic associations. The studies of Brown and Berko (1960), Ervin (1960), and Palermo (1970) showed that with age, the number of syntagmatic associations steadily declined. In contrast, Entwisle's (1966) study revealed that with age, the number of syntagmatic associations increased as college students gave more verb and adjective responses to the nouns and more adverbs to the verbs than fifth grade students. The current study investigates the word associations of child L2 and L1. As such, the results shed light on the word associations of children including the syntagmatic associations.

In addition to the paradigmatic and syntagmatic associations as the main types of associations, the phonological (clang) associations have also been observed in child L1 responses in previous research. Nevertheless, the phonological associations and their trend of

development have not received as much attention as they deserve. Not all the studies investigating children's associations paid enough attention to the existence and development of phonological association. Evidence from the few studies which considered phonological associations (e.g., Ervin, 1961) suggests that children give more phonological associations than adults. Therefore, phonological associations play more dominant roles in the organisation of words in child L1 ML. Research also suggests that with age and increase in the number of paradigmatic associations, the phonological associations decline (Ervin, 1961). The current study focuses on the three types of associations (paradigmatic, syntagmatic, and phonological) and thus contributes to existing research on phonological associations in children.

2.3.2. Word associations in adult L2

Studies which have investigated the word associations of adult L2 have mostly employed L2 participants who learned their L2 later in life and differed from each other in terms of their language proficiency levels. This section presents empirical studies on the word associations of adult L2 and native speakers. As the present study addresses different aspects of each study, the research purposes, methodology, findings, and discussions of the studies are covered. This is followed by a summary of the main findings.

2.3.2.1. Meara (1982, 1983, & 1984)

Meara's (1983) study aimed to investigate whether the word associations of adult L2 learners were similar to the word associations of children learning their L1 or whether they simply resembled the word associations of adult L1. Meara (1983) conducted his study on 76 native speakers of English who were learning French. These students were moderately proficient in French. The stimulus words were the French translations of the 100 words in the Kent-Rosanoff List (1910). This study compared the three most frequent actual responses of the L2 learners to the French native speakers' norm responses.

A large number of the responses that the adult L2 learners provided to the words on the WAT did not exist on the French norm list. A large number of these responses were the French translation of the corresponding English primary responses. There were also phonological responses produced by this group.

Meara (1982, 1984) stated that the L2 learners provide associations which are less stable, more varied, and less predictable than the L1 associations. L2 associations are less stable as the L2 learners' responses to the same stimulus words change from one week to another. L2 associations are more varied and less predictable as the actual responses given by the L2 learners do not resemble the L1 actual responses. The L2 learners also produce a large number of phonological responses. Meara (1982) further noted that "the semantic links between words in the learners' mental lexicon are fairly tenuous ones, easily overridden by phonological similarities, in a way that is very uncharacteristic of native speakers" (p. 32).

Although this study revealed differences between the actual responses of the English learners of French and the French norm list, it did not cover the types of associations (paradigmatic, syntagmatic, and phonological) which exist among words. Recent research comparing the word associations of adult native speakers revealed that even the responses of adult native speakers to the same stimulus words are not homogeneous and are unpredictable (Fitzpatrick, 2009). Therefore, comparing the responses of L2 learners to a norm list of associations may not be the best way of addressing the possible discrepancies between the L2 and L1 word associations. As such, the present study focuses on the types of associations rather than the actual words that the L2 learners provide.

2.3.2.2. Riegel and Zivian (1972)

Riegel and Zivian (1972) took a similar approach towards the word associations of adult L2 and compared the actual L2 and L1 responses rather than the type of association between the stimulus word and response. Riegel and Zivian (1972) carried out their study to ascertain whether the response variability of the language learners was influenced by their vocabulary size. They hypothesised that as language learners possess only a small vocabulary, their responses to the stimulus words are less variable than the responses of the native speakers who possess a large vocabulary.

Fourteen native speakers of English who were learning German as their L2 took part in this study. The participants had between one to five years of formal training in German through high school and college education. A WAT containing 40 words from high-, mid-, and low-frequency ranges was administered to the participants. This WAT contained the following combination of words:

- English (the L1) stimulus word — English (the L1) response
- English (the L1) stimulus word — German (the L2) response
- German (the L2) stimulus word — English (the L1) response
- German (the L2) stimulus word — German (the L2) response

The findings showed that the German (the L2) stimulus words and the German (the L2) responses were more variable and less predictable compared to the English (the L1) stimulus words and English (the L1) responses. Although the L2 vocabulary was smaller than the L1 vocabulary, the response variability was higher in the L2. Riegel and Zivian (1972) argued that it is the response preference of the participants rather than the size of their vocabulary which determines the predictability of responses. In other words, the connection among words is a more powerful factor than the size of their vocabulary in the responses provided by the L2 learners to stimulus words.

Riegel and Zivian (1972) hypothesised that the responses of the L2 learners to the stimulus words are less variable than those of the native speakers as they possess only small vocabularies. In contrast, the smaller vocabularies of the L2 learners may in fact lend explanation to the response variability rather than its stability. The L2 learners have smaller vocabularies, but their vocabularies grow as new words enter the L2 ML. New words entering the L2 ML develop connections with the existing words. This process of increase in the size of vocabulary and the development of connections continues. Therefore, it is possible that this property of the L2 ML (its constant growth and change) in fact causes variability in the word associations rather than stability. The current study sheds light on this argument as it investigates the impact that each dimension of the ML (such as vocabulary size) has on the other dimensions (such as associations).

2.3.2.3. Politzer (1978)

In contrast to the studies mentioned above (Meara, 1983; Riegel & Zivian, 1972) which focused on the actual responses that the L2 learners provided, Politzer's (1978) study focused on the types of associations existing among words in the L2 ML. This approach to word associations distinguishes this study from the previous research.

Politzer (1978) conducted a study on 203 first year high school students learning French as their L2. One of the purposes of this study was to identify the ratio of paradigmatic to

syntagmatic associations in the L2 (French) compared to the L1 (English). First, the participants were asked to respond to 20 French words with the first French word which came to their mind. Second, the English equivalents of the French words were given to the participants, and they were required to respond in English.

The participants provided more paradigmatic associations and fewer phonological associations and no-response items in English (the L1) than in French (the L2). Politzer (1978) discussed the results in terms of the teaching methods applied in schools to teach the L2 and the effect of the teaching method on the word associations. He argued that the L2 learners of French were taught the French translation of the English paradigmatic responses. In other words, they knew the French words with the paradigmatic associations with the stimulus words. Despite that, they chose syntagmatic responses. As dialogues are used intensively in L2 teaching, they may help to establish the syntagmatic associations in the L2 ML. Politzer (1978) further pointed out that the paradigmatic associations are formed through the use of repetition drill activities in grammar and writing, while the syntagmatic associations are formed through the use of dialogues in listening and speaking.

2.3.2.4. Sokmen (1993)

Sokmen's (1993) study aimed to explore the way words are clustered in the ML of the L2 learners. The participants of her study comprised 198 ESL learners including beginner (N = 92), intermediate (N = 59), and advanced students (N = 47). The beginners were in the first or second quarter of their ESL studies, and the intermediate students were in the third quarter. There were both male and female participants aged 20-30 from Japanese, Chinese, Arabic, Korean, and other language backgrounds.

As in the earlier studies (e.g., Meara, 1983; Palermo, 1971), a WAT was administered to the participants. It included 50 stimulus words which were selected from the Kent-Rosanoff List (1910) on the basis that they were easy enough for beginners to respond to. The stimulus words were presented to the whole class orally, and the participants responded on paper (aural-written method, see section 3.1).

The responses were classified according to their word class, part of speech, and popularity. In this study, word class included supra/subordinate classification, synonyms, coordinates, contrasts, and collocations. Additionally, three other classes were created for responses which

would not fit in any of the other classes: nonsense (when the relationship between the response and the stimulus word could not be determined), word forms (associations such as *sickness* and *sick*, *deep* and *depth*), and affective. According to Sokmen (1993), the ". . . affective category was necessary for associations which showed a visual image, an opinion, an emotional response, or a personal past experience" (p. 139), such as *table* and *study*, *dark* and *scared*, and *sickness* and *hospital*. Parts of speech included nouns, adjectives, and verbs. Popularity referred to the top three popular responses that the participants provided to each stimulus word. The ESL students' responses were compared to the Minnesota Word Associations Norms (Postman & Keppel, 1970).

The noun stimulus words usually elicited nouns (paradigmatic responses), but the verbs and adjectives usually elicited syntagmatic responses. Both groups of the ESL students responded with the following top three word combinations: noun-noun (68.36%), adjective-noun (61.45%), and verb-noun (59.32%). The ESL students also put forward a large number of affective responses (4,284), collocations (1,540), coordinates (839), contrasts (1,157), and supra/subordinate classifications (652). The beginners provided more contrasts and nonsense responses, and fewer collocations and verbs. The advanced students gave fewer contrasts but more affective responses, collocations, and verbs. Ninety percent of the most popular responses of the ESL learners were similar to those of the native speakers.

Sokmen (1993) explained that as the proficiency of the ESL learners increases, the words cluster around the verbs and collocations. In contrast, in the case of ESL learners with lower proficiency, the words tend to cluster around contrasts or nonsense associations. Also with the increase in the proficiency, the affective connections rise in the ML to make the words more memorable.

This study is interesting in the sense that it investigated the affective connections among words. This is an aspect which has not received much attention. However, the definition for the affective responses can be subjective. Sokmen (1993) categorised responses which showed a visual image, an opinion, an emotional response, or a personal past experience as affective, for example *sickness* and *hospital* or *table* and *study*. In contrast, the response of *sickness* to the stimulus word *hospital* can be categorised as paradigmatic, or the response of *study* to the stimulus word *table* can be categorised as either syntagmatic or paradigmatic. Therefore, the subjectivity of the affective responses impacts the categorisation of responses.

2.3.2.5. Soderman (1993)

Another study was conducted by Soderman (1993) which aimed to investigate the effect of proficiency (Experiment 1) and frequency of words (Experiment 2) on the associations of EFL learners. In contrast to Sokmen's (1993) study which revealed discrepancies among ESL students with different proficiency levels, this study demonstrated a high level of similarity among them. The participants of Experiment 1 were students from educational institutions in Finland and Sweden with four levels of proficiency.

- Group 1 (N = 28) comprised 13-14 year old students at the seventh grade of a Finnish comprehensive school[1]. They had been learning English for three years.
- Group 2 (N = 28) consisted of 17-18 year old students of a gymnasium[2]. They had been learning English for nearly 7 years.
- Group 3 (N = 28) comprised students aged 20 studying at the Abo Akademi University. These students had passed the matriculation test[3] in English.
- Group 4 (N = 28) consisted of the advanced students of English who had been studying English as the main subject at the Abo Akademi University for an average of 4.5 years.

Similar to the Sokmen's (1993) and Entwisle's (1966) studies, the WAT administered in Experiment 1 contained words from the Kent-Rosanoff List (1910) and was given to the students using the written-written method (see section 3.1). The findings of Experiment 1 revealed that the paradigmatic and syntagmatic associations were the dominant types of associations for all the participants. However, with an increase in proficiency, the number of paradigmatic associations increased and the number of syntagmatic, phonological, and other associations declined.

The proportion of paradigmatic responses for the four groups was 50.4%, 58.0%, 58.4%, and 62.0% respectively. However, there was no statistically significant difference between the three higher proficiency groups in the paradigmatic associations. Only the difference between the seventh grade students and the other groups was statistically significant. As proficiency increased, the proportion of syntagmatic associations decreased. However, there was no statistically significant difference observed among the four groups. Also, as proficiency

[1] A comprehensive school is a state school that does not select students on the basis of academic achievement.
[2] A gymnasium is a type of school which provides advanced secondary education in some parts of Europe.
[3] A matriculation test is a university entry test which reflects students' eligibility to enter university.

increased, the proportion of phonological responses dropped. However, this was only observed for the three more proficient groups and not for the seventh grade students. The seventh grade students provided fewer phonological responses compared to the other groups.

Based on the findings of research focusing on the impact of the frequency of the stimulus words on the word associations, the high level of similarity observed in the word associations of the L2 learners from various ages and proficiency levels could possibly be attributable to the frequency of the stimulus words utilised in Soderman's (1993) study. In this study, the Kent-Rosanoff List (1910) was used which only contains high-frequency stimulus words (see section 3.1.3.1.1). In order to investigate the effect of word frequency on the associations, Experiment 2 was conducted. In this experiment, both frequent and infrequent stimulus words were used. The WAT was administered only to the native speakers and advanced language learners.

Experiment 2 showed that the proportion of paradigmatic associations was higher for the frequent words for both the native and nonnative groups. The native speakers provided 62.7% paradigmatic responses for the frequent words and 44.3% for the infrequent words. The nonnative speakers gave 52.6% paradigmatic responses for the frequent words and 30.3% for the infrequent words. Statistical analysis yielded a main effect for the word frequency but not for the group (native or nonnative speakers). Therefore, Soderman (1993) argued that the familiarity with the stimulus word (defined by word frequency) rather than the proficiency level and language background of the participants determines the type of associations.

Soderman (1993) suggested that individual words in the ML develop from a stage where they elicit phonological and nonsense responses to a stage where they elicit more syntagmatic and paradigmatic associations. Individual words also have different rates of development. This is supported by the evidence that even the advanced L2 learners of Soderman's (1993) study produced a large number of syntagmatic and phonological associations. Additionally, the seventh grade students provided a large number of paradigmatic associations. As neither the native speakers nor the advanced language learners showed a clear preference for any of the association types, Soderman (1993) suggested that the higher levels of lexical organisation may not be represented by only paradigmatic associations but by both syntagmatic and paradigmatic associations. She explained that syntagmatic associations also require a high level of lexical knowledge.

The results of this study are of importance and relevance to the purposes of the current study as they demonstrated the impact of word frequency on word associations. Additionally, Soderman (1993) presented an insightful interpretation of the findings that the higher levels of lexical organisation may not be represented by only paradigmatic associations but by both syntagmatic and paradigmatic associations. As the syntagmatic associations also require a high level of lexical knowledge. This explanation is in line with Cruse's (2011) classification of the sense relations. He emphasises the importance of syntagmatic associations as one of the main types of sense relations. As the syntagmatic associations exist among words which sit in a phrase or sentence together (see section 4.5.1.1), it is through this type of associations that sentences make sense.

2.3.2.6. Wolter (2001)

Unlike Soderman (1993, Experiment 1) who used the high-frequency stimulus words in the WAT and observed a high degree of similarity between the response patterns of both L2 learners and native speakers, Wolter (2001) employed both high- and low-frequency words and reported contradictory findings. Wolter (2001) conducted a study to provide evidence for his hypothesis that the L2 and L1 ML are structurally similar. It is the depth of word knowledge (how well words are known) which plays an important role in the type of association that one word establishes with other words in the L2 ML.

Thirteen nonnative speakers (native speakers of Japanese) and nine native speakers of English participated in this study. The nonnative speakers were undergraduate and graduate university students, ESL teachers, and others. They had obtained a score of at least 500 on the TOEFL[4] test. The native speakers were from different cultural backgrounds and of different ages. They all had undergraduate or postgraduate degrees. Similarly to Soderman (1993, Experiment 2), Wolter (2001) employed both high- and low-frequency words in the construct of WAT. The stimulus words were selected from the COBUILD bank of the English corpus. List 1 contained 48 stimulus words from the 1k[5] to 9k frequency ranges (higher frequency words). This was administered to both native and nonnative speakers. List 2 contained 48 words from the 9k to 39k (8,500-39,150) frequency ranges (lower frequency words). Only the native speakers responded to the words on List 2. There was also a word familiarity task utilised in

[4] TOEFL is Test of English as a Foreign Language that nonnative speakers of English take before they can study at English speaking colleges and universities.
[5] K refers to 1000. Therefore, 9k means 9000 frequency range.

this study. The participants were required to score each stimulus word on List 1 and List 2 on a 4-point familiarity scale, 1 being unknown and 4 being well-known.

In contrast to Sokmen's (1993) study which reported a high degree of similarity between the native and nonnative groups, the native speakers of this study provided more paradigmatic and syntagmatic associations, and fewer phonological responses to the stimulus words on List 1 (higher frequency words) than the nonnative speakers. Interestingly, for the lower frequency stimulus words on List 2, the native speakers gave fewer paradigmatic and syntagmatic responses but more phonological associations. For the lower frequency words, the expected increase in the number of phonological and unclassifiable responses was observed but the expected increase in the number of syntagmatic responses was not.

The native and nonnative speakers produced reverse results in terms of familiarity with the stimulus words. For the familiar words, the native speakers gave more paradigmatic associations (48.9% compared to 39.8% for the syntagmatic associations), while the nonnative speakers produced more syntagmatic associations (54.1% compared to 35.4% for the paradigmatic associations). Nevertheless, the L2 and L1 ML seemed similar in terms of the less-known words as both groups provided more phonological associations, other responses, and no-response items.

Wolter (2001) explained the findings concerning the breadth (vocabulary size) and depth (how well words are known) of word knowledge. When an individual is asked for a response to a stimulus word, the competing responses can have paradigmatic, syntagmatic, or phonological associations with the stimulus word. The native speaker selects a word with paradigmatic association with the stimulus word, as the native speakers have a large number of possible responses (synonyms, antonyms, etc.) at their disposal. In contrast, the nonnative speaker gives a word with syntagmatic association with the stimulus word. Wolter (2001) further argued that this may have nothing to do with the lexical development of the ML. Rather it may be attributable to the fact that the native speakers have a larger number of words in their ML.

Similarly to the Stolz and Tiffany (1972) study, this study focused on the impact of familiarity with and frequency of the stimulus words on word associations. Therefore, it is of great importance to the present study. Even though the impact of the two variables on the word associations has been investigated previously (e.g., Soderman, 1993; Stolz & Tiffany, 1972), this study is distinctive. It is distinctive in terms of the word frequency as the stimulus

words were selected from an up-to-date word list with frequency information (COBUILD bank of the English corpus). This research also differs from previous research in terms of familiarity with the stimulus words as the participants themselves expressed their degree of familiarity with the stimulus words on a 4-point familiarity scale. As a result, two sets of findings were reported taking the familiarity with and frequency of the stimulus words into account separately.

2.3.2.7. Fitzpatrick (2006) and Racine (2012)

Fitzpatrick (2006) aimed to compare the nonnative and native speakers' associations in the ML and to investigate whether the language proficiency of the nonnative speakers affects their associations. Fitzpatrick's (2006) study is a step forward in association studies as she classified the participants' responses into the smaller subcategories according to the participants' explanations in the interview.

The participants in Fitzpatrick's (2006) study were 40 native and 40 nonnative speakers of English from various L1 backgrounds. They were exposed to academic English at undergraduate and/or postgraduate university levels. The nonnative participants had gained entry to university for either an undergraduate or a postgraduate degree. They had obtained a mean score of 6,614 on the Eurocentres Vocabulary Size Test (Meara & Jones, 1990) which was approximately equal to an IELTS score of 6.6.

The method used in the Fitzpatrick (2006) study involved the use of stimulus words selected from the Academic Word List (Coxhead, 2000). Words from varying frequencies and word classes were chosen, but very high-frequency words were excluded. The WAT was administered to the participants using the written-written method (see section 3.1). After completing the WAT, each participant was interviewed to explain why they provided their particular responses. A new set of categories was used to classify the participants' responses: meaning-based (equivalent of paradigmatic), position-based (equivalent of syntagmatic), and form-based (equivalent of phonological) associations. Each category was further divided into smaller subcategories. The response classification was made based on the participants' explanation in the interview.

Contrary to the findings of Wolter's (2001) study which demonstrated the native speakers' tendency towards paradigmatic associations and the nonnative speakers' tendency for

syntagmatic ones, in this study, both the native and nonnative groups provided more meaning-based responses (paradigmatic associations). The nonnative speakers gave slightly more meaning-based associations than the native speakers, but the difference between the two groups was statistically nonsignificant. Also, the native speakers produced more position-based associations while the nonnative speakers gave more form-based associations.

There was no correlation between the nonnative participants' proficiency levels (indicated by the size of their vocabulary) and their word associations for the main categories. Nor was there any evidence indicating that with the increase in language proficiency, the nonnative speakers' associations move towards nativelike associations.

In terms of the higher number of position-based associations, Fitzpatrick (2006) argued that the lack of collocations (one type of position-based association which was higher in the native speakers' responses) in the nonnative speakers' responses was not caused by the absence of certain words in the L2 ML. The native speakers' responses were likely to be known by the nonnative speakers, as they were not less frequent or more difficult than the nonnative speakers' responses. Thus, the lack of collocations was more likely to be caused by the absence or weakness of certain lexical connections in the L2 ML. Fitzpatrick (2006) concluded that the L2 and the L1 ML are fundamentally (qualitatively) different from each other. As such, as the language proficiency increased, the L2 ML did not become more like the ML of native speakers.

The second study, Racine (2012), replicated Fitzpatrick's (2006) study and reported similar findings. He conducted a study on 40 native and 40 nonnative speakers of English. The native speakers were students and staff at a UK university. The nonnative speakers were students and staff of a university in Japan. There is no information on the nonnative participants in terms of level of English language proficiency or their length of exposure to English. The stimulus words were identical to those chosen by Fitzpatrick (2006), Academic Word List (Coxhead, 2000).

The studies of both Fitzpatrick (2006) and Racine (2012) are very informative as the main three association categories (meaning-based, position-based, and form-based) are further divided into smaller subcategories. Nevertheless, each subcategory requires a sufficient amount of data in order for the findings to be statistically valid. This applies specifically to the meaning-based and position-based categories as they are divided into six and five subcategories respectively. In order to have sufficient data for each subcategory, a large

number of informants is required. Additionally, special attention needs to be paid to choose stimulus words which potentially elicit responses in the smaller subcategories. The participants of the current study are school-aged children. There is a small number of them in each group (N = 25-30) as it was difficult to gain access to many of them within the time limits of the study. Therefore, the current study does not divide the main three association categories into the smaller subcategories.

2.3.2.8. Nissen and Henriksen (2006)

Nissen and Henriksen (2006) conducted a study to investigate the L2 word associations and to determine the impact of word class on word associations. They hypothesised that the L2 students have more syntagmatic associations among words in the ML, while the L1 students have more paradigmatic associations. They also hypothesised that nouns elicit more paradigmatic associations, while verbs and adjectives elicit more syntagmatic associations. This study was carried out on 25 native speakers of Danish aged 17-19 who had been learning English as their L2 for seven to eight years.

This study utilised a WAT containing high frequency words from the Nation's Vocabulary Levels Test. These words were from 2000 and 3000 word frequency levels. Ninety words from three word classes of nouns, verbs, and adjectives were chosen. The WAT was administered in both Danish (L1) and English (L2). The Danish stimulus words were the translation of the English words.

The findings of this study revealed that somehow surprisingly, both the L2 and L1 participants provided more syntagmatic associations than paradigmatic ones. The participants provided 54% syntagmatic associations in the L1 and 46% syntagmatic associations in the L2, while they gave 32.8% paradigmatic associations in the L1 and 22.5% paradigmatic associations in the L2. As the results show, the number of paradigmatic and syntagmatic associations was higher in the L1 than in the L2. Statistical analysis also yielded significant differences between the two groups. Generally, nouns elicited more paradigmatic associations, and verbs and adjectives elicited more syntagmatic associations. Despite that, in the L1, nouns elicited a similar number of paradigmatic (43.9%) and syntagmatic associations (43.5%), while in the L2, nouns and verbs elicited a similar number of syntagmatic associations, nouns 43% and verbs 43.6%.

The findings of this study did not support the findings of previous research in terms of syntagmatic associations. The authors attributed the contradictory findings to the methodological difference between their study and previous research, notion of late syntagmatic associations, and word class influence on the word associations. Nissen and Henriksen (2006) noted that their study utilised words from three word classes of nouns (N = 30), verbs (N = 30), and adjectives (N = 30). As a result, due to the larger number of stimulus words in the two categories of verbs and adjectives (N = 60), the stimulus words used in this study elicited more syntagmatic associations than previous studies which mostly used nouns as their stimulus words (e.g., Soderman, 1993). Nevertheless, this explanation may not apply to other studies which used words from various word classes, yet paradigmatic associations were higher than syntagmatic ones in L1 (e.g., Wolter, 2001).

The findings were also explained in terms of the influence of word class on the word associations. Nissen and Henriksen (2006) explained that nouns may be assumed to be more highly integrated into the ML. One reason is that their meaning is often more clearly defined and less abstract than the meaning of verbs and adjectives. Therefore, they are possibly more integrated into the ML and consolidated in the word web. Verbs cannot be clearly defined, and they are often polysemantic. As such, adjectives and verbs present more cognitive challenges for children than nouns. If paradigmatic associations reflect a higher degree of word knowledge, then, it is not surprising that verbs and adjectives result in more syntagmatic associations, and nouns result in more paradigmatic associations. Although this explanation is valid, the stimulus nouns used in this study had more abstract meaning than concrete, such as *pride*, *opportunity*, *dignity*, *solution*, and *charity*. Additionally, although verbs and nouns may present more cognitive challenges to children, it does not seem to be the case for young adults as they have already had the concepts in their mind from their first language. It is also important to note that this study only utilised high-frequency words in the 2k and 3k frequency ranges, words which are used frequently in the linguistics environment and are likely to be well-known by both L2 and L1 participants. These findings cannot be generalised to a large number of words in the ML, including words from different frequency ranges and different degrees of familiarity for the participants.

2.3.2.9. Zareva (2007)

Unlike Fitzpatrick's (2006) study which suggested that the L2 ML is fundamentally (qualitatively) different from the L1 ML, and Wolter's (2001) study which revealed

discrepancies between the L2 and L1 ML in terms of familiar words, Zareva's (2007) study demonstrated that the discrepancies between the L2 and L1 ML were quantitative (difference in vocabulary size). Zareva (2007) used high-frequency stimulus words in order to investigate the effect of language proficiency on the organisation of words in the L2 ML from both quantitative and qualitative perspectives. The participants were 87 adults including 29 native speakers of English and 58 EFL/ESL learners. The native speakers were undergraduate students enrolled in an introductory linguistics course. The EFL/ESL learners were from different L1 backgrounds undertaking an ESL or a university course in the US or Europe. They were divided into intermediate and advanced groups based on their scores on the Cambridge Certificate in Advanced English (CAE) and TOEFL tests.

As with the other studies investigating word associations, a WAT was employed in this study containing 73 stimulus words from the Hornby Learner's Dictionary (1978). Each stimulus word was accompanied by a word familiarity test. As shown below, the participants had four levels of familiarity to choose from.

1) I *have not seen* this word before.
2) I *have seen* this word before, but I don't remember what it means.
3) I *think* this word means ---- [provide a synonym or brief explanation].
4) I *know* that this word means ---- [provide a synonym or brief explanation].

If the participants expressed their familiarity with the stimulus word in number 3 and 4, they were required to answer number 5 and provide three associations for the stimulus word.

5) I *associate* this word with ----, ----, and ---- (p. 133).

The quantitative aspects of the participants' responses were analysed by considering the total number of responses, response commonality (how popular the individuals' responses were among all responses produced), and response heterogeneity. The qualitative aspects of the participants' responses were examined with reference to the proportion of paradigmatic, syntagmatic, and phonological responses to the WAT.

Contrary to the Fitzpatrick (2006) study which revealed qualitative differences between the L2 and L1 ML, this study showed that the quantitative characteristics of the L2 ML were different from those of the L1 ML. There were statistically significant differences among the three groups in terms of the total number of responses, response commonality, and response

heterogeneity. The intermediate students provided significantly fewer responses, fewer common responses, and had lower heterogeneity than the other two groups. Despite the differences between the intermediate participants and the other groups, there was no statistically significant difference between the qualitative features of the advanced learners' and the native speakers' ML. Nor were there qualitative differences between the word associations of the intermediate and advanced language learners and those of the native speakers. All three groups produced more paradigmatic associations than syntagmatic associations. The native speakers gave the most paradigmatic associations and the fewest syntagmatic associations. The intermediate group gave the fewest paradigmatic associations and the most syntagmatic associations. No phonological responses were observed in any of the groups' responses.

Zareva (2007) drew the conclusion that:

> . . . smaller vocabulary sizes are characterized by fewer links among words, a lower degree of commonality and lesser heterogeneity of meaning connections. Overall, these features create the impression that the intermediate learners' lexicons are relatively loosely connected since their quantitative characteristics do not point to the strong and systematic interrelatedness among familiar words found for the native speakers and the advanced learners' lexicons . . . Language users with larger vocabularies have considerably richer connections, both in size, commonality, and heterogeneity (pp. 144-5).

This study is subject to the same line of praise and criticism as mentioned before. It is subject to praise as the participants of the study expressed their familiarity with the stimulus words in a separate task. Therefore, the degree of familiarity with the stimulus words was determined by each participant rather than by an educated guess that certain words were likely to be known by the language learners of a certain proficiency level. This study is subject to criticism as it only used high-frequency stimulus words which were known by both the intermediate and advanced L2 learners. As a result, the findings are only generalisable to the high-frequency words not words from various frequency ranges including medium- and low-frequency ones. Despite that, this is an important study, relevant to the purposes of the current study as it focused on the types of associations (paradigmatic, syntagmatic, and phonological) in adult L1. Further, in contrast to previous research, this study demonstrated that the difference between the L2 and L1 ML is quantitative rather than qualitative.

2.3.2.10. Fitzpatrick and Izura (2011)

Fitzpatrick and Izura (2011) conducted a study to investigate whether a) the L2 participants produced some response types (associations) more often and more quickly than others; b) the L2 participants' response time profiles mirrored those of the L1 participants'; c) the L2 word associations were mediated through the L1 and modulated by the L2 participants' proficiency level.

Native speakers of Spanish (N = 24) who started learning English as an L2 at an average age of 9 years old participated in this study. They were an average age of 26 years old and were studying or working in the UK. A WAT containing 95 Spanish words (from Perez & Navalon, 2005) and 95 English words (from Bird, Franklin, & Howard, 2001) and an LDT containing 72 items, 36 Spanish real words and 36 invented words, were utilised. Real words were presented in two sets of 18 words. Set A comprised the stimulus words which were the English translation of the stimulus words. Set B contained nonprime words. The LDT was used in this study to determine whether L2 associations were mediated through L1. The participants completed the two WATs, one in their L2 and one in their L1, and the LDT. Both tasks were presented to the participants on the computer screen. For the WAT, when a stimulus word appeared on the computer screen, the participants had to type the first word which came to mind as fast as possible. For the LDT, an item appeared on the screen, and the participants pressed P if it was a real word, and Q if it was an invented word.

The participants' responses were divided into six categories of associations (see Fitzpatrick & Izura, 2011, pp. 383-4 for details). ANOVA yielded significant effect for language and word association category. The participants provided fewer responses to the L2 stimulus words than to the L1 stimulus swords. Significant differences were observed between the L2 and L1 in terms of the number of associations that the participants provided in form and meaning, form, meaning and collocation, collocation, and equivalent meaning associations. There was no association provided to the L1 words with a formal relationship to the stimulus word (phonological association). The proportion of collocation responses was also very low in the L2. Some categories such as nonequivalent meaning elicited more associations than other categories in both L2 and L1, higher in L1 than in L2, yet it took the participants the longest to produce it.

In terms of RT, the findings revealed a significant main effect for language. L1 responses were provided faster than L2 responses. Faster responses were also produced for some

categories than others. Associations which co-occurred in a language and had a meaning relation (meaning and collocation) and associations which had both meaning and formal associations were significantly faster than any other association categories. The RT was correlated with language proficiency. As vocabulary size increased, the difference between L2 and L1 decreased.

The uncontroversial findings of this study that the L2 responses were fewer in number and slower in access were related to the fact that perhaps due to the developmental nature on the L2 ML and its smaller vocabulary size, it takes longer to process words in the L2 than in the L1. With regards to the higher number of collocations in the L1, the findings of this study did not support the argument that the associations which co-occur in the spoken and written language are an index of an L2 lexicon in the early stages of development as these associations were higher in the L1 than in the L2. The higher number of form and form and meaning associations in the L2 was explained considering the revised hierarchical model (Kroll & Stewart, 1994). According to this model, at least at the first stages of learning, the L2 words have weak semantic connections to their meanings but strong connections to their L1 equivalents. This form-based activation could be a consequence of the state of development of the L2 lexicon.

The higher number of nonequivalent meaning associations in the L2 was explained in terms of the fact that the lexicosemantic organisation of words in the L1 may be based more on the general conceptual knowledge, e.g., *sheep* and *animal*, and be less constrained by the conventional use of language, e.g., *black* and *sheep*. One possible explanation for higher RT to nonequivalent meaning associations is that in activating a response for the stimulus word, more than one response may be activated. The time it takes to choose one response over others possibly explains the higher RT to nonequivalent meaning associations.

This is a more recent study which has a new approach to word associations and their classification. The categories utilised in this study are new and except in a few cases, the findings of this study are not comparable to those of other studies reviewed so far. In the case of form and form and meaning associations, the findings of Fitzpatrick and Izura (2011) study suggest that the formal resemblance among words plays a more dominant role in word storage in the L2 than in the L1. The most surprising finding here is that the equivalent meaning associations, which include synonyms, subordinates, and coordinates, are higher in the L2 than in the L1. Matching these associations with the traditional association types, these

associations fall under paradigmatic associations. The findings of previous studies revealed that paradigmatic associations were more dominant in word storage in the L1 than in the L2 (e.g., Wolter, 2001). Further investigation is required to shed light on these contradictory findings.

2.3.2.11. Summary

This section has reviewed empirical studies on adult L2 associations. The earlier studies (e.g., Meara, 1983; Riegel & Zivian, 1972) investigated the actual responses that the L2 adults gave to the stimulus words and focused on the variability and predictability of the L2 responses. These early studies showed that a large number of adult L2 responses did not exist on the L1 norm lists (Meara, 1983). Further, the word associations in the L2 were more variable and less predictable than those in the L1 (e.g., Riegel & Zivian, 1972).

In contrast, more recent studies investigated the types of associations existing among words in the L2 ML (e.g., Wolter, 2001; Zareva, 2007). However, they demonstrated contradictory findings concerning the adult L2 association types. These studies can be divided into two major groups. The first group supports the notion that the L2 ML of an adult differs qualitatively from the L1 ML of native speakers. Wolter's (2001) and Fitzpatrick's (2006) findings fit in this group. In Wolter's (2001) study, the response patterns of the L2 adults were different from those of the native speakers. The L2 adults demonstrated a tendency towards syntagmatic associations, while the native speakers produced more paradigmatic associations to familiar words. In contrast, the L2 adults in Fitzpatrick's (2006) study gave a similar number of meaning-based (paradigmatic) but fewer position-based (syntagmatic) associations than the native speakers. Fitzpatrick (2006) related the findings to the lack or weakness of certain connections among words. She concluded that the L2 ML is fundamentally different from the L1 ML regardless of the proficiency levels of the participants.

Unlike the first group of studies, the second group supports the notion that the L2 ML is fundamentally similar to the L1 ML. The discrepancies observed between the two are quantitative. Soderman's (1993, Experiment 1) and Zareva's (2007) studies are in this group. In Soderman's (1993, Experiment 1) study, the paradigmatic and syntagmatic associations were the dominant types of associations in the responses of both the native and nonnative participants. Similarly, in Zareva's (2007) study, both the native and nonnative speakers

produced similar number of paradigmatic and syntagmatic associations for the high-frequency stimulus words. It is also important to note that the participants of these studies including Fitzpatrick (2006) and Meara (1983) were not controlled for initial age of exposure to L2 or length of exposure to L2. As one of the purposes of the current study is to ascertain whether the L2 ML resembles the L1 ML in terms of associations, this study sheds light on the contradictory findings of previous research.

Additionally, there is a more recent study (e.g., Fitzpatrick & Izura, 2011) which has a new approach to word associations and their classification. The categories used in this study are new and except for a few cases, for example that the formal resemblance among words plays a more dominant role in word storage in the L2 than in the L1, the findings of this study are not comparable to the studies reviewed so far.

2.3.3. Word associations in child L2

Research on child L2 word associations is scarce in the literature. Except for the studies which are reviewed in this section, not much attention has been paid to L2 children's associations. Most of these studies did not focus on the type of association. They utilised WATs which measured the number of associations in L2 (see section 3.1.4). This section presents the empirical studies investigating the word associations of L2 children.

2.3.3.1. Vermeer (2001)

The primary aim of Vermeer's (2001) study was to investigate the relationship between the breadth (vocabulary size) and depth (how well words are known) of word knowledge (Experiment 1), and whether the two were influenced by the word frequency (Experiment 2). Although the primary purposes of this study differ from the purposes of the current study, the findings are relevant as they focus on the relationship between associations and vocabulary size. However, it is noteworthy that this study did not focus on the type of association in L2 children.

Vermeer (2001) carried out his study on 50 kindergarten students aged 5-6, 25 of whom spoke Dutch as their first language (DL1) and 25 of whom spoke Dutch as their second language (DL2). The DL2 children were second or third generation of immigrants to the Netherlands and spoke their L1 (Arabic or Turkish) at home.

In Experiment 1, breadth was measured using a receptive vocabulary test and a description task from TAK (Language Test for All Children), (Verhoeven & Vermeer, 2001 cited in Vermeer 2001). The receptive vocabulary test was a multiple choice one containing 96 words. The children were required to choose their response by pointing to one picture out of four. For the description task, the children were required to characterise, describe, or define 44 words. Depth of word knowledge was measured by means of a WAT. The WAT employed in this study was different from the way it is used in the research literature. Children were required to characterise the stimulus words by responding to the following questions: *What is a ---? What does a --- look like? What does a --- do?*

A qualitative approach was employed for the analysis of the data. An association network was built for each stimulus word based on the responses of the majority of the children. Their responses were then scored on a 4-point scale from 0 indicating an unknown word to 3 indicating a very detailed description. The DL1 children obtained higher scores on the breadth measures and provided more characteristics on the WAT than the DL2 children. Interestingly, for the characteristics of the stimulus words, the DL2 children demonstrated their responses in a nonverbal way as they lacked the necessary words to verbalise them. For example, they drew a picture of a bottle instead of verbally characterising it. There was no difference between the DL1 and DL2 children in terms of the association network built for each stimulus word. However, there was a significant positive correlation between the breadth and depth of word knowledge. This suggested that the L2 children would provide more detailed descriptions for each stimulus word if they knew more words.

Experiment 2 was carried out to discover whether the probability of knowing a word was influenced by its frequency of occurrence in primary school education. The receptive vocabulary test and the description task were administered to the DL1 and DL2 children aged 4 and 7. The DL1 children obtained higher scores than the DL2 children on the tasks. Further, children aged 7 did better than children aged 4 on both tasks. This study also demonstrated a significant correlation between the number of correct responses and the word frequency. Vermeer (2001) argued that the high correlation between the breadth and depth of word knowledge is attributed to the fact that words in the ML are interconnected nodes of a network, and the meaning of each word is specified by its connections to the other nodes. Therefore, the dense network around a word corresponds to larger vocabulary size. When a child knows more words, it is likely that s/he knows more about each word. The knowledge

of words depends on the cognitive ability to learn the words and the frequency of words. Words with higher frequency are learned earlier than the low-frequency words.

The significance of the Vermeer's (2001) study and its relevance to the purposes of the current study is that it focused on the word associations of the L2 children who learned their L2 in childhood (during the sensitive period for language learning), by undertaking mainstream education in the L2, and by living in the L2 country. Further, this study explored the impact of word frequency on the L2 word associations. It is also the aim of the current study to investigate the impact of age, environment, and word frequency on the word associations. As such, this study will be referred to for comparison purposes.

2.3.3.2. Namei 2004

Namei (2004) conducted a study to investigate the word associations of L2 school aged children and young adults. In this study, she hypothesised that a) the number of phonological associations is higher in students with lower proficiency levels irrespective of their language; b) paradigmatic associations are higher in all participants irrespective of language (this hypothesis is based on the fact that the stimulus words used in this study were common words); c) the L2 ML is similar to the L1 ML in terms of organisation: In the early stages, there are more formal associations among words, while in the advanced stages, words are connected to each other semantically.

The participants in this study were 100 Swedish-Persian bilinguals at grades 0, 3, 6, 9, and 10-12. The majority of participants considered Swedish to be their more advanced language. The Swedish comparison group included 50 participants. The Kent-Rosanoff List (1910) containing 71 nouns and 29 adjectives was used in this study, which makes the findings of this study subject to the same line of criticism as explained earlier. The test was administered orally to grade 0-9 students. Students at grade 10-12 completed the written WAT.

In terms of L2 (Swedish) associations, the findings of this study revealed that with age, the number of phonological associations declined (29, 12, 5, 1, 1); the number of syntagmatic associations mostly increased (30, 23, 32, 39, 42); and the number of paradigmatic associations increased before it declined (41, 65, 63, 60, 57). Similar trends were observed in the L1 (Swedish) of the control group. The number of phonological associations declined (33, 6, 2, 2, 0); the number of syntagmatic associations increased (19, 21, 23, 34, 37); and the number of paradigmatic associations increased before it declined (48, 73, 75, 64, 63). The

number of phonological associations is twice as high in the L2 than in the L1 for grade 3 and 6 students. The number of syntagmatic associations is higher in the L2 for all groups. The number of paradigmatic associations is higher in the L1 for all groups. Nevertheless, both groups provided more paradigmatic associations than other associations at all grades.

In terms of the number of phonological associations found in both L2 and L1, the conclusion was reached that the organisation of ML is initially phonological regardless of the language. There may also be a correlation between phonological associations and language proficiency. Nevertheless, as phonological associations also occur at higher grades, they may also be related to other factors such as the cultural familiarity with the words, the word knowledge, and level of abstractness. As the syntagmatic-paradigmatic shift occurred between ages 6-10 in both L2 and L1, the author suggested that the syntagmatic-paradigmatic shift might be a matter of cognitive development rather than language.

2.3.3.3. Schoonen and Verhallen (2008)

Similar findings to Vermeer's (2001) study were revealed in Schoonen and Verhallen's (2008) study relating to vocabulary size and the number of associations. The L1 group and older children of Schoonen and Verhallen's (2008) study had a larger vocabulary than the L2 group and younger children. They also provided more associations to the stimulus words than the L2 group and younger children. Nevertheless, Schoonen and Verhallen's (2008) study primarily aimed to design a new task to measure children's depth of word knowledge.

The participants in Schoonen and Verhallen (2008) study were 795 students in third grade (9 years old) and fifth grade (11-12 years old) comprising both DL1 and DL2 students. A simplified version of Read's (1993) WAT (see sections 3.1.4.1) was employed in this study. It contained 50 words including verbs, nouns, and adjectives. Stimulus words used in the WAT were selected on the basis of their familiarity from various Dutch frequency lists for educational purposes (e.g., Coenen & Vermeer, 1988; Schrooten & Vermeer, 1994; Van Gelderen, 1994 cited in Schoonen & Verhallen 2008). Students were presented with a stimulus word. Each stimulus word was surrounded by related and unrelated words. Students were required to choose three responses which were more closely related to the stimulus word than those which were related to the stimulus word in a more incidental and contextual way. The test score was the number of words for which the intended three associations were made.

The findings of this study revealed that the third grade students found the three closely associated words for half of the stimulus words while the fifth grade students found them for two thirds of the stimulus words. Statistical analysis yielded grade as a significant variable which counted for 25% of the variance for the participants' scores. In terms of language background, Dutch and Frisian speaking students obtained the highest scores on the WAT and they hardly differed from each other. Moroccan and Turkish students had the lowest scores.

Although the primary aim of the Schoonen and Verhallen (2008) study was to design a new task to measure children's depth of word knowledge, their study is also a very important one and is closely related to the purpose of the current study. Similar to the current study, Schoonen and Verhallen (2008) focused on the word associations of L2 children who learned their L2 in childhood (during the sensitive period for language learning) by undertaking mainstream education in the L2 and living in the L2 country. Additionally, this study contributes to our understanding of child L2 ML by investigating not only the vocabulary size of L2 children but also their depth of word knowledge.

2.3.3.4. Summary

This section has reviewed the few empirical studies available in the research literature on child L2 associations. The evidence from these studies (Vermeer, 2001; Schoonen & Verhallen, 2008) demonstrated that the age and the language of children had significant effects on their vocabulary size and associations. Older children have a larger vocabulary as in Vermeer's (2001) study, children aged 7 obtained higher scores on the vocabulary size tasks than the younger children. There are also more associations among words as the fifth grade students of Schoonen and Verhallen's (2008) study found the three closely associated words for two third of the stimulus words, while the third grade students found them for half of the stimulus words. With age, the vocabulary size and the number of associations increased (Schoonen & Verhallen, 2008).

The findings of these studies also revealed that, although the L2 children had smaller vocabulary sizes compared to the L1 children, there was no difference between the L2 and L1 children in terms of the number of associations. Both groups built similar association networks for the stimulus words. The L2 children demonstrated the responses which they did not know in a nonverbal way (Vermeer, 2001). In terms of type of association, the findings of

Namei (2004) revealed that in both L2 and L1 ML, with age, phonological associations declined; syntagmatic associations mostly increased; and paradigmatic associations increased before they declined.

As mentioned earlier, research on the child L2 word associations is scarce in the research literature on word associations. Except for the studies reviewed in this section, there is little research available. Additionally, existing studies have mostly other purposes than investigating the type of association in child and adult L1 and utilised a different type of WAT (see section 3.1.4). Nevertheless, the few studies which investigated the type of association in the L2 ML (e.g., Namei, 2004) used the commonly-used high-frequency words of the Kent-Rosanoff List (1910). The findings of the current study therefore fill an important gap in the research literature on L2 word associations by focusing on the type of association in child L2 and the impact of age and the environment on L2 word associations.

2.4. Mental lexicon, vocabulary size, and reaction time

As mentioned earlier, "the mental lexicon is the database containing all words in the mind of the language user" (Dijkstra, 2005, p. 180). Vocabulary size is another dimension of the ML which refers to the number of words in it. Although there is no agreement among researchers on the vocabulary size of an adult native speaker of English, the best of current knowledge is that child native speakers learn around 1000 words each year up to the age of 20 (Biemiller & Slonin, 2001; Goulden, Nation, & Read, 1990). Nevertheless, there are large variations in the vocabulary size of native speakers (Nation & Webb, 2011). It is only possible to make, at best, an educated guess on the vocabulary size of individuals at different ages due to the variability of vocabulary size even in native speakers.

According to Meara (1996a), the third dimension of the ML is the reaction time to words which refers to the amount of time required to recognise words. Word recognition is the mental process of retrieving information about each word from the ML. Research in this area indicates that, after a string of letters is presented to an individual, several closely related words to that string of letters become active. After a more careful analysis of the string of letters is made, the competing words are reduced, and the target word is recognised. This mental process (word recognition) requires time which is called the reaction time to words (Dijkstra, 2005).

Research on word recognition in the bilingual lexicon takes different views. For example, the language selective word recognition theories suggest that as the two languages of the bilinguals are stored separately, when a bilingual is presented with a string of letters in a specific language, only the competing words in that specific language become active. Therefore, the word recognition should not take any longer for a bilingual compared to a monolingual. In contrast, the language nonselective theories suggest that as the two languages of the bilinguals are interconnected, when a bilingual is presented with a string of letters in a specific language, the competing words in both languages of the bilingual are activated. Therefore, word recognition takes longer for a bilingual.

Several studies in the field of psychology have investigated lexical access. Although these studies measured bilinguals' lexical access, they mostly focused on lexical access in oral word production rather than the reaction time to written words. These studies employed tasks such as object naming (e.g., Gollan et al., 2005; Roberts et al., 2002; Costa et al., 2006), picture naming (e.g., Kohnert et al., 1998; Roberts et al., 2002; Gollan et al., 2005), time limited verbal fluency (e.g., Hedden et al., 2005; Rosselli et al., 2002; Gollan et al., 2002), and neurological tasks (e.g., Rodriguez-Fornells et al., 2005). Even though some of the above-mentioned studies (those which are more relevant to the purposes of the current study) are discussed in this section, overall, the findings of these studies are not directly relevant to the present study as for the most part they focused on lexical access in word production. In contrast, the present study investigates the reaction time to written words. Studies investigating the vocabulary size and reaction time in child and adult L2 and L1 are reviewed covering the following themes:

- vocabulary size and reaction time in child L2 and L1 (section 2.4.1)
- vocabulary size and reaction time in adult L2 and L1 (section 2.4.2)
- correlation between vocabulary size and reaction time (section 2.4.3)

2.4.1. Vocabulary size and reaction time in child L2 and L1

This section presents empirical studies focusing on vocabulary size and reaction time in L2 and L1 children. Like the previous sections, since the present study addresses different aspects of each of these studies, this section focuses on the research purposes, methodology, findings, and discussions of previous research. This is followed by a summary covering the main findings of the studies reviewed.

2.4.1.1. Bialystok, Luk, Peets, and Yang (2010)

Bialystok, Luk, Peets, and Yang (2010) conducted a study to ascertain whether previously reported discrepancies between the vocabulary size of bilinguals and monolinguals would be replicated in a large-scale study on bilingual children from different age groups. A total of 1,738 students (772 English monolinguals and 966 bilinguals) aged 3-10 participated in this study. All the bilingual students were undertaking mainstream education in English and spoke the non-English language at home. The Peabody Picture Vocabulary Test III[6] (PPVT-III), (Dunn & Dunn, 1997) was applied to measure the receptive vocabulary size of the participants. Four pictures and the name of one of the four pictures were presented to the participants. The participants were required to point to the named picture.

This study demonstrated significant age and language effect with no interaction between them. The monolinguals outperformed the bilinguals at all ages, but the effect of age was less robust than the effect of language. Children aged 4-5 obtained higher vocabulary size scores than children aged 7. However, the effect was small and according to Bialystok et al. (2010), reflected the sampling variance between the children in the two age groups.

Bialystok et al. (2010) further noted that the PPVT-III contained words which were used in various topics and contexts. As the bilinguals speak a non-English language at home and English at school, it is possible that their knowledge of the English words dominantly used in the home context is limited while their knowledge of words used in the school context is similar to that of the monolinguals. In order to test this hypothesis, they further divided the words used in the PPVT-III into two categories: one for the home context and the other for the school context. Words in the home category included food and household items, culture specific items, and words unlikely to be used at school. Words in the school category included professions, animals, plants, shapes, musical instruments, and words used as part of school experience.

The findings of the context analysis exhibited no difference between the monolinguals and bilinguals of different age groups in terms of the school context vocabulary. However, the monolinguals obtained higher scores for words in the home category. Based on these results, Bialystok et al. (2010) emphasised that bilingual children do not have an academic vocabulary deficit (vocabulary used in the academic context in school). The difference between the vocabulary size of the monolinguals and bilinguals exists for words which are

[6] PPVT-III is a more recent version of the PPVT with great similarities with it. Despite the similarities, some changes have been applied. For example, the number of test items was increased, and some illustrations were added.

dominantly used in the home context. As bilingual children mostly use their non-English language at home, their English vocabulary is smaller in terms of the home context vocabulary. Therefore, the smaller vocabulary size of the bilingual children does not lead to any academic disadvantage.

This study is unique as it divided the vocabulary of the monolingual and bilingual children according to the context of use into the home and school context categories. The results of this study are important and relevant to the current study as they offered an insight into where the discrepancies exist between the vocabulary of monolinguals and bilinguals. Despite the insightful findings, dividing the vocabulary into home and school context categories can be problematic. The words that Bialystok et al. (2010) categorised as school context vocabulary such as words for professions, animals, plants, shapes, and musical instruments can also be used in the home context.

2.4.1.2. Rosenblum and Pinker (1983)

The research literature on bilinguals presents studies which have not primarily focused on the vocabulary size of monolinguals and bilinguals, yet they employed a vocabulary size task to measure proficiency. Although the purposes and the general findings of these studies are irrelevant to the current study, their vocabulary size findings are reported here.

Rosenblum and Pinker (1983) carried out a study to determine the relationship between a word and its meaning for monolingual and bilingual children. Their study aimed to establish whether preschool children treat an object's name as an inseparable property of the object or realise the conventional relationship between them. The participants were 12 English monolingual children and 12 Hebrew-English bilingual children aged 1-9. The bilingual children were from the age range of 1-5 years old, and the monolingual children were in the age range of 4-9 years old. The PPVT was administered to the participants in both English and Hebrew as a tool to measure vocabulary size.

The findings of this study in terms of the vocabulary size of the participants showed that the monolingual preschool children obtained higher scores than the bilingual children. The bilingual children obtained lower vocabulary size scores in both languages (Hebrew and English) compared to their monolingual peers until they reached the middle primary school ages. Rosenblum and Pinker (1983) explained these findings in terms of the bilingual

children's limited exposure to the L2 and L1. The L2 children have smaller vocabularies in each of their languages as they are exposed to fewer words in each language. These students divide their exposure to language into the exposure to the L2 and the L1. This study and its findings in terms of the vocabulary size of L2 children are of interest to the present study. The present study focuses on the different dimensions of the ML including the vocabulary size in children who learned their L2 in childhood (during the sensitive period for language learning) and in the L2 environment. Therefore, the findings of Rosenblum and Pinker's (1983) study are used for comparison purposes with the findings of the current study.

2.4.1.3. Merriman and Kutlesic (1993)

Merriman and Kutlesic's (1993) study primarily aimed to investigate the use of heuristics[7] for fast mapping by monolingual and bilingual children. As in the case of Rosenblum and Pinker (1983) study, the purpose of this study is not directly relevant to the current study. Nevertheless, the findings elicited using vocabulary size test are reported here.

Merriman and Kutlesic (1993) conducted their study on 36 Serbian-English bilingual children within the age range of 5-8 years old. These children were the first and second generation of Serbian immigrants to the US residing in Serbian communities. Additionally, 42 monolingual English-speaking children aged 5-8 participated in this study.

As in previous studies (Bialystok et al., 2010; Rosenblum & Pinker, 1983), the PPVT was administered to both groups. The bilingual children took the test in English and Serbian. The analysis of variance yielded main language effect. The score for the bilingual children was lower than that for the monolingual children. Like the explanations provided for the smaller vocabulary of the bilinguals by Rosenblum and Pinker (1983), Merriman and Kutlesic (1993) linked the smaller vocabulary of the bilingual children in their L2 to the fact that they had to split their time between the two languages resulting in a smaller vocabulary in each language. Like Rosenblum and Pinker's (1983) findings, the findings of Merriman and Kutlesic's (1993) study in terms of the vocabulary size of the bilingual children are closely related to the purposes of the current study. The current study focuses on the different dimensions of the ML (including the vocabulary size) in L2 children. Therefore, the findings of this study are used for comparison purposes with the findings of the current study.

[7] Heuristics refers to experience-based techniques such as making an educated guess or using common sense for learning and problem solving.

2.4.1.4. Magiste (1992)

In contrast to the above-mentioned studies (Bialystok et al., 2010; Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993) which focused on the vocabulary size of bilinguals, Magiste (1992) conducted a cross-sectional study in order to compare the lexical access of bilingual children in their L2 (Swedish) with their lexical access in their L1 (German). The participants of this study were 74 primary school students aged 6-11 and 77 high school students aged 13-19. They were German immigrants to Sweden undertaking bilingual education in German and Swedish. These students had lived in Sweden from 6 months to 8.5 years.

In this study, a picture-naming task was used to measure the children's speed of vocabulary production in German and Swedish. The pictures referred to common objects such as a chair and an apple. The participants were required to name the picture first in one language and then in the other with a short rest period between. Their responses were recorded and timed.

The analysis of variance yielded main effects for language and the LoR but not for the student category (primary school or high school children). A negative correlation was observed between the LoR in the L2 country and reaction time to the L2 words. As the LoR in the L2 country increased, the reaction time to the L2 words decreased, while the reaction time to the L1 words increased. The primary school children developed similar lexical access in their L2 and L1 after four years of living in the L2 country while the high school children achieved it after six years. Additionally, the children who came to the L2 country and started learning the L2 at the preschool age showed an advantage over the children who arrived in the L2 country later (around age 10).

Magiste (1992) discussed the findings in terms of the neurological reasons (sensory and motor origins), and the flexibility and spontaneity of children. The strength of Magiste's (1992) study is its focus on the effect that LoR in the L2 country has on the lexical access of bilingual children. Moreover, this study measured the lexical access in children's L2 and L1 providing the findings that an increase in the speed of word access in the L2 is accompanied by a decrease in the speed of word access in the L1.

2.4.1.5. Summary

This section has presented empirical studies focusing on vocabulary size and reaction time in L2 and L1 children. In terms of the vocabulary size, these studies revealed that the bilingual

children had a smaller vocabulary than the monolingual children (e.g., Bialystok et al., 2010; Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993). However, when vocabulary of the bilingual and monolingual children was divided into words mainly used either in the home context or in the school context, the findings revealed that the bilingual children had a smaller vocabulary for words used in the home context rather than in the school context (Bialystok et al., 2010). The smaller vocabulary sizes of the bilinguals were discussed in terms of their exposure to two languages. As bilingual children split their time between their L2 and their L1, they have a smaller vocabulary in each language.

In terms of the lexical access of bilinguals, the findings of Magiste's (1992) study revealed that the bilinguals had slower lexical access in their L2. As the LoR in the L2 country increased, they accessed words more quickly in their L2 but more slowly in their L1. The primary school children developed similar lexical access in their L2 to that in their L1 after four years living in the L2 country, while the high school children developed that after six years.

The studies reviewed in this section focused on the vocabulary size of children from a limited age group and at an age when the vocabulary was still growing such as 3-10 years old (Bialystok et al., 2010), 1-9 years old (Rosenblum & Pinker, 1983), and 5-8 years old (Merriman & Kutlesic, 1993). Therefore, these studies were not able to investigate whether the size of bilingual children's vocabulary in the L2 could catch up with the size of monolingual children's vocabulary in the L1. Thus, the current study offers contribution to the research on vocabulary size in L2 children by investigating whether the L2 ML resembles the L1 ML in terms of the vocabulary size at some age.

Additionally, the PPVT-III (see section 2.4.1.1) was used as a measure of vocabulary size in all the above-mentioned studies (e.g., Bialystok et al., 2010; Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993). The PPVT presents four pictures accompanied by the name of one picture. The task taker is required to match the picture with the name. This raises a question about the extent to which pictures can represent low-frequency and abstract words. A further question concerns the extent to which the ambiguity of pictures or the different interpretations of different participants of the same picture affect the vocabulary size scores. The current study contributes to previous research on vocabulary size and reaction time by using a verbal task which includes words from different frequency ranges.

2.4.2. Vocabulary size and reaction time in adult L2 and L1

This section presents empirical studies investigating the vocabulary size and reaction time in L2 adults by covering the research purposes, methodology, findings, and discussions of these studies.

2.4.2.1. Ivanova and Costa (2008)

Ivanova and Costa (2008) conducted a study in order to investigate whether the bilinguals were disadvantaged in terms of the speed of their lexical access in both their languages. The participants of their study were 37 monolingual Spanish speakers, 37 bilingual Spanish-Catalan speakers, and 37 bilingual Catalan-Spanish speakers. The bilinguals learned their L1 (Spanish and Catalan respectively) at home and had not had exposure to their L2 before school. The participants were required to name 50 pictures (25 representing high-frequency words and 25 representing low-frequency ones).

The analysis of variance yielded significant levels for the groups of participants and word frequency. The monolingual Spanish speakers named the pictures faster in Spanish than the Spanish-Catalan bilinguals. Both groups named the pictures referring to high-frequency words faster than the pictures representing low-frequency ones. The difference between the monolinguals and bilinguals was smaller for high-frequency words than for low-frequency ones. The groups of participants also interacted with the word frequency. The frequency effect was smaller for the monolinguals compared to the Spanish-Catalan bilinguals.

The findings of this study were in part explained in terms of the frequency of words. As the difference between the monolinguals and bilinguals was more pronounced for low-frequency words, it was concluded that the difference between the lexical access of the two groups was mostly caused by low-frequency words. The Spanish-Catalan bilinguals of the study used Spanish 73% of the time while the monolinguals used it 97.5% of the time. As a result, the bilinguals were exposed to high-frequency Spanish words but much less exposed to the medium- and low-frequency words. The bilinguals' disadvantage in terms of their lexical access, therefore, was observed in the low-frequency words.

Despite the importance of this study, as it focused not only on the lexical access to the high-frequency words but also to the low-frequency ones, it employed a picture naming task. Therefore, it is subject to the same line of criticism for the use of a picture naming task. In this study, the participants were required to name 25 pictures representing high-frequency

words and 25 pictures representing low-frequency ones. As mentioned earlier, the issue with the use of pictures is the extent to which the ambiguity of pictures or the different interpretations of different participants of the same picture affect lexical access.

2.4.2.2. Gollan, Montoya, Fennema-Notestine, and Morris (2005)

Gollan, Montoya, Fennema-Notestine, and Morris (2005) conducted a study in order to compare the lexical access of bilingual participants in their dominant language to that of the monolingual participants. Additionally, this study aimed to investigate the effect of repetition on lexical access. The participants in this study were 31 English monolinguals and 31 Spanish-English bilinguals. The Spanish-English bilinguals had learned both of their languages in a natural setting (at home) and at an early age. The vast majority of the bilinguals were English language dominant or reported that they spoke both languages like a native speaker.

The task utilised in Experiment 1 contained 180 pictures from the Snodgrass and Vanderwart (1980). A picture was presented to the participants which they were required to classify as natural or human-made as quickly as possible. The task used in Experiment 2 contained 60 black and white pictures. The participants were required to name the words as quickly as possible. The reaction time to the pictures was recorded by the computer.

The results of Experiment 1 revealed that the bilinguals classified the pictures as quickly as the monolinguals. For Experiment 2, the analysis of variance yielded a main effect for the participant type. The bilinguals needed more time for the picture naming task than the monolinguals. Further, the analysis of variance yielded a main effect for repetition. The lexical access improved when the same picture was shown repeatedly to the participants. Nevertheless, the bilinguals took longer to respond to the repeated pictures compared to the monolinguals. There was no difference between the bilinguals and monolinguals in terms of the picture classification (semantic concepts). The difference between the two groups existed in the picture naming (lexical access).

The findings were discussed in terms of the translatability of words (interference from the other language) and weaker links between the semantic concept (meaning) and the lexical representation (words). In terms of translatability, Gollan et al. (2005) divided the words into high- and low-translatability items. The high-translatability item refers to words which 75%

to 100% of the bilinguals managed to translate from English to Spanish. In contrast, the low-translatability item refers to words that fewer than 75% of the bilinguals translated correctly from English to Spanish. Gollan et al. (2005) had hypothesised that, as the bilinguals have interference across languages and as their lexical selection involves lexical competition between two languages, it takes longer to access the meaning of high-translatability items. However, the findings of this study revealed that both the monolinguals and the bilinguals responded more quickly to the high-translatability items than the low-translatability ones. Therefore, the translatability of words could not explain the findings.

As the translatability of words could not explain the results, the results were discussed in terms of the weaker links between the semantic concepts (meaning) and lexical representations (words). It was suggested that the bilinguals have weaker links between the semantic concept (meaning) and the lexical representation (words) as they split their time between the two languages. They spend less time strengthening the links between the semantic concepts and lexical representations in each language, even in the dominant language. The findings of this study supported the weak links hypothesis, as after repeating the same stimuli four times, the bilinguals responded as quickly as the monolinguals. This suggested that if the bilinguals spent the same amount of time and had similar exposure to the words in their dominant language as the monolinguals did, their lexical access would also be very fast.

Gollan et al.'s (2005) study is important and relevant to the purposes of the current study as it focused on the lexical access of bilinguals who learned their L2 during childhood in the L2 country. Additionally, it revealed that the bilinguals classified pictures as fast as the monolinguals although they were slower in naming them. This is an important finding as it indicates that the bilinguals have similar semantic concepts to the monolinguals, yet they are slower in accessing them. Despite its importance, this study also used a picture naming task (see section 2.4.1.5). Therefore, the drawbacks of this task may have affected the findings in terms of the bilinguals' lexical access.

2.4.2.3. Bialystok, Craik, and Luk (2008)

In another attempt to investigate the lexical access of bilinguals, Bialystok, Craik, and Luk (2008) conducted a study on adult bilinguals and monolinguals. The participants were 24 bilinguals with an average age of 19.7 and 24 monolinguals with an average age of 20.7. All

the participants were undergraduate students taking a psychology course in English. The bilinguals spoke another language at home. They rated their non-English language proficiency on a 5-point scale from 0 indicating poor to 4 indicating excellent. Their average English language proficiency was 3.3 which is roughly the equivalent of very good. They all arrived in Canada at the average age of 4.

The lexical access of the participants was examined by means of letter and category fluency tasks. In the case of letter fluency, participants were required to name as many words as possible which started with a certain letter in a period of one minute. For the category fluency test, the participants were asked to name animals in one minute. The score was the number of animals which was articulated in one minute, excluding the repetitions and errors.

The PPVT-III (Dunn & Dunn, 1997) and a modified version of the Boston Naming Test (Kaplan et al., 1983) were applied to measure the receptive vocabulary size. In PPVT-III, four pictures were presented to the participants with the name of one of them. The participants were required to point to the named picture. The modified Boston Naming Test contained 60 pictures and detailed definitions for each picture. For example, the word *tree* was presented with a picture of a tree and the following definition "*a tall woody plant with a trunk, branches, and leaves*" (p. 527). The participants were required to name the picture and definition. Spatial span tasks were also applied to measure the nonverbal cognitive capacity of the participants. They were measures of the memory span and working memory of the participants.

The findings relating to vocabulary size revealed that the monolinguals obtained higher scores than the bilinguals. The monolinguals did better than the bilinguals at both the picture and definition tasks. In terms of the lexical retrieval, the monolinguals did better than the bilinguals in the letter fluency test. However, there was no difference between the two in terms of category fluency. The findings of this study also revealed no difference between the bilinguals and monolinguals in terms of the memory span, but the bilinguals obtained higher scores in the capacity of their working memory.

Based on the findings of Experiment 1, Bialystok et al. (2008) argued that the differences observed between the monolinguals and bilinguals could not be discussed in terms of their cognitive abilities including their memory capacity. There was no difference observed between the monolinguals and bilinguals in terms of memory span. Additionally, the bilinguals did better at the working memory tasks. Bialystok et al. (2008) argued that the

differences observed between the lexical access of the monolinguals and bilinguals could be attributable to their vocabulary size.

Bialystok et al. (2008) conducted statistical analysis to investigate whether the discrepancies observed between the lexical access of monolinguals and bilinguals would disappear once the size of their vocabulary was controlled. The bilinguals were divided into high-proficiency (HP) and low-proficiency (LP) groups based on their vocabulary size scores on the PPVT-III. The monolinguals and HP bilinguals obtained the highest scores on the picture and definition tasks, and the LP bilinguals the lowest. There was no difference observed between the vocabulary size of the monolinguals and HP bilinguals.

Comparing the monolinguals and the HP bilinguals, the statistical analysis yielded a significant level for letter fluency. However, there was no difference between the two groups in terms of category fluency. Additionally, this study demonstrated no difference between the HP and LP bilinguals in terms of their memory span and the capacity of their working memory. Based on these findings, Bialystok et al. (2008) concluded that ". . . bilinguals balance their deficits in vocabulary against their advantages in executive functioning when performing lexical retrieval tasks, and that bilingual fluency depends both on the verbal proficiency level of the participant and on the executive demands of the task" (p. 536).

Bialystok et al.'s (2008) study is insightful as it focused on both the linguistic (vocabulary size and lexical access) and psychological (nonverbal cognitive capacities such as memory span and capacity of working memory) aspects of the bilinguals. Despite its insightful findings, this study utilised letter and category fluency tasks. For the letter fluency task, the participants were required to name as many words as possible which started with a certain letter within a one minute period. For the category fluency task, the participants were asked to name animals in a one minute period. In naming words which start with a certain letter or in naming animals in a period of one minute, other variables such as the spontaneity of the participants may affect the results.

In one of the vocabulary size tasks used in this study (Boston Naming Test), both pictures and detailed definitions for each picture were presented. For example, the word *tree* was presented with a picture of a tree and a written definition. The written definition helps the participants to guess the word regardless of whether it is an abstract or a low-frequency word. Further, it eradicates the ambiguity of the pictures or different interpretations of different participants of the same picture. Nevertheless, some participants may be faster at reading the

definitions than others. Therefore, the speed of recognising written words may affect the speed of access to the productive words. The drawbacks of the tasks used in this study may have affected the findings in terms of the bilinguals' lexical access. The current study fills an important gap in research literature of L2 vocabulary size and lexical access by utilising a different task from those utilised in previous research (explained in detail in Chapter 3).

2.4.2.4. Summary

This section has reviewed the studies conducted on the vocabulary size and lexical access of L2 and L1 adults. All the studies reviewed in this section (e.g., Bialystok et al., 2008; Ivanova & Costa, 2008; Gollan et al., 2005) employed adults who learned their L2 during childhood in the L2 country. These studies revealed that the bilingual adults had a smaller vocabulary (e.g., Bialystok et al., 2008) and slower access to words in their L2 (e.g., Ivanova & Costa, 2008; Bialystok et al., 2008; Gollan et al., 2005) compared to the monolinguals.

The bilinguals' slower lexical access in the L2 was discussed concerning the word frequency and weaker links between the semantic concepts (meaning) and the lexical representations (words). In terms of word frequency, Ivanova and Costa (2008) explained that the Spanish-Catalan bilinguals of their study used Spanish less often than the monolinguals. As a result, the high-frequency Spanish words had a chance of exposure while the medium- and low-frequency words had few opportunities for exposure. Therefore, the bilingual disadvantage in terms of lexical access was observed in low-frequency words. In terms of the weaker links between the semantic concepts (meaning) and lexical representations (words), Gollan et al. (2005) suggested that the bilinguals have weaker links between words and their meanings as they split their time between the two languages. They spend less time strengthening the links between the words and their meanings in each language even in the dominant one. If the bilinguals spent the same amount of time and had similar exposure to the words in their dominant language as the monolinguals did, they would access words as quickly as the monolinguals.

All the studies covered in this section (e.g., Ivanova & Costa, 2008; Bialystok et al., 2008; Gollan et al., 2005) used a picture naming task or a letter and category fluency task. As explained earlier, the drawback with the use of picture naming tasks is the extent to which the ambiguity of the pictures or the different interpretations of different participants of the same picture affect the lexical access results. Further, the issue with the use of letter and category

fluency tasks is that in naming as many words as possible which start with a certain letter or in naming animals in a period of one minute, other variables such as the spontaneity of the participants may affect the lexical access. The current study fills an important gap in the research literature on vocabulary size and lexical access of bilinguals by utilising a verbal task which includes words from different frequency ranges.

2.4.3. Correlation between vocabulary size and reaction time

This section presents empirical studies investigating the vocabulary size and reaction time of adult L2 learners and the correlation between the two by covering their research purposes, methodology, findings, and discussions. This will be followed by a summary of the findings.

2.4.3.1. Laufer and Nation (2001)

The aim of a study by Laufer and Nation (2001) was to determine whether there was a correlation between vocabulary size and reaction time, and whether the word frequency influenced the reaction time. The participants in this study were native speakers of English (N = 13) and EFL learners (N = 441). The native speakers were either staff members or graduate students of a university. The EFL learners were from Hebrew, Russian, and Arabic language backgrounds and were learning English in Israeli universities.

The Vocabulary Recognition Speed Test (VORST), (see section 3.2.2.2.2) was administered to the participants to measure the vocabulary size and reaction time. Words used in the VORST were from various frequency ranges (2k, 3k, and 5k) and the University Word List (UWL). The participants were required to match the word in question with one of the six options indicating the word's meaning. The vocabulary size scores of the participants were classified into the 15-32, 33-50, 51-68, and 69-90 out of 100. These four groups of participants were compared on their reaction time to the words.

The findings of this study demonstrated a statistically nonsignificant level for the reaction time to the words in the 3k frequency range for the two lower groups of EFL learners (with vocabulary sizes of 15-32 and 33-50). This indicated that EFL learners with vocabulary size score of 15-50 had a similar reaction time to high-frequency words (words in the 3k frequency range). In contrast, the results exhibited statistically significant levels for the reaction time comparing the two higher groups of EFL learners (with vocabulary sizes of 51-

68 and 69-90) with each other and comparing them with the lower EFL groups (with vocabulary sizes of 15-32 and 33-50). The reaction time to words in the 3k frequency range dropped only when the language learners learned words beyond the 3k frequency range. For words on the UWL, only the difference between the EFL students with the highest score for vocabulary size (69-90) and the other three groups was statistically significant. The results were only analysed for words in the 3k frequency range and the UWL.

In terms of the impact of word frequency on reaction time, there were significant differences in reaction time to words in the 3k, 4k, 5k, and 10k frequency ranges for the best EFL learners, those with a vocabulary size of 69-90. In the case of the native speakers, there was no statistically significant difference in reaction time to words from different frequency ranges. The only difference was observed in reaction time to words in the 3k and 10k frequency ranges.

The results also revealed that the relationship between vocabulary size and reaction time was not linear. This means that with an increase in vocabulary size, the reaction time did not decline automatically. The reaction time to words on each frequency range decreased when the learner's vocabulary size increased beyond that frequency range. Nevertheless, the findings of Laufer and Nation's (2001) study demonstrated moderate and strong negative correlations between vocabulary size and reaction time for words of different frequency ranges.

Based on these results, Laufer and Nation (2001) argued that for a fast reaction to low-frequency words, the vocabulary size has to increase beyond that level (the level of the low-frequency words). Therefore, the reaction time lags behind the vocabulary size. Laufer and Nation (2001) further explained that the lag between the vocabulary size and reaction time may be symptomatic of the nature of the vocabulary development or the learning conditions of the EFL learners. In the first case, a large vocabulary needs to be learned before some of the new words can be accessed quickly. In the second case, the lag between the vocabulary size and the reaction time represents the kind of practice that the language learners received. It may be that the EFL students were exposed to new words so they learned their meaning but did not practise them. Therefore, fluency (fast access to words) was not developed for those words.

Although Laufer and Nation (2001) focused on the vocabulary size and reaction time of adult EFL/ESL learners who learned their L2 in different circumstances from those of the

participants in the current study, this study is significant as it emphasised the impact of vocabulary size on the reaction time to words. The current study also investigates the impact of one dimension of the L2 ML (such as vocabulary size) on the others (such as reaction time). Additionally, Laufer and Nation (2001) utilised a task which contained words from various word classes and frequency ranges, and thus the findings of this study are generalisable to a wide range of words in the ML.

2.4.3.2. Harrington (2006)

Like Laufer and Nation (2001), Harrington (2006) conducted a study to discover whether there was a correlation between vocabulary size and reaction time, and whether the two measures of vocabulary size and reaction time could discriminate among students at various proficiency levels (intermediate, advanced, and the native speaker groups) and among words from various frequency ranges (words from the 2k, 3k, 5k, and 10k frequency ranges).

This study was carried out on three groups of participants (N = 110): intermediate ESL learners (N = 32), advanced ESL learners (N = 36), and native speakers of English (N = 42). The intermediate ESL learners were from East Asian language backgrounds taking English lessons in an Australian university. Their English level was 5 on the IELTS test (7 was the threshold for entry into the tertiary education). The advanced ESL learners and native speakers of English were undergraduate and graduate students studying at the same university. A yes/no Lexical Decision Task (LDT), (see section 3.2) was used to measure the vocabulary size and reaction time. It contained 150 lexical items including 90 words and 60 pseudowords. Words were from a range of frequencies, 2k, 3k, 5k, and 10k (Schmitt, Schmitt, & Clapham, 2001 List) and the Academic Word List (Coxhead, 2001). The pseudowords were generated from words of the same frequency range.

The findings of this study revealed that the vocabulary size and reaction time were capable of discriminating among students with various proficiency levels and among words from different frequency ranges (words from the 2k, 3k, 5k, and 10k frequency ranges). With an increase in language proficiency, vocabulary size increased and reaction time declined. The vocabulary size score was higher and the reaction time was faster for higher frequency words compared to lower frequency ones.

The native speakers of English had the highest level of accuracy (highest vocabulary size) followed by the advanced and intermediate ESL learners. For each frequency range, the native speakers also obtained the highest accuracy score followed by the advanced and intermediate groups. The native speakers had the lowest reaction time to words in all four frequency ranges followed by the advanced and intermediate ESL learners. For the two ESL groups (intermediate and advanced), both the vocabulary size and reaction time discriminated between performance on the four frequency ranges. For the native speaker group, the vocabulary size discriminated between performance at the frequency ranges of 2/3k, 5k, and 10k, and the reaction time discriminated between performance at the 2k, 3/5k, and 10k frequency ranges. There was also a significant negative correlation between vocabulary size and reaction time. As the vocabulary size increased, the reaction time to words decreased. In contrast to the findings of Laufer and Nation (2001), there was no evidence in this study in support of the claim that the reaction time to words lags behind the vocabulary size.

Based on the above-mentioned findings, Harrington (2006) argued that the reaction time is a good predictor of increase in the lexical knowledge of language learners. He recommended the use of reaction time in the placement tests. This study is insightful and relevant to the purposes of the present study as it investigated the relationship between the vocabulary size and reaction time, an aspect which has received little attention in research on the L2 ML. Additionally, this study used the yes/no LDT (see section 3.2), a valid and reliable task to measure the vocabulary size of L2 learners and their reaction time to L2 written words. As in the case of the Laufer and Nation (2001) study, since the words used in the yes/no LDT were from different word classes (e.g., nouns, adjectives, and verbs) and frequency ranges (high- and low-frequency ranges), the findings of this study are generalisable to a broad range of words in the ML.

2.4.3.3. Miralpeix and Meara (2010)

Another study was conducted by Miralpeix and Meara (2010) with similar purposes to the Laufer and Nation (2001) and Harrington (2006) studies. This study aimed to investigate whether there was a relationship between vocabulary size and reaction time in language learning and if so, what the nature of the relationship would be.

This study employed 145 university students, Spanish-Catalan bilinguals who were studying English as a third language at the University of Barcelona with proficiency levels ranging

from the intermediate to advanced. The X-Lex and Y-Lex tests were used to measure the participants' vocabulary size. The X-Lex and Y-Lex are computerised vocabulary size tests which contain words from the 1-5k and 6-10k frequency ranges respectively. The X-Lex contains words from the JACET List[8], and the Y-Lex contains words from both the JACET and BNC Lists (see section 3.1.3.1.2). Additionally, the two alternative choice animacy task of Segalowitz and Freed (2004), (see section 3.2.2.1) was utilised to measure the reaction time.

This study revealed no correlation between vocabulary size and reaction time. The language learners were divided into three groups according to their vocabulary size scores: the 3,400-5,100, 5,100-6,800, and 6,800-8,500. The reaction time was similar for Group 1 and Group 2 and only decreased for Group 3. The EFL learners with a vocabulary size of 5,100-6,800 had a similar reaction time to those with a smaller vocabulary size (smaller than 5,100). Nevertheless, the results did not indicate that the relationship between the vocabulary size and reaction time was random either. The reaction time was lower for the participants with a larger vocabulary size.

Miralpeix and Meara (2010) pointed out that the fact that there was no systematic correlation between the vocabulary size and reaction time could be interpreted in different ways. It is possible to have a large vocabulary size from which words are accessed slowly. It is also possible to have a small vocabulary size from which words are accessed quickly. It is further possible for people with a similar vocabulary size to access words at different speeds. Miralpeix and Meara (2010) further explained that ". . .lexical access may not play a determinant role until lexicons reach big enough sizes or that a close relationship between the two can just be observed at specific stages of the learners' language development. . ." (p. 10).

Miralpeix and Meara's (2010) study contributes to our understanding of the relationship between vocabulary size and reaction time. As such, the findings are related to the current study. Nevertheless, the findings of this study relating to the reaction time are only generalisable to the high-frequency nouns rather than to a broad range of words from different word classes across a wide range of frequencies. Additionally, this study was not able to detect potential discrepancies between the L2 and L1 ML which may only exist relating to low-frequency words. The two alternative choice animacy task of Segalowitz and

[8] JACET is a word list containing 8000 words from the British National Corpus (BNC) and the JACET Subcorpus. Words are from various frequency ranges and are presented on the list in eight levels (from 1 to 8) with reference to their frequency and educational significance.

Freed (2004) was used in the study which only contains high-frequency nouns. Therefore, the current study will make a contribution to the research on the L2 vocabulary size and reaction time by utilising a task which contains words from various word classes and frequency ranges.

2.4.3.4. Summary

This section has reviewed empirical studies which have investigated the correlation between vocabulary size and reaction time of the adult L2. These studies demonstrated that native speakers of English and advanced EFL/ESL learners had a larger vocabulary size and faster access to words compared to the intermediate group. As the language proficiency of the language learners and their vocabulary size increased, the reaction time to words declined (Laufer & Nation, 2001; Harrington, 2006).

Nevertheless, these studies revealed contradictory results in terms of the correlation between vocabulary size and reaction time. Laufer and Nation's (2001) and Harrington's (2006) studies revealed moderate and strong correlations between the two respectively. These studies indicated that as the vocabulary size increased, the reaction time to words declined. In contrast, Miralpeix and Meara's (2010) study revealed no correlation between the two. They suggested that a large vocabulary can be accompanied by slow access to the words, while a small vocabulary can be accompanied by fast access to the words. It is also possible to have similar vocabulary sizes but different speed rates. Therefore, as the current study also focuses on the correlation between one dimension of the ML (such as vocabulary size) and the other dimensions (such as reaction time), it will shed light on the contradictory findings of previous research.

2.5. Rationale for the current study

This section provides the rationale for the present study based on the gaps in the research literature on child and adult L2 and L1 ML reviewed in this chapter. Initially, this section focuses on the gap in research on associations. The rest of this section covers the gap in research on the vocabulary size and reaction time of L2 and L1 children and adults.

Little of the research conducted on L2 word associations has investigated the impact of age and the environment for language learning on the development of word associations (except

for Vermeer, 2001; Schoonen & Verhallen, 2008). Our understanding of the development of L2 word associations comes from the studies which investigated the word associations of the adult EFL/ESL learners (e.g., Sokmen, 1993; Wolter, 2001; Fitzpatrick, 2006; Zareva, 2007). Nor have age and the environment for language learning received the attention they deserve. The studies which investigated the impact of these two variables on the other L2 skills (e.g., morphosyntax and phonology) revealed that both variables affected the L2 skills. Thus, the current study fills an important gap in the research literature on L2 word associations by focusing on the two variables of age and the environment for language learning and their impact on word associations.

Studies which explored child and adult L1 (not L2) word associations revealed that the child L1 had a tendency towards syntagmatic and phonological associations while the adult L1 produced more paradigmatic associations. Nevertheless, there are gaps in the design and findings of these studies which are detailed below.

Research on L1 children and adults' associations has been mostly conducted on a few close age groups of children, comparing their associations with adult L1 associations. For example, Brown and Berko (1960) carried out a study on first, second, and third grade children and compared their associations with adult L1 associations (see section 2.3.1.1). In another study, Entwisle (1966) employed prekindergarten, kindergarten, first, third, and fifth grade children and compared their associations with adult L1 associations (see section 2.3.1.3). However, employing children from a few close age groups does not provide snapshots for the development of word associations within a longer period of time. In contrast, the current study employs participants from three different age groups within a period of 10 years (see section 4.3). This provides snapshots of what the L2 ML looks like at various points of its development within a longer period of time.

Most studies investigating word associations in L1 children and adults used only high-frequency stimulus words in the construct of their WATs (e.g., Brown & Berko, 1960; Ervin, 1961). The danger with the use of only high-frequency stimulus words is that they are words which are commonly used in everyday language with which most participants (both children and adults) are likely to have a high degree of familiarity. Thus, the high-frequency words are not capable of eliciting the potential differences between different participants in terms of the less frequent words. As a result, most findings of previous research on child and adult L1

associations are only generalisable to high-frequency words in the ML rather than words from a broad range of frequencies.

Furthermore, studies which investigated the impact of word frequency on word associations revealed word association patterns for native speakers which were similar to word association patterns of nonnative speakers. Evidence from Wolter's (2001) study suggested that like nonnative speakers of English, native speakers provided more phonological associations to low-frequency words. In contrast to research on child and adult L1 associations which used only high-frequency stimulus words, the present study uses both high- and low-frequency stimulus words in the construct of the WAT. Thus, the findings of the present study are generalisable to a broader range of words in the ML.

It is not only that our understanding of child and adult L1 associations derives from studies which are largely restricted to high-frequency words, our understanding is also derived from studies which used the Kent-Rosanoff List (1910) as the source of stimulus words (e.g., Entwisle, 1965; Sokmen, 1993; Soderman, 1993). Therefore, the findings of previous research are only generalisable to high-frequency nouns and adjectives elicited from an old list which does not reflect the dynamic nature of language. In contrast, this study uses an up-to-date list containing words from various word classes and frequency ranges as the source of stimulus words.

Even though the research conducted on child and adult L1 associations revealed that children had a tendency towards syntagmatic and phonological associations whereas adults produced more paradigmatic associations, these studies suggested different trends of development for syntagmatic associations. For example, Brown and Berko's (1960), Ervin's (1961) and Palermo's (1971) studies revealed that with age, the number of syntagmatic associations steadily decreased. In contrast, Entwisle's (1966) study revealed that with age, the number of syntagmatic associations increased as the college students provided more verb and adjective responses to the nouns and more adverbs to verbs than the fifth grade students. The current study contributes to the findings of previous research on word associations by paying specific attention to the trend of development for syntagmatic associations.

In addition to paradigmatic and syntagmatic associations as the main types of associations, phonological (clang) associations have also been observed in L1 children's associations. Nevertheless, phonological associations and their trend of development have received less attention than the other two types of associations. Not all studies investigating children's

associations paid enough attention to the existence and development of this type of association. The present study offers contribution to the research literature on word associations by shedding light on the trend of development for phonological associations.

Research conducted on adult L2 associations also presented contradictory findings (see sections 2.3.2 and 2.3.2.11). Some studies (e.g., Fitzpatrick, 2006; Wolter, 2001) demonstrated qualitative differences between the word associations of L2 and L1 adults. Other studies (e.g., Zareva, 2007) revealed that the difference between the two was quantitative. Even the findings of studies which revealed qualitative discrepancies between the L2 and L1 ML were contradictory. For instance, in Wolter's (2001) study, the adult L2 participants demonstrated a tendency towards syntagmatic associations (for words in the 1-9k frequency range). In contrast, in Fitzpatrick's (2006) study, both adult L2 and L1 participants provided more paradigmatic (meaning-based) associations. Therefore, the present study offers contribution to research on word associations by investigating the word associations of L2 and L1 students of different ages.

Research on child L2 word associations is scarce in the research literature on word associations. The findings of existing studies have revealed that both the age and language of children had significant effect on the size of their vocabulary and their word associations. Older children had larger vocabularies and more associations among words (Vermeer, 2001; Schoonen & Verhallen, 2008). These studies also demonstrated that although the child L2 had a smaller vocabulary than the child L1, there was no difference between them in terms of the number of associations (Vermeer, 2001). Despite the findings, these studies utilised a different type of WAT which was not able to elicit the types of associations in children. Instead, they only measured the number of associations (see sections 3.1.4). The current study focuses on the types of associations in L2 and L1 children.

Research on child L2 and L1 vocabulary size and reaction time revealed that bilingual children had a smaller vocabulary (e.g., Bialystok et al., 2010; Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993) and slower lexical access (Magiste, 1992) than monolingual children. Similarly, research on adult L2 and L1 vocabulary size and reaction time demonstrated a smaller vocabulary size and slower access to L2 words for bilingual adults (e.g., Bialystok et al., 2008; Ivanova & Costa, 2008; Gollan et al., 2005). Despite the findings, there are drawbacks in the tasks these studies utilised. Picture naming tasks (e.g., PPVT-III) have been used to measure the vocabulary size and lexical access of participants.

The issue with these tasks is the extent to which the pictures can represent lower frequency and abstract words, or the extent to which the ambiguity of the pictures or the different interpretations of different participants of the same picture affect the vocabulary size and lexical access scores. The current study contributes to the findings of previous research on child L2 vocabulary size and reaction time by using a verbal rather than a pictorial task (see section 3.2.3).

Further, some studies carried out in the research literature on the L2 ML explored the correlation between the vocabulary size and reaction time to words. However, even the findings of the few existing studies are contradictory. For example, Laufer and Nation's (2001) and Harrington's (2006) studies demonstrated moderate and strong correlations between the vocabulary size and reaction time respectively. In contrast, Miralpeix and Meara's (2010) study exhibited no correlation between the two. Therefore, the contradictory findings of previous research deserve more attention.

Although various studies focused on the different aspects of the L2 ML such as the associations (e.g., Brown & Berko, 1960; Palermo, 1971; Fitzpatrick, 2006), vocabulary size (e.g., Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993), and reaction time (e.g., Magiste, 1992; Ivanova & Costa, 2008), no study has examined the ML as a three dimensional network in which the associations, vocabulary size, and reaction time may influence each other. For example, an increase in vocabulary size may correspond with other dimensions of the L2 ML such as the paradigmatic and syntagmatic associations or the reaction time to words. The current study, therefore, contributes to existing research on the L2 ML by examining the L2 ML as an interconnected network of words in which change in one dimension of the network may influence other dimensions of the network.

Chapter 3: Word Association Task and Lexical Decision Task

As the main purposes of the current study are to determine whether the second language (L2) mental lexicon (ML) has a similar trend of development to the first language (L1) ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1, and whether the L2 ML resembles the L1 ML at some age, a Word Association Task (WAT) is required in this study to elicit the associations of words. Additionally, a Lexical Decision Task (LDT) is required as a tool to measure vocabulary size and reaction time. The first objective of this chapter is to introduce the WAT and LDT. The second objective is to review a range of similar tasks utilised in the areas of word associations, vocabulary size, and reaction time measures. This will help in determining the most applicable tasks for the current study, provide justification for adopting them, and eliminate those tasks not directly relevant to the purposes of the current study.

In the areas of word associations, vocabulary size, and reaction time measures, elicitation tasks have been used to provide information on the way words are organised (associated), and the speed at which they are retrieved. For example, the WAT as an elicitation task elicits associations (paradigmatic, syntagmatic, and phonological associations, see section 4.5.1.1) between stimulus words and responses provided by the task taker. On the basis of information elicited by this elicitation task, conclusions are drawn about the organisation of words in the ML of the task takers. Due to the nature of such information, elicitation tasks are preferred to the naturalistic data collection. The nature of such information requires creating an artificial environment in which a stimulus word is presented to a task taker, and the task taker is required to provide the first word that comes to mind as quickly as possible. This type of information cannot be extracted from naturalistic data.

There are a number of elicitation tasks devised in the area of associations among which the tasks devised by Read (1995) and Schoonen and Verhallen (2008) are most relevant to the purposes of the current study. Further, elicitation tasks have been devised by Meara (1986), Laufer and Nation (2001), Segalowitz and Freed (2004), Harrington (2006), and Coulson (2010) which have been utilised in the areas of vocabulary size and reaction time.

The first section of this chapter introduces the WAT and provides an overview of its development. This will be followed by an explanation of the purpose and construct of the WAT, and a review of a range of task formats resulting in the choice of the WAT (compiled using the Word Family List (WFL), Nation, 2012) utilised in the current study. The second

section of this chapter introduces the yes/no LDT and provides details on its development and purposes. This is followed by a review of similar tasks leading to the choice of LDT (yes/no LDT, Harrington, 2006) utilised in the current study.

3.1. Word Association Task

A WAT is traditionally a list of stimulus words presented to a task taker who is then required to produce the first response which comes to mind. For example, the stimulus word *apple* is presented to a task taker, and s/he responds *orange*. The response can be a single word, for example the response *orange* for the stimulus word *apple*, or continuous which is a certain number of responses to the stimulus word, such as *orange, pear, banana, tree, green*, and *red* for the stimulus word *apple*. The responses produced by the task takers are either matched against a norm list of associations or classified according to the associations between the stimulus word and response(s).

The first method (matching the task takers' responses against a norm list of associations) involves determining whether a task taker's responses are similar to the responses of the target respondents. For this purpose, a norm list of associations is generated from the responses provided by a large number of target respondents to a list of stimulus words, such as the Kent-Rosanoff (1910) and Woodrow and Lowell (1916) norm lists of associations. For example, a stimulus word such as *massive* is presented to an L2 task taker, and s/he provides the responses *huge, big, large*, and *mountain*. These responses are then matched against a norm list of associations which has been collected from a large number of L1 speakers. If the L2 task taker's responses appear on the norm list of associations, they are considered nativelike.

In the second method (classifying the associations according to the association types between the stimulus word and response), the responses provided to the WAT by the task takers are classified according to the associations between the stimulus word and response(s). The associations are classified as paradigmatic, syntagmatic, and phonological. For example, a task taker produces *large* to the stimulus word *massive*. The researcher decides the association between the stimulus word and response which in this case is paradigmatic (the stimulus word and response have a close semantic connection with each other and are from the same word class (see section 4.5.1.1).

Research in the area of associations has used different methods to present the stimulus words on the WAT to the task takers. These methods are the aural-oral method (Brown & Berko, 1960; Ervin, 1961; Wolter, 2001), the aural-written method (Sokmen, 1993), the written-oral method, and the written-written method (Entwisle, 1966; Fitzpatrick, 2006). As the name for each method indicates, the stimulus word is presented to the task taker through aural or written stimuli, and the task taker responds orally or in writing. In aural-oral and aural-written methods, the stimulus word is received aurally. The task taker provides response(s) either orally (aural-oral method) or in writing (aural-written method). In written-oral and written-written methods, the stimulus word is presented to the task taker in writing. The task taker provides oral or written responses respectively.

As Wolter (2001) notes, there has been little research in the area of word associations on whether the results generated from one method are comparable to the results generated from another method. Only Palermo (1971) compared the results of the aural-oral method to those of the written-written method. The findings of her study revealed that the number of paradigmatic associations that the task takers provided was higher using the aural-oral method than the written-written method. Additionally, according to Wolter (2001), the aural-oral method is in line with the view that if the visual stimuli (used in the written-oral and written-written methods) are eliminated from the WAT, there will be the least resistance in the mental processing of the stimulus words. Therefore, the aural-oral method seems to be more capable of assessing subconscious associations among words in the L2 and L1 ML.

3.1.1. Word Association Task purpose

WATs have been used to elicit how words are organised (associated) in the L1 and L2 ML (e.g., Fitzpatrick, 2006; Zareva, 2007) and how well they are known (depth of word knowledge), (e.g., Read, 1995, 2000). In addition, they have been used to measure vocabulary size (e.g., Meara & Fitzpatrick's Lex30 WAT, 2000) and language proficiency (e.g., Kruse et al., 1987). The WATs of interest to the current study are those which investigate the organisation of words in the L2 and L1 ML to determine whether the L2 ML has a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time. The WAT which provides information on the organisation of the ML has the following characteristics:

a) It generally elicits a productive (in contrast to receptive) response. Productive vocabulary refers to words which language users have a precise knowledge in respect of their form and meaning and subsequently use them in communication. In contrast, receptive vocabulary refers to words which language users can recognise in respect of their form and meaning but hardly use them in their communication (Nation, 2001).
b) Its response analysis primarily provides information on the type of associations (paradigmatic, syntagmatic, or phonological associations) between the stimulus word and response.
c) It is believed to elicit subconscious associations between the stimulus word and response.

This is seen in the following example for the response *banana* to the stimulus word *apple*:

a) *Banana* is a productive response as the task taker puts forward the response from memory rather than from a receptive list of possible responses.
b) There is a paradigmatic association between *apple* and *banana* as the stimulus word and response have a close semantic connection with each other and are from the same word class (see section 4.5.1.1).
c) As *banana* is the first word which came to the task taker's mind, it is thought that the paradigmatic association is a stronger type of association for the stimulus word *banana* than syntagmatic or phonological associations.

On the other hand, the WATs providing information on the depth of word knowledge have the following characteristics:

a) They generally elicit receptive responses.
b) Their response analysis primarily focuses on the number of associations for each stimulus word.
c) Generally, they do not tend to elicit subconscious connections between the stimulus word and responses.

This is demonstrated in the example where the task taker is presented with the stimulus word *sudden*, with possible responses being *surprising, quick, change,* and *noise*, and distracters being *beautiful, thirsty, doctor*, and *school* (example taken from Read, 1995). The task taker selects *surprising, quick, change,* and *noise* as responses for the stimulus word *sudden*.

a) The selected responses are receptive words as they were provided to the task taker to choose from.
b) The number of associations found is four which indicates that the task taker has a deep knowledge of the stimulus word as s/he found all the associated words to the stimulus word.
c) Although the selected responses have paradigmatic (quick and surprising) and syntagmatic (change and noise) associations with the stimulus word, the task does not specify which type of association is stronger.

3.1.2. Word Association Task development

Before the WAT was used in the field of linguistics in order to inform us of the way in which words are associated in the ML, it was used extensively in the fields of philosophy and psychology for centuries. Philosophers used the WAT in order to elicit information about the nature of the mind and the sequence of ideas in it. The sequence of ideas in mind is explained by the *classical association theory* (circ. 1750-1900). According to this theory, thoughts and ideas are determined by the *law of contiguity* as the primary law of association. The law of contiguity refers to the fact that one idea or thought naturally leads to another idea or thought which in turn leads to other ideas and thoughts. Therefore, the WAT helps in grasping the sequence of ideas and thoughts in the mind. The early Greek philosophers' belief in the law of contiguity was to the extent that they noted that this law can explain the most complicated thoughts and mental processes (Entwisle, 1966).

In addition to the primary law of associations, the law of contiguity, secondary laws were also formulated in philosophy. The secondary laws of associations took into consideration the task and task taker variables. The task variables included the frequency and intensity of ideas. For example, they maintained the strength of the relationship between two ideas and thoughts depended on how often they occurred together. The task taker variables also included the constitutional differences among the task takers, their different past experiences and change in their emotional state (Crammer, 1968).

In addition to the popularity of the WAT in the field of philosophy, a large number of investigations have been conducted in the field of psychology for the same reason that the word associations reflect the nature of the mind and its thought processes. According to Deese (1965) "we study associations in order to make inferences about the nature of human

thought, and these associations are cast in the language which embodies the thought" (1965, p. 4). Further, with the popularity of behaviourism in the field of psychology, and as verbal behaviour is known to affect thoughts, behavioural psychologists also took interest in word associations specifically in the study of the primary law of associations (as the law reflects the formation of ideas and thoughts in the human mind) and the use of the WAT (Soderman, 1993). Additionally, a large number of linguists and psycholinguists took interest in the study of word associations in order to investigate linguistic development and in particular lexical development.

In the 1960s, a directional change occurred in the use of the WAT. Before the 1960s, as the main purpose of the WAT was to grasp the sequence of ideas and thoughts in the mind (or the sequence of words in the mind), norm lists of associations were made based on responses provided by a large number of target respondents to a large number of stimulus words (see section 3.1). In contrast, in the 1960s, it was established that it is the semantic connection between the stimulus word and the response that is of importance rather than the actual responses that the participants provide to the stimulus words. Therefore, the WAT was used as a tool to elicit the semantic connections between the stimulus words and responses. The semantic connection was defined using different categories. The paradigmatic, syntagmatic, and phonological associations (see section 4.5.1.1) were among the most widely used categories.

In the 1960s, the use of the WAT was mainly limited to elicit child and adult L1 associations. Researchers used the WAT to compare the word associations of child L1 to those of adult L1 in order to investigate the lexical development in children (e.g., Brown & Berko, 1960; Ervin, 1961; Entwisle, 1966). In the 1970s, however, researchers in the field of L2 learning and specifically L2 lexical development took interest in the use of the WAT (e.g., Meara, 1978). They mainly utilised the WAT to compare the word associations of adult L2 learners and native speakers of the language. They focused on whether the associations of the L2 learners were similar to those of native speakers, and whether with an increase in proficiency, the L2 associations became nativelike (e.g., Fitzpatrick, 2006; Zareva, 2007).

3.1.3. Word Association Task construct

As mentioned earlier, a WAT is a list of stimulus words presented to a task taker who is then required to produce the first response which comes to mind. WATs are used to elicit the

organisation (associations) of words in the ML. This section provides details on the construct of the WAT. First, this section focuses on word lists and frequency data as sources of stimulus words. The Kent-Rosanoff List (1910) as one of the most frequently used word lists and Nation's Word Family List (2012) are introduced. Further, the advantages and disadvantages of these lists are discussed. Second, this section focuses on the sampling methods used to elicit stimulus words from lists and frequency data. Systematic sampling with a random start is introduced as one of the main sampling methods.

3.1.3.1. Word lists and frequency data

3.1.3.1.1. Kent-Rosanoff List (1910)

Various word lists and frequency data have been used as sources of stimulus words for the WAT in the literature relating to word associations. The famous but now old Kent-Rosanoff List (1910) has been used repeatedly in research on L2 and L1 word associations for both children and adults (e.g., Brown & Berko, 1960; Soderman, 1993; Sokmen, 1993). This list contains 100 common words (high-frequency words) from noun and adjective word classes. The repeated use of this list is due to the following characteristics:

a) This list contains high-frequency words. Studies conducted on L2 learners with lower proficiency levels have a preference for high-frequency stimulus words. Soderman (1993) used this list in her first experiment as the use of high-frequency words was a prerequisite for the beginner L2 learners of her study.
b) This list has a well-established norm list of associations which covers different norms for various ages, languages, and geographical areas.
c) This list has value for comparative purposes as it was used almost exclusively in all association studies before and during 1960s (Entwisle, 1966).

The use of the Kent-Rosanoff List (1910) is problematic today. In addition to being old and comprising only nouns and adjectives, the high-frequency words used on the list tend to elicit only high-frequency responses in both L2 and L1 participants. As such, the generalisability of the results is limited to only the high-frequency words. Furthermore, comparing a specific group's responses to the WAT with a norm list of associations has been criticised. Fitzpatrick's (2009) study revealed that even the responses of native speakers of English to the same stimulus words were variable and not homogeneous. Her study showed that the native speakers had personal preferences for a specific type of response or a specific type of

association (paradigmatic, syntagmatic, or phonological association). The disadvantages of this list preclude its use in the current study.

3.1.3.1.2. Nation Word Family List (2012)

The use of lists with frequency information became fashionable in the 1990s and 2000s. More researchers such as Wolter (2001) used lists with frequency information as a source of stimulus words (although lists with frequency information were sporadically used before as in Stolz and Tiffany's (1972) study). These lists contain information on the frequency of occurrence of words in large corpora. The frequency is derived from the written or transcribed oral corpora in a specific context (e.g., university context) or a general one (e.g., variety of contexts). This information (frequency of occurrence) is presented with the words on these lists. If a word has a higher frequency of occurrence, it is more likely to be known by the language users as it occurs more frequently in the everyday language. If a word has a lower frequency of occurrence, it is less likely to be known as it occurs less frequently in everyday language.

One large and up-to-date example of frequency data is the WFL devised by Nation (2012). In contrast to the Kent-Rosanoff List (1910), the WFL contains words from various word classes (nouns, adjectives, verbs, and adverbs) and frequency ranges. It has 34 word lists: Word list 1 contains words in the first 1k frequency of occurrence; word list 2 contains words in the 2k frequency of occurrence and so on until word list 34.

Words in the WFL are from two large corpora: the British National Corpus (BNC) and the Corpus of Contemporary American English (COCA). Therefore, this list is representative of a large number of words from a large array of sources. The BNC is a 100 million word text corpus of samples of written and spoken English. The corpus covers British English of the late twentieth century from a variety of sources with the intention that it be a representative sample of spoken and written British English of that time. It comprises two parts: the demographic and the context-governed. The demographic part contains transcriptions of spontaneous natural conversations between families and friends. The context-governed part contains a slightly more structured language, such as the language used in meetings, lectures, and broadcasts.

COCA is the only publically available corpus of American English. It is a large corpus which contains a wide range of texts from a wide range of sources. The corpus is composed of more than 410 million words from more than 160,000 texts. It is evenly divided between the five sources of fiction, popular, magazines, newspapers, and academic journals.

The strength of the WFL is that, in addition to containing words from written corpora, it contains words from spoken corpora. Nation (2012) believes that the formal written nature of the BNC affects the words appearing in the high-frequency levels. For example, words such as *cat*, *hello*, and *sun* occur in the lower frequency levels, and more formal words such as *civil* and *commissioner* occur in the first 1k frequency range. Nation suggests that the spoken nature of the words may represent the order in which L2 learners learn the words.

Despite the strength of the WFL, it has limitations. One limitation of the WFL, not exclusive to this list, is that there are words in the higher frequency ranges of the WFL which do not seem to be known or be among the most frequently used words of language users, for example *civil* and *commissioner*. This limitation is caused by the fact that the WFL contains words from a wide range of sources (fiction, magazines, newspapers, and journals). The formal and written nature of these sources affects the words occurring in the high-frequency ranges. Although Nation (2012) addressed this issue by including the spoken corpora in the WFL, the issue deserves more attention. The current study addresses this issue further as explained in detail in the methodology chapter (see section 4.4.2).

3.1.3.2. Sampling method

The stimulus words used in a WAT are selected from word lists and frequency data (the stimulus word sources) using a sampling method. Systematic sampling with a random start is one popular method for sampling words from large sources of stimulus words and has been used by researchers such as Wolter (2001) and Zareva (2007). In this sampling method, words are selected at a specific interval from a randomly determined starting point in a word source. For example, Wolter (2001) started from the 1000-1100 frequency range of a frequency list and selected one noun, one adjective, and one verb from a range of 100 words. The intervals for him were 500 words. Thus, three words were chosen from the 1000-1100 frequency range, the next three from the 1500-1600 frequency range, followed by the 2000-2100 frequency range, and so forth.

The motivation behind the use of systematic sampling with a random start method is that this sampling method allows a sample of words which represents different word classes and contains words from various frequency ranges (higher and lower frequency ranges) coming from a broad range of usage (formal and informal), (Zareva, 2007). According to Zareva (2007), the resulted sample is ". . . close to word occurrences in natural language . . ." (p. 132).

In addition to the use of systematic sampling with a random start, in some cases all the words on a list are used. For example, some researchers used all or most of the words on the Kent-Rosanoff List (1910) as the stimulus words for their studies (e.g., Soderman, 1993) as there are only 100 words on this list. Based on the advantages of systematic sampling with a random start discussed above, this method is used as the sampling method in the current study (see methodology chapter, section 4.4.1.1).

3.1.4. Word Association Task formats

In addition to the WAT as a list of stimulus words which elicits the type of association between the stimulus word and response, there is another type of WAT which measures the number of associations between them. In this task, there is a network of words in which the stimulus word is surrounded by associated words (words which are associated with the stimulus word in a meaningful way) and distracters (words which are not associated with the stimulus word). The task taker is required to link the associated words to the stimulus words. The purpose of this task is to measure the number of associations that the task takers notice and thus determine the depth of word knowledge. If a task taker notices more associations for a particular stimulus word, the word knowledge is deeper for that word compared to stimulus words for which the task taker notices fewer associations. This section will review two WATs which measure the number of associations between stimulus words and responses.

3.1.4.1. Read (1995)

Read (1995) emphasised the importance of measuring the depth of word knowledge and noted that it is important to make a distinction between the breadth (the number of words that individuals know) and the depth (how well each word is known) of word knowledge in the area of L2 vocabulary learning. In an attempt to bridge the gap between the measures of breadth and depth, Read (1995) designed a WAT format containing 40 stimulus adjectives

which measures the depth of word knowledge. The stimulus adjectives were selected from Bernard's Second and Third Thousand Word List (Nation, 1986). The focus was on words with which most of the task takers were likely to be familiar. This was determined by the purpose of this WAT which was to measure the depth of word knowledge for words which were known.

In this task, each stimulus adjective is followed by eight associated words and distracters divided into two groups of four. The example shown in Table 3.1 below illustrates the relationship between the stimulus word *sudden* and its associated words and distracters.

Table 3.1
Associated Words and Distracters for the Stimulus Word Sudden

Beautiful Quick Surprising Thirsty	Change Doctor Noise School

As Table 3.1 shows, the adjectives are either synonyms for the stimulus word or represent one aspect of its meaning. They can have paradigmatic associations (*quick* and *surprising*) or syntagmatic associations with the stimulus word (*change* and *noise*). Over half of the stimulus words used in this task have two associates in the first box and two in the second. The others have a pattern of one in one box and three in the other to reduce the potential for guessing. The task taker is required to select four words associated with the stimulus word.

One of the advantages of this task is that it does not have the limitations of an interview. Read (1995) noted that the standard procedure for measuring the depth of word knowledge specifically for children involves eliciting an explanation or definition for each word. The explanation and definition are usually elicited from the task taker in an interview. The obvious limitations of an interview are that:

a) only a limited number of words can be covered in a reasonable amount of time;
b) it is labour intensive as each task taker has to be interviewed individually;
c) the interview demands a certain level of speaking proficiency in the L2 specifically when the interviewees are required to respond in their L2.

In contrast, this task covers a reasonable number of words. It is not labour intensive, nor does it require high levels of speaking proficiency. Moreover, it probes the depth of vocabulary knowledge in a meaningful way.

Another advantage of this task is that it reduces guessing by the task takers. As mentioned above, the eight associated responses and distracters are presented in two groups of four. The correct responses have a pattern of two (in the first box) and two (in the second box) or one (in the first or second box) and three (in the other). In this way, guessing by the task taker is reduced.

Despite the advantages of this task, it is discarded for use in the current study. This is due to the fact that this task measures the number of associations between stimulus words and responses but does not elicit the type of associations (paradigmatic, syntagmatic, and phonological, see section 4.5.1.1) between them. As the current study focuses on the type of associations, this task is not utilised in the current study.

3.1.4.2. Schoonen and Verhallen (2008)

Schoonen and Verhallen (2008) developed a WAT for Dutch primary school L2 and L1 children. Like Read (1995), Schoonen and Verhallen (2008) observed that there was a lack of efficient instruments for assessing the depth of word knowledge of Dutch primary school children. They explained that knowledge of a word is more than just matching the word to the corresponding picture or synonym. It includes the word's meaning, word class, pragmatic and sociolinguistic knowledge, and its collocations none of which existing vocabulary tests addressed.

Schoonen and Verhallen (2008) designed a WAT based on the Read (1995) WAT which measures the depth of word knowledge. The WAT contains 50 sets of stimulus words selected from several Dutch frequency lists for educational contexts (Coenen & Vermeer, 1988; Schrooten & Vermeer, 1994; Van Gelderen, 1994, cited in Schoonen & Verhallen, 2008). Only the content words are included as they are the main carriers of meaning. The assumption of this task is that if a task taker identifies the words associated to a stimulus word (which represent different aspects of the stimulus word's meaning), s/he has a deeper knowledge of the word compared to a task taker who cannot identify them.

Schoonen and Verhallen (2008) changed the design of Read's (1995) task. As the new task was to be used with school-aged children, changes were applied as follows:

a) There are no distracters in this format. This is due to the fact that the purpose of the new format is for the task taker to differentiate between words which are semantically associated to the stimulus words, and words which are more incidentally associated.
b) There are six possibly associated words instead of eight.
c) The stimulus words are presented in a word web.

In Figure 3.1 below, the stimulus word *banana* is placed at the centre of six associated words. The task takers are required to select three words which are associated with the stimulus word irrespective of the physical context of the words. This means that there is no absolute boundary between the right and wrong answers. However, according to Schoonen and Verhallen (2008), the instruction to choose three associations should lead the task taker to the correct answers.

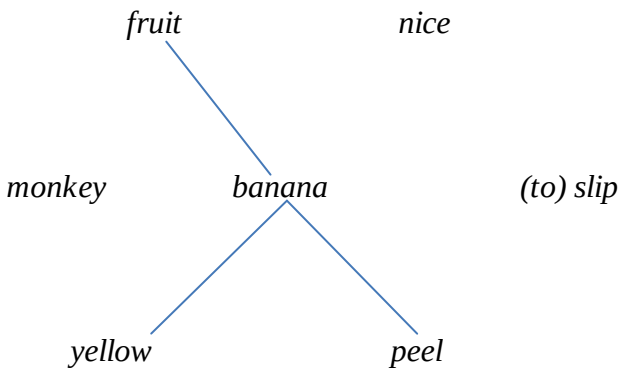

Figure 3.1. Stimulus word *banana* in the network of associated words.

Despite the strength of this task as it assesses depth of word knowledge, this task is not utilised in the current study. Like the previous task (devised by Read, 1995), this task measures the number of associations between the stimulus word and responses but does not elicit the type of associations between them. As the current study focuses on the types of associations, this WAT is eliminated.

3.1.5. Word Association Task in the current study

The main purposes of the current study are to investigate whether the L2 ML has a similar trend of development to the L1 ML in terms of associations (types of association: paradigmatic, syntagmatic, and phonological), vocabulary size, and reaction time, and whether the L2 ML resembles the L1 ML at some age. It is crucial, therefore, to utilise a WAT which elicits the type of association between the stimulus word and response. Thus, a

WAT which elicits the type of association was chosen over a WAT which probes the depth of word knowledge (e.g., Read, 1995; Schoonen & Verhallen, 2008 WATs, see section 3.1.4). Among the word lists and frequency data available in the literature of research on word associations reviewed earlier (e.g., Kent-Rosanoff List, 1910; Nation's WFL, 2012), the attributes of Nation's WFL (2012) established it as the most appropriate source of stimulus words for the current study.

The most important attribute of Nation's (2012) WFL for the current study is that the WFL contains words from various word classes (e.g., nouns, adjectives, and verbs) and frequency ranges (1k-34k). Having words from various word classes and frequency ranges in the WAT allows the findings of the current study to be representative of a large number of words in the ML not just the high-frequency words from a particular word class. Thus, the findings are generalisable to a larger range of words in the ML.

In addition to the advantage of the WFL in terms of the generalisability of the findings, the use of words from various frequency ranges allows the study to compare L2 and L1 students with close language proficiency levels (the participants of the current study). The difference between the two groups with close language proficiency may apply to low-frequency words. To determine whether the difference applies to low-frequency words, the WFL is used in the present study as it contains words from various frequency ranges including the low-frequency ones.

Further, unlike the Kent-Rosanoff List (1910), the WFL is new and contains an updated set of word lists and thus reflects the dynamic nature of the English language. Additionally, the WFL contains words from two large corpora: the BNC and the COCA. It is not limited to a specific context (e.g., university texts) but represents words from a broad range of sources from spontaneous natural conversations to more structured languages (see section 3.1.3.1.2).

Despite all the advantages, the problem in the WFL of unfamiliar words occurring in the high-frequency ranges (see section 3.1.3.1.2) needed to be addressed. As mentioned earlier, there are formal and less familiar words which exist in the high-frequency ranges of the WFL. The participants of the current study were school-aged children and thus were likely to be unfamiliar with those words. The current study dealt with this issue by conducting a pilot study. This is explained in detail in the methodology chapter (see section 4.4.2).

Also, it would have been more suitable to use a stimulus word source which was generated using school children's corpora in the Australian context. The WAT compiled using stimulus

words from this type of corpora represents words to which children are exposed in and out of school in the Australian context. This option was hindered by the lack of frequency data for school-aged children in the Australian context.

3.2. Yes/no Lexical Decision Task and its purpose

The yes/no LDT is a standard psycholinguistic tool which is used to measure vocabulary size and reaction time. This task contains words and pseudowords. Words are selected from word lists and frequency data (similar to the word sources used for WATs). Pseudowords are nonwords made by the task developers to control guessing by task takers. Pseudowords obey the phonological, morphological, and orthographic rules of the language but do not exist in the given language such as *morge* (example taken from Harrington's yes/no LDT used in the present study). In this task, a written item (a word or a pseudoword) appears on the computer screen, and the task taker has 5 seconds to respond *yes* if s/he knows the word, or *no* if s/he does not know the word by pressing the appropriate key on the keyboard. If s/he says *yes* to a word, the task taker gains scores. If the task taker claims knowledge of a pseudoword, the vocabulary knowledge score is adjusted to a lower score (Harrington, 2006).

In this task format a *yes* response to a word is defined as a hit whereas a *yes* response to a pseudoword is defined as a false-alarm; a *no* response to a word is a miss whereas a *no* response to a pseudoword is a correct rejection (Harrington, 2006). The response matrix is shown below in Figure 3.2.

	word	nonword
yes	Hit	False-alarm
no	Miss	Correct rejection

Figure 3.2. Item alternatives in the yes/no LDT.

The score for vocabulary size is calculated by using the correction for guessing formula (cgf). The cgf calculates the vocabulary size by subtracting the proportion of false-alarms from the proportion of hits, divided by the proportion of pseudowords which were correctly rejected. The task taker is given a score out of 100. Reaction time is measured by the mean amount of

time it takes the task taker to respond to each word and is only measured for the hits. The task score is automatically calculated by the computer (Harrington, 2006).

The cfg scoring method is based on the *blind guessing model* which is used to correct the scores for guessing by the task takers. When a *yes* response is chosen, there are two possibilities: either the task taker knows the meaning of the word, or s/he is guessing at random. In the first case, the probability of a correct answer is 1, while in the second case, the probability of a correct answer is 1/K, K being the number of response alternatives. Below is the equation for the blind guessing model:

$$P(h) = P^*(h) + P(f)\ [1 - p^*(h)]$$

The observed hit rate = P(h), true hit rate = P*(h), false-alarm rate = P(f).
The above equation is reformulated as the equation of correction for guessing which enables researchers to estimate the true hit rate (Huibregtse et al., 2002):

$$P^*(h) = \frac{P(h) - P(f)}{1 - P(f)}$$

The yes/no LDT is used in the area of L2 acquisition research to measure vocabulary size and reaction time. Vocabulary size is measured by the ability of the task taker to discriminate between words and pseudowords and has implications for testing and placement (e.g., Meara, 1996b). Reaction time is measured by the time it takes to respond to each item and has implications for lexical processing skills, reading, and writing in the L2 (Segalowitz & Hulstijn, 2005; van Gelderen et al., 2004). The yes/no LDT has also been used with bilinguals to determine the dominant language (Lambert, 1955; Lambert et al., 1959). The higher speed of word recognition in one language indicates the dominant language. In addition to measuring vocabulary knowledge, the yes/no LDT has also been used in grammar tests (Beeckmans et al., 2001; Eyckmans, 2004).

3.2.1. Yes/no Lexical Decision Task development

The yes/no LDT in today's format has been developing rapidly since the 1980s. This section presents the formulation and development of the yes/no LDT. In particular, it provides details

on the traditional basis of the format in the 1920s, the introduction of pseudowords to the task in the early 1980s, the use of the yes/no LDT in L2 studies in the late 1980s, the first computerised use of this task in the late 1980s, the use of various formulas for calculating scores from the early 1990s to date, and its use in the measurement of reaction time.

3.2.1.1. Traditional basis

The yes/no LDT is based on a checklist format. A checklist format is a traditional pencil and paper method which was first used in L1 studies to measure vocabulary size. It presents task takers with a list of words from which they are required to mark the words they know. The score on this format is based on the task takers' self-assessment of their vocabulary knowledge. The checklist format was first developed in the 1920s and was utilised by researchers such as Sims (1929), Tilley (1936), and Zimmerman et al. (1977).

3.2.1.2. Use of pseudowords

It was in the early 1980s that pseudowords were first introduced to the checklist format. On the basis that the task takers' self-assessment of their vocabulary knowledge was a poor way of assessing vocabulary knowledge, Anderson and Freebody (1983) added a number of nonexisting imaginary words (pseudowords) in the yes/no LDT. The use of pseudowords enabled researchers to make an educated guess on how much guessing a task taker makes. If task takers mark the pseudowords as known, their score for vocabulary size is adjusted to a lower score.

3.2.1.3. Application in L2 studies

In the late 1980s, Meara and Buxton (1987) applied the yes/no LDT containing both words and pseudowords in L2 studies to establish whether the score for vocabulary size generated using the yes/no LDT correlated with the score for vocabulary size using a multiple choice vocabulary task (the Cambridge First Certificate Examination). They designed a yes/no LDT consisting of 60 words and 40 pseudowords. The task takers were required to indicate whether they knew the meaning of the presented items or not. The findings revealed a high correlation between the results generated using the yes/no LDT and those generated using the multiple choice task. Therefore, the yes/no LDT was established as an informative measure of vocabulary knowledge in L2 studies. On the significance of yes/no LDT, Meara and Buxton

(1987) further stated that "what looks initially like a simple-minded idea turns out, on future examination, to be a remarkably powerful test technique" (p. 150).

3.2.1.4. Computerised version

It was also in the late 1980s that the first computerised yes/no LDT was introduced. Meara and Jones (1988) developed the first computerised format of this task under the title Eurocentres Vocabulary Size Test (EVST). The computerised version of the task emerged out of the need for a fast and efficient placement test for the Eurocentres schools[9]. The placement tests used at the time were not time and resource efficient as the administration and marking of the tests took a long time. In this context, Meara and Jones (1988) used the computerised version of the yes/no LDT for L2 students to estimate their vocabulary size. This task was divided into a number of levels, each level containing words from a 1k frequency range. If task takers scored highly on the highest frequency range, they were tested on the next frequency range. Today, one of the advantages of the yes/no LDT is that it is time and energy efficient. This advantage makes it an attractive tool for the measurement of vocabulary size.

3.2.1.5. Different models to calculate vocabulary size scores

3.2.1.5.1. Blind guessing model

In the early 1990s, Meara (1992) proposed a different model for calculating the score for vocabulary size using the yes/no LDT. In the 1980s, concern was raised regarding the use of the blind guessing model (see section 3.2) for calculation of the score for vocabulary size. The concern was that this model overestimated the true vocabulary knowledge of task takers. According to Huibregtse et al. (2002), the overestimation of true vocabulary size is due to the following issues with the blind guessing model:

The first issue with the blind guessing model is that the calculation of score for vocabulary size fails to take into consideration the response style of the individual task takers. Response style is the individual preference for choosing one response over another. For example, if a word is known moderately well, one task taker may say s/he knows the word, while another may say s/he does not know the word. Although knowledge of the word is similar for both

[9] The Eurocentres schools are language schools in the UK which provide short language courses. A large number of students are assessed and assigned to the classes of their level every few weeks.

task takers, a *yes* response is recorded for the first task taker, and a *no* response for the second one.

The second issue with the blind guessing model concerns the assumption of the *yes* response in this model. The *Yes* response in the model means perfect knowledge of the word, while it may well be that the task taker does not really know the meaning of the word and is making a sophisticated guess. A sophisticated guess refers to making a random guess which happens to be the correct response. This model does not take into account sophisticated guessing by the task takers.

The third issue with the blind guessing model concerns the peculiarities of the cgf (correction for guessing formula) equation (see section 3.2.1.5.1). For example, if the observed hit is 1.0 in the equation, the corrected hit will be 1.0 regardless of the proportion of false-alarms. This means that if task takers respond *yes* to all the words and reject all the pseudowords, they obtain the same score as task takers who respond *yes* to all the words and most of the pseudowords.

3.2.1.5.2. Signal Detection Theory

Considering the issues with the blind guessing model, Meara (1992b) proposed the delta m formula based on Signal Detection Theory (SDT). In contrast to the blind guessing model, this model accounts for sophisticated guessing and the gradual acquisition of words. Nevertheless, there are concerns with the accuracy of vocabulary size scores using this model. Huibregtse et al. (2002) noted that in this model, the vocabulary size score rapidly reaches the value of 0. This occurs even when the false-alarm rate (guessing) is low. Additionally, the SDT causes large differences in vocabulary size scores in cases where the actual difference is small. For example, if the task taker responds *yes* to half of the real words and none of the pseudowords, the value of the delta m is 0.5. In the same scenario, if the task taker responds *yes* to one pseudoword instead of none, the value of the score becomes 0.37. The difference between 0.5 and 0.37 is more than 10% of the total score range, while the difference between the two task takers is responding *yes* to one pseudoword instead of none.

3.2.1.5.3. I/SDT

In the 2000s, a more complicated formula, the I/SDT, was proposed by Huibregtse et al. (2002) which took the above-mentioned issues into consideration. However, there are other

issues with this formula. According to Mochida and Harrington (2006), I/SDT is overly conservative, and the scores are generally overcorrected for false-alarms. I/SDT overestimates the performance of the task taker when the hit and false-alarm rates are low. Additionally, when the hits are low and the false-alarms are high, I/SDT provides an uninterpretable score or even a null interpretation. This is not the only problem. Even this formula does not account for the individual's tendency to choose a specific response (response style). Further, Mochida and Harrington (2006) argued that despite the fact that, theoretically, one method of scoring can be preferred over the other, in actual terms, the difference between the scores generated from different scoring methods is very small.

3.2.1.6. A measure of reaction time

While initially the yes/no LDT was utilised in L1 and L2 studies as a measure of vocabulary size, it is also used to measure reaction time. The interest in developing a task which measures the speed of word recognition (reaction time) in addition to vocabulary size is rooted in the important role that word recognition plays in comprehension and the importance of speed in the word recognition process. The importance of considering speed in the word recognition process has increasingly interested researchers in the area of L2 learning. This has resulted in the development of LDTs which are facilitated by speed recording devices. The calculation of reaction time is simpler than the calculation of vocabulary size. The total reaction time is the mean reaction time for each hit (yes to word) which is calculated by the computer. The reaction time is not calculated for the miss, right rejection, or false-alarm as the purpose of this task is to measure the reaction time to known words.

3.2.2. Other task formats

In addition to the yes/no LDT format, there are other task formats which have been utilised in the recent literature on the measurement of vocabulary size and/or reaction time. For example, in these task formats, the task taker is required to do the following:

a) decide whether the presented item is animate or inanimate (Segalowitz & Freed, 2004);
b) link the presented item to its definition in a multiple choice format (Laufer & Nation, 2001);
c) find a hidden word in a string of letters (Meara, 1986; Coulson, 2010).

Depending on the purpose of the studies, different task formats have been utilised in different studies. For example, Segalowitz and Freed's (2004) task only contains high-frequency words and is used in studies which do not investigate the effect of word frequency on reaction time. This section provides details on each of the above-mentioned tasks, their advantages and disadvantages, and justification for not using them as a measure of vocabulary size and reaction time in the present study.

3.2.2.1. Segalowitz and Freed (2004)

In an attempt to investigate the cognitive abilities which interact with language learning and influence oral performance, Segalowitz and Freed (2004) designed a two alternative choice animacy task to measure the speed at which words are accessed.

This is a computerised task containing high-frequency written nouns in English and Spanish. Animate and inanimate nouns are presented to the task takers in a random order such as *the boy, a lady, a pencil, a lamp,* etc. Each noun appears on the computer screen with a definite and indefinite article (the, a, and an). This is to ensure that the English nouns are not interpreted as verbs and to stress the English or Spanish characters of words. The high-frequency words are chosen from the Quinlan List (1992) which are familiar to educated English speakers. Examples of these high-frequency words are *comb*, *bicycle*, and *spoon*. Most of the Spanish words are the Spanish translation of the English words used in the task. The task taker has to decide on whether the word is animate or inanimate as quickly as possible and press the appropriate key on the keyboard. The reaction time to words is recorded by computer.

Although the two alternative choice animacy task devised by Segalowitz and Freed (2004) is utilised to measure reaction time to words, the reaction time scores are only representative of a limited number of words and cannot be generalised to a broader range of words in the ML. This task consists of nouns which are familiar to educated English speakers (e.g., *the boy, a lady, a pencil, a lamp*). It excludes lower frequency words or words from other word classes. The scores, therefore, are not generalisable to lower frequency words and words from different word classes.

In addition to the generalisability issue with Segalowitz and Freed's (2004) two alternative choice animacy task, the ability of the task to distinguish between two groups of language

users with close language proficiencies is an issue. For example, when this task is used with L1 students and high-proficiency L2 learners, it is likely that the L2 learners will recognise the high-frequency nouns at a similar speed to the L1 participants. It is possible that the difference between the two groups is with the lower frequency words. As this task does not include lower frequency words, it is not capable of differentiating between the two groups. As the participants of the present study have close levels of language proficiency, the use of this task is eliminated from this study.

3.2.2.2. Laufer and Nation (2001)

Laufer and Nation (2001) focused on the importance of the fluency of words in language usage and noted that in order for words to play an important role in everyday language usage, they have to be available fluently. Laufer and Nation (2001) devised a multiple choice task, Vocabulary Recognition Speed Test (VORST), which measures vocabulary size and reaction time. This computerised version is based on an earlier paper version called Vocabulary Levels Test (VLT), (Nation 1983, 1990 cited in Laufer & Nation, 2001). The difference between the two is that the new version contains a time-keeping device to measure reaction time.

3.2.2.2.1. Vocabulary Levels Test

The VLT (the old version) contains 90 words which are presented in 5 parts. Each part contains 18 words from one of the 5 word frequency ranges: 2k, 3k, 5k, 10k, and the University Word List (UWL). The words used in the VLT are from the Thorndike and Lorge (1944) frequency list checked against the more recent Francis and Kucera (1982) list. Each frequency range contains six blocks, and each block contains six words and three definitions. The task takers are required to match the target word with its definition by writing the appropriate number beside each definition as shown below:

1.business

2.clock	*6 part of a house*
3.horse	*3 animal with four legs*
4.pencil	*4 something used for writing*

5.shoe

6.wall

3.2.2.2.2. Vocabulary Recognition Speed Test

The Vocabulary Recognition Speed Test (VORST) is the more recent computerised version of the VLT detailed above. The computerised version is similar to the VLT in terms of the number of parts (five), tested words, and the testing procedure (to match the target words with the definitions). However, the computerised version differs from the paper version in that instead of showing all three definitions at the same time, it only displays one definition on the left of the screen together with the six word choices on the right. The task taker is required to type the number (a number from 1 to 6) of the correct answer in front of the target word. The computer then displays the next page with the new definition but the same six word choices. For example, the following is displayed on the screen for the definition *choose by voting*:

choose by voting--------
1. apply
2. elect
3. jump
4. manufacture
5. melt
6. threaten

The next screen repeats the same six word choices on the right, but a new definition appears on the left side of the screen:

become like water--------
1. apply
2. elect
3. jump
4. manufacture
5. melt
6. threaten

After the three definitions have been answered, the computer shows the following question and answer options: *Do you want to change your answer? Y/N*. If the task taker chooses *yes*, the computer displays the same section again. If the task taker responds *no*, the computer moves to the next set of words.

The strength of VORST compared to Segalowitz and Freed's (2004) two alternative choice animacy task is that it contains words from various word classes (e.g., nouns, verbs, and adjectives) and frequency ranges (the 2k, 3k, 5k, and 10k frequency ranges, and the UWL). Therefore, the scores are generalisable to a wider range of words in the ML including lower frequency words from different word classes. Further, as the task includes words from lower frequency ranges such as 10k, it has the ability to distinguish between groups of language users who are close in their language proficiency.

Another advantage of the VORST is its ability to capture a deeper word knowledge which goes beyond recognising words. This task provides a definition for the target word, and the task taker has to find the target word by reading the six possible responses. Therefore, this task measures vocabulary size by testing the task taker's knowledge of the word meaning. This characteristic distinguishes it from the yes/no LDT as the yes/no LDT measures vocabulary size by testing the task takers' ability to recognise the word without testing their knowledge of the word meaning. As such, the VORST is preferred for the purpose of eliciting a deeper aspect of word knowledge.

Although matching definitions to target words is an advantage for measuring vocabulary size in the VORST, it can be a hindrance for measuring reaction time which makes the VORST slow with a high score variability. VORST is a slow task as the task taker is required to read six alternative words for each definition. In situations where time is a crucial factor as in primary and high schools, this property becomes a hindrance. In addition, the variability of the reaction time is higher for the same reason, that the task taker has to consider six alternative responses for each definition. Harrington (2006) pointed out that the mean reaction time for a multiple choice task varies from 8 to 18 seconds for words in the 3k frequency range, while in the yes/no LDT, the reaction time ranges from .5 to 1.5 seconds. This property of the VORST may affect the validity of the mean reaction time for a group of task takers with high variability among them. As the participants of the current study are primary and high school students, a faster task with lower reaction time variability is preferred.

3.2.2.3. Meara (1986) and Coulson (2010)

In addition to the two alternative choice animacy task (Segalowitz & Freed, 2004) and the multiple choice VORST (Laufer & Nation, 2001), there is a hidden word format which has been utilised to measure the reaction time to words. Meara (1986) used the hidden word format due to the technical issues of the time. Q-Lex uses the same hidden word format which is being developed (Coulson, 2010).

Meara (1986) developed a task which measures the reaction time to words in a period of one to two seconds. This task presents strings of 20 letters in a line with each string containing an embedded single word. Apart from the embedded word, the remaining letters are random but obey the phonological and orthographic rules of English. For example, the word *simple* is embedded in the following string of letters (example from Meara, 1986).

****

* *weolsulusimpletggiha* *

****

The task taker is required to find the hidden word. Accuracy and reaction time are recorded by the computer. While this format emerged out of the practical and technical issues that Meara (1986) encountered, Q_Lex is a word recognition task devised by Coulson (2010) which uses the same method of finding a hidden word in a string of letters. The task taker is required to press the appropriate key on the keyboard when s/he recognises the word. The program records the reaction time.

Despite the fact that finding a hidden word in a string of letters is interesting, one disadvantage of this task is that variables other than the speed of word recognition may influence the reaction time to words. This task format is commonly used in Australia for both educational and noneducational purposes. Therefore, the L1 participants of the current study are likely to be familiar with it. However, the L2 participants, specifically students aged 6-7, may not be familiar with this task format as it is not commonly used internationally. Therefore, the participants' lack of familiarity with the task format may affect their scores for reaction time. This concern precludes its use in the present study.

3.2.3. Yes/no Lexical Decision Task in the current study

As the main purposes of the current study are to investigate whether the L2 ML has a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time, and whether the L2 ML resembles the L1 ML at some age, it is crucial to utilise a task which measures vocabulary size and reaction time. Thus, the yes/no LDT devised by Harrington (2006) is used as a tool to measure the vocabulary size and reaction time to words. The choice of this task is due to the attributes outlined below:

The yes/no LDT has been established as a valid and reliable tool to measure vocabulary size and reaction time. This task has been validated against more traditional tasks. Meara and Buxton (1987) reported a correlation of r = .7 between the yes/no LDT and a multiple choice task, and Mochida and Harrington (2006) reported a correlation of r = .8. With regard to the use of the yes/no LDT as a measure of vocabulary size in the L2, Meara's (1996) study revealed that the task worked well across a wide range of proficiency levels (beginners as well as advanced learners).

One strength of the yes/no LDT is that the findings generated using this task are generalisable to a broader range of words from different word classes across a wide range of frequencies in the ML. As the main purpose of the current study is to investigate whether the L2 ML has a similar trend of development to the L1 ML (in terms of associations, vocabulary size, and reaction time), it is necessary to utilise a task which includes words from various frequency ranges and word classes rather than tasks which contain only high-frequency nouns (e.g., Segalowitz & Freed, 2004, see section 3.2.2.1).

The other strength of the yes/no LDT is its ability to distinguish between groups of participants with similar language proficiencies. As the L2 participants of the current study live in the L2 country, undertake mainstream education in the L2, and have high levels of proficiency in their L2, it is crucial to use a vocabulary size and reaction time task which is capable of distinguishing between them and the L1 participants. Thus, the yes/no LDT is chosen for the present study as, in contrast to Segalowitz and Freed's (2004) task (see section 3.2.2.1), it contains words from both high- and low-frequency ranges.

Further, the mean reaction time scores provided by the yes/no LDT are less variable and more valid. The yes/no LDT is a fast task with less variable reaction time as the task taker has to

respond to one item (a word or a pseudoword) each time (see section 3.2). In contrast, in a multiple choice task such as VORST (see section 3.2.2.2.2), the reaction time and the variability of the reaction time are high as the task taker has to consider six alternative responses for each stimulus word. According to Harrington (2006), the mean reaction time varies from 8 to 18 seconds for words in the 3k frequency range in the VORST, while in the yes/no LDT, the reaction time typically ranges from .5 to 1.5 seconds. These reasons also encouraged the use of the yes/no LDT in the present study.

Additionally, the yes/no LDT is able to include a large number of words which makes it a reliable tool to measure vocabulary size and reaction time. It is necessary to include a large number of words in the task in order for the vocabulary size and reaction time scores to be reliable. In contrast to Nation's (2001) VORST in which for each task item, the task taker has to read six alternative response items, each item in the yes/no LDT requires little time to be read and completed. This allows the use of a large number of words in the construct of the yes/no LDT. The ability of this task to include a large number of words makes it a reliable tool to measure vocabulary size and reaction time.

Despite all the advantages of the yes/no LDT, there are some concerns with it which have been addressed in the current study. These concerns are outlined below:

There are a few studies such as Cameroon's (2002) which reported no correlation between the results of the yes/no LDT and a multiple choice task. Cameroon's (2002) study also reported that ESL learners had a high false-alarm rate. In response, Harrington and Carey (2009) explained that the performance of an individual on the yes/no LDT is affected by various factors outlined below:

a) the language background of the task takers: Dutch learners of French who participated in Eyckmans' (2004) study had much higher false-alarm rates than the Asian background L2 learners in Mochida and Harrington's (2006) study;
b) the proficiency levels of the task takers: Meara's (1996) study revealed that the reliability and validity of the yes/no LDT increased as the proficiency levels of the participants increased;
c) the guessing and individual response styles of the task takers: Nunnally and Bernstein (1994) suggested that the participants' individual response style and guessing have

consequences on their responses to the words and pseudowords. Some participants tend to say *yes* when they are in doubt, whereas others tend to say *no*;

d) the number of task items and the ratio of words to pseudowords: Meara (1996) suggested a ratio of 100 words to 50 pseudowords on the basis of his earlier research that the use of 60 words seemed to be a small sample to rely on.

The current study paid specific attention to the above-mentioned issues:

a) The L2 participants of this study were mostly from Asian language backgrounds (see sections 4.3.2.1, 4.3.2.2, and 4.3.2.3);
b) The L2 participants had high proficiency levels in the L2 (see section 4.3.1.3);
c) In order to control for the participants' individual response style and guessing, the instruction was given to choose *yes* only for the items they were sure that they knew and not to guess. Additionally, the false-alarm rate which indicates the amount of guessing was low (false-alarm rate < 20) except for L2 and L1 participants aged 6-7 (see sections 5.2.6 and 5.2.7);
d) The proportion of words to pseudowords was not 100 to 50 as Meara (1996) suggested, yet following a personal consultation with Harrington in 2010, proportions of 57 to 23 and 41 to 9 were concluded for the older (aged 11-12 and 15-17) and younger (aged 6-7) participants respectively.

Another concern with the use of the yes/no LDT was that the literacy levels of the youngest participants of the current study (students aged 6-7) could affect their performance on the task and thus affect the reliability of their score for vocabulary size and reaction time. In order to eliminate the effect of their literacy levels on the scores, either an aural task or a picture naming task (e.g., Peabody Picture Vocabulary Test III, Dunn & Dunn, 1997) could be used. However, there is no standard aural task available which measures the vocabulary size and reaction time to words. Although the design of an aural task was considered, this was not feasible within the timeframe of this study. With a picture naming task, the extent to which the pictures can represent abstract and low-frequency words is unclear. Additionally, the ambiguity of pictures or the different interpretations of different participants of the same picture may influence the scores. Thus, the use of an aural or a picture naming task was eliminated from the current study.

Chapter 4: Research Methodology and Data Analysis

This chapter presents a detailed description of the research methodology and data analysis for the current study, the components crucial to the quality of this study and its findings. First, this chapter presents the research methodology including the research design, ethical considerations, participants, and data collection procedures. Second, this chapter provides details on the data processing and the descriptive and statistical analysis for the current study.

4.1. Research design

Research in the field of lexical storage and retrieval in first (L1) and second language (L2) mental lexicon (ML) presents a number of choices regarding research design and data collection. The optimal research design for L2 ML organisation and development would be the use of neurolinguistic methods on a large number of L2 learners over a long period of time. Nevertheless, the logistical difficulties and resource limitations make this option difficult. Therefore, the final decision on research design is made in the context of the research purposes and practical constraints.

Given the purposes of the present study: whether the L2 ML has a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1, and whether the L2 ML resembles the L1 ML in terms of associations, vocabulary size, and reaction time at some age, the research method incorporates five components: (1) the access to the L2 students undertaking mainstream education in the L2, (2) the quantitative design, (3) the cross-sectional design, (4) the behavioural elicitation tasks, and (5) a pilot study.

1) L2 students undertaking mainstream education in L2 (English) were selected.
2) A quantitative design was chosen for the current study. Quantitative design was chosen over qualitative design as this study investigates the impact of different variables such as age and language (the L2 or L1) on different dimensions of the ML (associations, vocabulary size, and reaction time).
3) Cross-sectional design was chosen in order to investigate the trend of development for the L2 ML. Cross-sectional design was chosen over longitudinal design as the cross-sectional design is more time efficient. It provides a snapshot of the L2 ML in terms of associations, vocabulary size, and reaction time at different points of its development (lower primary school, upper primary school, and upper high school in

this study) rather than longitudinal observations over a number of years. The concern with the use of cross-sectional design is that the trends revealed using this design may not be the actual trends in real life. Nevertheless, using a bio-data survey (see section 4.3.2), this study controlled for other variables such as the participants' age of arrival (AoA) into the L2 country, their length of exposure to the L2, and the L2 participants' primary languages. As elicited by the bio-data survey, these students had different AoA into the L2 country, yet their knowledge of the L2 was limited prior to their entry into mainstream education in the L2. Therefore, although some L2 students entered the L2 country earlier than others, the AoA does not seem to interfere with the cross-sectional design of the study. Additionally, all the L2 students aged 6-7 had the shortest and all the L2 students aged 15-17 had the longest exposure to the L2.

4) Two behavioural elicitation tasks: a Word Association Task (WAT) and the yes/no Lexical Decision Task (LDT) were used to elicit the word associations and measure the vocabulary size and reaction time of the participants respectively.

5) A pilot study was designed in order to test the feasibility of the design of this research in a small-scale study before commencing the data collection.

Together, (1) the access to the L2 students undertaking mainstream education in the L2, (2) the quantitative design, (3) the cross-sectional design, (4) the behavioural elicitation tasks, and (5) the pilot study provided the basis upon which the trend of development for the L2 ML in terms of associations, vocabulary size, and reaction time was investigated.

4.2. Ethical considerations

Ethical considerations are an important part of any study. The current study is approved by the University of Canberra Human Research Ethics Committee which is in line with the National Statement on Ethical Conduct in Human Research (see Appendix A). This study is also approved by the ACT Education and Training Directorate (previously known as the ACT Department of Education and Training), (see Appendix B). This allowed the researcher to approach all the ACT public primary and high schools and invite them to participate in the present study.

Approval to participate in the research was also granted by the school principals and the participants' parents (see Appendices C and D). Both the school principals and the participants' parents were asked to read the Participant Information Sheets (see Appendix E), and sign the consent forms if they were happy for their children to participate in this study. The students and parents were both assured that while the parents' consent was needed in every case, the students' participation was voluntary. Students were free not to participate or to withdraw from undertaking the tasks at any time without any consequences. They were also assured that their personal details would remain confidential.

4.3. Participants

4.3.1. Selection of participants

As the main purposes of this research are to determine whether the L2 ML has a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1, and whether the L2 ML resembles the L1 ML at some age, it was necessary for the participants of the current study to satisfy strict selection criteria. This section presents the selection criteria used to recruit the participants for this study.

4.3.1.1. Criterion 1: age

Age was an important criterion for the participants in this study. L2 and L1 participants aged 6-7, 11-12, and 15-17 were selected in order to capture a snapshot of what the L2 ML looks like at different ages. This was dictated by three main reasons: The purpose of this study is to investigate the trend of development in the L2 ML; age is one variable which provides for similar circumstances for learning the L2; and the cross-sectional design used in this study requires students from different ages. In the literature on the L2 ML, school-aged L2 children and the impact of age on the development of the L2 ML have been relatively neglected. In cases where these children were studied, only a few close age groups were covered. For example, Schoonen and Verhallen (2008) conducted their study on 9 and 11-12 year old children. The participants of the present study were from three age groups of 6-7, reflecting the beginning of the primary school years, 11-12, reflecting the final primary school years, and 15-17, reflecting the final high school years.

4.3.1.2. Criterion 2: length of education in the L2

Another important criterion was length of education (LoE) in the L2. The L2 participants aged 6-7 had undertaken mainstream education in the L2 for at least one year. The L2 students aged 11-12 had undertaken at least four years (between four to six years), and the L2 students aged 15-17 at least seven years (between 7 to 11 years) mainstream education in the L2. As the LoE in the L2 is another variable providing for similar circumstances for learning the L2, it was crucial for the participants in the current study to have undertaken mainstream education in the L2. This criterion excluded students who had recently arrived in Australia yet were highly proficient in English.

4.3.1.3. Criterion 3: proficiency

Although proficiency is an important variable in the L2 ML development, the main purpose of the present study is to investigate the role that age plays in the L2 ML development. Nevertheless, it was important to exclude the effect of varying levels of proficiency in the present study. This was achieved by only including participants who were highly proficient in their L2. The Language Proficiency Rating (LPR) which determines L2 students' levels of proficiency on a scale of 0 to 5 (0 indicates lack of English, and 5 indicates nativelike proficiency) was used in the study to recruit the participants for this study. All the participants of this study apart from L2 students aged 6-7 (see section 4.3.2.1) had LPRs in the range of 3.75 to 5. Therefore, they were considered highly proficient in English. A detailed description of the LPR is provided in section 4.3.3.

4.3.1.4. Criterion 4: completion of English courses

Completion of English courses was another criterion in this study. The L2 participants had completed English courses at Introductory English Centres (IEC)[10] at Australian schools prior to their entry into mainstream education in the L2. Undertaking the IEC courses establishes a high level of assurance that English is the participants' L2 not L1 as they did not have

[10] In Australian schools, the English language proficiency of the students who come from non-English speaking backgrounds is assessed. If their English proficiency is lower than a certain level, they are required to attend Introductory English Centres for a period of three terms before they enter mainstream education in English.

sufficient English to start formal schooling in English. Even though now they are highly proficient in English, they learned their L2 after their L1 was developed.

4.3.1.5. Criterion 5: use of the L1 at home

Use of the L1 at home was also an important criterion in this study. The L2 participants of the current study spoke their L1 at home. Similar to Criterion 4, as this study aims to investigate the trend of development in the L2 ML, it was crucial to have informants for whom English was the L2 not the L1. There is the possibility that although a student comes from a non-English background, English is the dominant language, and s/he lacks skills in the L1. To eliminate this possibility, only students who spoke their L1 at home were targeted.

4.3.2. Recruitment of participants

The participants were recruited after the selection criteria were established for the L2 students. All the primary and high schools in Canberra were contacted to provide students meeting the selection criteria of the current study. This was to ensure that the selection of participants was not biased towards any specific district with a specific socioeconomic status (Mackey & Gass, 2005). As a result, 17 public primary and high schools across all districts of Canberra agreed to participate in the current study (see Figure 4.1). The participating schools were in the middle-class educated suburbs of Canberra.

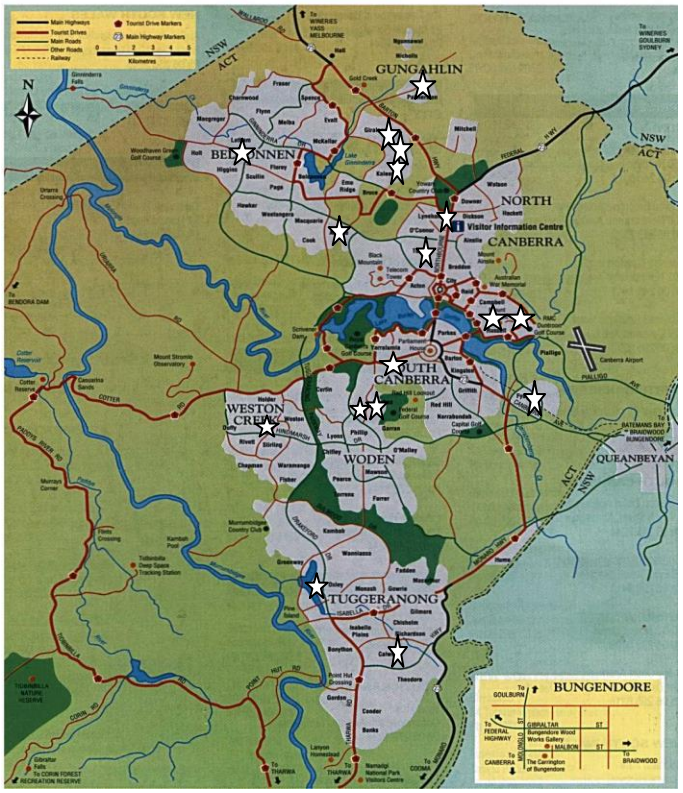

Figure 4.1. Map of Canberra.

Stars depict the approximate location of the participating schools.

The participating schools were asked to nominate L2 students from the three age groups of 6-7, 11-12, and 15-17, and provide their LPRs. The L2 students were given a modified[11] version of the Freed et al. (2004) Language Contact Profile as a bio-data survey to provide information on their age, LoR in the L2 and L1 countries, self-assessed proficiency in the L2 and L1, completion of English courses at the IECs, and the use of their L2 and L1 (see Appendix F).

It is important to note that the original aim of this study was to recruit at least 30 students from each group in order for the results to be more generalisable. Ultimately, however, within the time limits for the data collection, and given the strict selection criteria for the L2 students, this was not possible. Of the 100 L2 and 80 L1 students provided by the schools, 75 L2 students who met the selection criteria and all 80 L1 students were the participants in the current study. This resulted in three groups of L2 and three groups of L1 students aged 6-7, 11-12, and 15-17. Each group is described in detail below.

[11] This is a shorter version containing only the questions which were relevant to the selection criteria of the current study.

4.3.2.1. Group 1: L2 students aged 6-7

Group 1, L2 students aged 6-7, was made up of 25 students at year 1 and year 2 selected from four primary schools. Of the 25 students, 13 were male and 12 were female. Although the selection criteria dictate high proficiency levels (LPR > 3.75), this group had lower proficiency levels (LPR < 2). Five students were born in Australia and twenty overseas. Their L1s included Korean, Chinese, Urdu, German, Greek, and Indian languages (Hindi, Telugu, and Bangalore). They could not read or write in their L1.

It is essential to note that ideally the proficiency levels of the L2 students aged 6-7 should be high similar to the proficiency levels of the other two L2 groups. However, it was impossible to recruit L2 students with high proficiency levels at the beginning of their education in a new language (English). Further, the interest of this research is L2 lexical development in students who already have an established L1 at preschool levels. This excludes students whose L2 is the strong language even at the beginning of the L2 education.

4.3.2.2. Group 2: L2 students aged 11-12

This group also had 25 L2 students in year 5 and year 6 selected from five schools. The 16 male and the 9 female students had high LPRs (3.75 to 5). As in the case of Group 1, five of these students were born in Australia and 20 were born overseas. There were 12 languages in this group: Korean, Chinese, Vietnamese, Burmese, Laotian, Indian (Panjabi), Malay, Bahasa Indonesia, Dzongkha (the national language of Bhutan), Arabic, Serbo-Croatian, and Spanish. These students had received the majority of their education in their L2. Apart from one student, all the students could also read and write in their L1.

4.3.2.3. Group 3: L2 students aged 15-17

As in the case of Groups 1 and 2, this group comprised 25 students. They came from five schools and were in year 10 and year 11. The 15 male and 10 female students had high LPRs (3.75 to 5). Nine of these students were born in Australia and sixteen overseas, and between them had the following L1 languages: Chinese, Japanese, Korean, Vietnamese, Thai, Burmese, Malay, Ukrainian, Dinka (spoken in South Sudan), and Indian languages (Hindi, Gujarati, Bangalore, Tamil, Telugu, and Kannada). They had received the majority of their education in English. Apart from five students, all the students could read and write in their native languages.

4.3.2.4. Group 4: L1 students aged 6-7

Similar to Group 1, this group contained 25 year 1 and year 2 students, but they were L1 students. The nine male and 16 female students who took part in the current study came from two schools in Canberra.

4.3.2.5. Group 5: L1 students aged 11-12

There were 30 (seven male and 23 female) L1 students in this group who came from four schools in Canberra. Like Group 2, these students were aged 11-12 and were from year 5 and year 6.

4.3.2.6. Group 6: L1 students aged 15-17

Similar to Group 3, there were 25 students in this group from year 10 and year 11. Unlike Group 3, this group contained 11 male and 14 female L1 students who took part in the present study from four schools in Canberra. Table 4.1 provides a summary of the participants in the current study.

Table 4.1

Summary of Participant Information

Age	Language	LPR	Student *n*	M	F	L1 *n*	School *n*
6-7	L2	2	25	13	12	6	4
11-12		3.75 – 5	25	16	9	12	5
15-17		3.75 – 5	25	15	10	10	5
6-7	L1	-	25	9	16	-	2
11-12		-	30	7	23	-	4
15-17		-	25	11	14	-	4

Note. LPR = language proficiency rating; M = male; F = female; L1 = first language; *n* = number; L2 = second language.

The strict selection criteria employed for the recruitment of participants for the current study assured that not only that the selection of participants was a rigorous process but also the recruitment was unbiased towards any specific socioeconomic status. Further, there were at least 25 participants in each group.

4.3.3. Language Proficiency Ratings

It was crucial for the present study to measure the proficiency levels of the L2 participants. The primary purpose of the current study is to investigate whether the L2 ML has a similar trend of development to the L1 ML if the L2 is learned in similar circumstances to the L1. The term "similar circumstances" refers to learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and by living in the L2 country. Therefore, the effect of proficiency on the development of the L2 ML had to be eliminated. Additionally, the participants' levels of L2 proficiency provided information on their literacy levels. This was also important for the current study as the literacy level of the participants was relevant to both word associations and vocabulary size.

Teachers in Australian schools assess the progress of L2 students utilising English as a Second Language (ESL) Scales. The ESL Scales contain seven to eight levels of proficiency which form the basis of L2 students' LPR scores (0-5). It should be noted that the ESL Scales are used as guidelines for determining LPR scores in schools. However, there is no one-to-one relationship between a level on the ESL Scales and an LPR score. For example, a midrange score of 4 on the ESL scales does not necessarily correspond with a midrange LPR score of 2.5.

The ESL Scales have three strands: Oral Interaction (listening and speaking), Reading and Responding, and Writing. The lower levels of each strand represent an initial knowledge of English, while the higher levels in each strand reflect the achievement that L2 students require for successful independent learning in English in high school (ESL Scales, 1994). The current research took into account the proficiency levels of the L2 students in the two strands of Oral Interaction and Reading and Responding. This was to ensure that the L2 students could comprehend the oral stimulus words used in the WAT and the written words used in the yes/no LDT.

Higher level L2 student (participants of the current study with LPRs > 3.75) in the strand of Oral Interaction, according to the ESL Scales (1994), "communicates effectively in most formal and informal social and learning situations about familiar and unfamiliar issues of some complexity" (p. 13). S/he also "interprets complex spoken English used for a range of purposes . . ." (p. 13). In the strand of Reading and Responding, s/he "evaluates a given text

with reference to its validity and quality . . .” (p. 15). Also s/he “uses a repertoire of strategies to assess and interpret texts and to monitor own reading” (p. 15).

In contrast, a lower level L2 student (participants of this study with LPRs of average 2) in the strand of Oral Interaction, according to the ESL Scales (1994) “communicates verbally and nonverbally in simple social and classroom situations, taking cues from immediate context and using gesture . . .” (p. 13). In the strand of Reading and Responding, s/he “reads simple texts using . . . knowledge of basic sounds/symbol relationships” (p. 15).

4.4. Data collection

After the selection criteria were established, and the participants recruited, the data had to be collected from the participants using behavioural elicitation tasks (the WAT and the yes/no LDT). Before commencing the data collection, a pilot study was designed in order to test the feasibility of the design of this study. This section reviews the data elicitation method and the pilot study.

4.4.1. Data elicitation method

Elicitation tasks were chosen as the principal method for the collection of data from the participants. Two elicitation tasks were utilised: a WAT compiled using the Word Family List (WFL) by Nation (2012) and the yes/no LDT devised by Harrington (2006) to measure vocabulary size and reaction time. The first section provides details on the WAT followed by the procedure for its use, and the second section presents the yes/no LDT and the procedure for its use.

4.4.1.1. Word Association Task and procedure

A WAT was used in the current study in order to elicit the association types of the L2 and L1 participants. The rationale for the choice of the WAT is presented in section 3.1.5. This WAT contained 45 words selected from Nation’s WFL (2012). Words were selected by the researcher from the 1k to 15k frequency ranges of the list using the systematic sampling with a random start method (see section 3.1.3.2). One noun, one adjective, and one verb were selected from each 1k frequency range up to the 15k frequency range. In selecting the words, care was taken to ensure that a word which belonged to more than one word class such as *order* which is both a noun and a verb was not selected. In the response classification, the

word class of the stimulus word is taken into account. Thus, if a word has more than one word class, the response classification presents difficulties. Initially, the following list of stimulus words was formed:

> *importance, considerable, remember, curriculum, vital, decide, incident, supreme, determine, gallery, clever, receive, oxygen, subtle, refer, transmission, agricultural, happen, likelihood, miserable, inform, reminder, sunny, fulfil, football, memorable, appoint, testimony, hopeless, propose, feminism, hierarchical, transform, ash, tentative, threaten, sausage, brisk, anticipate, slab, powerless, reproduce, mercury, predominant, swear*

After the pilot study was conducted on four school students (see section 4.4.2), the selected words were replaced by words which were more familiar to school-aged students. The familiarity with the words for the school-aged children was checked with two ACT school teachers familiar with the curriculum. The revised WAT follows:

> *boy, delicious, add, car, big, become, apple, clever, bake, cookie, false, celebrate, diary, deaf, drown, ribbon, bald, delete, dean, bland, overtake, duchess, picturesque, eject, bloke, posh, overdo, hooligan, nutty, undertake, porcelain, mega, pester, barrow, hygienic, bumble, pram, dodgy, metabolize, nightingale, extracurricular, exfoliate, sophomore, multipurpose, deactivate*

The following instructions were given to all the participants before conducting the task:

> This is a Word Association Task. After hearing a word, say the first word that comes to your mind. You do not need to think about it for long as there is no right or wrong answer. For example, if you hear the word *flower*, you may say *red* because *flowers* can be *red*, or you may say *butterflies, trees*, etc. All these answers are correct.

The WAT was conducted using the aural-oral method (see section 3.1) to maximise the possibility of accessing the students' subconscious word associations in the ML (see section 3.1). The stimulus words were read aloud by the researcher. After hearing a stimulus word, each student produced a single response. The task was terminated when the students expressed their unfamiliarity with six consecutive stimulus words. When the researcher could not see a relationship between the stimulus word and response, the student was asked for clarification. For example, the response *orange* for the stimulus word *overtake* required clarification. The students' responses were audio-recorded, and written notes were taken.

4.4.1.2. Yes/no Lexical Decision Task and procedure

As explained earlier (see section 3.2.3), the yes/no LDT devised by Harrington (2006) was selected for the current study to measure vocabulary size and reaction time to words. The version of yes/no LDT used in this study consisted of two sets of tasks: the English Word Task L80 and S50. The L80 contained 80 task items including 57 words and 23 pseudowords. The 57 words were selected from the frequency ranges of 2k, 3k, 5k, and 10k. This task was used for the participants aged 11-12 and 15-17 as it contained lower frequency words in the 10k frequency range. The English Word Task S50 contained 50 task items including 41 words and 9 pseudowords. This task included words from the 2k, 3k, and 5k frequency ranges. This smaller task excluding words in the 10k frequency range was used for participants aged 6-7. The task items used in the yes/no LDT are presented below:

> **S50 words**: *psychology, length, declare, compromise, party, holiday, tongue, yellow, steer, crisis, able, plane, extra, abroad, actor, hat, sorry, fight, undergo, worse, leap, debate, beat, exceed, yesterday, attack, broadcast, finery, dozen, heart, access, tough, visible, wet, house, ceremony, cross, flash, clear, drop, gain,* **S50 pseudowords**: *soosh, pudmish, pretade, lonvert, fidal, minimile, glodar, unisue, lacant*
>
> **L80 words**: *manufacture, elect, chill, victory, climb, contemplate, mound, devise, apron, creed, cringe, saliva, bench, blanket, original, jumble, lawn, throttle, immense, vacation, stool, education, benevolence, puddle, artillery, stop, sport, tier, seclusion, forge, belt, zeal, birth, compliment, palm, provoke, marble, noise, apparatus, gravel, province, notion, skirt, scale, batch, rasp, structure, casualty, merit, journey, dignity, hungry, mess, alabaster, revelry, temperature, charity,* **L80 pseudowords**: *streck, indoment, braqe, fotulor, dite, epimend, norzal, moylay, salvary, mundy, savare, isual, toral, rement, primotal, obrolude, sleffer, maunicer, glotmy, berrow, suprete, buyly, abjentical*

Words in both tasks were selected from the Vocabulary Levels Test (VLT) (see section 3.2.2.2.1). The VLT contains words from different word classes such as nouns, verbs, and adjectives in a wide range of frequencies (1-10k). Pseudowords were generated from words of the same frequency range as the tested words. The length of the pseudowords resembles the length of the tested words (Harrington, 2006). Before conducting the task, the following instructions were given to all the participants:

> This is a yes/no Lexical Decision Task. A word comes on your computer screen. If you know the word, please press the right arrow key, or click on *yes*, and if you do not know the word, please press the left arrow key, or click on *no*. There are some words that look like English words, but they are not real words. If you say *yes* to a nonword, you lose marks. Try not to guess, and choose *yes* only when you are sure that you know the basic meaning(s) of the word.

The task was administered on the Language MAP website, a multimedia program for spoken and written language assessment. This program was developed by Harrington and Ingram (2003) at the University of Queensland. The participants undertook a practice version of the task before they started the main task. For the main task, the participants had 5 seconds to respond to each word. If they failed to respond within the 5 seconds, a no-answer was recorded by the program. Classroom observation of the youngest participants of this study, aged 6-7, has shown that these students missed a few words as they did not have enough time to respond to them. Thus, the time limit imposed on word appearance influenced the vocabulary size and reaction time scores of this age group. Nevertheless, based on classroom observation, the 5-second time limit did not appear to be a problem for the older age groups, ages 11-12 and 15-17.

Additionally, the participants of this study could either click on yes/no, or press the arrow keys to respond to words. It seems that pressing the arrow keys can be performed faster than clicking on yes/no. Although this may create variation among task takers in their reaction time to words, its impact on group results does not seem to be large.

It is also important to note that the WAT and the yes/no LDT used in this study tap into two different aspects of word knowledge. The WAT taps into the productive aspect of word knowledge, as after hearing the stimulus word, the task taker says the first word which comes to mind. In contrast, the yes/no LDT measures receptive word knowledge. It presents the stimulus words, and the task taker responds *yes* or *no*. There is a difference between productive and receptive word knowledge. Productive word knowledge allows use of words in speaking and writing, while receptive word knowledge allows understanding of the words used in listening and reading (Gass & Selinker, 2008). Although language users have both productive and receptive words in their ML, knowledge of a word starts with knowledge of

the receptive aspect of the word before it becomes productive. Language users first hear or read a word and learn its meaning(s) and use(s) before they use it productively in their own speaking or writing.

It would have been beneficial if different dimensions of the ML were measured using a task which tapped into either the productive or receptive aspect of word knowledge. Nevertheless, the lack of a standard test measuring reaction time to productive words led to the use of tasks which tap into two different aspects of word knowledge. On a positive note, however, this study reveals the relationship between an increase in receptive word knowledge and productive word associations. Additionally, in reality, the distinction between receptive and productive word knowledge may not be very clear as the ability to listen and read, in other words the receptive use of words, requires the language user to anticipate the coming language which involves the productive use of words (Milton, 2013).

4.4.2. Pilot study

A pilot study was conducted to determine whether the tasks (the WAT and the yes/no LDT) nominated for use in the current study were suitable for the participants. The tasks were administered to four L1 students aged 6 (N = 2, one male and one female) and aged 12 (N = 2, one male and one female) in a primary school. The exclusion of L2 speakers and L1 speakers aged 15-17 from the pilot study was based on the assumption that if the tasks were applicable to L1 students aged 6 and 12, they were correspondingly applicable to the L1 students aged 15-17, and if the tasks were not applicable to the L1 students, they were not applicable to the L2 students either.

The participants received high scores and low false-alarm rates (low guessing rates) for the yes/no LDT indicating that this task was suitable for the participants of the current study. For the WAT, however, participants aged 6 and 12 found a large number of unfamiliar words, even in the high-frequency ranges, for example *considerable, curriculum, vital, incident, determine,* and *subtle*. The participants could not provide responses to these words. In order to elicit responses from the participants, the abstract and formal stimulus words previously selected were replaced by more familiar words in the same frequency ranges. For example, *clever, diary, deaf, drown, become,* and *delicious* were chosen for 1-5k frequency range. As mentioned earlier, the familiarity of the stimulus words for the school children was checked

with two ACT school teachers familiar with the school curriculum. Nevertheless, the new stimulus words were not piloted on the target groups.

4.5. Data processing

After completion of the data collection, the data collected using the WAT and the yes/no LDT underwent processing, covering the scoring, the creation of databases, and the data screening. The processing prepared the data for descriptive and statistical analysis. Accuracy and consistency were the main concerns during this process.

4.5.1. Scoring

4.5.1.1. Scoring for Word Association Task

The participants' responses to each stimulus word on the WAT were classified into categories, paradigmatic, syntagmatic, phonological, other, and no-response item categories. The categories and the definitions of those categories are detailed below:

Paradigmatic associations: This type of association exists between words (the stimulus word and response) which have a close semantic connection with each other. The stimulus word and response are from the same word class and have the same grammatical function in the sentence (Wolter, 2001). Cruse (2011) presents the following as the main paradigmatic association types:

1) Hyponymy: This relationship exists between *apple* and *fruit*. In this example, *fruit* is the superordinate for *apple*, and *apple* is a hyponym for *fruit*.

2) Subordination: This type of relationship exists between *dog* and *terrier* as *terrier* is a kind of *dog*, and *dog* is a kind of *animal*.
3) Coordination: For example, *dog* and *cat*, or *fork* and *spoon* are coordinates. They are under the same superordinates (*animal* and *cutlery*).
4) Meronymy: This is a part-whole relationship which exists between *hand* and *finger* or *car* and *engine*.
5) Synonymy: This relationship exists between words with the semantic similarities such as *small* and *little*, or *almost* and *nearly*.

6) Antonymy: This relationship exists between words with semantic opposition such as *heavy* and *light*, or *kind* and *cruel*.

For a response to be classified under the paradigmatic association category, it had to be in the same word class as the stimulus word, have a semantic connection with the stimulus word, and fall in one of the above-mentioned categories. However, if the stimulus word and response were in the same word class, but there was a clear sequential relationship between them such as *wheel* and *chair*, the response was classified as syntagmatic (Wolter, 2001).

Syntagmatic associations: This type of association exists between words which sit in a phrase or sentence together. Thus, there is a sequential or collocational relationship between them. They are also mostly (but not always) from different word classes such as *dog* and *barks* (Wolter, 2001).

Phonological (clang) associations: This type of association exists between words which resemble each other phonologically but lack any semantic connection, such as *dog* and *bog* (Wolter, 2001). Additionally, responses which are variations of the stimulus words like *cat* and *cats* are also classified as phonological.

Other responses: In cases where there was no clear relationship (paradigmatic, syntagmatic, or phonological) between the stimulus word and response such as *undertake* and *fish*, and cases where the response could be classified as both paradigmatic and syntagmatic like *cookie* and *chocolate*, as the participant could mean *chocolate (chip)cookie* or *a chocolate bar*, the other response was recorded. The rationale for having the other response category was that although the connections among words in the ML are complex, there should be a distinction between responses which have clear semantic relationships with their stimulus words, and those which do not (Wolter, 2001).

No-response item: In cases where there was no response provided to a stimulus word, and the participant expressed unfamiliarity with it, the no-response item was recorded.

4.5.1.2. Scoring for yes/no Lexical Decision Task

The scores for vocabulary size and reaction time were automatically calculated by computer. As mentioned earlier, in the yes/no LDT, a *yes* response to a word is a hit. A *yes* response to a

pseudoword is a false-alarm. A *no* response to a word is a miss, and a *no* response to a pseudoword is correct rejection.

The score for vocabulary size was calculated by the correction for guessing formula (cgf). The cgf calculated the score by subtracting the proportion of false-alarms from the proportion of hits divided by the proportion of pseudowords which were correctly rejected (Harrington, 2006):

$$P^*(h) = \frac{P(h) - P(f)}{1 - P(f)}$$

The observed hit rate = P(h), true hit rate = P*(h), false-alarm rate = P(f), (Huibregtse et al., 2002, pp. 231-2).

The computer measured the reaction time by the mean amount of time it took the task taker to respond to each word, and was only measured for the hits. As discussed before (see section 3.2.1.5.1), although there are concerns that this formula may overestimate the true vocabulary knowledge of the task takers, the main reason for the choice of this formula is that other proposed formulas (see section 3.2.1.5) have their own shortcomings, and most importantly, their suitability for use in the field of applied linguistics has not been discussed to a great extent. Additionally, the actual difference between the scores generated using different scoring methods is fairly small (Mochida & Harrington, 2006).

4.5.2. Creating the database

The Microsoft Excel program was chosen to organise data in and to facilitate the descriptive analysis of the data. This program was chosen as many categories can be created in the spreadsheets, and the categories can be modified, added, and deleted. The database contained the entire data corpus. Each group of students was represented by a separate spreadsheet for each task resulting in 12 spreadsheets: word associations, vocabulary size, and reaction time data for each of the six groups (vocabulary size and reaction time data were presented together). For the word associations, three spreadsheets were created. As shown in Table 4.2, in the first spreadsheet, the columns specified the general information (names of the participants and their usernames), stimulus words used in the WAT, and the participants' responses.

Table 4.2
Sample Excel Sheet for WAT – Participants' Responses

Name	Username	Boy	Delicious	Add
A	Canb116	Girl	Cookie	Number
I	Canb74	Child	Yummy	Words
Y	Canb75	Soy	Yummy	
M	Canb76	Blue	Car	Two

Note. WAT = Word Association Task.

As Table 4.3 indicates, the second spreadsheet reflected the association category for each response: P for the paradigmatic associations, S for the syntagmatic associations, Ph for the phonological associations, O for other responses, and --- for no-response items.

Table 4.3
Sample Excel Sheet for WAT – Categories for Responses

Name	Username	Boy	Delicious	Add
A	Canb116	P	S	S
I	Canb74	P	P	S
Y	Canb75	Ph	P	---
M	Canb76	S	O	S

Note. WAT = Word Association Task.

As shown in Table 4.4, in the third spreadsheet, the letters representing the response categories were converted into numbers in order for the Microsoft Excel and the Statistical Package for Social Sciences (SPSS) programs to be able to apply calculations. --- was 0; P was 1; S was 2; O was 3; and Ph was 4. The numbers facilitated the computer calculations and did not carry interval values.

Table 4.4
Sample Excel Sheet for WAT – Categories Converted to Numbers

Name	Username	Boy	Delicious	Add
A	Canb116	1	2	2
I	Canb74	1	1	2
Y	Canb75	4	1	0
M	Canb76	2	3	2

Note. WAT = Word Association Task.

For the yes/no LDT, the columns reflected general and specific information. General information refers to the name of the participant, the username, and name of the task (S50 or

L80). Specific information reflected the vocabulary size and reaction time scores, and the false-alarm rate. Table 4.5 is a sample of the spreadsheets produced.

Table 4.5
Sample Excel sheet for the yes/no LDT

Name	Username	Task Name	Voc size	False-alarm	RT
A	Canb116	S50	60	20	1883.83
I	Canb74	S50	80	10	1464.59
Y	Canb75	S50	60	20	1589.95
M	Canb76	S50	52	10	1549.33

Note. LDT = Lexical Decision Task; Voc = vocabulary; RT = reaction time.

4.5.3. Data screening

Since the data analysis relied entirely on the produced spreadsheets, it was essential that the data processing be performed with a high degree of accuracy. This was particularly important for the WAT since the WAT scoring was performed manually rather than by computer. To this end, the data provided using the WAT underwent three steps of screening:

1) Each response recorded by the researcher on the WAT response sheets was checked against the audio tapes to validate accuracy of the data. Particular attention was paid to any unclear response.

2) The inter-rater reliability was applied to instil confidence in the allocation of an association category (paradigmatic, syntagmatic, phonological, other, and no-response) to each response. To this end, a linguist and a layperson were asked to classify the participants' responses following the instructions. They used the same association categories for the response classification. An inter-rater reliability of 95% was found among the reports.

3) The intra-rater reliability was also conducted by the researcher in order to generate internal consistency in terms of the response classification. Internal consistency was checked by choosing one group of participants and classifying their responses in a separate spreadsheet, as though they had not been classified before. After that, the first and second classifications were compared against each other. In cases where the second classification was different from the first, a third inspection was carried out. The final response classification was the classification which was chosen twice.

4.6. Descriptive and statistical analysis

4.6.1. Descriptive analysis

In order for the results of this study to be displayed and provide information at a glance, the descriptive analysis was computed. This section provides details for the types of analysis undertaken and the rationale for adopting them.

4.6.1.1. Median test

In the descriptive analysis of frequency data, it is important to display the data using a measure of central tendency to provide information at a glance (Hatch & Lazaraton, 1991). In order to achieve this, a measure of central tendency was applied. Based on the particular reservations that go with each method of the central tendency, the median test was chosen. In this study, the data for some of the variables were not normally distributed as legitimate extreme data were present. Additionally, there were fewer than 30 observations (participants) in each group (Hatch & Lazaraton, 1991). In cases where the mean was a more suitable measure for a group, both the mean and median were computed. In this case, only the median was reported for the purpose of consistency with the rest of data. However, this does not affect the accuracy of the central tendency in the distribution as the mean and median are the same in the normally distributed data.

4.6.1.2. Standard deviation

The standard deviation was also computed for the data. This was to measure the variability of associations, vocabulary size, and reaction time scores within the database, and to present the extent to which the data was spread out from the point of central tendency (Hatch & Lazaraton, 1991). This measure was very useful as the current study compares the performance of students from different age and language groups.

4.6.2. Statistical analysis

The data organised in the Microsoft Excel sheets were transferred to the SPSS program (IBM SPSS Statistics 21, 2012) to facilitate the statistical analysis of the data. Statistical tests (the Mann Whitney U, Kruskal-Wallis, and the Spearman rank-order correlation tests) were performed in order to instil confidence in any claims derived from the findings of this study. Although independent and unbiased scores were assigned to each variable (one condition for

the use of parametric procedures), the nonparametric procedures were chosen over the parametric ones. The application of the nonparametric procedures was due to the following reasons:

1) The dependant variables of the present study (e.g., the associations and vocabulary size) had a noninterval nature. The noninterval nature of the dependant variables dictates the use of a nonparametric statistical test (Hatch & Lazaraton, 1991). The variable of associations is divided into different categories (e.g., paradigmatic association category). As the different categories name different association types, they are considered to have nominal and therefore noninterval nature. Thus, a nonparametric procedure was required for the variable of associations.

   The variable of vocabulary size has an ordinal nature. This study measured the vocabulary size using the yes/no LDT (see section 4.4.1.2) containing words from various frequency ranges and pseudowords. A vocabulary size score, for example a score of 80, was given to the task takers based on their responses to the tested items. Although a score of 80 is twice as many as a score of 40, in the yes/no LDT, a score of 80 does not necessarily mean that the task taker responded to twice as many words, or recognised twice as many pseudowords. In the yes/no LDT, the frequency of words and the presence of pseudowords affect the nature of the scores. Therefore, a nonparametric procedure was also required for the variable of vocabulary size.

   In contrast, reaction time has an interval nature. The reaction time in the yes/no LDT was calculated by the amount of time it took the participants to respond to each word. Time has an interval nature. As such, the reaction time score was considered interval.

2) The data was not normally distributed for most variables, nor was the mean the most appropriate measure of the central tendency. As the normal distribution of data and the use of the mean as the most appropriate measure of the central tendency are prerequisites for applying parametric procedures (Hatch & Lazaraton, 1991), this choice was eliminated from the current study. Among the nonparametric tests, the Mann Whitney U, Kruskal-Wallis, and the Spearman rank-order correlation tests were performed. These tests are described below.

4.6.2.1. Mann Whitney U test

Among the nonparametric tests, the Mann Whitney U test is utilised when two levels of one independent variable are compared (Hatch & Lazaraton, 1991). As the present study compares the L2 and L1 ML in terms of different dimensions, the Mann Whitney U test was used. For example, when the number of paradigmatic associations in the responses of the L2 students aged 11-12 was compared to the number of paradigmatic associations in the responses of the L1 students aged 11-12, this test was utilised.

4.6.2.2. Kruskal-Wallis

Among the nonparametric tests, the Kruskal-Wallis test is employed when more than two levels of one independent variable are compared (Hatch & Lazaraton, 1991). The Kruskal-Wallis test was performed as the current study also investigates the trend of development for the different dimensions of the ML comparing the participants from three different age groups (6-7, 11-12, and 15-17).

4.6.2.3. Spearman rank-order correlation test

As the current study also aims to determine the correlation between different dimensions of the ML such as the correlation between vocabulary size and reaction time, a correlation test was chosen. Among the nonparametric correlation tests, the Spearman rank-order correlation test was utilised as the underlying assumptions for the use of this test were met in the current study. The current data were not normally distributed for most variables. Non-normal distribution of data is a prerequisite for the use of the Spearmen correlation test (Hatch & Lazaraton, 1991). Therefore, this test was chosen as the most appropriate test to identify correlations between different dimensions of the ML.

4.7. Summary

This chapter has presented a detailed description of the methodology and data analysis adopted for the current study. It focused on research design, ethical considerations, the participants, data collection, data processing, and the descriptive and statistical analysis of data. The research design (quantitative design, cross-sectional design, use of behavioural elicitation tasks, and a pilot study) and the selection of L2 learners undertaking mainstream education in English aimed to provide a situation in which the research questions could be

answered. The main concern with the data processing (scoring, creating the database, and data screening) was to establish and maintain accuracy and consistency in the database. The descriptive and statistical analysis of the data laid the foundation to describe the trend of development for different dimensions of the L2 ML and to compare that trend with the trend in the L1 ML.

Chapter 5: Results

5.1. Overview

The objective of this chapter is to present the findings of this study in response to the following two research questions:

1) Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

The term "similar circumstances" refers to learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and living in the L2 country.

2) Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

In order to respond to the first research question, the first section of this chapter presents the trend of development for associations, vocabulary size, and reaction time separately for L2 and L1 students of all age groups (6-7, 11-12, and 15-17). Initially, each section focuses on the descriptive analysis (median and standard deviation) for each of the above-mentioned dimensions of the ML considering different age and language groups. Then, each section displays the statistical analysis to determine whether the differences between the participants of different age and language groups are statistically significant.

The first section also presents a correlation analysis for vocabulary size, associations, and reaction time. As the current study views the ML as an interconnected network of words and connections (see section 1.1), this section also focuses on whether there is any correspondence among different dimensions of the ML.

Additionally, the first section presents the results for the effect of the stimulus word frequency utilised in the current study (in the Word Association Task (WAT)) on the types of associations that the L2 and L1 students of different age groups provided. This is to determine whether the frequency of stimulus words influenced the associations.

In order to respond to the second research question, the second section of this chapter displays the descriptive analysis for the associations, vocabulary size, and reaction time comparing L2 and L1 students at different ages (6-7, 11-12, and 15-17). The statistical

analysis is also presented in order to determine whether the differences between L2 and L1 students are statistically significant at any age.

Further, the second section exhibits the correlation analysis for Length of Residence (LoR) in the L2 country, Length of Education (LoE) in the L2, Age of Arrival (AoA) into the L2 country, and the different dimensions of the L2 ML. This is to determine whether there is any correspondence between these variables and any dimension of the L2 ML.

5.2. Research question 1

Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

5.2.1. Paradigmatic associations

The findings of this study revealed a similar trend of development for the paradigmatic associations in both the L2 and L1. Table 5.1 shows that both the L2 and L1 students aged 6-7 provided fewer paradigmatic associations than students aged 11-12, and in turn students aged 11-12 produced fewer paradigmatic associations than students aged 15-17 (6-7 < 11-12 < 15-17).

Table 5.1

Median and Standard Deviation for Paradigmatic Associations in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	4	3.26	25
	11-12	16	5.93	25
	15-17	20	5.19	25
L1	6-7	7	4.20	25
	11-12	19	4.88	30
	15-17	23	5.92	25

Note. L2 = second language; L1 = first language; *M* = median; *SD* = standard deviation.

Figure 5.1 illustrates that with age, a clear increase occurred in the number of paradigmatic associations for both L2 and L1 students.

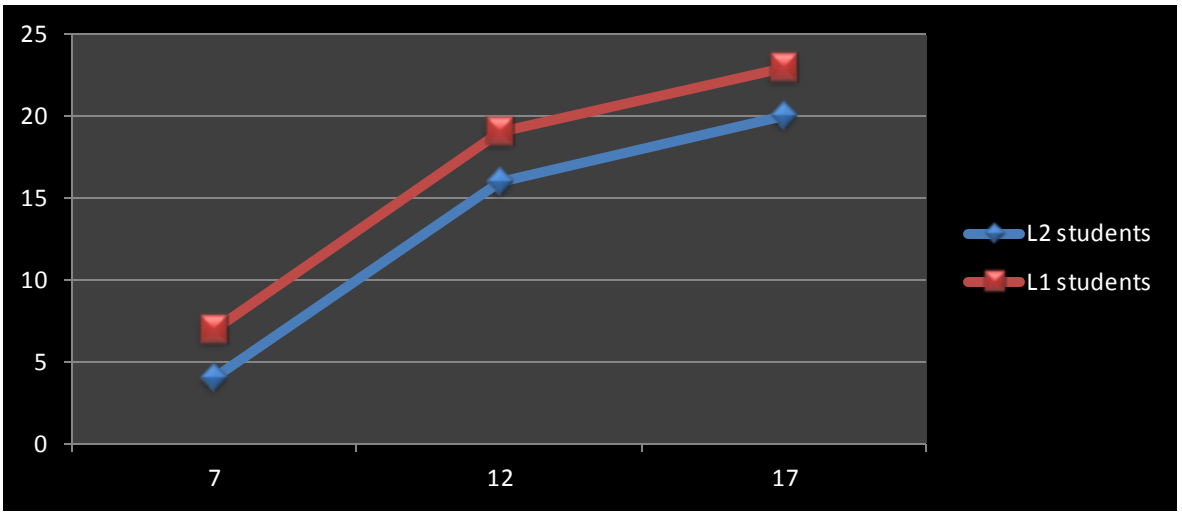

Figure 5.1. Trend of development for paradigmatic associations.

The findings were strengthened by the Kruskal-Wallis test as it yielded a significant age effect for paradigmatic associations (p value < .05). As shown in Table 5.2, the Mann Whitney U test results revealed that the difference between the number of paradigmatic associations provided by students aged 6-7 and 11-12 and students aged 11-12 and 15-17 was statistically significant in both L2 and L1. It is important to note that for both L2 and L1 students aged 6-7, the standard deviation levels were high, indicating differences between the number of paradigmatic associations produced by individual participants.

Table 5.2

Significance of Difference for Paradigmatic Associations in All Groups

Age	L2	L1
6-7 & 11-12	.000	.000
11-12 & 15-17	.015	.003

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

5.2.2. Syntagmatic associations

Table 5.3 indicates that both L2 and L1 students aged 6-7 gave fewer syntagmatic associations than students aged 11-12, and in turn, students aged 11-12 provided fewer syntagmatic associations than students aged 15-17 (6-7 < 11-12 < 15-17).

Table 5.3

Median and Standard Deviation for Syntagmatic Associations in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	7	3.77	25
	11-12	10	3.75	25
	15-17	16	3	25
L1	6-7	11	3.31	25
	11-12	13	4.37	30
	15-17	15	5.05	25

Note. L2 = second language; L1 = first language; *M* = median; *SD* = standard deviation.

Figure 5.2 below indicates that with age, the number of syntagmatic associations increased for both L2 and L1 students.

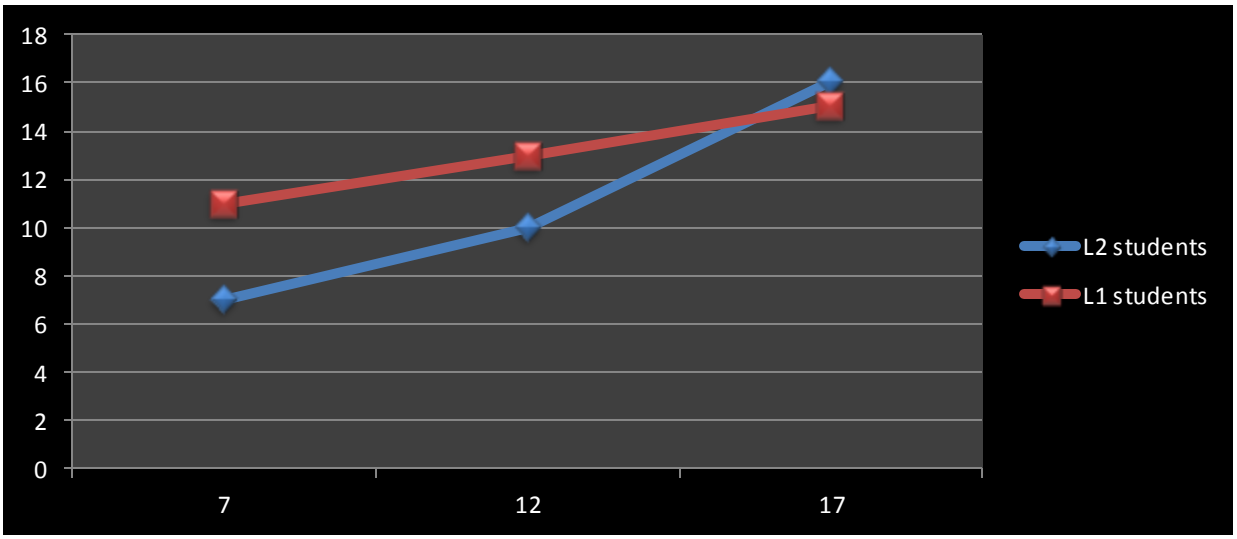

Figure 5.2. Trend of development for syntagmatic associations.

A strong age effect was also observed for syntagmatic associations as the Kruskal-Wallis test demonstrated a significant level (p value < .05) for both L2 and L1 students. As shown in Table 5.4, the Mann Whitney U test revealed that the difference between the number of syntagmatic associations provided by students aged 6-7 and 11-12 and students aged 11-12 and 15-17 was statistically significant in L2. For L1 students, however, the difference between students aged 6-7 and 11-12 was also statistically significant, while the difference between students aged 11-12 and 15-17 was not. Additionally, L2 students aged 6-7 had high levels of standard deviation.

Table 5.4

Significance of Difference for Syntagmatic Associations in All Groups

Age	L2	L1
6-7 & 11-12	.002	.036
11-12 & 15-17	.000	.088

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

5.2.3. Phonological associations

This study revealed a similar trend of development for phonological associations in both the L2 and L1. Table 5.5 below shows that both L2 and L1 students aged 6-7 provided fewer phonological associations than students aged 11-12, while students aged 11-12 gave more phonological associations than students aged 15-17 (6-7 < 11-12 > 15-17).

Table 5.5

Median and Standard Deviation for Phonological Associations in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	0	2.37	25
	11-12	3	2.93	25
	15-17	1	1.70	25
L1	6-7	1	1.77	25
	11-12	3	3.38	30
	15-17	1	1.32	25

Note. L2 = second language; L1 = first language; *M* = median; *SD* = standard deviation.

Figure 5.3 below illustrates an increase in the number of phonological associations from age 6-7 to 11-12 and a decrease from age 11-12 to 15-17 for both L2 and L1 students.

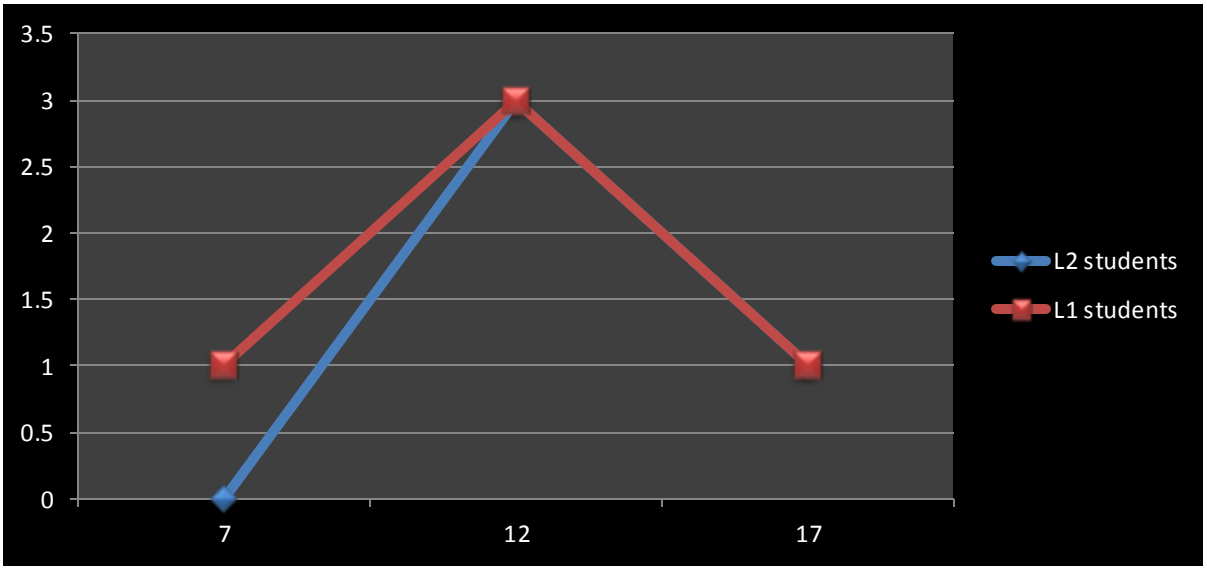

Figure 5.3. Trend of development for phonological associations.

With this *p* value (*p* value < .05), the Kruskal-Wallis test also showed a significant age effect for phonological associations for both L2 and L1 students. As displayed in Table 5.6, the Mann Whitney U test revealed that the difference between the number of phonological associations provided by students aged 6-7 and 11-12 and students aged 11-12 and 15-17 was statistically significant in both L2 and L1. High levels of standard deviation were also observed for the L2 and L1 participants of all age groups.

Table 5.6

Significance of Difference for Phonological Associations in All Groups

Age	L2	L1
6-7 & 11-12	.026	.029
11-12 & 15-17	.016	.017

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

5.2.4. No-response items

The findings of the current study revealed a similar trend of development for the no-response items in both the L2 and L1. Table 5.7 shows that both L2 and L1 students aged 6-7 gave fewer responses (more no-response items) to the WAT than students aged 11-12. Similarly, students aged 11-12 produced fewer responses (more no-response items) to the WAT than students aged 15-17 (6-7 > 11-12 > 15-17). With age, the number of no-response items

declined in both the L2 and L1. In other words, with age, the number of responses to words that both L2 and L1 participants managed to provide, increased.

Table 5.7

Median and Standard Deviation for No-response Items in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	31	4.73	25
	11-12	11	8.20	25
	15-17	5	5.41	25
L1	6-7	12	3.53	25
	11-12	7	4.85	30
	15-17	2	2.64	25

Note. L2 = second language; L1 = first language; M = median; SD = standard deviation.

Figure 5.4 below shows a clear decrease in the number of no-response items for both L2 and L1 students.

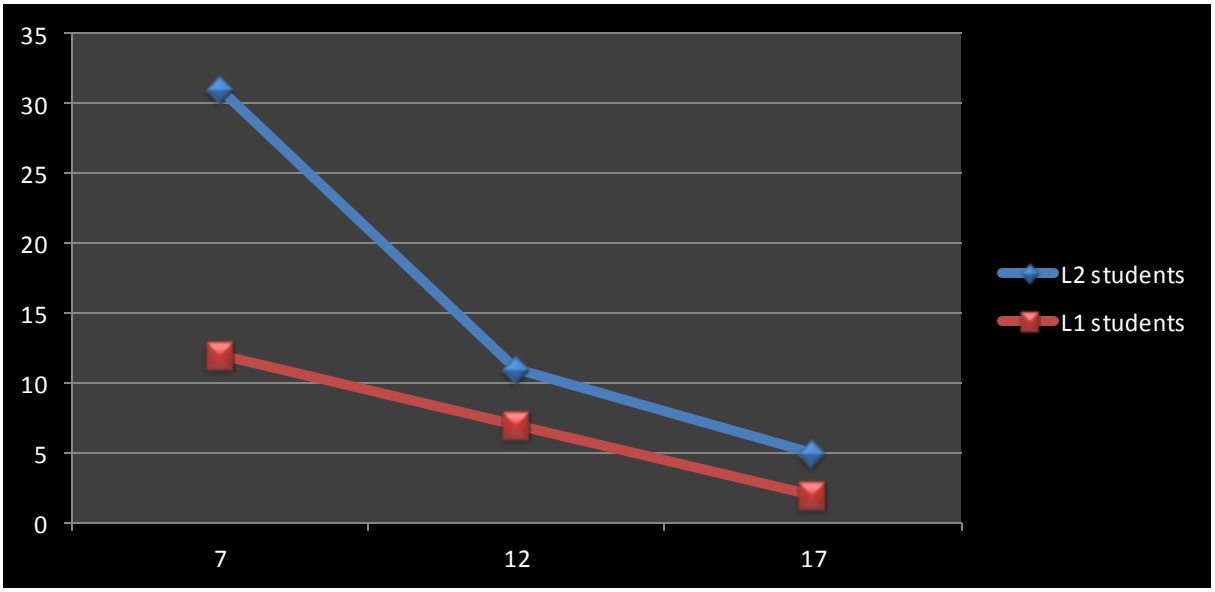

Figure 5.4. Trend of development for no-response items.

The Kruskal-Wallis test yielded a significant age effect (p value < .05) for both L2 and L1 groups. As displayed in Table 5.8, the Mann Whitney U test revealed that the difference between the number of no-response items provided by students aged 6-7 and 11-12 and students aged 11-12 and 15-17 was statistically significant in both L2 and L1.

Table 5.8

Significance of Difference for No-response Items in All Groups

Age	L2	L1
6-7 & 11-12	.000	.000
11-12 & 15-17	.000	.000

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

5.2.5. Other responses

In addition to the main categories for the associations (paradigmatic, syntagmatic, and phonological) and the no-response items, there were responses which could not be classified in any of the main categories or could be classified in more than one category. These associations, classified as "other responses", accounted for a small number of associations put forward by both L2 and L1 participants. Table 5.9 exhibits the number of other responses in both L2 and L1.

Table 5.9

Median and Standard Deviation for Other Responses in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	1	0.88	25
	11-12	2	1.61	25
	15-17	2	1.15	25
L1	6-7	2	1.57	25
	11-12	2	2.2	30
	15-17	2	1.77	25

Note. L2 = second language; L1 = first language; *M* = median; *SD* = standard deviation.

As a small number of the participants' responses were categorised as other responses, and as this category includes unclassifiable responses and responses which could be classified as both paradigmatic and syntagmatic associations, this category is not included in further analysis and discussion. High levels of standard deviation were also observed for most groups indicating differences between individual participants.

5.2.6. Vocabulary size

The findings of the current study revealed a similar trend of development for vocabulary size in both L2 and L1. Table 5.10 reveals that both L2 and L1 students aged 6-7 had a smaller vocabulary size than students aged 11-12, and in turn, students aged 11-12 had a smaller vocabulary size than students aged 15-17 (6-7 < 11-12 < 15-17). It is important to note that, although the vocabulary size scores are displayed here for both L2 and L1 students aged 6-7, these scores are considered unreliable and are not used for any further analysis or discussion. The vocabulary size scores of L2 and L1 students aged 6-7 are unreliable as they had high false-alarm rates in the yes/no Lexical Decision Task (LDT), (false-alarm > 20). The high false-alarm rate indicates that L2 and L1 students aged 6-7 applied a large amount of guessing in their responses to words in the yes/no LDT.

Table 5.10

Median and Standard Deviation for Vocabulary Size in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	54	18.35	25
	11-12	72	15.65	25
	15-17	86	6.69	25
L1	6-7	56	14.05	25
	11-12	80	8.91	30
	15-17	90	8.93	25

Note. L2 = second language; L1 = first language; M = median; SD = standard deviation.

Figure 5.5 indicates that with age, a clear increase occurred in vocabulary size for both L2 and L1 students.

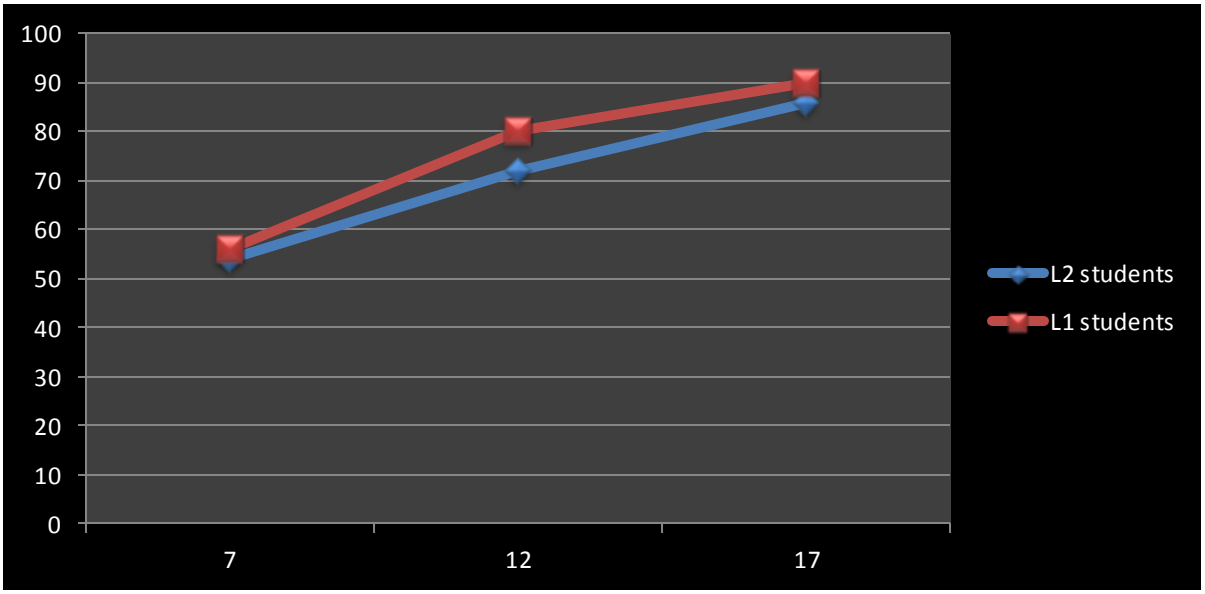

Figure 5.5. Trend of development for vocabulary size.

As shown in Table 5.11 below, the Mann Whitney U test yielded a significant age effect for vocabulary size in both L2 and L1.

Table 5.11

Significance of Difference for Vocabulary Size in All Groups

Age	L2	L1
11-12 & 15-17	.000	.009

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

5.2.7. Reaction time

As shown in Table 5.12 below, this study revealed a similar trend of development for reaction time in both L2 and L1. Both L2 and L1 participants aged 6-7 had higher reaction time to words than participants aged 11-12, and participants aged 11-12 had higher reaction time than participants aged 15-17 (6-7 > 11-12 > 15-17). With age, the reaction time decreased in both L2 and L1. Like the vocabulary size scores reported in the previous section, the reaction time scores for L2 and L1 students aged 6-7 are considered unreliable. This is also due to the high false-alarm rates reported for this age group.

Table 5.12

Median and Standard Deviation for Reaction Time in All Groups

Language	Age	*M*	*SD*	*n*
L2	6-7	1515	438.89	25
	11-12	1083	362.73	25
	15-17	837	170.11	25
L1	6-7	1543	391.15	25
	11-12	1157	275.83	30
	15-17	957	162.95	25

Note. L2 = second language; L1 = first language; *M* = median; *SD* = standard deviation.

Figure 5.6 illustrates a decrease in reaction time as a result of increase in age for both L2 and L1 students.

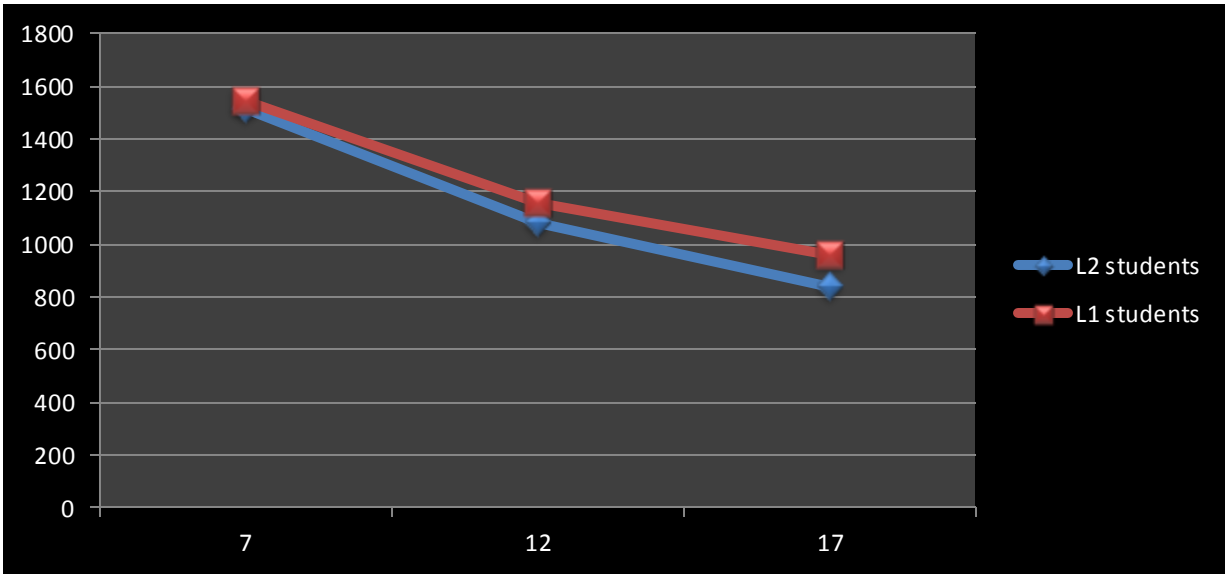

Figure 5.6. Trend of development for reaction time.

As exhibited in Table 5.13 below, the findings were strengthened by the Mann Whitney U test as it yielded a significant age effect for reaction time in both L2 and L1.

Table 5.13

Significance of Difference for Reaction Time in All Groups

Age	L2	L1
11-12 & 15-17	.009	.013

Note. The mean difference is significant at .05 level; L2 = second language; L1 = first language.

As shown in Table 5.14, in cases where there was a statistically significant difference between students of different age groups, Cohen's *d* also yielded medium and large effect sizes.

Table 5.14

Effect Size for Associations – L2 and L1 Students of All Ages

Group	Language	Variable	*d*-value	*r*-value
6-7 & 11-12	L2		-2.507	-0.781
11-12 & 15-17	L2	P	-0.717	-0.337
6-7 & 11-12	L1		-2.635	-0.796
11-12 & 15-17	L1		-0.737	-0.345
6-7 & 11-12	L2		-0.797	-0.370
11-12 & 15-17	L2	S	-1.766	-0.662
6-7 & 11-12	L1		-0.515	-0.249
11-12 & 15-17	L1		-0.423	-0.207
6-7 & 11-12	L2		-1.125	-0.490
11-12 & 15-17	L2	Ph	0.834	0.385
6-7 & 11-12	L1		-0.741	-0.347
11-12 & 15-17	L1		0.779	0.363
6-7 & 11-12	L2		2.987	0.831
11-12 & 15-17	L2	No-res	0.863	0.396
6-7 & 11-12	L1		1.178	0.507
11-12 & 15-17	L1		1.280	0.539
6-7 & 11-12	L2		-1.163	-0.502
11-12 & 15-17	L1	Voc size	-1.121	-0.488
6-7 & 11-12	L2		0.868	0.398
11-12 & 15-17	L1	RT	0.882	0.403

Note. L2 = second language; L1 = first language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

5.2.8. Correlation between vocabulary size and other dimensions of mental lexicon

The Spearman rank-order correlation test was performed to determine the strength of relationship between vocabulary size, associations (paradigmatic, syntagmatic, and phonological), and reaction time. Table 5.15 indicates that vocabulary size was positively correlated with paradigmatic and syntagmatic associations for both L2 and L1 students. Additionally, the vocabulary size was negatively correlated with no-response items and reaction time for both L2 and L1 students. With an increase in vocabulary size, the number of

paradigmatic and syntagmatic associations rose, and the number of no-response items and the reaction time fell. There was no correlation between vocabulary size and phonological associations.

Table 5.15

Correlation between Vocabulary Size, Associations, and Reaction Time

Language	RT	P	S	Ph	No-res
L1	-.715**	.608**	.420**	-.088	-.661**
L2	-.834**	.733**	.682**	.220	-788**

Note. L1 = first language; L2 = second language; RT = reaction time; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items.

** p < .01.

5.2.9. Frequency and associations

This section illustrates the findings for the effect of word frequency on type of association. Each section focuses on the type of association that both L2 and L1 students of different age groups provided to the stimulus words in each of the 5k frequency ranges.

5.2.9.1. Frequency and associations - L2 and L1 students aged 6-7

The present study revealed that L2 students aged 6-7 provided the highest number of paradigmatic and syntagmatic associations and the lowest no-response items to the high-frequency words (words in the 1-5k frequency range). With a decrease in the frequency of stimulus words, the number of paradigmatic and syntagmatic associations fell, and the number of no-response items rose. Table 5.16 shows the number of associations that L2 students aged 6-7 provided to words in different frequency ranges.

Table 5.16

Frequency and Associations of L2 Students Aged 6-7

Category	1-5k	5-10k	10-15k
Paradigmatic	6	0	0
Syntagmatic	9	0	0
Phonological	1	0	0
No-response	5	21	22

Note. L2 = second language.

Figure 5.7 indicates that with a decrease in the frequency of stimulus words, the number of paradigmatic and syntagmatic associations declined, and the number of no-response items rose.

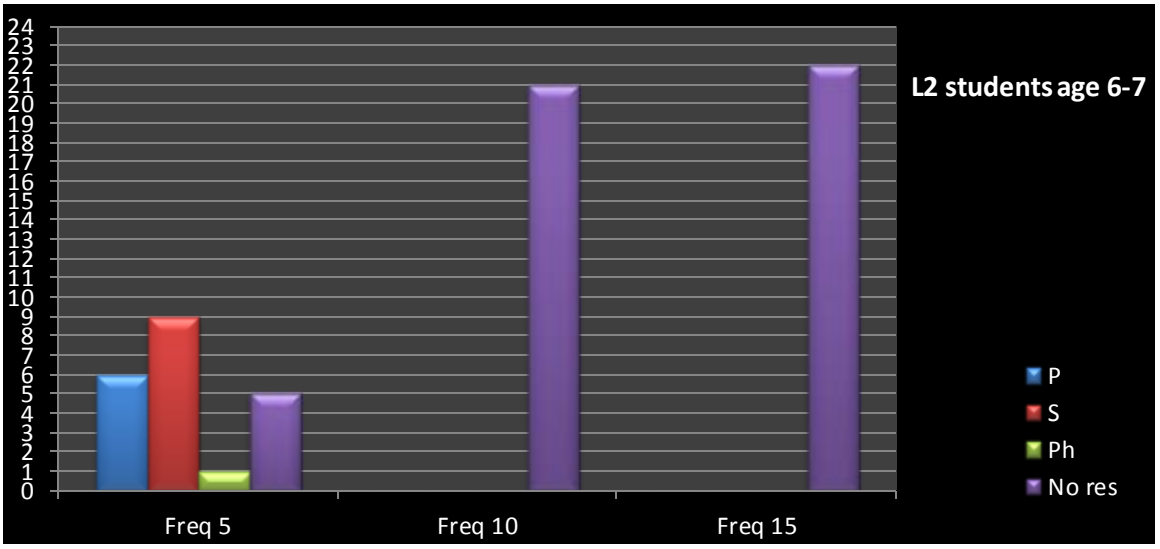

Figure 5.7. Frequency and associations of the L2 students aged 6-7.

The Kruskal-Wallis test yielded a significant frequency effect for paradigmatic (*p* value = .000) and syntagmatic associations (*p* value = .000), and no-response items (*p* value = .000). As shown in Table 5.17, the Mann Whitney U test demonstrated significant levels for paradigmatic and syntagmatic associations, and no-response items for words in the 1-5k and 5-10k frequency ranges. This test yielded nonsignificant levels for phonological associations.

Table 5.17

Significance of Frequency Effect on Associations for L2 Students Aged 6-7

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.000	.000	.188	.000
5-10k & 10-15k	.946	.818	.393	.471

Note. The mean difference is significant at .05 level; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

As in the case of the associations of L2 students, the findings of the current study showed that L1 students aged 6-7 gave the highest number of paradigmatic and syntagmatic associations, and the lowest number of phonological associations and no-response items for high-frequency words (words in the 1-5k frequency range). Table 5.18 illustrates the type of association that L1 students aged 6-7 provided for words in different frequency ranges.

Table 5.18

Frequency and Associations of L1 Students Aged 6-7

Category	1-5k	5-10k	10-15k
Paradigmatic	8	0	0
Syntagmatic	12	0	0
Phonological	0	1	0
No-response	1	17	22

Note. L1 = first language.

Figure 5.8, below, shows that with a decrease in the frequency of the stimulus words, the number of paradigmatic and syntagmatic associations fell, and the number of phonological associations and no-response items rose. The number of phonological associations increased only for words in the 5-10k frequency range.

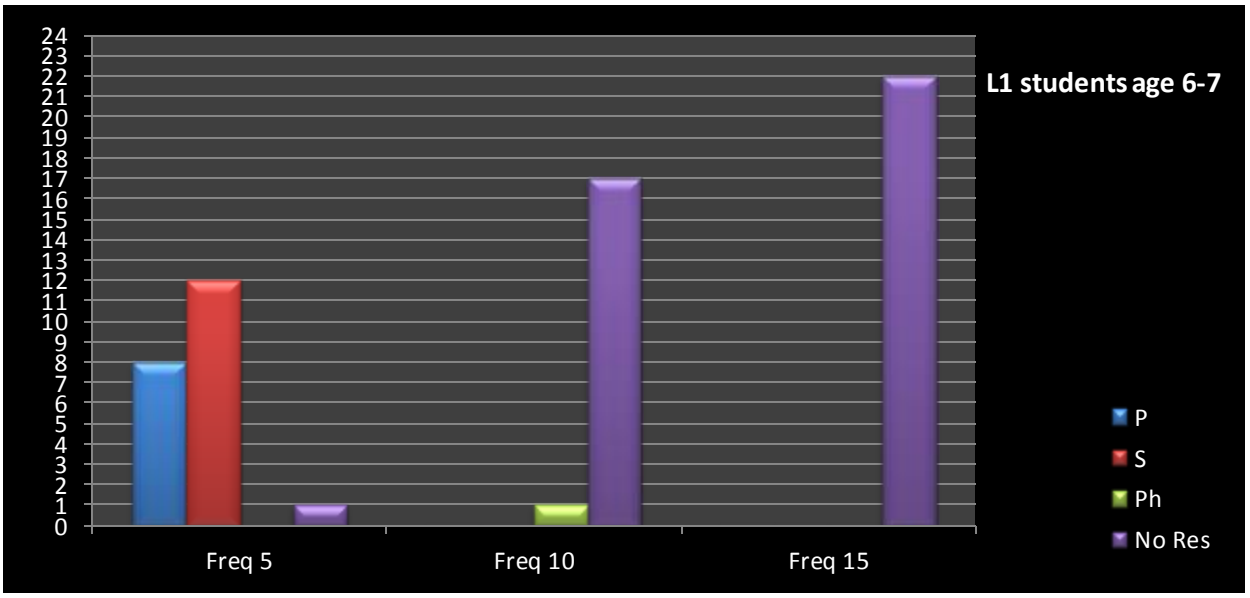

Figure 5.8. Frequency and associations of the L1 students aged 6-7.

The Kruskal-Wallis test revealed a significant frequency effect for paradigmatic (*p* value = .000), syntagmatic (*p* value = .000), and phonological associations (*p* value = .002), and no-response items (*p* value = .000). As shown in Table 5.19, the Mann Whitney U test indicated that the difference between the number of paradigmatic, syntagmatic, and phonological associations, and the no-response items was statistically significant when comparing words in the 1-5k and 5-10k frequency ranges. The difference in the number of no-response items was

also statistically significant when comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.19

Significance of Frequency Effect on Associations for L1 Students Aged 6-7

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.000	.000	.013	.000
5-10k & 10-15k	.387	.241	.087	.000

Note. The mean difference is significant at .05 level; L1 = first language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

5.2.9.2. Frequency and associations - L2 and L1 students aged 11-12

As shown in Table 5.20, L2 students aged 11-12 produced more paradigmatic and syntagmatic associations, and fewer phonological associations and no-response items to high-frequency words (words in the 1-5k frequency range). With a decrease in the frequency of stimulus words, the number of paradigmatic and syntagmatic associations declined, and the number of phonological associations and no-response items increased. However, there was no difference between the number of paradigmatic, syntagmatic, or phonological associations when comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.20

Frequency and Associations of L2 Students Aged 11-12

Category	1-5k	5-10k	10-15k
Paradigmatic	10	3	3
Syntagmatic	7	2	2
Phonological	0	1	1
No-response	1	11	10

Note. L2 = second language.

Figure 5.9 shows that as the frequency of stimulus words decreased, the number of paradigmatic and syntagmatic associations also decreased, and the number of phonological associations and no-response items increased.

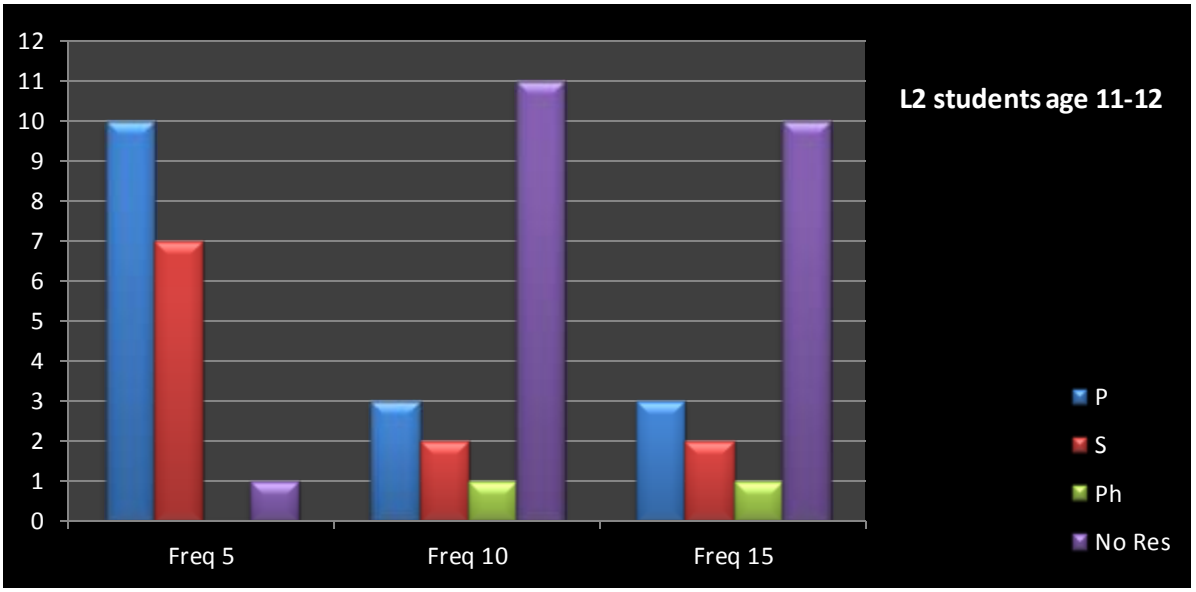

Figure 5.9. Frequency and associations of the L2 students aged 11-12.

A strong frequency effect was observed as the Kruskal-Wallis test yielded a significant frequency effect for paradigmatic (*p* value = .001), syntagmatic (*p* value = .000), and phonological associations (*p* value = .001), and no-response items (*p* value = .000). As shown in Table 5.21, the Mann Whitney U test suggested significant levels for paradigmatic, syntagmatic, and phonological associations, and no-response items when comparing words in the 1-5k and 5-10k frequency ranges. In contrast, this test revealed nonsignificant levels for both the associations (paradigmatic, syntagmatic, and phonological) and the no-response items when comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.21

Significance of Frequency Effect on Associations for L2 Students Aged 11-12

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.000	.000	.002	.000
5-10k & 10-15k	.966	.989	.347	.669

Note. The mean difference is significant at .05 level; L2 = second language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

L1 students aged 11-12, as Table 5.22 demonstrates, provided more paradigmatic and syntagmatic associations, and fewer phonological associations and no-response items for the high-frequency words (words in the 1-5k frequency range). With a decline in the frequency of stimulus words, the number of paradigmatic associations fell, and the number of no-response

items and phonological associations rose. The syntagmatic associations decreased for words in the 5-10k frequency range, yet they increased for words in the 10-15k frequency range. The phonological associations only increased for words in the 10-15k frequency range.

Table 5.22

Frequency and Associations of L1 Students Aged 11-12

Category	1-5k	5-10k	10-15k
Paradigmatic	12	10	6
Syntagmatic	10	4	5
Phonological	1	1	3
No-response	0	5	8

Note. L1 = first language.

Figure 5.10 indicates that with a decrease in the frequency of stimulus words, the number of paradigmatic and syntagmatic associations declined, and the number of no-response items and phonological associations increased (with the exception of the number of syntagmatic associations which increased for words in the 10-15k frequency range).

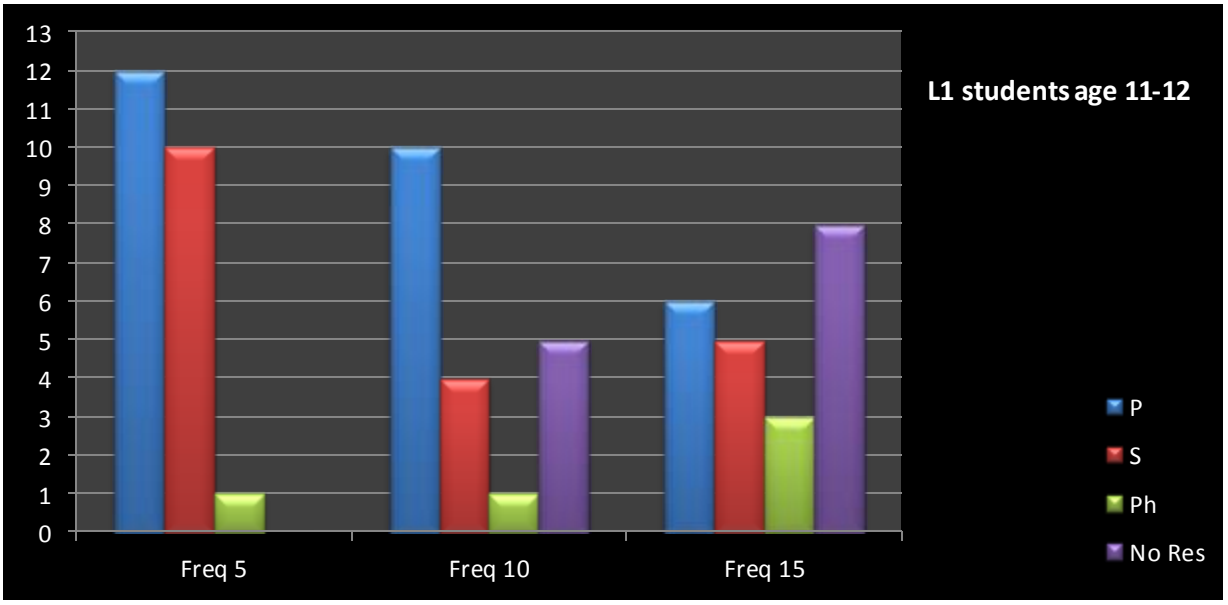

Figure 5.10. Frequency and associations of L1 students aged 11-12.

The Kruskal-Wallis test also yielded a significant frequency effect for paradigmatic (*p* value = .001), syntagmatic (*p* value = .002), and phonological associations (*p* value = .001), and the no-response items (*p* value = .000). As shown in Table 5.23, the Mann Whitney U test

revealed significant levels for the number of paradigmatic associations and no-response items when comparing words in various frequency ranges (1-5k, 5-10k, and 10-15k). Nevertheless, this test suggested a significant level for syntagmatic associations only when comparing words in the 1-5k and 5-10k frequency ranges. Further, a significant level was revealed for phonological associations but only when comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.23

Significance of Frequency Effect on Associations for L1 Students Aged 11-12

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.025	.032	.380	.003
5-10k & 10-15k	.021	.923	.037	.019

Note. The mean difference is significant at .05 level; L1 = first language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

5.2.9.3. Frequency and associations - L2 and L1 students aged 15-17

Table 5.24 shows that L2 students aged 15-17 produced the highest number of paradigmatic and syntagmatic associations and the lowest number of no-response items to high-frequency words (words in the 1-5k frequency range). As the frequency of stimulus words decreased, the number of paradigmatic and syntagmatic associations also decreased, and the number of no-response items increased.

Table 5.24

Frequency and Associations of L2 Students Aged 15-17

Category	1-5k	5-10k	10-15k
Paradigmatic	10	8	7
Syntagmatic	11	6	6
Phonological	0	0	0
No-response	0	4	5

Note. L2 = second language

Figure 5.11 shows that with a decline in the frequency of stimulus words, the number of paradigmatic and syntagmatic associations also declined, and the number of no-response items rose. There was no difference between the number of syntagmatic associations for words in the 5-10k and 10-15k frequency ranges.

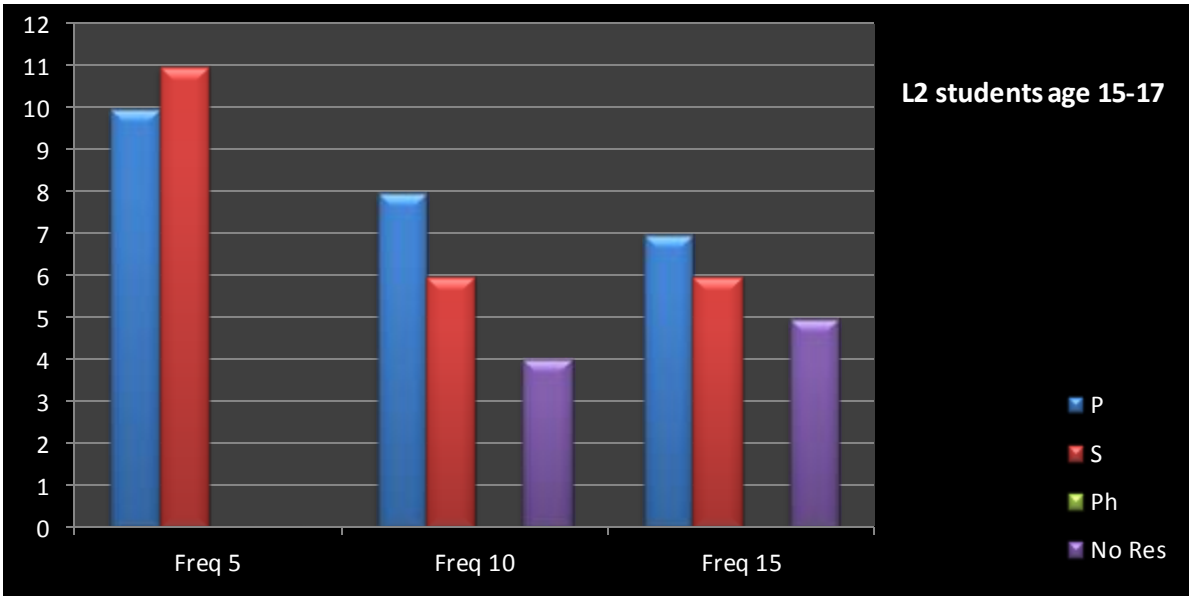

Figure 5.11. Frequency and associations of the L2 students aged 15-17.

A strong frequency effect was observed as the Kruskal-Wallis test revealed significant levels for paradigmatic (*p* value = .002) and syntagmatic associations (*p* value = .048), and no-response items (*p* value = .000). With the *p* values demonstrated in Table 5.25, the difference for paradigmatic and syntagmatic associations, and no-response items was only significant when comparing words in the 1-5k and 5-10k frequency ranges. The difference was nonsignificant when comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.25

Significance of Frequency Effect on Associations for L2 Students Aged 15-17

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.014	.015	.155	.001
5-10k & 10-15k	.550	.542	.065	.307

Note. The mean difference is significant at .05 level; L2 = second language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

Both the type of association and the number of associations for L1 students aged 15-17 were slightly different from those of the L2 students of the same age. Table 5.26 shows that with a decrease in the frequency of stimulus words, the number of paradigmatic associations decreased. However, the number of syntagmatic associations decreased for words in the 5-10k frequency range but increased for words in the 10-15k frequency range. L1 students aged 15-17 also gave more no-response items and phonological associations for lower frequency words.

Table 5.26

Frequency and Associations of L1 Students Aged 15-17

Category	1-5k	5-10k	10-15k
Paradigmatic	15	13	11
Syntagmatic	9	5	9
Phonological	0	0	1
No-response	0	1	2

Note. L1 = first language.

Figure 5.12 illustrates the trend revealed above.

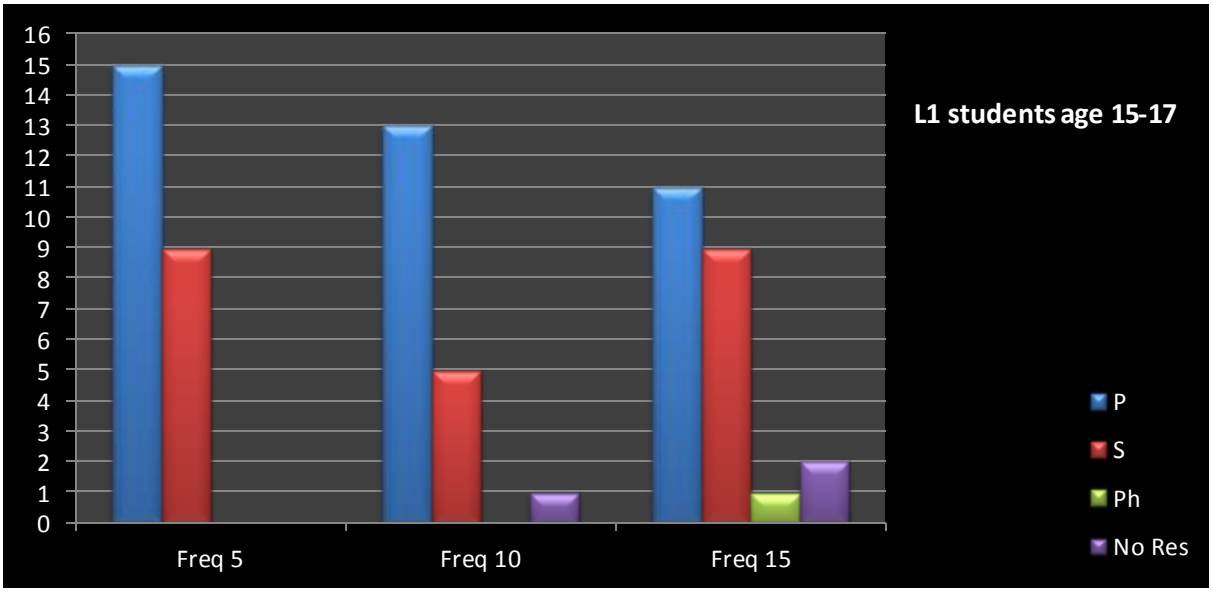

Figure 5.12. Frequency and associations of L1 students aged 15-17.

The Kruskal-Wallis test yielded a significant frequency effect for paradigmatic (*p* value = .001), syntagmatic (*p* value = .003), and phonological associations (*p* value = .002), and no-response items (*p* value = .002). Table 5.27 shows that, according to the results of Mann Whitney U test, the difference between the number of paradigmatic and syntagmatic associations was statistically significant when comparing words in the 1-5k, 5-10k, and 10-15k frequency ranges. The difference for phonological associations and no-response items was statistically significant comparing words in the 5-10k and 10-15k frequency ranges.

Table 5.27

Significance of Frequency Effect on Associations for L1 Students Aged 15-17

Frequency	P	S	Ph	No-res
1-5k & 5-10k	.034	.025	.849	.610
5-10k & 10-15k	.041	.029	.029	.003

Note. The mean difference is significant at .05 level; L1 = first language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; k = 1000.

5.2.10. Summary

The findings of the current study addressing the first research question revealed that overall the L2 ML had a similar trend of development to the L1 ML in terms of the paradigmatic and phonological associations, no-response items, vocabulary size, and reaction time. With age, vocabulary size and the number of paradigmatic associations increased, whereas reaction time and the number of no-response items decreased. Surprisingly, the number of phonological associations increased before it decreased in both L2 and L1. The study revealed discrepancies between L2 and L1 trends of development for syntagmatic associations. In the L2, the number of syntagmatic associations increased steadily. In contrast, in the L1, the number of syntagmatic associations rose comparing students aged 6-7 to 11-12 but remained static comparing students aged 11-12 to 15-17.

With regards to the correlation between different dimensions of the ML, the study indicated that vocabulary size was positively correlated with paradigmatic and syntagmatic associations for both the L2 and L1 participants. Additionally, there was a negative correlation between vocabulary size, no-response items, and reaction time in both L2 and L1. With an increase in vocabulary size, the number of paradigmatic and syntagmatic associations increased, while the number of no-response items and reaction time declined. There was no correlation between vocabulary size and phonological associations.

In terms of the effect of word frequency on word associations, the present study demonstrated that this factor influenced the types of associations in the ML regardless of age and language. Overall, both L2 and L1 participants of all ages provided more paradigmatic and syntagmatic associations, and fewer no-response items and phonological associations to the high-frequency words (words in the 1-5k frequency range). With a decline in frequency of the stimulus words, the number of both paradigmatic and syntagmatic associations declined, and the number of no-response items and phonological associations rose.

5.3. Research question 2

Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

In order to respond to the second research question, this section presents descriptive and statistical analysis comparing the L2 and L1 students from each age group (6-7, 11-12, and 15-17) in terms of associations, vocabulary size, and reaction time. Additionally, this section presents the correlation analysis of the effect of the LoR in the L2 country, the LoE in the L2, and the AoA into the L2 country on different dimensions of the L2 ML.

5.3.1. L2 and L1 students aged 6-7

Table 5.28 shows that L2 students aged 6-7 produced fewer paradigmatic and syntagmatic associations, and more no-response items compared to L1 students. However, L1 students provided more phonological associations than L2 students.

Table 5.28

Median for Different Dimensions of L2 and L1 ML - Students Aged 6-7

Language	Age	Voc size	P	S	Ph	No-res	RT
L2	6-7	-	4	7	0	31	-
L1	6-7	-	7	11	1	12	-

Note. L2 = second language; L1 = first language; ML = mental lexicon; Voc = vocabulary; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; RT = reaction time.

Figure 5.13 compares L2 and L1 students aged 6-7 in terms of their associations, vocabulary size, and reaction time.

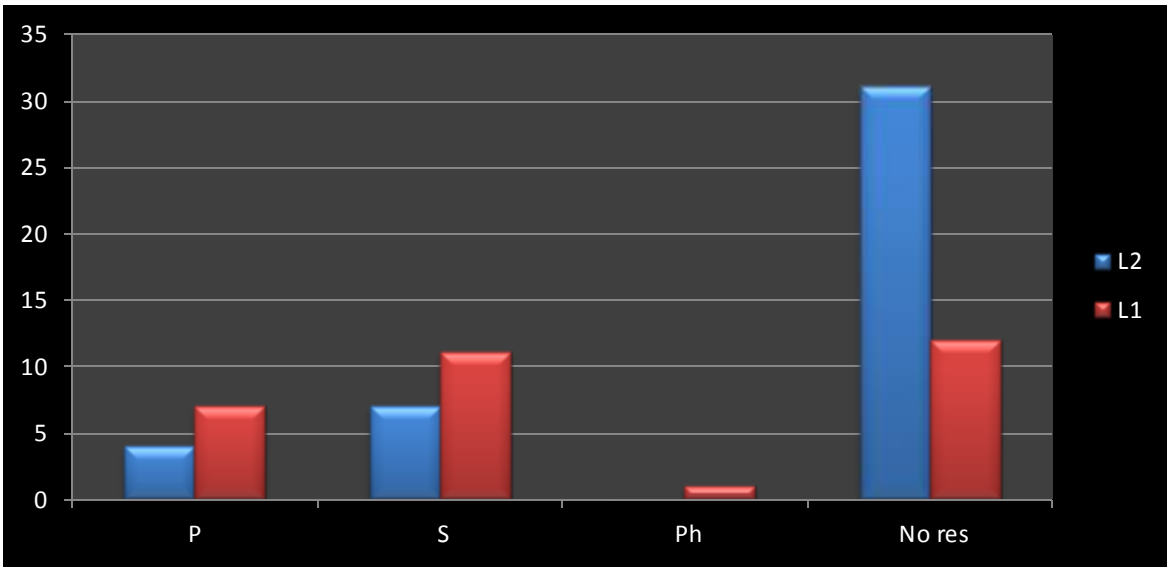

Figure 5.13. Comparison of the associations and no-response items of L2 and L1 students aged 6-7.

As displayed in Table 5.29, the Mann Whitney U test yielded significant levels for paradigmatic and syntagmatic associations, and no-response items. This test demonstrated a nonsignificant level for phonological associations. Thus, the number of paradigmatic and syntagmatic associations, and the no-response items differentiated L2 students aged 6-7 from their L1 peers.

Table 5.29

Significance of Difference for Different Dimensions of L2 and L1 ML - Students Aged 6-7

Age	P	S	Ph	No-res	Voc Size	RT
6-7	.010	.007	.120	.000	-	-

Note. The significance level is .05. L2 = second language; L1 = first language; ML = mental lexicon; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

5.3.2. L2 and L1 students aged 11-12

Table 5.30 shows that the scores of L2 students aged 11-12 for vocabulary size and reaction time were lower than those of L1 students the same age. Further, they provided fewer paradigmatic and syntagmatic associations, and more no-response items. Both groups gave the same number of phonological associations.

Table 5.30

Median for Different Dimensions of L2 and L1 ML - Students Aged 11-12

Language	Age	Voc size	P	S	Ph	No-res	RT
L2	11-12	72	16	10	3	11	1083
L1	11-12	80	19	13	3	7	1157

Note. L2 = second language; L1 = first language; ML = mental lexicon; Voc = vocabulary; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; RT = reaction time.

Figure 5.14 compares L2 and L1 students aged 11-12 in terms of associations, vocabulary size, and reaction time.

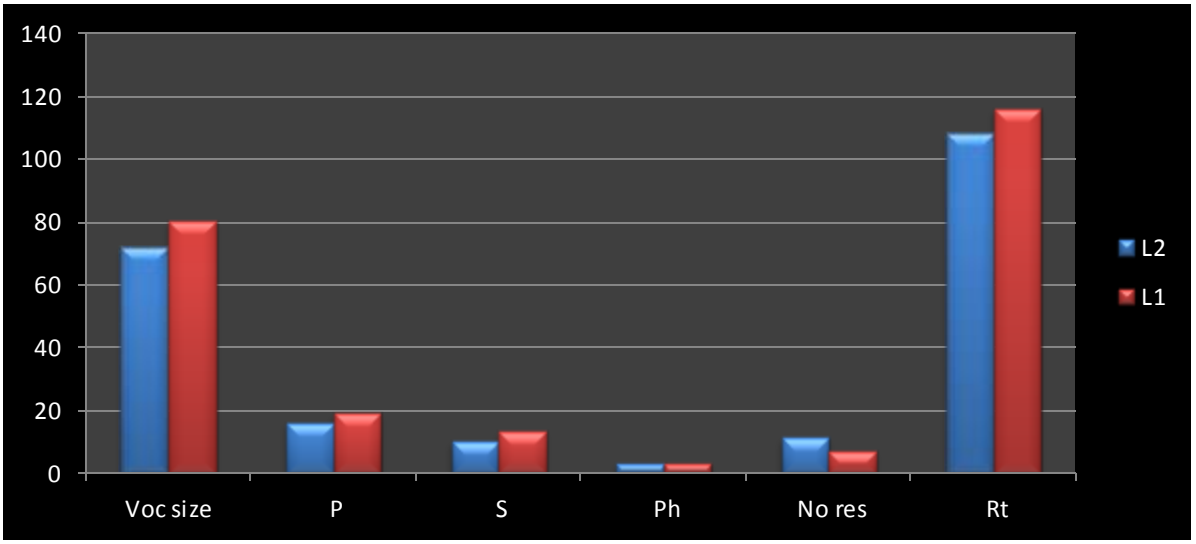

Figure 5.14. Comparison of the associations, vocabulary size, and reaction time of L2 and L1 students aged 11-12.

According to the results of the Mann Whitney U test exhibited in Table 5.31, there were statistically significant differences between the two groups in terms of vocabulary size, the number of paradigmatic and syntagmatic associations, and the number of no-response items. There was no statistically significant difference for phonological associations and reaction time to words.

Table 5.31

Significance of Difference for Different Dimensions of the L2 and L1 ML - Students Aged 11-12

Age	P	S	Ph	No-res	Voc Size	RT
11-12	.010	.034	.674	.022	.015	.084

Note. The significance level is .05; L2 = second language; L1 = first language; ML = mental lexicon; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

5.3.3. L2 and L1 students aged 15-17

Table 5.32 indicates that L2 students aged 15-17 produced fewer paradigmatic associations but more syntagmatic associations and no-response items than their L1 peers. Additionally, their scores for vocabulary size and reaction time were lower than L1 students the same age.

Table 5.32

Median for Different Dimensions of L2 and L1 ML - Students Aged 15-17

Language	Age	Voc size	P	S	Ph	No-res	RT
L2	15-17	86	20	16	1	5	837
L1	15-17	90	23	15	1	2	957

Note. L2 = second language; L1 = first language; ML = mental lexicon; Voc = vocabulary; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; RT = reaction time.

Figure 5.15 compares the associations, vocabulary size, and reaction time of L2 and L1 students aged 15-17.

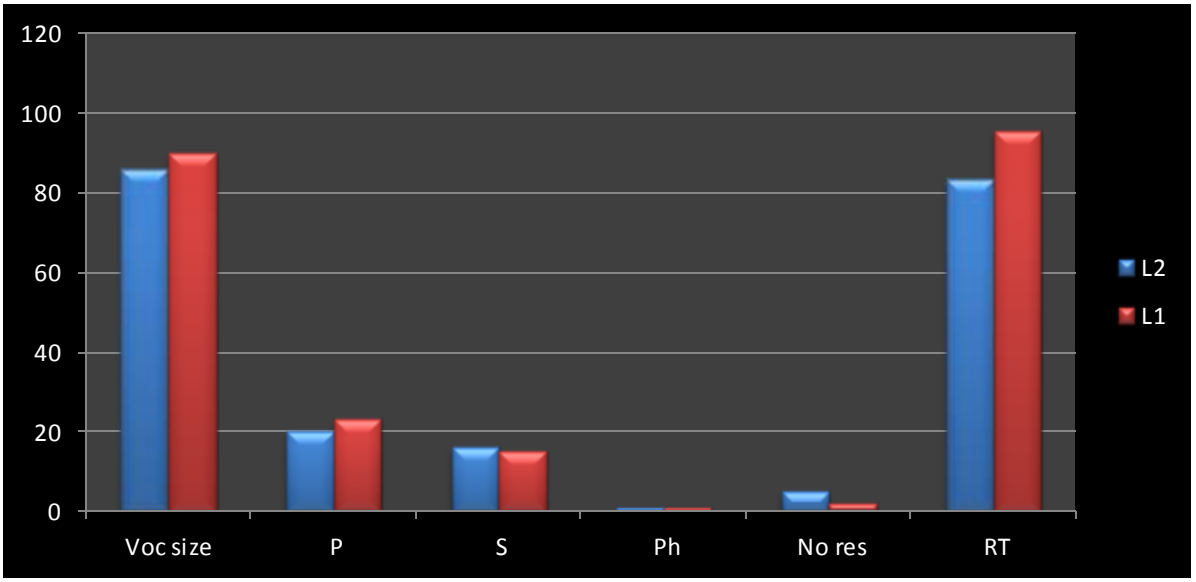

Figure 5.15. Comparison of the associations, vocabulary size, and reaction time of L2 and L1 students aged 15-17.

As demonstrated in Table 5.33, the Mann Whitney U test yielded significant levels for paradigmatic associations and no-response items. This test revealed nonsignificant levels for syntagmatic and phonological associations, vocabulary size, and reaction time. Thus, the number of paradigmatic associations and no-response items distinguishes L2 students aged 15-17 from their L1 peers.

Table 5.33

Significance of Difference for Different Dimensions of L2 and L1 ML - Students Aged 15-17

Age	P	S	Ph	No-res	Voc size	RT
15-17	.015	.171	.696	.000	.076	.617

Note. The significance level is .05; L2 = second language; L1 = first language; ML = mental lexicon; P = paradigmatic; S = syntagmatic; ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

As the differences between the L2 and L1 groups were relatively small, the effect size was calculated to show the magnitude of difference. In cases where there was a statistically significant difference between the L2 and L1 groups, Cohen's *d* also yielded medium and high effect sizes (see Table 5.34).

Table 5.34

Effect Size for Different Dimensions of ML – L2 and L1 Students of All Ages

Group	Variable	d-value	r-value
6-7		-0.797	-0.370
11-12	P	-0.552	-0.266
15-17		-0.538	-0.260
6-7		-1.127	-0.491
11-12	S	-0.736	-0.345
15-17		0.240	0.119
6-7		-0.478	-0.232
11-12	Ph	0	0
15-17		0	0
6-7		4.552	0.915
11-12	No-res	0.593	0.284
15-17		0.704	0.332
6-7		-	-
11-12	Voc-size	-0.628	-0.299
15-17		-0.506	-0.245
6-7		-	-
11-12	RT	-0.230	-0.114
15-17		-0.720	-0.338

Note. ML = mental lexicon; L2 = second language; L1 = first language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

5.3.4. Length of residence in L2 country

As displayed in Table 5.35, the Spearman rank-order correlation test demonstrated that the LoR in the L2 country was positively correlated with the associations (paradigmatic and syntagmatic) and vocabulary size. As the LoR in the L2 country increased, the vocabulary size and the number of paradigmatic and syntagmatic associations also increased in the L2 ML. There was no correlation between the LoR in the L2 country and the phonological associations. Table 5.35 also demonstrates that the LoR in the L2 country was negatively

correlated with the no-response items and the reaction time. As the L2 students' LoR in the L2 country increased, the no-response items and reaction time to words declined.

Table 5.35

Correlation between LoR in L2 Country, Associations, Vocabulary Size, and Reaction Time

Variable	P	S	Ph	No-res	Voc size	RT
LoR	.659**	.557**	.097	-.706**	.557**	-.477**

Note. LoR = length of residence; L2 = second language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

** $p < .01$.

5.3.5. Length of mainstream education in L2

Table 5.36 shows a positive correlation between the LoE in the L2, associations (paradigmatic and syntagmatic), and vocabulary size. With an increase in the LoE in the L2, vocabulary size and the number of paradigmatic and syntagmatic associations increased. Statistical analysis revealed no correlation between the LoE in the L2 and the number of phonological associations. Table 5.36 also displays a negative correlation between the LoE in the L2, the number of no-response items, and reaction time. As the LoE in the L2 increased, the number of no-response items and reaction time declined.

Table 5.36

Correlation between LoE in L2, Associations, Vocabulary Size, and Reaction Time

Variable	P	S	Ph	No-res	Voc size	RT
LoE	.802**	.688**	.100	-.852**	.736**	-.638**

Note. LoE = length of education; L2 = second language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

** $p < .01$.

5.3.6. Age of arrival into L2 country

As shown in table 5.37, there was no correlation between the AoA into the L2 country and any dimension of the L2 ML (association, vocabulary size, or reaction time) for L2 students. The age of arrival was only calculated for L2 students. As the L1 participants of the current

study were all born in Australia, this analysis was irrelevant for them.

Table 5.37

Correlation between AoA into L2 Country, Associations, Vocabulary Size, and Reaction Time

Variable	P	S	Ph	No-res	Voc size	RT
AoA	-.086	.006	-.082	.075	-.082	.107

Note. AoA = age of arrival; L2 = second language; P = paradigmatic; S = syntagmatic; Ph = phonological; No-res = no-response items; Voc = vocabulary; RT = reaction time.

5.3.7. Summary

In order to respond to the second research question, this section has compared L2 and L1 students of each age group (6-7, 11-12, and 15-17) in terms of their associations, vocabulary size, and reaction time. Additionally, this section provided correlation analysis for the LoR in the L2 country, the LoE in the L2, the AoA into the L2 country, and different dimensions of the L2 ML.

The findings of this study addressing the second research question revealed discrepancies between L2 and L1 students aged 6-7, 11-12, and 15-17. Nevertheless, L2 students aged 15-17 were the most similar to their L1 peers in terms of most associations (all except for paradigmatic associations) and reaction time.

Further, the present study revealed a positive correlation between both the LoR in the L2 country and the LoE in the L2, the number of paradigmatic and syntagmatic associations, and vocabulary size. A negative correlation was observed between the two variables, the number of no-response items, and reaction time. There was no correlation between the LoR in the L2 country and the LoE in the L2, and the number of phonological associations. Additionally, statistical analysis yielded no correlation between the AoA into the L2 country and any dimension of the ML (associations, vocabulary size, and reaction time) for L2 students.

Chapter 6 – Discussion

6.1. Overview

The objective of this chapter is to provide critical analysis of the findings of this study reported in Chapter 5, addressing the following two research questions:

1) Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

Similar circumstances in this context involve learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and living in the L2 country.

2) Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

In order to respond to the two research questions, a Word Association Task (WAT) was utilised to elicit word associations from L2 and L1 students of different ages (see section 3.1.5). Additionally, the yes/no Lexical Decision Task (LDT) was applied as a tool to measure the participants' vocabulary size and reaction time (see section 3.2.3). Descriptive and statistical analysis were performed to compare the associations, vocabulary size, and reaction time of L2 and L1 students of different ages and determine whether the discrepancies between students of different age and language groups were statistically significant (see section 4.6).

The findings of the current study regarding the first research question revealed that overall the L2 ML had a similar trend of development to the L1 ML if the L2 was learned in similar circumstances to the L1. Despite the similarities, however, slight discrepancies were observed between the trends of development in the L2 and L1 ML. The results showed a similar trend of development for the L2 and L1 ML in terms of paradigmatic and phonological associations, no-response items, vocabulary size, and reaction time.

In particular, the number of paradigmatic associations increased as both L2 and L1 students aged 6-7 produced the fewest and students aged 15-17 provided the most paradigmatic responses (6-7 < 11-12 < 15-17). The difference among the three groups was statistically significant (see section 5.2.1).

The number of phonological associations rose before it declined for both L2 and L1 students. Students aged 6-7 produced a lower number of phonological responses than students aged 11-12, and students aged 15-17 gave fewer phonological responses compared to students aged 11-12 (6-7 < 11-12 > 15-17). The statistical analysis yielded significant levels comparing the three age groups (see section 5.2.3).

The number of no-response items declined as both L2 and L1 students aged 6-7 gave the highest and students aged 15-17 gave the lowest number of no-response items in the WAT (6-7 > 11-12 > 15-17). There was statistically significant difference among the three groups (see section 5.2.4).

Vocabulary size increased as both L2 and L1 students aged 11-12 obtained lower scores for vocabulary size whereas students aged 15-17 obtained higher scores for vocabulary size in the yes/no LDT (11-12 < 15-17). Statistical analysis demonstrated a significant level comparing the two age groups (see section 5.2.6). As mentioned in the results chapter, the scores for the vocabulary size of L2 and L1 students aged 6-7 were unreliable as they had high false-alarm rates in the yes/no LDT. The high false-alarm rate indicates that there was a considerable amount of guessing in the responses to words on the yes/no LDT by both L2 and L1 students aged 6-7.

Reaction time declined as both L2 and L1 students aged 11-12 obtained higher scores and students aged 15-17 obtained lower scores for reaction time on the yes/no LDT (11-12 > 15-17). The difference between the two groups was statistically significant (see section 5.2.7). Both L2 and L1 students aged 6-7 also had a high false-alarm rate for reaction time in the yes/no LDT. This suggests their reaction time scores were unreliable.

Nevertheless, despite the similarities observed between the L2 and L1 ML trends of development, the L2 ML demonstrated a slightly different trend from the L1 ML in terms of syntagmatic associations. In case of the L2 students, the number of syntagmatic associations increased steadily comparing students aged 6-7 to students aged 15-17. L2 students aged 6-7 gave the fewest and L2 students aged 15-17 provided the most syntagmatic responses to the WAT (6-7 < 11-12 < 15-17). There were statistically significant differences among the three age groups (see section 5.2.2). In contrast, for the L1 students, the number of syntagmatic associations increased initially but remained static later. Statistical analysis yielded a significant level comparing the syntagmatic associations of L1 students aged 6-7 with those of L1 students aged 11-12. In contrast, there was no statistically significant difference

between the number of syntagmatic associations provided by L1 students aged 11-12 and 15-17 (see section 5.2.2).

The results of this study relating to the first research question were also computed for the correlation analysis between vocabulary size, associations, and reaction time. As the present study views the ML as an interconnected network of words and connections (see section 1.1), this was done to identify the correspondence among the different dimensions of the ML. The findings of the correlation analysis revealed that the number of paradigmatic and syntagmatic associations was positively correlated with vocabulary size in both the L2 and L1. No-response items and reaction time were negatively correlated with vocabulary size for both L2 and L1 students. There was no correlation between vocabulary size and phonological associations. As vocabulary size increased, the number of paradigmatic and syntagmatic associations also increased, and no-response items and reaction time to words declined in both L2 and L1 ML (see section 5.2.8).

Further, in response to the first research question, the study examined the impact of word frequency on the participants' word associations. The results showed that stimulus word frequency influenced the type of associations provided by both the L2 and L1 participants. Overall, high-frequency words (words in the 1-5k frequency range) elicited more paradigmatic and syntagmatic associations and fewer no-response items and phonological associations in both L2 and L1 of students regardless of age. As the frequency of stimulus words declined, the number of paradigmatic and syntagmatic associations also declined, and the number of no-response items and phonological associations increased (see section 5.2.9).

In order to respond to the second research question, L2 and L1 students of different age groups (6-7, 11-12, and 15-17) were compared against each other in terms of associations, vocabulary size, and reaction time. Further, correlation analysis was performed in order to identify the correspondence between the length of residence (LoR) in the L2 country, length of education (LoE) in the L2, age of arrival (AoA) into the L2 country, and the different dimensions of the L2 ML.

The results addressing the second research question revealed a large number of discrepancies between L2 and L1 students aged 6-7 and those aged 11-12. L2 students aged 6-7 produced fewer paradigmatic and syntagmatic associations, and more no-response items than L1 students of the same age. Although L1 students gave more phonological associations than L2 students, there was no statistically significant difference between them (see section 5.3.1). L2

students aged 11-12 obtained lower scores for both vocabulary size and reaction time than L1 students of the same age. However, the difference between L2 and L1 students was statistically nonsignificant for reaction time. Further, L2 students provided fewer paradigmatic and syntagmatic associations and more no-response items. Both groups gave the same number of phonological associations (see section 5.3.2). Nevertheless, L2 students aged 15-17 were the closest to their L1 peers in terms of the number of most associations (all except for paradigmatic associations) and reaction time. Despite the similarities, L2 students aged 15-17 had a smaller vocabulary size (indicated by higher no-response items in the WAT) and gave fewer paradigmatic associations than L1 students of the same age (see section 5.3.3).

Further, this study showed a positive correlation between both the LoR in the L2 country and the LoE in the L2, the paradigmatic and syntagmatic associations, and vocabulary size. A negative correlation was observed between the LoR in the L2 country and the LoE in the L2, no-response items, and reaction time. There was no correlation between the two variables and the number of phonological associations. Interestingly, nor was there a correlation between the AoA into the L2 country and any dimension of the L2 ML. This chapter discusses the findings of the current study addressing the first research question in four sections:

- trend of development for paradigmatic associations in L2 and L1 (section 6.2.1)
- trend of development for syntagmatic associations in L2 and L1 (section 6.2.3)
- trend of development for phonological associations in L2 and L1 (section 6.2.5)
- trend of development for vocabulary size (including no-response items) and reaction time in L2 and L1 (section 6.2.7)

Each section discusses the results in the broader context of child linguistic and cognitive development. Additionally, it compares the L2 and L1 trends of development considering the correlation among the different dimensions of the ML (associations, vocabulary size, and reaction time) and the impact of word frequency on word associations.

In addition, the chapter discusses the results of the present study addressing the second research question in three sections:

- L2 and L1 students aged 6-7 (section 6.3.1)
- L2 and L1 students aged 11-12 (section 6.3.3)
- L2 and L1 students aged 15-17 (section 6.3.5)

Each section explains the findings comparing L2 and L1 students of each age group in terms of their associations, vocabulary size, and reaction time. Section 6.4 of this chapter discusses the impact of age and the environment for language learning on the different dimensions of the L2 ML.

6.2. Research question 1

Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

6.2.1. Trend of development for paradigmatic associations in L2 and L1

In the literature on word associations, studies which focused on the effect of age on the word associations of L2 school-aged children are rare. Except for the works of researchers such as Vermeer, and Schoonen and Verhallen (e.g., Vermeer, 2001; Schoonen & Verhallen, 2008), the existing research in this area is old. Furthermore, the focus is on the development of word associations in L1 school-aged children rather than L2 school-aged children (e.g., Brown & Berko, 1960; Ervin, 1961; Entwisle, 1966; Palermo, 1971). In the more recent literature, researchers have focused mainly on the word associations of adult EFL/ESL learners. In particular, they have examined the effect of proficiency, word frequency (e.g., Soderman, 1993), depth of word knowledge (e.g., Wolter, 2001), and choice of stimulus words (e.g., Fitzpatrick, 2006, 2009) on L2 word associations. Hence, this study fills an important gap in the research on word associations by investigating word associations in both L2 and L1 school-aged children. As such, the results of the current study are compared to the results available in the older literature on L1 children's associations and the results of studies investigating the word associations of adult EFL/ESL learners.

As shown in Figure 5.1 in section 5.2.1, the L2 ML had a similar trend of development to the L1 ML in terms of paradigmatic associations. With age, the number of paradigmatic associations increased in the ML regardless of whether it was the L2 or L1. Additionally, both L2 and L1 students aged 6-7 provided fewer paradigmatic associations than syntagmatic ones. The number of paradigmatic associations produced by both L2 and L1 students aged 6-7 was lower than the number produced by older students. Moreover, the number of

paradigmatic associations produced by both L2 and L1 students aged 6-7 was lower than the number of syntagmatic associations. These indicate that paradigmatic associations are not the strongest type of association in the child ML regardless of whether the child is functioning in the L2 or the L1. However, with age, paradigmatic associations play a more dominant role in both the L2 and L1 ML.

The increase in the number of paradigmatic associations in the L2 and L1 ML observed in this study is not surprising as previous research on L1 word associations (e.g., Brown & Berko, 1960; Ervin, 1961; Entwisle, 1966; Palermo, 1971) revealed similar findings. Research on L1 word associations showed that the associations of child L1 differed from the associations of adult L1. Children's associations were heterogeneous by part of speech to the stimulus words (syntagmatic associations) while adults' associations were homogeneous by part of speech to the stimulus words (paradigmatic associations), (Brown & Berko, 1960). In other words, the word class of the stimulus word matched the word class of the response in adults more often than in children (Entwisle, 1965), (see sections 2.3.1.1 and 2.3.1.3).

Nevertheless, the findings of this study made an important contribution to the research on L2 and L1 word associations in the sense that this study and the recent literature (e.g., Wolter, 2001; Zareva, 2007) define paradigmatic associations somehow differently from the definitions of early studies. In the current study as well as in the recent literature, more broadly, the term "paradigmatic associations" refers to associations between words which are semantically connected with each other and are from the same word class. This definition fits in the semantic theory that the meaning of each word is understood by its connection with other words in the ML. For example, the meaning of *terrier* is understood by its connection with *dogs* and *animals* (see sections 2.3 and 4.5.1.1). Contrary to this study, the early research determined the associations by focusing only on the word class of the stimulus word and the response (see section 2.3.1.1). Therefore, this study contributes to the results of previous research by revealing that with age, the number of paradigmatic associations increases with paradigmatic associations reflecting the semantic connections among words.

The results of this study suggest that the L2 ML has a similar trend of development to the L1 ML in terms of paradigmatic associations. This indicates that variables independent of language (whether it is L2 or L1) affect its development. Discussion in previous research focused on the increase in the number of paradigmatic associations in terms of the way children organise their vocabulary into the part of speech (Brown & Berko, 1960, see section

2.3.1.1) and the contextual similarity of the words (Ervin, 1961, see section 2.3.1.2). Nevertheless, the increase can also be discussed in terms of a wide range of reasons such as the memory capacity of children and their use of memory strategies, children's cognitive development, and their increasing vocabulary size. The following sections discuss the increase in the number of paradigmatic associations in both the L2 and L1 ML in terms of the above-mentioned reasons.

Memory capacity and use of memory strategies. The memory capacity of children aged 6-7 and their minimal use of memory strategies are reasons which lend explanation to the lower number of paradigmatic associations in the L2 and L1 ML of children aged 6-7 (younger children), and that with age, the number of paradigmatic associations increases. Younger children have smaller memory capacity than older children and adults. With age, memory capacity increases in order to absorb new information and to hold it in the long-term memory. As memory capacity increases, children learn to apply memory strategies to maximise the absorption of new information and hold it in the long-term memory. Organisation is one of the strategies that children use. Organisation strategies involve strategies which help group related information together. This allows a large number of items to sit in a few categories and makes recollection faster and more efficient. For example, older children organise items in categories of clothing, body parts, food, and animals. School children begin to use organisation strategies around the age of 7 to 8 (Berk, 2006).

There is a close link between the memory strategy of organisation and paradigmatic associations. Comparing paradigmatic and syntagmatic associations, the paradigmatic associations are found between words in the same category. For example, *cat*, *dog*, and *monkey* are in the category of *animals* or *save*, *delete*, *forward*, and *backspace* are in the category of *computer commands*. In contrast, syntagmatic associations exist between words which sit in a phrase or sentence together. For example, *little* and *cat* sit together in the phrase *little cat*, or *save* and *data* sit together in the sentence *save the data*. Children aged 6-7 have smaller memory capacity, and they use memory strategies less often than older children. Thus, words in their ML are not organised in categories in the same way they are in older children's ML. With age, as the memory capacity of children and their reliance on memory strategies increase, the number of paradigmatic associations also increases. This is one of the reasons which explains why both L2 and L1 students aged 6-7 gave the fewest paradigmatic associations and why with age, the number of paradigmatic associations rose regardless of whether this occurred in the L2 or the L1.

Cognitive development. The lower number of paradigmatic associations in the L2 and L1 ML of children aged 6-7 and their increase with age may also be attributable to the cognitive development of children. Students aged 6-7 are at the end of the preoperational stage of cognitive development which is from age 2 to 7 (Piaget's developmental stage theory). At this stage, children's understanding of the hierarchical categorisation of language is limited. This means that children have only a limited ability to classify objects with regards to their higher level (superordinate) and lower level (subordinate) categories. For example, their understanding that *dog* is a kind of *animal* (*animal* as the superordinate), and *terrier* (*terrier* as subordinate) is a kind of *dog* is limited**.**

Children's associations and the hierarchical categorisation are closely linked. The hierarchical categorisation reveals itself in the paradigmatic associations of hyponymy as the superordinates (e.g., *animal*), subordinates (e.g., *dog* and *terrier*), and coordinates (e.g., *cat*, *dog*, and *cow*) (see section 4.5.1.1). Therefore, paradigmatic associations require that children understand the hierarchical categorisation of language. At ages 6-7, children's understanding of hierarchical categorisation is limited. As a result, children have fewer paradigmatic associations in their ML regardless of the language they function in.

In order to understand the hierarchical categorisation of language, children are required to understand the concepts of inclusivity, asymmetry, and transitivity (Rocsh et al., 1976). Inclusivity refers to the fact that the lower level category is included in the higher level category, as *apple* is included in the category of *fruit*. Asymmetry refers to the fact that the lower level category is a kind of the higher level category, but the higher level category is not a kind of the lower level category. For example, *apple* is a kind of *fruit*, but *fruit* is not a kind of *apple*. Transitivity means that the attributes of the higher level category such as *fruit* are applicable to the lower level category such as *apple*, but the attributes of the lower level category cannot be assumed to be applicable to the higher level category. According to Nelson (1996), understanding the concepts of inclusivity, asymmetry, and transitivity is a developmental achievement of children which occurs at the early or later primary school years. Children's limited understanding of the hierarchical categorisation of words is another reason which explains the tendency of both L2 and L1 students towards syntagmatic associations at age 6-7.

Contrary to students aged 6-7, students aged 11-12 are at the end of their concrete operational stage of cognitive development (Piaget's developmental stage theory) which occurs between

the age of 7 and 11. At this stage, children become more aware of the classifications and hierarchies of language. They also understand the concepts of inclusivity, asymmetry, and transitivity. Piaget observed that a boy he knew collected baseball cards, classified them according to their leagues and teams, and grouped them based on playing positions and batting. Hence, as L2 and L1 students' understanding of the classifications and hierarchies of language increases, words in their ML become classified in the categories and hierarchies. This lends explanation as to why L2 and L1 students aged 11-12 produced more paradigmatic associations than L2 and L1 students aged 6-7.

Vocabulary size. The further increase in the number of paradigmatic associations for participants aged 15-17 is perhaps attributable to the increase in their vocabulary size. Although the cognitive development of children continues to increase, according to Piaget's developmental stage theory, there is little difference between the formal operational stage (students aged 15-17) and the concrete operational stage (students aged 11-12) in terms of understanding the classifications and hierarchies of language. The formal operational stage of cognitive development (students aged 15-17) starts around age 11 and continues until adulthood. At this stage, children develop the capacity to think in an abstract and scientific way. Therefore, the impact of vocabulary size should be considered on the further increase in paradigmatic associations.

Based on the explanations presented above, awareness of categories and hierarchies occurs at the concrete operational stage (age 11-12 for participants of this study). Words become more organised and classified in categories, and paradigmatic associations play more dominant roles in the organisation of words in the ML. Younger students have a smaller vocabulary size than older students as their knowledge of the world is limited. As their knowledge of the world increases in and out of school through exposure to oral and written material in a wide range of subjects, new words enter the ML and develop associations. One type of association is the paradigmatic one. Hence, as the vocabulary size of children increases, the number of paradigmatic associations rises. The increase in vocabulary size also lends explanation to the increase in the number of paradigmatic associations.

In support of the effect that vocabulary size has on the increase in paradigmatic associations, Table 5.15 demonstrated a positive correlation between vocabulary size and the number of paradigmatic associations. Additionally, it showed a negative correlation between vocabulary size and the number of no-response items. With age, as the vocabulary size of children

increased in both L2 and L1, the number of no-response items declined, and paradigmatic associations increased[12]. Further, on the importance of the impact of vocabulary size on paradigmatic associations, it is logical to think that fewer paradigmatic associations are not always a matter of cognitive development. One may have the cognitive abilities required to understand the hierarchical categorisation of language but not know the linguistic labels (words) for them. This specifically applies to adult EFL/ESL learners. As adults, they have the cognitive abilities to understand the hierarchical categorisation of language, but do not know the words in the new language yet.

Word frequency. Although children's memory capacity and use of memory strategies, cognitive development, and their increasing vocabulary sizes offer explanation to the increase in the number of paradigmatic associations, word frequency also influences the number of paradigmatic associations in both L2 and L1. Section 5.2.9 demonstrates that the high-frequency stimulus words elicited more paradigmatic associations, and the low-frequency stimulus words elicited fewer. The impact of the frequency of stimulus word on the number of paradigmatic associations observed in this study is in line with previous research. For example, the participants of Wolter's (2001) and Stolz and Tiffany's (1972) studies provided fewer paradigmatic associations to lower frequency words than high-frequency ones (see sections 2.3.2.6 and 2.3.1.5).

As the name suggests, the frequency of stimulus words refers to how frequently words are used in both the oral and written language. The high number of paradigmatic associations for high-frequency words indicates that the language user becomes familiar with the words which are used more frequently in the linguistic environment in terms of their pronunciation/spelling, meaning, and use in various contexts. As a result, these words develop more meaningful associations with the other words in the ML, one of which is the paradigmatic association. In contrast, language users have low familiarity with low-frequency words. Consequently, the low-frequency words develop fewer meaningful associations (if any) with other words in the ML.

[12] The higher number of no-response items indicates the higher number of words that the participants of the current study did not know and therefore did not provide response to (see section 4.5.1.1).

6.2.2. Summary

This section has focused on the result that the L2 ML had a similar trend of development to the L1 ML in terms of paradigmatic associations. With age, the number of paradigmatic associations rose, regardless of whether it was in the L2 or L1.

This section has discussed the similarities between the L2 and L1 trends of development for paradigmatic associations in terms of children's memory capacity, their use of memory strategies, their cognitive development, and their increasing vocabulary size. With age, children's memory capacity increased, and they used the memory strategy of organisation more often to organise related items together. At the same time, they went through different stages of cognitive development where they understood the classifications and hierarchies of language. Additionally, their vocabulary size continued to increase. These reasons lent explanation to the increase in the number of paradigmatic associations in both the L2 and L1 ML.

This section has also emphasised the impact of stimulus word frequency on word associations. The higher number of paradigmatic associations for higher frequency words and the lower number for lower frequency words indicate that the language user is more familiar with words which are used more frequently in the linguistic environment. Therefore, these words develop more meaningful associations with other words in the ML, including paradigmatic associations.

6.2.3. Trend of development for syntagmatic associations in L2 and L1

Except for the few studies in the literature on child L1 word associations which paid attention to the development of syntagmatic associations, for example, Ervin (1961), Entwisle (1966), and Palermo (1971), this type of association has been relatively neglected. Previous research on child word associations largely focused on paradigmatic associations as the main organising associations in the ML, neglecting syntagmatic associations. Syntagmatic associations have been linked to child L1 (Ervin, 1961; Entwisle, 1966, see sections 2.3.1.2 and 2.3.1.3) and low proficiency EFL/ESL learners (e.g., Meara, 1983, see section 2.3.2.1). More attention has been paid to syntagmatic associations in the last two decades, specifically in the research on adult L2 associations (e.g., Wolter, 2001; Zareva, 2007; Fitzpatrick, 2006).

In addition to the scarcity of studies on the development of syntagmatic associations in children, however, the findings of existing studies are contradictory. For example, Ervin's

(1961) and Palermo's (1971) studies suggested that, with age, the number of syntagmatic associations declined (see sections 2.3.1.2 and 2.3.1.4). In contrast, Entwisle's (1966) and Namei's (2004) studies revealed that with age, the number of syntagmatic associations increased (see sections 2.3.1.3 and 2.3.3.2). The current study pays specific attention to this type of association as, in contrast to previous research, this study indicated that, with age, the number of syntagmatic associations rose. Table 5.3 and Figure 5.2 in section 5.2.2 show that the L2 ML had a similar trend of development to the L1 ML in terms of syntagmatic associations. With age, syntagmatic associations increased (comparing students aged 6-7 to 11-12). These associations played a more dominant role for L2 and L1 students aged 6-7 than for other age groups.

It seems that with age, two phenomena occur: a) the paradigmatic association plays a more dominant role in the structure of the L2 and L1 ML than the syntagmatic association, or in other words, syntagmatic-paradigmatic shift occurs; b) although syntagmatic-paradigmatic shift occurs, with age, the syntagmatic association continues to increase. The increase in the number of syntagmatic associations in the response of both L2 and L1 students also indicates that variables other than language influence the development of syntagmatic associations. These variables include children's exposure to word strings in the natural language, the increase in their vocabulary size, the frequency of the stimulus words, and the word class of the stimulus words. The following sections discuss the increase in the number of syntagmatic associations in terms of the above-mentioned variables.

Exposure to word strings. One reason which offers explanation to the increase in the number of syntagmatic associations is children's exposure to word strings in the natural language. Both L2 and L1 participants of the present study were exposed to natural language in the L2 environment. As discussed earlier, in natural language, words are presented in word strings or chunks. As children are exposed to word strings, they absorb and store the words in the word strings. For example, *sandy* and *beaches*, and *false* and *teeth* occur together, and children store them together in their ML (Wray, 2002). With age, as the exposure of both the L2 and L1 students to the natural language rises, the number of prestructured word strings also rises. In terms of the associations, this means that with age, the number of syntagmatic associations increases as they exist between words which sit in a phrase or sentence together (see section 4.5.1.1). The present study also suggested that there was a peak for this increase around the age of 11-12 in both the L2 and L1 ML. Comparing students aged 6-7 to 11-12, syntagmatic associations increased in both the L2 and L1.

Vocabulary size. In addition to exposure to word strings in the natural language, the increasing vocabulary size of children may also play a role in the increase of syntagmatic associations. As shown in Table 5.15 of section 5.2.8, the present study demonstrated a high positive correlation between vocabulary size and syntagmatic associations. As the vocabulary size increased, the number of syntagmatic associations also increased in both the L2 and L1. Students aged 6-7 have a smaller vocabulary size than the older students. As they have a smaller vocabulary size and fewer words in their ML, there are also fewer associations among words, one of which is the syntagmatic association. As the number of words in the ML increases, the number of associations among words also increases. Words develop connections with each other, and one of these connections is the syntagmatic one. Thus, the vocabulary size may be a factor which plays a role in the increase of syntagmatic associations in both the L2 and L1 ML.

Discrepancies between L2 and L1 in terms of syntagmatic associations. Comparing L2 and L1 students aged 6-7 and 11-12, despite the similarities between the L2 and L1 ML in terms of the trend of development for syntagmatic associations, this study, nevertheless, revealed discrepancies between the L2 and L1 comparing students aged 11-12 and 15-17. The number of syntagmatic associations continued to increase in the L2, but remained static in the L1 (see section 5.2.2). This discrepancy is explained below.

L2 students aged 11-12 possessed a smaller vocabulary size and provided fewer paradigmatic and syntagmatic associations than L1 students the same age (see section 5.3.2). In order to catch up with their L1 peers, ideally, their vocabulary size and both paradigmatic and syntagmatic associations had to increase. The current study provided support that this occurred as the vocabulary size of L2 students continued to grow, and paradigmatic and syntagmatic associations continued to increase (comparing the L2 students aged 11-12 and 15-17), (see sections 5.2.1, 5.2.2 and 5.2.6). At age 15-17, L2 students were able to catch up with their L1 peers in terms of syntagmatic associations. However, they lagged behind them in terms of their vocabulary size and paradigmatic associations.

L2 students aged 15-17 caught up with their L1 peers in terms of syntagmatic associations as these associations exist between words which sit in a phrase and sentence together such as *little* and *cat*. In contrast, paradigmatic associations exist between words with close semantic connections between them such as hyponyms, synonyms, antonyms, and meronyms (see section 4.5.1.1). Hence, syntagmatic associations may not be as reliant on vocabulary size and

knowledge of new words as paradigmatic associations are. L2 students aged 15-17 had a smaller vocabulary size than L1 students, and they knew fewer synonyms, antonyms, meronyms, and hyponyms for each word (fewer paradigmatic associations). However, they were able to put words together in a phrase or sentence as well as their L1 peers. Therefore, at age 15-17, L2 students managed to catch up with their L1 peers in terms of syntagmatic associations but not paradigmatic ones.

Word frequency. As shown in section 5.2.9, the present study revealed that the frequency of stimulus words had an impact on the number of syntagmatic associations regardless of the age and language of the participants. High-frequency words elicited more syntagmatic associations than low-frequency words. As the frequency of the stimulus words decreased, the number of syntagmatic associations also declined. As stated earlier, language users are more familiar with high-frequency words in terms of their pronunciation/spelling, meaning, and use in various contexts, as they are used more frequently than low-frequency words. Therefore, high-frequency words develop more meaningful associations with other words in the ML, including both paradigmatic and syntagmatic associations. In contrast, as low-frequency words are used less frequently, language users are less familiar with them. Thus, they develop less meaningful associations with other words in the ML.

Word class. The word class of the stimulus word has been found to influence the type of association in the ML. The findings of this study can also be related to the word class of the stimulus words used in the WAT. The WAT included three word classes, specifically, nouns, adjectives, and verbs. The findings of previous studies (Nissen & Henriksen, 2006) revealed that nouns elicited more paradigmatic associations, while adjective and verb stimulus words elicited more syntagmatic associations. Nouns are nominal and therefore more suited for paradigmatic associations, while adjectives and verbs are relational and thus more suited for syntagmatic associations. It is generally agreed that nouns are organised hierarchically into levels. For example *bulldog* is a kind of *dog*, and *dog* is a kind of *animal*. Furthermore, several semantic relationships exist among nouns, such as synonymy, antonymy, hyponymy, and meronymy. Adjectives, in contrast, modify nouns. For example, *strong* modifies *man* in *strong man*. The semantic organisation of an adjective is very different from that of nouns. Adjectives are not organised hierarchically into levels. "Nothing like the hyponymic relation that generates nominal hierarchies is available for adjectives" (Miller & Fellbaum, 1991, p. 210). Likewise, the semantic organisation of verbs is also different from that of nouns. Verbs do not have hyponyms and meronyms in the same way that nouns do. For example, the

sentence "*to stroll is a kind of to walk*" is not a well-chosen meaning simply because *to stroll* and *to walk* are not nouns (Miller & Fellbaum, 1991).

Given the information above, it may seem that the increase in the number of syntagmatic associations in both the L2 and L1 ML may be related to the fact that the WAT utilised in the current study contained more word classes suited for syntagmatic associations, adjectives and verbs (N = 30), than word classes suited for paradigmatic associations, nouns (N = 15). Nevertheless, both L2 and L1 students aged 11-12 and 15-17 provided more paradigmatic associations than syntagmatic ones. Additionally, the participants of this study gave a large number of paradigmatic associations to adjectives and verbs. For example, the stimulus word *delicious* elicited a large number of paradigmatic associations such as *nice*, *yummy*, *disgusting*, and *foul*, or *bland* elicited *tasteless*, *complex*, *plain*, *boring*, *strong*, and *tasty*. In another example, the stimulus word *bake* elicited *cook* in many cases. Thus, the word class of the stimulus word is not the only reason for the increase in the number of syntagmatic associations.

Response classifications. The result of the present study that, with age, the number of syntagmatic associations increased contradict the trend proposed by studies such as Palermo (1971) and Ervin (1961). For example, in Ervin's (1961) study, kindergarten and year 1 participants produced more syntagmatic associations than year 6 students. Ervin (1961) argued that with age, as the vocabulary size of children increased, their reliance on paradigmatic associations increased, and the number of other associations, including the syntagmatic and phonological ones, declined (see section 2.3.1.2). It is only natural to think that with an increase in vocabulary size, the number of synonyms and antonyms for each word (paradigmatic associations) increases. However, the current study does not indicate that the increase in the number of paradigmatic associations is offset by a decrease in the number of syntagmatic associations. The contradiction observed between the findings of this study and the findings of previous research may be explainable in terms of the response classifications. As explained above, in the early studies, the word class of the stimulus word and response determined the type of association. If the stimulus word and response were from the same word class, there were paradigmatic associations between them; if the stimulus word and response were from two different word classes, there were syntagmatic associations between them (see section 2.3.1.1). In contrast, in the present study and in recent research, other variables such as the sequential relationship between the stimulus word and response or

the semantic connections between them also determined the type of association (see section 4.5.1.1).

6.2.4. Summary

This section has focused on the results that the L2 ML had a similar trend of development to the L1 ML in terms of the syntagmatic associations, comparing students aged 6-7 to 11-12, and a dissimilar trend comparing students aged 11-12 to 15-17. The section has discussed the similarities between the L2 and L1 trends in terms of children's exposure to word strings in natural language, an increase in vocabulary size, and frequency and the word class of the stimulus words.

With age, children's exposure to word strings in natural language increased. At the same time as vocabulary increased, the number of connections among words also increased, one of which was the syntagmatic association. The frequency of the stimulus word also influenced the associations. High-frequency stimulus words elicited more, and low-frequency stimulus words elicited fewer syntagmatic associations regardless of the age and language of the participants. Additionally, it is possible that as the WAT contained a large number of adjectives and verbs, these word classes elicited more syntagmatic associations.

This section has explained the discrepancies between the L2 and L1 trends of development comparing students aged 11-12 to 15-17 in terms of their vocabulary size. As the L2 students had a smaller vocabulary size, they knew fewer words. Therefore, their reliance on syntagmatic associations continued to increase.

6.2.5. Trend of development for phonological associations in L2 and L1

Table 5.5 and figure 5.3 in section 5.2.3 displayed a similar trend of development for phonological associations in the L2 and L1 ML. With age, the number of phonological associations increased initially comparing the students aged 6-7 to 11-12 and declined after that comparing the students aged 11-12 to 15-17, regardless of the participants' language. In this study, the trend of development observed for phonological associations also contradicted the trend proposed in previous research (e.g., Ervin, 1961; Entwisle, 1966). For example, Ervin's (1961) study suggested that with age, the number of phonological associations of children declined. A similar trend was reported in Entwisle's (1966) study. The kindergarteners of her study produced the most and the college students the fewest

phonological associations (see section 2.3.1.3). This section discusses the trend observed in the current study for phonological associations and the contradiction between the findings of this study and previous research in terms of familiarity with and the frequency of the stimulus words and the children's increasing phonological awareness.

Familiarity and frequency of the stimulus words. The stimulus words used in the current study included both high- and low-frequency words from the 1k to 15k frequency ranges (see section 4.4.1.1). Students aged 6-7 only responded to words in the 1-5k frequency range and expressed unfamiliarity with the stimulus words of lower than the 5k frequency range (5-15k). Additionally, they did not provide responses to unfamiliar words even within the 1-5k frequency range (more no-response items, see section 5.2.9.1). As phonological associations exist between words which sound alike but have no connections in meaning (see section 4.5.1.1), it is possible that if the participants were asked to respond to all the stimulus words regardless of their frequency, and regardless of whether they were familiar with them or not, they would have responded with more phonological associations. Therefore, the familiarity with and the frequency of the stimulus words possibly explain the lower number of phonological associations of L2 and L1 students aged 6-7.

Even though the stimulus words in Ervin's (1961) study were all high-frequency words (therefore, based on the explanation above, one would think that the child L1 would not produce any phonological responses), child L1 participants of her study were not familiar with all the high-frequency words and provided more phonological associations. With age, as the children's familiarity with the same high-frequency stimulus words increased, the number of phonological associations dropped. Further, in Entwisle's (1966) study, although the stimulus words were from both high- and low-frequency ranges, there was no analysis provided comparing the number of phonological associations given by participants in response to both high- and low-frequency words. In the absence of this information, the impact of the frequency of stimulus words on phonological associations is unclear in Entwisle's (1966) study.

In contrast to L2 and L1 students aged 6-7 who only responded to most of the words in the 1-5k frequency range, students aged 11-12 provided responses to words up to the 10k frequency range, and some to words up to the 15k frequency range. Section 5.2.9 demonstrates that the number of phonological associations increased for lower frequency words in the response of both L2 and L1 participants. L2 students aged 11-12 gave more phonological associations to

words in the 5-10k, and L1 students aged 11-12 gave more phonological associations to words in the 10-15k frequency range. It is possible that L2 students aged 11-12 were less familiar with words in the 5-10k frequency range as they are less frequent. Therefore, they responded to them with more phonological associations. Students aged 15-17 also responded to words up to the 15k frequency range. However, this age group is possibly more familiar with words in all the frequency ranges, particularly, the higher frequency ones (1-5k and 5-10k) as they have been exposed to them for longer. Hence, L2 and L1 students aged 15-17 gave fewer phonological associations to words in different frequency ranges than students aged 11-12 (see sections 5.2.9.2 and 5.2.9.3).

The level of familiarity of L2 and L1 children with the words plays an important role in the number of phonological associations, regardless of the language. As words from the lower frequency ranges enter the ML, they build meaningful associations (paradigmatic and syntagmatic) with existing words. As the meaningful associations are built, the number of associations which are only based on the formal resemblance of the words (phonological associations) decreases. The effect of familiarity with and the frequency of the stimulus word on phonological associations has been indicated in research on adult EFL/ESL learners. For example, in Zareva's (2007) study, there were no phonological associations given to familiar stimulus words by either beginner or advanced ESL learners. The stimulus words used in Zareva's (2007) study were high-frequency words that English language learners learn first (see section 2.3.2.9). Also, in support of the impact of the frequency of the stimulus words on phonological associations, Wolter's (2001) study showed that phonological associations increased for lower frequency stimulus words even in native speakers' responses (see section 2.3.2.6). Thus, the familiarity with and the frequency of the stimulus words are important variables which affect the type of associations regardless of the language.

Phonological awareness. In addition to the impact of familiarity with and the frequency of the stimulus words on phonological associations, this section discusses the trend of development for phonological associations in terms of the increasing phonological awareness of children. With age, children's phonological awareness of the language and their ability to play with the phonological components of language increase. As children's interaction with the oral and written language increases, phonological knowledge becomes more refined and diverse (Gleason & Ratner, 2009). It is possible, therefore, that as children's awareness of the phonological aspect of language increases, their reliance on the phonology also rises which probably results in more phonological associations to less familiar words. There seems to be a

peak for this increase which occurs around the age of 11-12 after which the number of phonological associations decreases (comparing students aged 15-17 of the current study to students aged 11-12).

Different types of phonological associations. On a closer inspection, not all the phonological associations in the L2 and L1 students' responses were similar in nature. For example, association pairs such as *add* and *addition* or *become* and *became* are qualitatively different from association pairs such as *bake* and *bacon*, or *bland* and *blind*. In the first examples, the responses are derived from the stimulus words. In contrast, in the second examples, there is merely a formal relationship between the stimulus words and responses as they only sound alike. The current study divided the participants' phonological associations into different types in order to have a better understanding of the participants' phonological associations and their development. However, there was no sufficient data for different types of phonological associations. Nor was there statistically significant difference between the number of phonological associations in each of the groups. Therefore, this could not be covered in the present study. Further research is required to shed light on the types of phonological associations in children.

6.2.6. Summary

This section has focused on the findings that with age, the number of phonological associations increased in both the L2 and L1 ML before it decreased. The section has explained the trend of development for phonological associations in terms of familiarity with and frequency of the stimulus words and the children's increasing phonological awareness.

Children provided more phonological associations to lower frequency stimulus words with which they were less familiar. With age, as the children's phonological awareness increased, their reliance on the phonological properties of words also increased. Therefore, the number of phonological associations rose. There was a peak for this increase around the age of 11-12 years after which the number of phonological associations declined.

This section has also noted that the phonological associations in the L2 and L1 students' responses were not similar in nature. In some cases, the children's responses were derived from the stimulus words. In other cases, there was only a formal relationship between the

stimulus words and responses. This could not be further investigated in this study as there was not sufficient data for each type of phonological associations.

6.2.7. Trend of development for vocabulary size and reaction time in L2 and L1

In discussing the trend of development for vocabulary size, both the vocabulary size scores and the no-response items of the participants are taken into consideration. The former is the score that the participants obtained for vocabulary size on the yes/no LDT (see section 5.2.6). The latter is the number of words for which the participants provided no response on the WAT, as they were unfamiliar with the words (see section 5.2.4). No-response items have been little used in the literature on child L1 associations (Brown & Berko, 1960; Entwisle, 1966; Palermo, 1971) and child L2 associations (Vermeer, 2001; Schoonen & Verhallen, 2008). Consequently, the effect of no responses on word associations has not been investigated. This may be due to the fact that previous research (Ervin, 1961; Palermo, 1971) mainly used high-frequency and common stimulus words in their WATs. As such, the participants of their studies managed to provide responses to most if not all of the stimulus words as they were familiar with them. In contrast, the current study pays specific attention to the no-response items as with age, the number of no-response items from both L2 and L1 participants of the current study decreased.

Increase in vocabulary size. Figures 5.4 and 5.5 (see sections 5.2.4 and 5.2.6) demonstrate a similar trend of development for vocabulary size and no-response items in both the L2 and L1 ML. With age, the vocabulary size increased, and the number of no-response items decreased. The results of this study in terms of the vocabulary size are in line with the results of previous research on children's vocabulary development. For example, in Bialystok et al.'s (2010) study, bilingual children aged 10 had a larger vocabulary size than bilingual children aged 3 (see section 2.4.1.1). Similarly, in Vermeer's (2001) study, bilingual children aged 7 obtained higher scores for vocabulary size than the bilingual children aged 4 (see section 2.3.3.1). It is noteworthy that the vocabulary size task utilised in the current study was different from those used in previous research. The present study utilised the yes/no LDT (see section 4.4.1.2), while previous research used picture naming tasks (e.g., the Peabody Picture Vocabulary Test III in Bialystok et al., 2010). Despite the use of different tasks, the findings are consistent that with age, L2 children's vocabulary size increases.

As discussed earlier, the increase in L2 and L1 students' vocabulary size and the decrease in the no-response items are attributable to children's increasing knowledge of the world. Younger students have a smaller vocabulary than older students as their knowledge of the world is limited. As children's knowledge of the world increases in and out of school, through exposure to oral and written material in a wide range of subjects such as science, maths, and history, their vocabulary increases, and the number of words they do not know (no-response items) declines.

Length of residence. Table 5.12 in section 5.2.7 showed that with age, the reaction time to words decreased regardless of whether it was the L2 or L1. These findings are not consistent with the findings of previous research (e.g., Magiste, 1992). There was no statistically significant difference between the lexical access of primary and high school students in Magiste's (1992) study. The contradictory findings of the current study with previous research may be attributable to the length of residence (LoR) of the L2 students in the L2 country. L2 participants of the current study aged 15-17 had lived in the L2 country longer than the younger participants (aged 6-7 and 11-12). In contrast, some of the L2 high school participants of Magiste's (1992) study had shorter LoR than the primary school participants (see section 2.4.1.4). Therefore, the difference between the LoR of the L2 participants of this study and those in Magiste's (1992) study may account for the contradictory findings.

Children's reading skills. There are different possibilities which lend explanation to the decrease in the reaction time of children. One possibility is that as children grow up, they spend more time on reading, and their reading skills improve. As reading skills improve, the underlying components for reading skills also improve, one of which is the speed at which words are recognised (reaction time to words). For children, the word recognition includes recognition of letters, knowledge of letter-phoneme correspondence, and semantic knowledge (Rayner et al., 2003). When children first learn to read, they are slower in decoding the written script. However, with age, the purpose of reading changes as children read to learn about things. At this stage, the decoding of the written script becomes faster. This fits with the findings that with age, the reaction time to words decreased regardless of whether the children functioned in their L2 or L1.

Vocabulary size and reaction time. As the present study investigated the ML as a network with the three dimensions (see section 1.1), it was also of interest to examine the impact that one dimension of the ML (e.g., vocabulary size) had on another (e.g., reaction time).

Although the literature presents studies which measured the bilinguals' vocabulary size and their lexical access (e.g., Bialystok et al., 2008), there are very few studies in the literature on the L2 ML which have examined the relationship between the two. Even the existing studies (e.g., Laufer & Nation, 2001; Harrington, 2006; Miralpeix & Meara, 2010) reported somehow contradictory findings. For example, Harrington's (2006) study showed a negative correlation between vocabulary size and reaction time. In contrast, there was no correlation observed in Miralpeix and Meara's (2010) study. With this gap, the current study makes a contribution to the literature on the L2 ML by investigating the impact of vocabulary size on reaction time.

Table 5.15 in section 5.2.8 exhibits a strong negative correlation between vocabulary size and reaction time. As vocabulary size increased, the reaction time to words declined. At the surface level, the negative correlation observed in the current study between vocabulary size and reaction time indicates that as more words enter the ML (vocabulary size increases), and as individuals' knowledge of various aspects of words increases, the reaction time to words decreases. However, the relationship between the two seems to be more complex. The findings of the present study regarding the vocabulary size and reaction time of L2 students aged 11-12 showed that although their vocabularies were smaller than those of L1 students of the same age, they accessed words as quickly as their L1 peers (see section 5.3.2). The smaller vocabularies of L2 students aged 11-12 were not accompanied by slower reaction time to words as these students accessed words as fast as L1 students of the same age. Even though there is a systematic relationship between vocabulary size and reaction time, the relationship between the two is somehow more complex.

Additionally, the findings of previous research (e.g., Laufer & Nation, 2001) do not offer support to the claim that large lexicons are accompanied by fast access to words. Laufer and Nation's (2001) study showed that the relationship between vocabulary size and reaction time to words was not linear. With an increase in vocabulary size, the reaction time did not decrease automatically. The reaction time to words on each frequency range decreased only when the size of a learner's vocabulary increased beyond that frequency range. Therefore, according to Laufer and Nation (2001), reaction time to words lags behind vocabulary size (see section 2.4.3.1).

In order to investigate the relationship between vocabulary size and reaction time in more depth, the findings of previous research were examined. Laufer and Nation's (2001) study demonstrated a moderate correlation between the vocabulary size and reaction time of EFL

learners with different scores for vocabulary size (see section 2.4.3.1). Comparing the results of this study to those of Laufer and Nation's (2001) study, one variable which seems to influence the reaction time to words and its correlation with vocabulary size is the environment for language learning. The participants of the current study had been learning English through mainstream education in English and generally living in an English speaking environment. Unlike them, the participants of Laufer and Nation's (2001) study were adult EFL learners learning English in Israeli universities. They were learning English as a foreign language in the classroom setting. In learning a second language in the L2 environment, L2 learners have an extensive and on-going exposure to the language in school and in the wider society. Therefore, the chances of encountering the words they have learned are better. In addition, they encounter words which they do not know yet. So, they see/hear the form of words before they learn their meaning and use. As a result of the extensive and on-going exposure to L2 words in the L2 environment, the L2 students of this study developed fast access to words although they had smaller vocabularies than their L1 peers. In contrast, in learning a foreign language in the classroom setting, students learn new words, but their chances of encountering the same words in the future are slim or not as high as if they were learning the L2 in the L2 environment. The contact that foreign language learners have with the new language is through books and classroom materials. Therefore, it seems that the environment for language learning plays an important role in how quickly language learners access words in their ML. The conclusion drawn here is that Laufer and Nation's (2001) claim that "the reaction time lags behind the vocabulary size" probably applies to learning a foreign language in the classroom setting but not to learning the L2 in the L2 environment.

Nor are the findings of the present study in line with the findings of Miralpeix and Meara's (2010) study. There was no correlation observed in their study between vocabulary size and reaction time. It is important to note that in addition to the two considerable differences between the present study and Miralpeix and Meara's (2010) study concerning the age of participants and the language learning environment (see section 2.4.3.3), the methodological differences may account for the contradictory findings. The task used in Miralpeix and Meara's (2010) research contained only high-frequency words used commonly in everyday language. It is possible that all the participants (with different vocabulary sizes) of their study had fast access to those frequently encountered and used words regardless of vocabulary size. Therefore, the lack of correlation between the L2 participants' vocabulary size and reaction time in Miralpeix and Meara's (2010) study may be attributable to the fact that the test

utilised in their study was not able to gauge the differences between participants with different vocabulary sizes in reaction time to the lower frequency words.

It is safe to conclude that as the findings of this study reveal, vocabulary size and reaction time are correlated. The children's knowledge of various aspects of words, such as phonology, orthography, morphology, semantics, and pragmatics, increases as they are exposed to words in the L2 environment. The more frequent exposure to various aspects of words provides for faster access to the words in the ML. The environment for language learning plays an important role in this process. In learning the L2 in the L2 environment (through undertaking mainstream education in the L2 and generally living in the L2 country) language learners have various opportunities for exposure to different aspects of word knowledge. They learn the form of the words and develop fast access to the form before they learn their meaning.

6.2.8. Summary

This section has focused on the finding that with age, vocabulary size increased (the number of no-response items declined), and reaction time to words declined regardless of first language. The increase in vocabulary size was discussed in terms of the students' increasing knowledge of the world. As the students' knowledge of the world increased, the number of words in their ML also increased (vocabulary size enlarged). The decrease in reaction time was explained in terms of the children's increasing mastery of reading and their increasing vocabulary size.

Although there was a strong negative correlation between vocabulary size and reaction time, the relationship between the two seemed to be more complex. This study does not support Laufer and Nation's (2001) claim that reaction time lags behind vocabulary size. The L2 participants of the current study aged 11-12 had a smaller vocabulary than their L1 peers, yet they recognised words as quickly. This was explained in terms of the environment for language learning. Learning the L2 in the L2 environment provided for extended and on-going exposure to the L2 and its words. As a result, word recognition accelerated.

Nor were the findings of the current study consistent with Miralpeix and Meara's (2010) findings. The contradiction between the findings of this study and theirs was discussed in

terms of the high-frequency words used in their task which were not able to gauge the reaction time differences between participants with different vocabulary sizes.

6.3. Research question 2

Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

This section discusses the findings of the present study relating to the second research question. As mentioned earlier, in order to respond to the second research question, the L2 and L1 students of different age groups (6-7, 11-12, and 15-17) were compared against each other in terms of their associations, vocabulary size, and reaction time. Additionally, the correlation analysis was performed for the LoR in the L2 country, LoE in the L2, AoA into the L2 country, and different dimensions of the L2 ML. The following section discusses the findings in detail.

6.3.1. L2 and L1 students aged 6-7

The findings of the present study addressing the second research question revealed discrepancies between L2 and L1 participants aged 6-7. Thus, the L2 ML of participants aged 6-7 does not resemble the L1 ML of their L1 peers. As shown in Table 5.28 (see section 5.3.1), L2 participants aged 6-7 gave fewer paradigmatic and syntagmatic associations and more no-response items than L1 participants of the same age. There was no statistically significant difference between the two groups in terms of phonological associations. As mentioned earlier, both vocabulary size and reaction time scores were unreliable for this age group (see sections 5.2.6 and 5.2.7).

These findings are consistent with the findings of previous studies conducted on L2 children's associations and vocabulary size (e.g., Vermeer, 2001). The L2 children aged 5-6 of Vermeer's (2001) study obtained lower scores for vocabulary size and gave fewer characteristics on the WAT[13] than L1 children of the same age. There was also a statistically

[13] The WAT used in Vermeer's (2001) study was different from the way it is usually used in the literature. The participants were required to provide information on the characteristics of the stimulus words by responding to questions about each stimulus word. For example, *what is a car? What does a car look like? What does a car do?* Additionally, Vermeer (2001)

significant positive correlation between the vocabulary size and characteristics on the WAT supporting the finding of the current study that as vocabulary size increases, the number of associations also increases. It is important to note here that Vermeer's (2001) study, which is one of the few studies on L2 children's associations, focused on the number of associations in child L2 and L1 rather than the types of associations (paradigmatic, syntagmatic, and phonological) and thus did not reveal the types of associations in the response of L2 and L1 children. The results of the current study make contribution to the under-researched area of child L2 associations by focusing on the types of associations among words.

This section discusses the discrepancies observed between L2 and L1 students aged 6-7 in terms of their shorter and more limited exposure to the L2. L2 participants aged 6-7 attended Introductory English Centres (IECs) to learn English before they could enter mainstream education in English (see section 4.3.1.4). The undertaking of courses at the IECs established that the L2 students did not have sufficient English to start formal schooling. At the time of data collection for this study, they had undertaken mainstream education in English for nearly one year. Therefore, their exposure to English was both shorter and more limited than that of the L1 students of the same age; shorter, as they only started learning English a year before they participated in this study; more limited, as they spoke their L1 at home with their parents and siblings (see section 4.3.1). Additionally, as the L2 participants of the current study were new to their L2, their L2 proficiency was low (LPR < 2), (see section 4.3.2.1). There is no surprise that the L2 participants aged 6-7 provided more no-response items (had a smaller vocabulary) and fewer paradigmatic and syntagmatic associations than their L1 peers. Thus, the short and limited exposure of L2 participants aged 6-7 to their L2 lends explanation as to why these students had a smaller vocabulary and gave fewer paradigmatic and syntagmatic associations than the L1 students of the same age.

It is important to note that although the L2 students aged 6-7 had smaller vocabularies (more no-response items) and provided fewer paradigmatic and syntagmatic associations than their L1 peers, they did not provide any more phonological associations than the L1 students of the same age. In contrast, the L1 students produced more phonological associations than the L2 students although not at a statistically significant level. Therefore, the present study does not offer support to the previous claims that phonological associations are mainly found in the

built an association network for each of the stimulus words based on the responses of the majority of children to the stimulus words (see section 2.3.3.1).

response of L2 learners (e.g., Meara, 1983) and children (e.g., Ervin, 1961). The conflict between the findings of this study and those of previous research can perhaps be attributed to the familiarity with and frequency of the stimulus words. This is explained in detail in section 6.2.5.

Further, both the L2 and L1 participants of this study gave a small number of phonological associations to the stimulus words (see section 5.3.1). Perhaps children's familiarity with the stimulus words explains the small number of phonological associations. When an unfamiliar stimulus word is presented to a task taker, there are at least two possible responses. The first possibility is that as the task taker is not familiar with the stimulus word or has only a small degree of familiarity with it, the first response that comes to mind is a response which sounds like the stimulus word but lacks any semantic connections with it (a phonological response). Alternatively, when the task taker does not know a stimulus word, the first thing that comes to mind is the realisation that the word is unfamiliar. Both the L2 and L1 participants of the current study expressed their unfamiliarity with the stimulus words by saying *I do not know the word*. In this study, the participants were not forced to respond to all the stimulus words regardless of whether they knew the word or not. Nevertheless, it is possible that more phonological responses would have appeared if the participants had been asked to respond to all the stimulus words regardless of their familiarity with them. Therefore, the condition of the task is one possible reason which explains the phonological associations in children.

Despite the discrepancies observed between L2 and L1 children aged 6-7, both groups provided more syntagmatic associations than paradigmatic ones. This finding provides support for the earlier argument that as children have smaller memory capacity, and as they use the memory strategy of organisation less often, their ML is organised around fewer paradigmatic but more syntagmatic associations. At the same time, the lower stage of their cognitive development and their smaller vocabulary size (compared to the older children) contribute to their reliance on syntagmatic associations, regardless of their first language. This is extensively explained in section 6.2.1.

6.3.2. Summary

This section has offered an explanation for the findings that the L2 ML of children aged 6-7 did not resemble the L1 ML of children the same age. The section has discussed the discrepancies in terms of the short and limited exposure of L2 children to their L2. At the

time of the data collection, the L2 participants had undertaken mainstream education in English for nearly one year. Additionally, as they were new to their L2, their language proficiency was low. Hence, they had a smaller vocabulary and fewer associations among words.

Despite the smaller vocabulary (more no-response items) and the fewer paradigmatic and syntagmatic associations, L2 children aged 6-7 did not provide any more phonological associations than the L1 students. Perhaps, the children's familiarity with the stimulus words accounted for this finding. Both L2 and L1 participants expressed their lack of familiarity with the stimulus words rather than providing more phonological associations.

Furthermore, despite the discrepancies observed between the associations of L2 and L1 children aged 6-7, both groups produced more syntagmatic than paradigmatic associations. This finding is consistent with the argument that as children have smaller memory capacity, and as they use the memory strategy of organisation less often, their ML is organised around fewer paradigmatic but more syntagmatic associations.

6.3.3. L2 and L1 students aged 11-12

The findings of the present study relating to the second research question also demonstrated discrepancies between L2 and L1 students aged 11-12. L2 students aged 11-12 obtained lower scores for vocabulary size and responded with fewer paradigmatic and syntagmatic associations and more no-response items than their L1 peers. There was no difference between the two groups in terms of either the phonological associations or the reaction time (see section 5.3.2).

In terms of the word associations of L2 and L1 students aged 11-12, the findings of this study are consistent with the findings of previous research on child L2 associations. In previous research (e.g., Schoonen & Verhallen, 2008), L2 children aged 9 and 11-12 obtained lower word association scores than L1 children of the same age (see section 2.3.3.3). It is worth mentioning that as in the case of Vermeer's (2001) study discussed in the previous section, Schoonen and Verhallen (2008) measured the number of associations rather than the types of associations (paradigmatic, syntagmatic, and phonological) between the stimulus words and

responses[14]. The findings of the present study contribute to the findings of previous research by focusing on the types of associations in both L2 and L1 children.

The results of the present study concerning the vocabulary size of L2 students aged 11-12 are also in parallel with the results of previous research on the vocabulary size of bilingual children. The previous research comparing the vocabulary size of both monolinguals and bilinguals revealed a significant language effect (e.g., Bialystok et al., 2010; Rosenblum & Pinker, 1983). The monolinguals outperformed the bilinguals at all ages (3 to 10 years old) in terms of their home context vocabulary in Bialystok et al.'s (2010) study (see section 2.4.1.1). Similarly, in Rosenblum and Pinker's (1983) study, the bilingual children obtained lower scores for vocabulary size in both their languages compared to their monolingual peers until they reached mid primary school ages (see section 2.4.1.2).

It seems that the shorter and more limited exposure of the L2 participants to the L2 (compared to their L1 peers) accounts for the smaller size of their vocabulary (indicated by scores for vocabulary size on the yes/no LDT and the additional no-response items in the WAT) and their fewer paradigmatic and syntagmatic associations. Even though these students had lived in the L2 country and undertaken mainstream education in the L2 for at least four years (between four to six years) (see section 4.3.1.2), they still had a smaller vocabulary and produced fewer paradigmatic and syntagmatic associations than L1 students of the same age. Compared to L1 students, L2 students had less exposure to the L2 as they split their time between the two languages: their L2 in school and their L1 at home with parents and siblings. This led to smaller vocabulary size in the L2 children. As these students had a smaller vocabulary, they also had fewer connections among the words in the L2 ML, including the paradigmatic and syntagmatic associations. The vocabulary size and the lower number of paradigmatic and syntagmatic associations still differentiated L2 students aged 11-12 from their L1 peers even though they had lived in the L2 country and undertaken mainstream education in the L2 for five to six years.

The findings of this study also parallel the findings of previous research (e.g., Magiste, 1992) in terms of the reaction time to words. The previous research revealed that as the amount of time L2 children had spent in the L2 country increased, they accessed words faster. The primary school children developed similar lexical access to words in their L2 and L1 after

[14] In Schoonen and Verhallen's (2008) study, the stimulus words were presented in the middle of the related and unrelated words. The participants were required to choose three responses which were closely related to the stimulus words, than those which were related to the stimulus words in a more incidental way (see section 2.3.3.2).

four years living in the L2 country, while the high school children achieved similar lexical access after six years of residence. It is noteworthy that despite the similar findings, there are methodological differences between this study and the previous research. The present study focused on the reaction time to written L2 words. In contrast, the previous research (e.g., Magiste, 1992) measured bilingual children's speed of lexical access in speech (see section 2.4.1.4). Additionally, in Magiste's (1992) study, L2 children's speed of word access in their L2 was compared against the speed of word access in their L1 rather than to the speed of word access of monolingual children. Although the current study investigated the reaction time to written L2 words, the findings of this study are consistent with the findings of previous research.

Further, although L2 students aged 11-12 had smaller vocabularies than L1 students of the same age, they reacted to the words in their L2 ML as quickly as their L1 peers. As explained earlier (see section 6.2.7), perhaps, the L2 participants' environment for language learning provides explanation for this finding. The L2 participants of the current study had been learning English through undertaking mainstream education in the L2 and by living in the L2 country. Learning the L2 in these circumstances provides the L2 children with extensive and on-going exposure to the L2 both in and out of school. Therefore, the chances of encountering words they have learned are much better. In addition, they encounter new words the meanings of which are unknown to them. So, they see or hear the form of the words before they learn their meaning and use. As a result of extensive and on-going exposure to the L2, the L2 participants of the current study developed fast access to the L2 words although they had a smaller vocabulary than the L1 students aged 11-12. Therefore, it seems that the L2 participants' environment for language learning accounts for their fast reaction to L2 words.

6.3.4. Summary

This section has focused on the finding that the L2 ML of children aged 11-12 did not resemble the L1 ML of children of the same age. This section has discussed the smaller vocabulary size of the L2 participants and their fewer paradigmatic and syntagmatic associations in terms of their shorter and more limited exposure to the L2 compared to their L1 peers. The L2 children had less exposure to the L2 as they split their time between their two languages. As these students had a smaller vocabulary, they also had fewer paradigmatic

and syntagmatic associations among words. Despite the smaller vocabulary size, the L2 students reacted to the written L2 words as quickly as their L1 peers. This was explained in terms of the L2 participants' environment for language learning.

6.3.5. L2 and L1 students aged 15-17

The findings of this study addressing the second research question showed that L2 students aged 15-17 were the closest to their L1 peers in terms of most dimensions of the L2 ML. Yet, the number of paradigmatic associations and no-response items distinguished the L2 ML from the L1 ML at age 15-17. The major similarities observed between the L2 and L1 ML of students aged 15-17 are perhaps attributable to factors such as age and the environment for language learning. The impact of these factors on the L2 ML is explained in detail in section 6.4.

The findings of the current study relating to the L2 associations are not consistent with those of previous research on adult L2 associations. Both the L2 and L1 participants of this study demonstrated a tendency towards paradigmatic associations at ages 15-17 (although the L2 participants provided fewer paradigmatic associations than their L1 peers) and gave fewer syntagmatic associations than paradigmatic ones. In contrast, in both Wolter's (2001) and Zareva's (2007) studies, nonnative speakers produced more syntagmatic associations than paradigmatic ones. Additionally, they responded with more phonological associations compared to the native speakers (see sections 2.3.2.6 and 2.3.2.9). In order to explain the conflict between the findings of this study and the findings of previous research, their findings and arguments are examined below.

Wolter (2001) explained the tendency of nonnative participants towards syntagmatic associations partly in terms of the L2 participants' vocabulary size (breadth of words). He suggested that when an individual is presented with a stimulus word, the competing responses can have paradigmatic, syntagmatic, or phonological associations with the stimulus word. For a native speaker, a word with paradigmatic associations with the stimulus word (in the form of a synonym) is selected as native speakers have a large number of possible responses at their disposal. For a nonnative speaker, a word with syntagmatic associations with the stimulus word is selected (see section 2.3.2.6). In contrast to Wolter's (2001) explanation, the L2 participants of the current study aged 15-17 also had a smaller vocabulary (as they had more no-response items) than their L1 peers. Nevertheless, like the L1 participants, they

demonstrated a tendency towards paradigmatic associations not syntagmatic ones. This conflict between the findings of this study and those of previous research may be attributable to the environment for language learning. The L2 participants of this study learned their L2 through undertaking mainstream education in the L2 and living in the L2 country. Consequently, they had been exposed to a large number of words in various contexts. As the vocabulary size of the L2 participants increased, the number of synonyms, antonyms, meronyms, coordinates, subordinates, and superordinates also increased in their L2 ML. As a result, the number of paradigmatic associations increased. Thus, when a stimulus word was presented to the L2 participants of this study, the first word which came to their mind was a word with paradigmatic associations with it.

In contrast, the previous research was conducted on L2 participants who may not have learned their L2 in similar circumstances to the L2 participants of this study. Perhaps, they learned their L2 in the classroom setting or as a foreign language. In learning an L2 in such environments, the focus is on putting words together to make sentences in order to communicate. L2 learners may not focus on expanding their vocabulary beyond their immediate communication needs. As a result, when they hear a stimulus word, the first word that comes to mind is probably a word which sits in a phrase or sentence with the stimulus word (a response with syntagmatic associations with the stimulus word). Therefore, the environment for language learning seems to account for the tendency of L2 participants towards paradigmatic or syntagmatic associations.

The results of the present study are consistent with Fitzpatrick's (2006) study in terms of the L2 participants' paradigmatic associations. Like the present study, Fitzpatrick's (2006) study showed that both native and nonnative participants had a clear tendency towards paradigmatic associations (meaning-based responses). Despite the similarities in the number of paradigmatic associations, the native speaker participants of her study provided more syntagmatic associations (position-based responses) than the nonnative speakers (see section 2.3.2.7). In contrast, there was no statistically significant difference between the number of syntagmatic associations that the L2 and L1 participants of the current study produced.

The discrepancies between the findings of this study and those of Fitzpatrick's (2006) relating to syntagmatic associations can be discussed in terms of the L2 participants' exposure to word strings in the natural language. Like the L1 participants, the L2 participants of the current study had been exposed to the L2 naturally in the L2 environment and through

education in the L2. As mentioned earlier in this chapter, in the natural language, words are presented in word strings or chunks. As children are exposed to word strings, they absorb and store the words in the word strings (Wray, 2002), (see section 6.2.3). As both the L2 and L1 participants of this study had been exposed to natural language, they possess similar numbers of prestructured word strings in their ML. In terms of the associations, this means that the L2 and L1 participants of this study had similar numbers of syntagmatic associations. Thus, the L2 participants' exposure to word strings in natural language possibly accounts for the contradictory findings of the current study compared with the findings of previous research (Fitzpatrick, 2006) concerning the syntagmatic associations in the L2.

The findings of this study relating to the phonological associations of L2 and L1 participants are in line with the findings of Zareva's (2007) study. In both studies, the number of phonological associations did not distinguish between the L2 and L1 ML. As discussed earlier, familiarity with the stimulus words is a factor which accounts for the number of phonological associations regardless of whether they are in the L2 or L1 (see section 6.2.5). As words from the lower frequency ranges enter the ML and become familiar, learners build meaningful associations (paradigmatic and syntagmatic associations) between the new words from the lower frequency ranges and the existing words in the ML. As the meaningful associations are built, the number of associations which are only based on the formal resemblance of the words decreases (phonological associations decrease). The participants of the present study only responded to the words with which they were familiar and expressed their lack of familiarity with the rest. Similarly, in Zareva's (2007) study, the participants only provided associations to the words they were familiar with (see section 2.3.2.9). Therefore, the familiarity of the participants with the stimulus words influences the number of phonological associations.

The findings of this study concerning the vocabulary size of L2 children aged 15-17 are also consistent with previous research investigating the vocabulary size of adult EFL/ESL learners (e.g., Harrington, 2006) as well as studies investigating the vocabulary size of bilinguals who learned their L2 during childhood in the L2 country (e.g., Bialystok et al., 2008). As in the findings of this study, the findings of previous research suggested that nonnative speakers had a smaller vocabulary than native speakers. The vocabulary of L2 students aged 15-17 is smaller than that of their L1 peers as they know words of two languages: their L1 as spoken at home which was their main language before starting mainstream education in English and their L2, English. As a result, they have a smaller vocabulary in their L2.

The findings of this study in terms of the reaction time of L2 participants to the words are not in line with previous research on the lexical access of bilinguals (e.g., Ivanova & Costa, 2008; Gollan et al., 2005). In the current study, L2 participants aged 15-17 reacted to the L2 words as quickly as their L1 peers. In contrast, in the previous research, bilingual participants had slower lexical access in the L2 compared to monolinguals (see section 2.4.2).

It is very important to note that the current study measured the participants' reaction time to written L2 words, while previous research (e.g., Ivanova & Costa, 2008; Gollan et al., 2005) measured the amount of time it took the participants to produce words orally. Therefore, the focus of the present study on the reaction time to the written L2 words in contrast to the focus of the previous research on the oral production of the L2 words may account for the differences observed between the findings of this study and the findings of previous research. As explained earlier, as L2 children spend more time reading L2 texts, and as their reading skills in the L2 improve, the underlying components for reading skills also improve, one of which is the speed at which words are recognised. During school years, L2 children move from the "learning to read" stage when they decode written L2 texts slowly to the "reading to learn" stage when they are faster and more efficient in reading. Additionally, these participants had little experience with written L1 texts as they had been undertaking mainstream education in their L2 as opposed to their L1. Therefore, the L2 participants' experience with reading L2 texts over a long period of time (almost a decade) perhaps explains why these L2 participants aged 15-17 reacted to the L2 words as quickly as their L1 peers.

In contrast, the bilingual participants speak both of their languages, the L2 mostly at school and the L1 mostly at home, with parents, siblings, and friends from the same L1 background. As the bilinguals split their time between the two languages, they have weaker links between the semantic concepts (meaning) and the oral lexical representation (words). They spend less time strengthening the links between the semantic concepts and the lexical representation in each language. If the bilinguals spent the same amount of time producing oral L2 words as the monolinguals, they would produce words as quickly as the monolinguals (Gollan et al., 2005). Therefore, perhaps the focus of the present study on the reaction time to written L2 words in contrast to the focus of previous research on the oral production of L2 words explains the discrepancies between the findings. It may in fact be more appropriate to say that the findings of the current study complement the findings of previous research. They collectively suggest that L2 students develop a similar reaction time to written L2 words

(compared to L1 students) if they undertake mainstream education in the L2. Nevertheless, the L2 students have slower access to oral L2 words as they split their time between producing speech in both of their languages.

6.3.6. Summary

This section has focused on the finding that L2 students aged 15-17 were similar to their L1 peers in terms of most dimensions of the ML. Like the L1 students aged 15-17, the L2 students showed a tendency towards paradigmatic associations and provided the same number of syntagmatic associations. These findings were discussed in terms of the environment for language learning and the L2 participants' exposure to word strings in natural language.

The smaller vocabulary size of L2 participants aged 15-17 was explained in terms of their knowledge of two languages. The L2 participants split their time between the two languages. Overall, therefore, they know fewer words in their L2. The findings of this study concerning the similarity of the reaction time to words in both the L2 and L1 ML were explained considering the L2 participants' experience with reading L2 texts over a long period of time and their limited experience with written L1 texts.

6.4. The impact of age and the environment on mental lexicon

In response to the first research question, the findings of the current study revealed that overall the L2 ML had a similar trend of development to the L1 ML (except for the syntagmatic associations) if the L2 was learned in similar circumstances to the L1. Further, in response to the second research question, the present study showed that the L2 ML was the most similar to the L1 ML for students aged 15-17. The large number of similarities observed between the L2 and L1 trends of development and the L2 and L1 ML of students aged 15-17 are possibly attributable to the similarity of the circumstances for language learning in the case of L2 and L1 students. As mentioned earlier, the term "similar circumstances" refers to learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and generally living in the L2 country.

At ages 15-17, the L2 participants of the current study had lived in the L2 country and undertaken mainstream education in the L2 for nearly a decade. Tables 5.35 and 5.36 in sections 5.3.4 and 5.3.5 demonstrate a strong positive correlation between the LoR in the L2 country and the LoE in the L2, associations (syntagmatic and paradigmatic) and vocabulary size. There was also a strong negative correlation between the two variables, no-response items, and reaction time. It is important to note that despite the strong correlation between the LoR in the L2 country and the different dimensions of the L2 ML, it is possible that the L2 participants' residence in the L2 country affected different dimensions of the L2 ML as their residence in the L2 country automatically involved undertaking formal education in the L2. This is explained in detail below.

The L2 participants of this study had lived in the L2 country and received formal education in the L2 both implicitly and explicitly. They had completed English courses at the Introductory English Centres (IEC) where they started to learn the language explicitly in the classroom through formal teaching (see section 4.3.1.4). After completing courses at the IECs, they entered mainstream education in English where the language of communication was English. English was the medium of teaching in the curriculum, and the focus of teaching was on the meaning rather than on the form of language. In other words, the participants of the current study attended school (not IEC) not primarily to learn English but rather to learn other things such as literacy, numeracy, science, and history through the English language. If the L2 participants of the current study had not received formal education in the L2, perhaps by only living in the L2 country, their L2 ML would not have developed relatively similarly to the L1 ML, and the L2 ML would not have resembled the L1 ML in terms of most dimensions at age 15-17. Therefore, it seems that residence in the L2 country caused the similarities observed between the L2 and L1 ML as the L2 participants' residence in the L2 country was accompanied by undertaking formal education in the L2. In support of this argument, the findings of previous research (e.g., Flege & Liu, 2001) also showed that living in the L2 country improved neither the morphosyntactic knowledge of the L2 participants nor their comprehension. The LoR in the L2 country was correlated with the morphosyntactic knowledge and comprehension only for the L2 participants who were enrolled as students during most of their stay in the L2 country (see section 2.2).

Further, the age of language learning is another crucial factor which seems to lead to the similarities observed between the L2 and L1 ML. However, Table 5.37 in section 5.3.6

presents no correlation between the AoA into the L2 country and any dimension of the L2 ML. The lack of correlation is perhaps attributable to the fact that the L2 participants of this study started learning their L2 right before they started mainstream education in the L2. Their L1 was the main language for communication before entering mainstream education in the L2 as it was spoken at home with the parents and siblings. As a result, whether they had lower AoAs into the L2 country (they were born in the L2 country) or higher (they were not born in the L2 country), it did not have an impact on their L2 ML. Therefore, the AoA into the L2 country did not correlate with the different dimensions of the L2 ML. Additionally, this study demonstrated no correlation between the AoA into the L2 country and different dimensions of the L2 ML as the L2 participants were from different age groups (6-7, 11-12, and 15-17). If the L2 participants were from the same age group (e.g., 15-17) but had arrived in the L2 country at different ages, then the impact of AoA into the L2 country could be examined on the different dimensions of the L2 ML.

Even though this study demonstrated no correlation between the AoA into the L2 country and different dimensions of the L2 ML, the age of language learning is one possible factor which accounts for the similarities observed between the L2 and L1 ML trends of development and the L2 and L1 ML of students aged 15-17. The L2 participants of the present study learned their L2 during the sensitive period for language learning. During this period, their brain was flexible enough to acquire the L2 quickly and easily. Additionally, as they began learning the L2 early in life, their L1 was still not fully developed. Therefore, their L1 did not influence the development of the L2 as much as it would in adults. Further, by learning the L2 early in life, the L2 participants more or less went through the same steps as the L1 students in terms of their formal education. They attended both primary and high school in Australia and had extensive exposure to the L2 in school. Therefore, the quantity (how often they received input and produced output in the L2) and quality (where and from who they received the L2 input) of their L2 input and output were similar to the quantity and quality of the L1 students' input and output. It is important, however, to argue that if the lexical development was a function of time (LoR in L2 and LoE in L2) rather than age, then we should expect that highly proficient adult L2 speakers who learned their L2 outside of the sensitive period for language learning yet were exposed to it for an extended period of time and lived and worked in the L2 country have an L2 ML with similar structure to the ML of the native speakers. In contrast, the findings of previous research have shown differences between adult native and nonnative

speakers in terms of the structure of the ML (their preference for a specific type of association), (e.g., Fitzpatrick, 2006; Wolter, 2001).

It is also noteworthy that although the age of language learning is important in the development of the L2 ML, it is not the only factor which contributes to the major similarities for the large similarities between the L2 and L1 ML. If the L2 participants of this study had arrived in the L2 country early in life but had not received formal education in the L2 or had not been exposed to the L2 in the L2 speaking environment, perhaps their L2 ML would not have developed relatively similarly to the L1 ML. It seems that the above-mentioned variables: the residence in the L2 country, education in the L2, and the age of language learning are confounding variables for each other, and one loses its influence if the others are not present.

In this study, there were also discrepancies observed between the L2 and L1 students of all ages. Although as discussed above, age and the environment in which the L2 participants of this study learned their L2 led to a structurally similar L2 ML to the L1 ML, the L2 participants provided fewer paradigmatic and syntagmatic associations and more no-response items than the L1 participants. This discrepancy can be explained in terms of the fact that the L2 participants of this study were bilinguals who had two MLs. As a bilingual, each of their MLs was smaller than the ML of a monolingual speaker (L1 participants of this study). Additionally, the L2 students had smaller vocabularies as they had shorter and more limited exposure to the L2 compared to the exposure of the L1 students to their L1. As these students had smaller vocabularies (compared to the L1 students), they also had fewer connections among words in the L2 ML, including the paradigmatic and syntagmatic associations. There is no surprise that the L2 participants of this study provided more no-response items (had smaller vocabularies) and fewer paradigmatic and syntagmatic associations compared to their L1 peers. This should not be considered as a deficiency for the L2 students as putting both lexicons of these students together, the L2 students have a larger lexicon with more associations among words.

To summarise, this section has explained the impact of age and the environment for language learning on the similarities between the L2 and L1 ML trends of development and the L2 and L1 ML of students aged 15-17. The L2 participants of the current study had lived in the L2 country and undertaken mainstream education in the L2 both implicitly and explicitly. If they

had not received formal education in the L2, perhaps only living in the L2 country, their L2 ML would not have developed relatively similarly to the L1 ML.

This section has also emphasised the importance of age of language learning on the L2 ML. As the L2 students of the present study learned their L2 during the sensitive period for language learning, their brain was flexible enough to acquire the L2 quickly and easily. Further, their L1 was not as fully developed as to influence the development of the L2 as much as it would in the case of adults. The lack of correlation between the AoA into the L2 country and the different dimensions of the L2 ML were discussed considering the fact that the L2 students started learning the L2 just before they started mainstream education in the L2. Further, as the participants of this study were from different age groups, the impact of the AoA into the L2 country on the different dimensions of the L2 ML could not be examined.

Chapter 7: Conclusions

7.1. Overview of the present study

The present study was conducted to investigate whether the second language (L2) mental lexicon (ML) had a similar trend of development to the first language (L1) ML in terms of associations, vocabulary size, and reaction time if the L2 was learned in similar circumstances to the L1. The current study also aimed to find out whether the L2 ML could resemble the L1 ML in terms of the associations, vocabulary size, and reaction time at any age. The two research questions were:

1) Does the L2 ML have a similar trend of development to the L1 ML in terms of associations, vocabulary size, and reaction time if the L2 is learned in similar circumstances to the L1?

2) Does the L2 ML resemble the L1 ML in terms of associations, vocabulary size, and reaction time at any age?

In order to respond to the research questions, the current study employed 75 L2 students from three age groups of 6-7, 11-12, and 15-17 and 80 L1 students of the same ages as control groups. All the L2 participants had completed the English courses at Introductory English Centres (IEC) before they entered mainstream education in an Australian school. Therefore, English was their L2 and was learned after their L1. A Word Association Task (WAT) was administered to the participants to elicit the word associations. Additionally, a yes/no Lexical Decision Task (LDT) was utilised to measure the vocabulary size and reaction time to words (see the methodology and data analysis chapter).

In reference to the first research question, this study revealed that the L2 ML had overall a similar trend of development to the L1 ML in terms of paradigmatic and phonological associations, no-response items, vocabulary size, and reaction time. With age, the number of paradigmatic associations increased; phonological associations increased before they decreased; no-response items declined; vocabulary size enlarged; and reaction time to words dropped in both the L2 and L1 ML. However, there were discrepancies observed between the L2 and L1 trends of development in terms of the syntagmatic associations. In the L2 ML, the number of syntagmatic associations had a steady increase comparing students aged 6-7 to 15-17. In the L1 ML, the number of syntagmatic associations increased comparing students aged

6-7 to 11-12 but remained static afterwards comparing students aged 11-12 to 15-17 (see section 5.2).

Additionally, the findings of this study revealed positive correlations between vocabulary size and the number of paradigmatic and syntagmatic associations. There were negative correlations between vocabulary size, no-response items, and reaction time (see section 5.2.8). The current study also showed that both the L2 and L1 students of all ages provided more paradigmatic and syntagmatic associations, but fewer no-response items and phonological associations to high-frequency words (words in the 1-5k frequency range), (see section 5.2.9).

In reference to the second research question, the present study revealed that L2 students aged 15-17 were the closest to their L1 peers in terms of the number of most associations (all except for the paradigmatic associations) and reaction time. Despite the similarities, L2 students aged 15-17 had a smaller vocabulary size (indicated by more no-response items in the WAT) and produced fewer paradigmatic associations compared to the L1 students of the same age (see section 5.3.3). Further, there were positive correlations between both length of residence (LoR) in the L2 country and length of education (LoE) in the L2, the number of paradigmatic and syntagmatic associations, and vocabulary size. There were negative correlations between the LoR in the L2 country and the LoE in the L2, the number of no-response items, and the reaction time. There was no correlation between the age of arrival (AoA) into the L2 country and any dimension of the L2 ML (see sections 5.3.4, 5.3.5, and 5.3.6).

Overall, the findings of the study revealed that the L2 ML had a similar trend of development to the L1 ML (except for the syntagmatic associations) and could resemble the L1 ML in terms of most dimensions of the ML after almost a decade of undertaking mainstream education in the L2 and living in the L2 country. As explained before (see section 6.3.5), the discrepancies observed between the L2 and L1 ML of students aged 15-17 were perhaps attributable to the fact that although the L2 students learned the L2 in similar circumstances to the L1 students, they had shorter and more limited exposure to the L2 compared to the L1 students of the same age. Shorter exposure as they started learning the L2 just before they started mainstream education in the L2 (not from birth) and more limited as they used their L1 for communication with parents and siblings.

7.2. Contributions of the present study

The present study was carried out with an emphasis on the influence that age and the environment for language learning have on different dimensions of the L2 ML. Although previous research focused on the different dimensions of ML such as associations (e.g., Wolter, 2001; Fitzpatrick, 2006, 2009), vocabulary size and reaction time (e.g., Laufer & Nation, 2001; Harrington, 2006), it is mostly conducted on adult EFL/ESL learners. Therefore, our understanding of the development of the L2 ML originates from studies on adult EFL/ESL learners at various levels of proficiency. Age and the environment for language learning have not received the attention they deserve. In contrast, the current study focused on children learning the L2 during the sensitive period for language learning, through undertaking mainstream education in the L2, and living in the L2 country.

Additionally, the cross-sectional design of this study provided snapshots of what the L2 ML looks like at different points of its development within a 10 year period. The participants of this study were from three age groups, 6-7, 11-12, and 15-17. In contrast, most of the previous studies employed participants from several age groups with only small age gaps between them. For example, Brown and Berko (1960) carried out their study on first, second, and third grade students (see section 2.3.1.1). Similarly, Entwisle (1966) employed prekindergarten, kindergarten, first, third, and fifth grade students and compared their word associations with those of the adults (see section 2.3.1.3). Even though having participants from a few close age groups served the purposes of previous research, it does not provide snapshots of what the L2 ML looks like at different points of its development. The current study has filled an important gap in research on the L2 ML by employing participants from three different age groups within a 10 year period.

The current study also focused on the development of the L2 ML in child immigrants in the Australian context. No previous research in the literature on the L2 ML has investigated the L2 ML trend of development in child immigrants in the Australian context. Vocabulary deficiency has been reported to be one of the major weaknesses of child immigrants and consequently affects their performance in other subjects. Therefore, the current study contributes to this area by paying specific attention to the development of the L2 ML in child immigrants, in particular, child immigrants in Australia. Having a better understanding of the L2 ML development in child immigrants may open the door for further research which in turn may help develop teaching materials to meet these children's needs.

Also, this study utilised both high- and low-frequency stimulus words in the construct of the WAT (see section 4.4.1.1). The findings of the study revealed that although age and the environment for language learning affected the L2 ML, word frequency was another determining variable in the word associations of children (see section 5.2.9). In contrast, previous studies investigating children's associations utilised commonly used high-frequency stimulus words in the construct of their WATs (e.g., Brown & Berko, 1960; Ervin, 1961; Palermo, 1971). Thus, those studies were not capable of eliciting the potential differences which exist between participants of different ages with regards to low-frequency words. The present study utilised both high- and low-frequency words and investigated the impact of word frequency on word associations.

The current study contributes to existing research on the development of the ML as it pays specific attention to the syntagmatic associations in the L2 and L1 ML. In this study, the syntagmatic associations were observed in both the L2 and L1 ML and in the responses of both children and adults. Additionally, with age the number of syntagmatic associations increased (see section 5.2.2). In contrast, previous research linked the syntagmatic associations to the child L1 (e.g., Brown & Berko, 1960; Ervin, 1961) and low-proficiency EFL/ESL learners (e.g., Meara, 1983). They suggested that with age and proficiency, the number of syntagmatic associations declines. Nevertheless, further research with a large sample size would be of value to investigate the L2 ML in terms of the syntagmatic associations to ascertain whether the same patterns revealed in this study are repeated in large samples.

Additionally, this study focused on the phonological associations and their trend of development in the L2 and L1 ML. The study also revealed the surprising finding that with age, the number of phonological associations increased in both the L2 and L1 students' associations (comparing the students aged 6-7 to 11-12). In contrast, the phonological associations and their trend of development have not previously received much attention in the research on child associations. Further, studies which focused on the phonological associations reported that with age, the number of phonological associations declined (e.g., Ervin, 1961; Entwisle, 1966). The present study fills an important gap in the research on word associations by paying specific attention to the phonological associations and their trend of development.

Furthermore, this study sheds light on the contradictory findings of previous research in terms of the word associations in adult L2 and L1. The study revealed that the L2 ML had a relatively similar trend of development to the L1 ML in terms of most associations and resembled the L1 ML at ages 15-17 in terms of most dimensions (see sections 5.2 and 5.3.3) if the L2 was learned in similar circumstances to the L1. In contrast, the previous research presented contradictory findings in terms of the word associations in adult L2 and L1. Some studies (e.g., Fitzpatrick, 2006; Wolter, 2001) revealed qualitative differences between the word associations of adult L2 and L1. Other studies (e.g., Zareva, 2007) reported quantitative discrepancies between the two. The findings of the present study revealed that age and the environment for language learning were two important variables which influenced word associations in the L2 ML.

Another important finding of the current study was in reference to the impact of vocabulary size on the different dimensions of the ML. The vocabulary size of both L2 and L1 students was closely correlated with the number of paradigmatic and syntagmatic associations and the reaction time (see section 5.2.8). In contrast, previous research relatively neglected the impact of vocabulary size on the different dimensions of the ML and specifically on the word associations. It was therefore unclear whether an increase in the vocabulary size would affect the other dimensions of the ML. This finding specifically applies to studies which compare adult EFL/ESL learners' word associations to those of native speakers. In determining that, the vocabulary size of the language learners needs to be considered.

In addition, the current study utilised a different type of task to measure the vocabulary size and reaction time in the L2 and L1 ML (see section 4.4.1.2). Despite that, the findings of this study confirmed the findings of previous research that with age, the vocabulary size increased and the reaction time to words declined (e.g., Bialystok et al., 2010; Rosenblum & Pinker, 1983; Merriman & Kutlesic, 1993; Magiste, 1992). In the previous research, picture naming tasks were used as a measure of vocabulary size and lexical access. The main drawback with these tasks was the extent to which the ambiguity of the pictures or the different interpretations by different participants of the same picture affected the vocabulary size and lexical access scores. The current study contributes to research on child L2 vocabulary size and reaction time by using a verbal rather than a pictorial task.

7.3. Limitations of the present study

One limitation of the present study is that the WAT utilised only elicited the types of associations existing among words in the ML (syntagmatic/paradigmatic/phonological). It would also be of value if, in addition to the WAT used in this study eliciting the types of associations, another WAT was used which elicited the number of associations among words in the ML (see section 3.1.4). The use of an additional WAT would provide richer data and further insight into word associations in the L2 ML. However, this option was hindered in the present study by the time limitations and the schools' inability to commit to sufficient time for the data collection.

Another limitation of the current study is its small sample size for each group of participants. There were 25-30 students in each of the six groups. This limitation was mainly caused by two factors. The first factor was that the schools had busy schedules and the process of getting approval from the children's parents and arrangements for the data collection made access to a large number of students impossible. The second factor was that the number of L2 students who met the selection criteria (see section 4.3.1) was low. A larger sample size for each age and language group sheds more light on the L2 ML trend of development and the similarities and differences between students of different age and language groups.

The present study also suffered from the inherent property of cross-sectional research designs. Although the cross-sectional design of this study presented snapshots of the L2 ML at different points of its development over a 10 year period, a similar study with a longitudinal research design is recommended. A longitudinal research design would confirm whether the trend of development revealed in this study with the cross-sectional design occurs in real life.

A further constraint on this study was the limitations of the tasks utilised in the study. The yes/no LDT was not appropriate for students aged 6-7. Their vocabulary size and reaction time results were unreliable as the task reported a high false-alarm rate for them (see sections 5.2.6 and 5.2.7). The yes/no LDT was not appropriate for this age group as they had low literacy levels and therefore a slow reaction to the words. On the other hand, use of a simple task compatible with the literacy level and speed of the students aged 6-7 would have been very easy for the older students (students aged 11-12 and 15-17). Additionally, it would not have gauged the differences which exist among students of different age and language groups. Further research on the design of new tasks measuring vocabulary size and reaction

time and suitable for use on a broad age range of school-aged children would benefit research in this area.

The findings of the current study relating to word associations were limited by the researcher's judgements. The responses that the participants provide to the WAT are classified as paradigmatic, syntagmatic, or phonological. Researchers judge the responses based on their understanding of the connection between the stimulus word and the response. Therefore, the response classification is based on the researchers' second guessing of the connection. This is not always the same as the participants' intended connection. Although the current study used "other category" for unclear responses and responses which could be classified in more than one category (see section 4.5.1.1), the use of a subsequent interview is recommended for future research. In an interview, a participant has the opportunity to clarify the connection between the stimulus word and the response. In this study, use of an interview was hindered by the number of students involved (N = 155) and the time limitations in schools.

In the current study, the participants' responses to the stimulus words were classified into three main groups: paradigmatic, syntagmatic, and phonological associations. Although this classification revealed similarities and differences among the different age and language groups, it would be of value if each type of association could be further divided into smaller subcategories. This would allow further depth and precision in the classification of the word associations. Nevertheless, it is important to note that in order for the smaller subcategories to be meaningful, the number of responses in each of the subcategories should be sufficient. This, in itself, requires a large number of participants and a large number of stimulus words in the construct of the WAT. As mentioned earlier, the logistical difficulties made this option impossible for this study.

The other limitation of this study relates to the words used in the yes/no LDT. This task contained words in the 1-10k frequency range. Although the yes/no LDT was able to measure the vocabulary size and reaction time of the participants, it was limited to words up to the 10k frequency range. As a result, this task tested the knowledge of words up to the 10k frequency range but not beyond. This is perhaps not an issue with beginner, intermediate, and advanced EFL/ESL learners. However, the task does not take into account the low-frequency words of native speakers of English or the L2 speakers with a large vocabulary (larger than 10k frequency range). Use of a task containing lower frequency stimulus words may be more

informative of the vocabulary size and reaction time of the native and L2 speakers with a large vocabulary.

The L2 participants in this study were from a range of language backgrounds. The study made no analysis on the impact of their L1 on the different dimensions of L2 ML due to the small sample size for each language group (see section 4.3.2). It would be of value to replicate the same study and include a large number of participants from specific language backgrounds and investigate the impact of language background on the different dimensions of the L2 ML. This would be particularly useful for the analysis of reaction time to the written word to determine whether children's knowledge of the L1 alphabet affects their reaction time to written L2 words.

7.4. Summary

This chapter has presented the conclusions for this study. The first section provided an overview of the present study, its aims and research questions, methodology, and main findings. This was followed by the contributions of this study, its limitations, and suggestions for further research.

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Appendices

Appendix A

COMMITTEE FOR ETHICS IN HUMAN RESEARCH APPROVED - Project number 10-152

Ms Neda Akbari
Faculty of Arts and Design
University of Canberra
BRUCE ACT 2617

Dear Neda,

The Committee for Ethics Research has considered your application to conduct research human subjects for the project entitled ***Comparing the L1 and L2 Mental Lexicon Developments, Breadth, Depth and Accessibility.***

The following general conditions apply to your approval.

These requirements are determined by University policy and the ***National Statement on Ethical Conduct in Research Involving Humans*** (National Health and Medical Research Council, 2007).

Monitoring:	You, in conjunction with your supervisor, must assist the Committee to monitor the conduct of approved arch by completing and promptly returning project review forms, which will be sent to you at the end of your project and, in the case of extended research, at least annually during the approval period.
Discontinuation of research:	You, in conjunction with your supervisor, must inform the Committee, giving reasons, if the research is not conducted or is discontinued before the expected date of completion.
Extension of approval:	If your project will not be complete by the expiry date stated above, you must apply in writing for extension of approval. Application should be made before current approval expires; should specify a new completion date; should include reasons for your request.
Retention and storage of data:	University policy states that all research data must be stored securely, on University premises, for a minimum of five years. You and your supervisor must ensure that all records are transferred to the University when the project is complete.
Changes in contact details:	You should advise the Committee of any change of address during or soon after the approval period including, if appropriate, email address(es).

Please add the Contact Complaints form (attached) for distribution with your project.

Yours sincerely
Committee for Ethics in Human Research

Michaela Dalgleish
Ethics & Compliance Officer
Research Services Office
T (02) 6201 5870 F (02) 6201 5466
E Michaela.Dalgleish@canberra.edu.au

www.canberra.edu.au
Postal Address:
University of Canberra ACT 2601 Australia
Location:
University Drive Bruce

Appendix B

Education and Training

File Ref: 2011/00468-3

Ms Neda Akbari
6 B Bindel Street
ARANDA ACT 2614

APPROVAL OF RESEARCH PROPOSAL

Dear Ms Akbari

Thank you for your application to conduct the proposed research titled *Comparing the L1 and L2 mental lexicon developments, breadth, depth, and accessibility.*

On 13 May 2011, the Education and Training Directorate *(previously known as Department of Education and Training)* approved extension for your research to include Hughes Primary School.

As per your email request on 19 June 2011, the Directorate has approved your research in all ACT public primary and high schools with the following conditions:

- you provide us the list of participating schools once available
- research in participating schools will be concluded by 31 October 2011
- any further change in the methodology, scope and timeframe of the project requires the Directorate's approval
- within one month of completing your research, you are required to forward a copy of your research (paper/report/thesis) either electronically to det.research@act.gov.au or by mail to the following address:

  Senior Manager
  Measurement, Monitoring and Reporting
  Education and Training Directorate
  ACT Government
  GPO Box 158
  CANBERRA ACT 2601

With a copy of this approval letter, you may now directly approach the principals of these schools for permission to carry out your research. It will be at the discretion of the principal as to whether your research can proceed at their site.

A person entering a school to conduct research is a *visitor* to the school and must comply with the *Visitors in Schools* policy available at:
http://www.det.act.gov.au/publications_and_policies/policy_a-z

GPO Box 158, Canberra ACT 2601 | 220 Northbourne Avenue, Braddon ACT 2612
ABN 71 506 957 312 Telephone 02 6207 5111 | Facsimile 02 6205 9333 | Web www.det.act.gov.au

Appendix C

Consent Form for Principals

Study Title:

Comparing the 1st and 2nd Language Mental Lexicon Development

Consent Statement:

I have read and understood the information about this study. I am not aware of any condition that would prevent my students' participation, and I agree for my students to participate in this study. I have had the opportunity to make enquiries about my students' participation, and my enquiries have been answered to my satisfaction.

Name:.....Signature.....

Date:.....

A summary of the study report may be forwarded to you upon request.

Email address.....

School name……

Postal address: University of Canberra ACT 2601 Australia

Tel.: +61 (2) 6201 5656

Fax: +61 (2) 6201 2649

Email: Neda.Akbari@canberra.edu.au

Appendix D

UNIVERSITY OF CANBERRA
AUSTRALIA'S CAPITAL UNIVERSITY

Consent Form for Parents

Study Title:

Comparing the 1st and 2nd Language Mental Lexicon Development

Consent Statement:

I have read and understood the information about this study. I am not aware of any condition that would prevent my child's participation, and I agree for my child to participate in this study. I have had the opportunity to make enquiries about my child's participation, and my enquiries have been answered to my satisfaction.

Name:.....Signature.....

Date:.....

A summary of the study report may be forwarded to you upon request.

Email address.....

Postal address: University of Canberra ACT 2601 Australia

Tel.: +61 (2) 6201 5656

Fax: +61 (2) 6201 2649

Email: Neda.Akbari@canberra.edu.au

Appendix E

UNIVERSITY OF CANBERRA
AUSTRALIA'S CAPITAL UNIVERSITY

Participant Information Sheet for Parents

Study Title:

Comparing the 1st and 2nd Language Mental Lexicon Development

Researcher:

Neda Akbari
PhD student
Faculty of Arts and Design

Chair of the supervisory panel:

Dr. Yanyin Zhang
Senior lecturer
Faculty of Arts and Design

Postal address: University of Canberra ACT 2601 Australia

Tel.: +61 (2) 6201 5656
Fax: +61 (2) 6201 2649
Email: Neda.Akbari@canberra.edu.au

Dear parents,

This information sheet is designed to give you information about this study which you need to know before giving consent for your child to participate in this study.

Purpose of the study

Words play an important role in language proficiency in second language learning as they carry meaning and communication occurs through the meaning of words. This study focuses on vocabulary development in second language learning. The findings of this study will have implications for second language teaching methods.

Participant involvement

The participants in this study are three groups of English as a second language (ESL) students aged 6-7, 11-12, and 15-17 and three groups of native speakers of English. The participants are required to complete two tasks after the selection:

For Task 1, the participants hear a word, like *apple* and say the first word that comes to their mind, like *orange*. There are no right or wrong answers.

For Task 2, a word comes on the computer screen; the participants click on *yes* if they know the word and click on *no* if they do not know it.

Both tasks are game-like and take the participants roughly 15 minutes to complete them. Students will do the tasks in school on two separate occasions.

In addition to the two tasks mentioned above, a short language proficiency screening may be conducted if necessary.

Confidentiality and anonymity

Students' names and results will not appear in the final reports and in any publication arising from this study. Only the researcher has access to the students' results.

Data storage

The data will be stored in the University of Canberra in a locked filing cabinet and password protected computer files.

Risks/discomforts

Even after the parents' permission, the students may choose not to participate in this study. They will be told that they are free not to do the tasks and to withdraw at any time with no penalty. They can also choose not to respond to a word or answer a question at any time with no penalty.

Benefits

There will be no direct benefit to your child for participating in this study. However, the collective findings of this study may have implications for second language teaching methods.

Costs

There will be no cost to you or to your child for participation.

Ethics committee approval

This study has been approved by the University of Canberra Human Research Ethics Committee which is in line with the National Statement on Ethical Conduct in Human Study.

Queries and concerns

All enquiries may be directed to the researcher or the primary supervisor.

Principal researcher: Neda Akbari (PhD student)

Email address: Neda.Akbari@canberra.edu.au

Primary supervisor: Dr. Yanyin Zhang

Email address: Yanyin.Zhang@canberra.edu.au

Appendix F

Bio-Data Survey

Name----------

Year----------

1. Gender: Male/Female
2. Age ----------
3. Country of birth ----------
4. How many years have you lived in Australia? ----------
5. Have you attended the Introductory English Centers? ----------
6. What is your native language? ----English ----Other ----------
7. What is your mother's native language? ----English ----Other ----------
8. What is your father's native language? ----English ----Other ----------
9. What language(s) do you speak at home? ----English ----Other ----------
   If more than one, with whom do you speak each of these languages? ----------
   ----

10. In what language(s) did you receive the majority of your education? ----English ----Other ---------
    If more than one, please give the approximate number of years for each language. ----------
    ----

11. Have you ever been to your parents' language speaking region/country? Circle one: Yes/No
    11a. If yes, when? ---------- 11b. Where? ----------
    11c. For how long? ----1 year or less ----2 years ----more than 2 years

12. In the boxes below, rate your language ability in each of the languages that you know. Use the following rating: 0) Poor, 1) Good, 2) Very good, 3) Native/nativelike.

Language	Listening	Speaking	Reading	Writing	Number of years of study/exposure
English					
Other					
Other					

13. Have you studied in your parents' native language(s) at each of the levels listed below? If yes, for how long?
    a) Child care ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    b) Kindergarten ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    c) Primary school ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    d) High School ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    e) Other ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years

14. Have you studied English at each of the levels listed below? If yes, for how long?
    a) Child care ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    b) Kindergarten ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    c) Primary school ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    d) High School ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years
    e) Other ----No ----Yes ----less than 1 year ----1-2 years ----more than 2 years

15. On average, how often do you communicate with native or fluent speakers of your parents' native language(s) in their language?
    ----never ----a few times a year ----monthly ----weekly ----daily

16. For each of the items below, choose the response that corresponds to the amount of time you estimate you spend on average doing each activity in your parents' native language(s).
    a) Talking to parents and siblings
       ----never ----a few times a year ----monthly ----weekly ----daily
    b) Watching TV and movies
       ----never ----a few times a year ----monthly ----weekly ----daily
    c) Reading magazines and books
       ----never ----a few times a year ----monthly ----weekly ----daily
    d) Listening to songs
       ----never ----a few times a year ----monthly ----weekly ----daily
    e) Talking to relatives and friends
       ----never ----a few times a year ----monthly ----weekly ----daily

17. List any other activities that you commonly do using your parents' native language(s). ----------
    ----