An Interlanguage Study of L2 Mental Lexicon[*]

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This interlanguage study examines the L2 mental lexicon of Thai EFL learners with different degrees of language exposure- i.e., the high exposure group and the low exposure group. The scores from the English Language Exposure (ELE) Questionnaire were used to select the two groups of participants. To explore the lexical processing and the organization of the mental lexicon, two psycholinguistic tasks were employed: lexical decision task (LDT) and word association task (WAT). The LDT was used to investigate the semantic priming effect of the prime on the target words which in this study are the frequently co-occurring words or the lexical collocations of the verb + noun in the Thai learners of English with high and low exposure to English. The results exhibit that the collocational processing is faster than the non-collocation. However, the difference is not outstanding. The WAT (McNeill, 1966) was conducted to investigate the organization of L2 learner's mental lexicon or the association between the words prompted and their networks. The findings indicate that the L2 mental lexicon is mostly meaning-based. The majority of links between words in the mental lexicon engages meaning and concept. The results support the interlanguage phenomenon that the two groups of participants have different mental lexicon and different paths of lexical access. The learners with high degree of language exposure tend to have the stronger links between English words in the lexicon than the learners with low exposure. The high-exposure learners produce more meaningful responses than the low-exposure learners do. The production of phrases and chunks by the high-exposure learners is considered a characteristic of native speakers. On the other hand, the production of the low exposure group exhibits the L1 transfer found common in EFL learners.

Keywords: lexical access, L2 vocabulary acquisition, lexical processing, organization of L2 mental lexicon

1 Introduction

In L1 mental lexicon studies, the lexical processing was extensively examined and modeled. Scholars were interested in examining the access to the information of a word and its linguistic properties in the lexicon- i.e., lexical access. Taft (1991) views that the 'access' is the matching between functional characteristics of the words in the mental lexicon and the input. Different models of lexical access were proposed- e.g., Search Model (Forster, 1976), Logogen Model (Morton & Patterson, 1980), and Cohort Model (Marslen-Wilson, 1984; Marslen-Wilson & Welsh, 1978; Marslen-Wilson & Tyler, 1980; and Taft & Hambly, 1986). These studies suggested that either visual or auditory input, at the sufficient degree, will activate the information of the target word in a person's mind. As well as examining the lexical access, the psycholinguists investigated how words are stored in our minds- i.e., the organization of the mental lexicon. Classic studies propose that the words are stored in the mental lexicon as a hierarchy (Collins & Quillian, 1969, 1970) or a web (Collins & Loftus, 1975). These studies argue that, in L1 mental lexicon, the association of words are semantic-based. Singleton (1999) points out that meaning also plays a crucial role in L2 mental lexicon. On the contrary, Hoey (2005) proposes the Lexical Priming Theory based on the corpus-driven studies. One of the assumption is that collocation words are stored in order with syntactic links in the lexicon. The present study explores whether the association of collocation words as a syntactic link is more salient than the semantic one in L2 mental lexicon.

L2 mental lexicon studies were mainly on the connection between the L1 and L2 lexicons. Previous studies found that, when a person knows two languages, information of L1 and L2 words is stored in separate compartments and could be connected to each other (Dong, Gui & MacWhinney, 2005; Singleton, 1999; Sudasna, Luksaneeyanawin, & Burnham, 2002; Wolter & Gyllstad, 2011). Singleton (1999) argues that the connection may be either between individual L1 and L2 lexical nodes or via conceptual store. He points out that such connection in the lexicon varies among L2 speakers. Sudasna, Luksaneeyanawin, & Burnham (2002) propose that the difference in L2 lexicon is dependent on the factors related to the accessors- i.e., levels of proficiency and experience in L2. The researchers examined bilingual mental lexicon operations and found that L2 speakers who had high proficiency did not refer to L1 lexicon for the lexical accessing. In contrast, both L1 and L2 mental lexicons of lower proficient L2 speakers need to cooperate before a word is being accessed. Besides, the researchers found that experience in L2 affected the lexical access. For a person with limited L2 experience, the word is retrieved via L1 system and the L2 word is retrieved via lexical link. The organization of L1 and L2 mental lexicons are assumed to be similar, but the access to words can be varied.

Recent studies on L2 mental lexicon were dominantly conducted with proficient L2 learners living in English speaking contexts (Conklin & Schmitt, 2012; Durrant & Schmitt, 2010; Fitzpatrick & Izura, 2011; Gyllstad & Wolter,

2016; Jiang, 2002, 2004; Sonbul & Schmitt, 2013; Wolter & Gyllstad, 2011). To examine the production of L1 and L2 words, Fitzpatrick & Izura (2011) employed word association task (WAT). Many other tasks were used to explore the language processing of L2 mental lexicon, e.g. lexical decision task (LDT), self-paced reading, and gap filling tasks. These studies paid attention to L2 speakers who are bilinguals.

For learners in the non-English speaking countries, exposure to language is a crucial factor for acquiring L2 vocabulary (Fernández & Schmitt, 2015). There is a lack of research in L2 learners with different degrees of language exposure in the EFL context. In order to fill the gap, the present study examines Thai EFL learners with different degrees of language exposure. Two research questions (RQ) and the statements of hypothesis were formulated as follows:

RQ1: What are the organization and the lexical processing in the English mental lexicon of Thai learners?

Hypothesis 1: The frequently co-occurring words are stored closely in the English mental lexicon of Thai learners.

RQ 2: What are the similarities and differences between the mental lexicon of Thai learners with low and high English language exposure?

Hypothesis 2: The learners with low and high language exposure have different mental lexicon, and different paths in lexical access of L2 words.

2 Research Design

This study is a cross-sectional interlanguage study, which employs two psycholinguistic tasks to examine the mental lexicon of Thai EFL learners.

2.1 Participants

The participants in this study were sampled with the stratified random sampling method. The participants were stratified and selected according to their degrees of English language exposure. They were divided into two groups: the high-exposure group (HE-group) and the low-exposure group (LE-group). Two groups of learners were divided by the average scores of their language exposure. All participants were Thai EFL undergraduate students in a university in Thailand. These participants were 19- to 20-year-old students studying in different faculties- i.e., Logistics, Engineering, Management and Tourism, Humanities and Social Sciences, Sciences, Informatics, and Music and Performing Arts. To avoid the effects of hand preference, all participants were right-handed.

2.2 Instruments

There are three instruments used: English Language Exposure-ELE Questionnaire, lexical decision task (LDT), and word association task (WAT). The ELE-Questionnaire was employed to screen the participants. The questionnaire has been developed by Sudaporn Luksaneeyanawin and a number of researchers working under her supervision at the Centre for Research in Speech and Language Processing, Chulalongkorn University, Thailand. from the late 90s to present (Chaitawin, 1997; Jangarun & Luksaneeyanawin, 2016; Kijkar, 2004; Modehiran, 2005; Nimphaibule, 1996; Pongprairat & Luksaneeyanawin, 2013; Sertthikul, 2004; Sudasana, Luksaneeyanawin, Burnham, 2002; Tarnisarn, 2012; Thaworn, 2012; Wong-aram, 2011; Worathumrong & Luksaneeyanawin, 2016) The lexical decision task (LDT) was used to examine the lexical processing (Forster, 1976, 1979; Forster & Bednall, 1976; Forster, Davis, Schoknecht, & Carter 1987; O'Connor & Forster, 1981; Taft & Forster, 1975, 1976). The words association task (WAT) was designed to investigate how words are stored in the mental lexicon (McNeill, 1966).

2.2.1 ELE-Questionnaire

With the use of the ELE-Questionnaire, it has been proved that L2 learners with different degrees of language exposure are different in their perception and production of language in all aspects- i.e., pronunciation (Chaitawin, 1997; Nimphaibule, 1996; Kijkar, 2004; Sertthikul, 2004; Tanisarn, 2012; Pongpairat & Luksaneeyanawin, 2013), syntax (Jang-arun & Luksaneeyanawin, 2016; Thaworn, 2012), pragmatics (Modehiran, 2005; Worathumrong & Luksaneeyanawin, 2016), and processing (Sudasana, Luksaneeyanawin, & Burnham, 2001; Sudasana, 2002; Wong-Aram, 2011). Learners with high exposure to English language perform better than learners with low exposure.

There are three parts in the ELE-questionnaire: (1) information about English language experience and the amount of its exposure at home and school, (2) information about the amount of time spent on all kinds of learning activities (formal education, extracurricular, and self-practice activities), and (3) intensive English language exposure including English camps and summer schools in the English speaking countries. The questionnaire is presented in Appendix A.

The questionnaire was developed to measure the time spent in a day doing different activities that engage English language, e.g. formal classroom, tutoring class, self-practice, and extra-activities. It is assumed that the maximum daily hours of using English by Thai EFL learners are 12. The score weight in the questionnaire is divided into three kinds of English exposure: experience (35%), learning activities (30%), and intensive exposure (35%). As the average scores of the HE-group is 44.10%, it can be interpreted as this group of learners spend approximately 5.29 hours a day

using English. Having average score as 24.39%, the LE-group spend around 2.93 hours a day using English.

2.2.2 Lexical Decision Task (LDT)

In the present study, LDT was used to examine the semantic priming effect of the verb (prime) on the noun (target). In the mental lexicon, if the elements of a collocation are stored more closely to each other than those of a non-collocation, the reaction time of the collocations should be less. The task was presented on a laptop running DMDX software (Forster & Forster, 2003) with the word presenting in the center of the screen. There are 90 pair items created in three conditions: collocation, non-collocation, combination of words and non-words (fillers). The initial word of each collocation is the prime. For example, '*feel*' is the prime for '*pain*' (target word). The same prime is used to coin the non-collocation, e.g., '*feel-drug*' and the pair of word with non-word, e.g., '*feel -gwane*'. The list of the experimental items is presented in Appendix B. To counterbalance, 90 students (45 with high exposure and 45 with low exposure) were divided into three groups to use different set of experimental items, namely group A, B, and C. Each group contained 30 participants, 15 students with high exposure and 15 with low exposure.

2.2.3 Words Association Task (WAT)

The WAT was conducted to investigate the organization of L2 mental lexicon. The cue words used in this study include 30 verbs and 30 nouns used in the LDT so that the responses in the WAT could be compared with the LDT. The participants were presented with a word (cue word) at a time. After they saw the cue word, they were asked to write the first English word coming to their minds in the response sheet. The response of WAT is open-ended because it activates complex association of words. The assumption is that the responded words are stored closely with the cue words in the participants' mental lexicon. The relationship between the responses and the cue words can be identified as having meaning-based association, position-based association, form-based association, or erratic association (Fitzpatrick, 2007).

2.3 Procedures

The ELE Questionnaire was randomly distributed to 620 undergraduate students in the university. They were explained about the objectives of the study and that their participations were voluntary. The participants spent approximately 20 to 30 minutes to complete the questionnaire. The responses were rated by the scoring criteria. The participants' scores were ranked from the lowest to the highest exposure- i.e., those with highest scores (above the 75th of percentile) and those with the lowest scores (below the 25th of percentile). The high exposure group is referred to as the HE-group and the

low exposure group as the LE-group. Table 1 shows that the average scores of these two groups are distinctive.

Table 1. The ELE Weighed Scores (%)

	All participants (n= 620)	HE-group (n= 45)	LE-group (n= 45)
Mean	35.07	44.10	24.39
S.D.	7.80	4.97	4.38
Minimum	12.81	38.12	12.81
Maximum	59.37	59.37	31.17

Based on the scores of the questionnaire, 90 participants (45 with HE and 45 with LE) participated in the experiments voluntarily. Every participant joining the two experiments was paid one hundred baht after completing all the tasks. Individual participants were explained that they were to do three English vocabulary activities. The first activity is the LDT. The participants looked at the letters on the computer screen and pressed the button instantly to decide if the letters they saw were English words or not. In the second activity, Stroop task, the participant named the colors of the word aloud. This task was conducted to avoid the effect of priming on the second task-WAT. The results from the Stroop task were not used in the present study. For the WAT, the participants looked at a word on the screen and wrote down any word that first came to their mind on the response sheet. The participants did the LDT before WAT so that the information being accessed in their mind was not overloaded.

3 Results and Discussion

3.1 The L2 lexical access with LDT

The L2 lexical access of all participants and the comparison between the HE-group and LE-group are exhibited in this section. The lexical access is examined through the lexical decision task (LDT). The reaction time from the LDT are used to indicate the distance between the prime and the target words in the mental lexicon. The fast response refers to a close relationship between two words. The findings show that the participants respond to the stimuli in the collocation condition faster than other conditions.

Table 2. Response Time in Milliseconds and Errors in Percentage of All Participants (n=90).

Conditions	RT (ms.)	Errors	SD	Min	Max
Collocation	878.87	15%	206.75	439.49	1,511.18
Non-collocation	896.38	13%	220.08	386.65	1,632.10
Non-words (fillers)	979.68	24%	233.96	404.58	1,781.59

Table 2 illustrates the reaction time and percentage errors among three conditions. The differences among the mean reaction time of the three conditions are significant (F (2, 268) =5.49, *p* = 0.005). The reaction time of the non-word condition is significantly different from the collocation condition (*p* = 0.002) and the non-collocation condition (*p* = 0.000). The difference between the reaction time of the collocations and non-collocations is marginally significant (*p* = 0.578). The findings are consistent with the previous studies examining L1 Turkish speakers (Cangir, Büyükkantarcıoğlu, & Durrant, 2017) and L2 learners (Wolter & Gyllstad, 2011; Gyllstad & Wolter, 2016) that the reaction time of the collocations is faster than the non-collocations. Since the difference is not outstanding, the findings partly support hypothesis 1 that the frequently co-occurring words (collocations) are stored closely together.

In the present study, two groups of participants (HE-group and LE-group) have completely different degrees of exposure (HE-group's mean = 44.10%, SD = 4.97; LE-group's mean = 24.39%, SD = 4.38; *p* = .00 < 0.05). As mentioned earlier, the learners with more language exposure tend to perform better. The findings show that the reaction time in the LDT of these two groups are distinctive. The difference between the mean reaction time of the HE-group and LE-group is significant (*F* (2, 268*)* =14.98, *p* = 0.0001). The HE-group's responses are faster than the LE-group's and the error rates of the HE are less than the LE in all three conditions. (see Table 3).

Table 3. Comparison of the Mean Reaction Time in Milliseconds and Percentage of Errors

Conditions	HE-group (n= 45)		LE-group (n= 45)	
	RT (ms.)	Errors	RT (ms.)	Errors
Collocation	813.20	7%	933.94	21%
Non-collocation	830.41	5%	974.19	21%
Non-words (fillers)	949.49	20%	1016.29	30%

Both groups exhibit the same pattern of lexical processing. Among three conditions: collocation, non-collocation, and non-word (filler), the mean reaction time of the collocation is the fastest. The performance of both groups in the collocation condition is significantly faster than the non-word (HE-group, *t* (44) = -3.69, *p* = 0.001; LE-group, *t* (44) = -2.28, *p* = 0.03). While the mean reaction time of the non-collocation and the non-word filler are significantly different in the HE-group (*t* (44) = -3.61, *p* = 0.001), the difference is not distinctive in the LE-group *(t* (44) = -1.39, *p* = 0.17). The insignificance in the LE-group reflects weaker L2 network, which could be a result of the limited chance to attentively encounter English words in daily lives due to the restricted vocabulary knowledge.

Besides, there is no significant difference between the collocation and non-collocation in both groups (HE-group, *t* (44) = -0.83, *p* = 0.41; LE-group, *t* (44) = -0.19, *p* = 0.06). Such findings are not consistent with

Gyllstad and Wolter (2016) and Fitzpatrick (2007), who examined the lexical processing of L2 proficient learners who lived in the English speaking countries. Those participants can be called English as a Second Language (ESL) learners. Their processing should absolutely be more native-like than the participants in the present study, who learn English as a Foreign Language (EFL learners).

The findings of the present study could be compared with Wolter and Gyllstad's (2011) in that the faster reaction time in the collocation exhibit the native-likeness. The performance of the HE-group exhibits the higher level of proficiency in lexical processing than the LE-group. The findings conform to the previous studies conducted in Thailand (Sudasana, Luksaneeyanawin, & Burnham, 2002; Sudasana, 2002; Wong-Aram, 2011), which found the relationship between language exposure and language processing. The L2 processing of the high-exposure learners tend to be faster and more proficient than the learners with low exposure.

The errors are counted either when there is no response (by 2000 milliseconds), or when the response is incorrect. It is obvious that the reaction time and the errors of the HE-group and the LE-group are dissimilar. The error rate of HE-group is much lower than the LE-group (collocation condition: HE= 7%, LE=21%; non-collocation condition: HE= 5%, LE=21%). It could be assumed that the links of the frequently co-occurring words in the English mental lexicon of HE-group are stronger than the LE-group.

The results from the LDT indicate that the processing of collocations is faster than non-collocations with no significant difference. In other words, it could not be confirmed that the frequently co-occurring words (collocations) are stored more closely together than the non-collocations. The collocation used in LDT is a fix-type, where the target words directly follow the prime. The different types of lexical links in L2 mental lexicon will be revealed more in the WAT experiment in the following section.

3.2 The organization of L2 mental lexicon by WAT

This section presents the organization of the L2 mental lexicon, which is explored through the WAT, and the comparison of the organization in the lexicon of the HE-group and LE-group. The WAT provides us information about the association of words in the mental lexicon. The WAT requires the learners to produce an English word when they saw the stimulus. Based on Fitzpatrick (2007), the responses are grouped into four types: meaning-based association (e.g., *empty-vacant, cold-uncomfortable, cat-animal, charity-kind*), position-based association (e.g., *hot-dog, weight-paper, bird- (get the)-worm*), form-based association (e.g., *scared-scary, very-berry*) and other types (e.g., *hamburger-swim* or no response given). The findings show that the largest proportion of the network in all participants is meaning-based (34.03%). This evidence could be used to explain the insignificant difference between the reaction time of the collocation and non-collocation in the LDT

aforesaid. Besides, about one-third of the responses are position-based association (28.53%), the findings are consistent with the LDT that a lot of words are stored in the mental lexicon as collocations (see Table 4).

Table 4. The Frequency of Each Classification in All Participants (n = 90).

Category	Numbers of responses (%)	
1. Meaning-based association	1,838	(34.03%)
2. Position-based association	1,541	(28.53%)
3. Form-based association	419	(07.76%)
4. Others	1,602	(29.67%)
Total	5,400	(100 %)

More than half of the responses are meaning-based (34.03%) and position-based (28.53%). It has to be noted that the association of some pairs of words can be either meaning-based or position-based (e.g. *spend-time, telephone-call*). It can be implied that the association of words are mainly semantic-based. The patterns of responses in the present study are similar with the previous studies in L2 speakers (Fitzpatrick & Izura, 2011). This suggests that the organization of the English mental lexicon tend to have a strong semantic relationship.

Hoey (2005) points out that, when people repeatedly encounter the collocations, they expect the collocated pairs to appear in a particular context. He argues that, having a syntactic link, the frequently co-occurring words are stored closely in the mental lexicon. The findings of the present study partly support this claim because the largest numbers of word association in L2 mental lexicon are semantic-based rather than position-based. In Fitzpatrick's (2007) study, the participants (L1 speakers) made other responses (erratic association and blanks) fewer than 10%. As presented in Table 4, L2 learners leave blanks and produce errors in a high proportion (29.67%). It could be assumed that the association between words in the L2 mental lexicon are not as strong as in the L1.

Four types of responses are further analyzed into subcategories. Table 5 exhibits the responses in the subcategories of classification. Among all subcategories, the highest responses are the blanks (19.70%) and consecutive xy collocation (19.48%) respectively. While the blanks reflect the avoidance of L2 learners, the consecutive one represents the native-likeness.

Table 5. The Responses in the Present Study of All Participants (n = 90).

Category	Subcategory	Example	No of responses (%)	
1.Meaning-based association	1.1 Defining synonym	*feel-emotion*	363	(06.72%)
	1.2 Specific synonym	*feel-touch*	74	(01.36%)
	1.3 Lexical set/ context related	*time-morning*	440	(08.15%)
	1.4 Conceptual related	*time-punctual*	961	(17.80%)

2.Position-based association	2.1 Consecutive xy collocation	*time-out*	1,052	(19.48%)
	2.2 Consecutive yx collocation	*summer-time*	486	(09.00%)
	2.3 Other collocational association	*someone-('s)-story*	10	(00.19%)
3.Form-based association	3.1 Change of affix	*call-calling*	68	(01.26%)
	3.2 Similar form only	*give-gave, bring-ring*	351	(06.50%)
4. Others	4.1 Erratic association	*bring-lazy*	539	(09.97%)
	4.2 Blank		1,064	(19.70%)

Comparing the organization of the L2 mental lexicon, explored through the WAT in the HE and LE groups, Figure 1 below shows that the organizations of the mental lexicon in the two groups are distinctively different. Most responses of the HE-group are meaning-based association (42.21%), while the other type (errors and blanks) is the highest numbers of responses in the LE-group (43.93%). The findings show that the LE-group gave much more blanks (31.07%) than the HE-group (8.33%). The researchers conduct a focus-group interview to ask the participants about the blanks. The participants report that, when they do not know the meanings of some words, they cannot think of other words. Some of them know the words presented on the screen, but they have no idea about other English words. It could be assumed that the semantic network is not well established in the lexicon of learners with low exposure. Fitzpatrick (2007) and Hui (2011) propose that native speakers' responses are mostly meaning-based and position-based. It could be implied that the performance of the HE-group is closer to the native likeness than the LE-group.
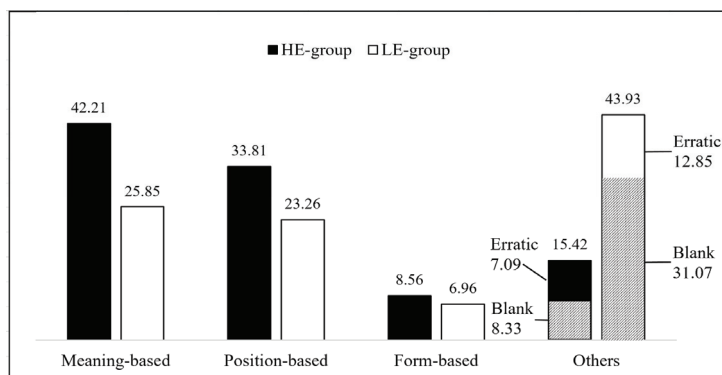

Figure 1. Types of responses (%) in the HE and LE groups

The results show that the organization of the mental lexicon in the high-exposure and low-exposure learners are dissimilar since the LE-group produce a lot of erratic responses. The certain numbers of the answers are combination of English letters referring to Thai words. For example, when the participants see the word '*drink*' on the screen, they write '*Cha*' (a Thai word of '*tea*') in the response sheet. It indicates that the learners try to match the stimulus word with the other words stored in their L1 mental lexicon. The first word come in their minds are from their L1 mental lexicon but employ the form (spelling) in the L2 mental lexicon. This supports Sudasana, Luksaneeyanawin, & Burnham's (2001) argument that L1 and L2 mental lexicons of low exposure learners cooperate when the information of an L2 words is accessed.

Table 6. Numbers of Responses (%) in Sub-Categories

Sub-categories	HE-group (n=45)		LE-group (n=45)	
1. Meaning-based association	**1,140**	**(42.21%)**	**698**	**(25.85%)**
1.1 Defining synonym	251	(09.29%)	112	(04.15%)
1.2 Specific synonym	46	(01.69%)	28	(01.04%)
1.3 Lexical set/ context related	269	(09.97%)	171	(06.33%)
1.4 Conceptual related	574	(21.27%)	387	(14.33%)
2. Position-based association	**913**	**(33.81%)**	**628**	**(23.26%)**
2.1 Consecutive xy collocation	623	(23.40%)	422	(15.63%)
2.2 Consecutive yx collocation	281	(10.41%)	205	(07.59%)
2.3 Other collocation	9	(00.33%)	1	(00.04%)
3. Form-based association	**231**	**(08.56%)**	**188**	**(06.96%)**
3.1 Change of affix	34	(01.26%)	34	(01.26%)
3.2 Similar form only	197	(07.30%)	154	(05.70%)
4. Others	**416**	**(15.42%)**	**1,186**	**(43.93%)**
4.1 Erratic association	192	(07.09%)	347	(12.85%)
4.2 Blank	225	(08.33%)	839	(31.07%)
Total	2,700	(100%)	2,700	(100%)

The comparison between the two groups of learners exhibits the characteristics of learner's interlanguage. Table 6 shows that the types of responses and the production of chunks of the HE-group and LE-group are distinctive. Most of the position based responses in the HE-group are consecutive xy collocation, e.g. *time-out*, (23.40%). On the other hand, the LE-group mainly give blanks in the response sheet which reflects the avoidance of making errors. The learners (LE-group) do not want to write a word because they are unsure.

Among the four subcategories of the meaning-based association, both groups mostly produce conceptual related responses (HE= 21.27%; LE = 14.33%). It conforms to Singleton (1999) that two words are connected via the conceptual stores in a part of L2 mental lexicon. Both groups produce the consecutive xy collocation, e.g., *time-out* (HE=23.40%; LE=15.63%) rather

than the consecutive yx collocation, e.g., *summer-time* (HE=10.41%; LE=7.59%).

It indicates that the pattern of links between words in the mental lexicon of the LE-group is similar with the HE-group. As presented in Figure 1, both groups mainly produce associative words which are meaning-based (HE= 42.21%; LE= 25.85%) and position-based (HE= 33.81%; LE=23.26%). It could be seen that the proportion of meaning-based association in the HE-group is much larger than the LE-group whose responses are mostly blanks (31.07%). The problems are either that the LE-group could not find the links of words or they do not even have those words in their lexicon.

A few numbers of responses are 'other collocational association', a subcategory of the position-based association (HE=0.33%; LE=0.04%). Such responses refer to the word that commonly precedes or follows the stimulus word with some other words in between, e.g., *nice to meet you, Do you hear me? help me please, make it happen, piece of cake, inside out.* Such collocational association is the combination of open-class words (content word) with closed-class word (function word). They are meaningful chunks which represent the proficiency of the lexicon. Conklin & Schmitt (2008) point out that the ability to produce chunks in a very short period of time is an indicator of native-likeness. In the HE-group, many participants produce more than one English word at a time. For example, when they saw the word '*side*', their response is '*inside out'*. It shows that the combination of words or phrases are stored very closely to each other in high exposure learners' mental lexicons. This goes along with Wolter & Gyllstad (2011) who propose that the combination of words (more than two words frequently co-exist) are stored closely together in the mental lexicon of advanced L2 learners.

Both groups produce much fewer form-based association than other response types (HE-group= 8.07%; LE-group = 6.96%). The findings do not conform with Hui's study (2011), where the low-proficient Chinese learners produce form-based association rather than other types. Hui (2011) points out that such response production is probably caused by the teaching method in China which focuses on word-formation, e.g. *scare-scary*. As a result of the transfer of training (Selinker, 1972), the network of English words in Chinese learners' mental lexicon is form-based. In the present study, the responses of the HE-group and the LE-group are rather related to the meanings and the positions of words than the sounds and spelling (forms). Lexical access may be the result of different degrees of English exposure as well as the learners' vocabulary learning methods.

In sum, the findings support hypothesis two that the learners with low and high language exposure have different mental lexicon, and different paths in lexical access of L2 words. Both HE-group and LE-group respond to the collocations faster than the non-collocations, and the fillers (non-words). The average reaction time of the HE-group and LE-group is significantly different. The association of words is rather semantic-based than form-based (both in the low or high exposure group). The organizations of mental lexicon in the two groups are dissimilar. While the HE-group could produce a lot of

associative words, the LE-group failed to do so. The strengths of the links between both groups are different, in which the semantic network in the HE-group tends to be stronger than that of LE-group.

4 Conclusion

The present study investigates the L2 mental lexicon of Thai EFL learners with different degrees of exposure (HE-group and LE-group) through two psycholinguistics tasks: LDT and WAT. The findings from the LDT task show that the reaction time of the collocation (frequently co-occurring words) is faster than the non-collocation, but the difference is marginally non-significant. It implies that, in a part of the mental lexicon, the words that often co-exist, e.g., *spend-time*, are stored closely together. The link between these co-existing words can be called position-based association. The results of the WAT also show other types of links between the words stored in the lexicon. The majority of the links between words in the L2 mental lexicon is meaning-based (e.g. *spend-give*), which clearly explains the marginally significant difference of the reaction time between collocations and non-collocations.

The findings of this study partly support Hoey's (2005) claim that the collocated words are stored closely in the mental lexicon and connected via syntactic links. The results show that the associations of English words in the L2 mental lexicon are mainly semantic-based. The syntactic links are not as salient as the semantic links. The words are probably stored like a web in L2 mental lexicon, where the links between words can be either semantic or syntactic. For example, the headword '*spend*' is stored closely together with '*time*' and '*money*' as collocations. The words related to '*spend*' by meaning (e.g. *pay, give*, and *purse*) are stored very closely in the lexicon as well.

The HE-group and LE-group exhibit different mental lexicon and different paths in lexical access of L2 words. The different average reaction time in the three conditions: collocations, non-collocations, and non-words, is in the same pattern. The participants in HE-group and LE-group respond to the collocations faster than the non-collocations, and non-words. This seems to be a universality feature among L1 and L2 speakers (Cangir, Büyükkantarcıoğlu, & Durrant, 2017; Durrant & Schmitt, 2009; Wolter & Gyllstad, 2011). The HE-group has the stronger links between collocations than the LE-group. The findings from the WAT clearly show the different paths of the lexical access. Most of the association between words in the mental lexicon of the HE-group is meaning-based. The low-exposure learners give a lot of blanks which means they avoid responding to the stimuli. The findings support the interlanguage phenomenon that the HE-group is considered more proficient language learners and possess the characteristics of native-likeness.

Language experience is the crucial factor affecting the L2 lexical processing. In the EFL context, learners who have more English contact

hours seem to be more successful. Teachers may provide class activities that help increase the exposure time. They should also be aware of the limited exposure to English in the learners and design tasks for the learners to gain more opportunities to use English language. Technology could be an excellent tool for EFL learners in the tasks designed to enhance their language exposure.

The limitation of the present study should be noted. In the present study, the categorization of responses in the WAT following Fitzpatrick (2007) seem to be overlapping. Some responses could be classified as having either meaning-based or position-based relationship (e.g., *telephone-call*). The classification or responses in WAT should be redesigned in the future research.

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Appendix A
English Language Exposure Questionnaire*

*This questionnaire has been developed at the Centre for Research in Speech and Language Processing-CRSLP, Faculty of Arts, Chulalongkorn University for the research in psycholinguistics and applied linguistics under the supervision of Dr**.** Sudaporn Luksaneeyanawin**.** More than 10 graduate researches have been conducted using this questionnaire from the late 90s up to present**.**

Part 1) Information about English language experience and the amount of its exposure at home and school, including English proficiency from past till present
A) Directions: Please answer by placing a checkmark (✓) or writing the answers according to your experiences.
1. Name _____ Surname _____ Undergraduate year of study_____
2. Faculty _____ Major _____ University _____
3. Your high school is _____ which is a public or a private school.
    You studied in the   regular program (Thai)   English program
                          International program
4. Your mobile phone number _____ email _____
5. You were born in   Thailand   other countries (please specify) _____
    If you were born in other countries, you lived there for _ month(s)/year(s).
6. The language(s) I usually speak at home. (Check all that apply)
        Thai language
        Dialect (s), i.e. Northeastern Dialect, Southern Dialect, (please specify) _____
        Foreign language (s) (please specify) _____
7. The language (s) I usually speak with my family members. (Check all that apply)

(Ex: I usually speak English with my father)

I speak Thai with _____.

I speak _____ (please specify the dialect (s)) with _____.

I speak _____ (please specify the foreign language(s)) with _____.

8. Except Thai language, the language (s) I comfortably use is/are

8.1 listening – speaking 1) _____ 2) _____ 3) _____

8.2 reading – writing 1) _____ 2) _____ 3) _____

9. I started learning English since I was _____

at home (home schooling before pre-school)

in pre-school   in kindergarten

in lower primary (year 1-3)   in upper primary (year 4-6)

B) Directions: Please place a checkmark (✓) to indicate your true experience at school and university

1. On average, my grade in English course at school and university is:

Grades / Levels	Grade 0 (F)	Grade 1 to 1.5 (D to D+)	Grade 2 to 2.5 (C to C+)	Grade 3 to 3.5 (B to B+)	Grade 4 (A)
At primary school					
At secondary school					
At university					

2. On average, my English teachers speak English to me in English courses:

Marks / Levels	Never	Rarely (Mostly Thai)	Sometimes (Alternatively with Thai)	Often (Mostly English)	Always
At primary school					
At secondary school					
At university					

Part 2) information about the amount of time spent on all kinds of learning methods: formal education, extra curriculum and English self-practice activities

Directions: Please place a checkmark (✓) to indicate the extent to which you think you had/ have opportunities to expose to English in each of the following situations.

Never = 0%   Rarely = 1-25%   Sometimes = 26-50%

Often = 51-75%   Extremely often = 76-100%

Situation	Marks				
	Never	Rarely	Sometimes	Often	Extremely often
1. Have you every studied English with any foreign teacher at school or university?					
2. Have you ever studied other subjects in English? (except English)					
3. Have you ever look up new words in the dictionary when you do activities?					

	Never	Rarely	Sometimes	Often	Extremely often
4. Have you ever used English–English Dictionary?					
5. Have you ever played online games in English?					
6. Have you ever played any games using English language such as scrabbles or crosswords?					
7. Have you ever done self-practice by listening to English conversation?					
8. Have you ever listened to or sung English songs?					
9. Have you ever gone to see concerts using English language?					
10. Have you ever watched movies, TV series or documentary in English?					
11. Have you ever watched or listened to news in English?					
12. Have you ever given an English presentation?					
13. Have you ever talked with people in English?					
14. Have you ever had English post online social network such as Facebook or Twitter?					
15. Have you ever done online chat in English through social network such as Facebook messenger or Line?					
16. Have you ever read English messages, articles, or news via online social network like Facebook or Twitter, or from websites?					
17. Have you ever search for the information from websites in English?					
18. Have you ever read texts written in English?					

Situation	Marks				
	Never	Rarely	Sometimes	Often	Extremely often
19. Have you ever read bulletin boards, bill boards, or other kinds of sign written in English?					
20. Have you ever read magazines or newspaper written in English?					
21. Have you ever read novels, comic books or other kinds of books in English?					
22. Have you ever written a diary or short essays in English?					
23. Have you ever summarized or taken notes in English?					
24. Have you ever had any correspondence with the others, sending emails in English?					
25. Have you ever studied with foreign learners at schools or university?					

Part 3) Intensive English language experience
Directions: Please answer by placing a checkmark (✓) or writing the answers according to your experiences.
1. Have you ever taken intensive English course (s)? (Check all that apply)
    No.(Skip to question no.2)
    Yes, during the semester.   Yes, during the semester break.
  1.1. Approximately, how many hours per week did you take English course?
      1-3 hours/week   3-6 hours/week   more than 6 hours/week
  1.2. Your teacher (s) is/are (Check all that apply)   Thai   Foreigners
  1.3. While studying English intensive class, how much do your teachers use English language to communicate with you (speak or write in English)?

Marks Teachers	Never	Rarely (Mostly Thai)	Sometimes (Alternatively with Thai)	Often (Mostly English)	Always
Thai teacher (s)					
Foreign teacher (s)					

2. Have you ever been abroad in some English-speaking countries?
    No. (Skip to question no.3)
    Yes. 1) I have been to _____ for   travelling
                        attending summer camp/intensive course
                        others (please specify)_____

     2) I have been to _____ for   travelling
                        attending summer camp/intensive course
                        others (please specify)_____
     3) I have been to _____ for   travelling
                        attending summer camp/intensive course
                        others (please specify)_____
2.1 How long did you stay in each country?

Lengths Countries	Less than 1 week to 1 month	1 to 3 months	More than 3 months	More than 1 year
1st country				
2nd country				
3rd country				

2.2 During the stay (s) in the place (s) you reported above, which choice can indicate the average extent that you think you used English?

Lengths Countries	Never	Rarely (Mostly Thai)	Sometimes (Alternatively with Thai)	Often Mostly English)	Always
1st country					
2nd country					
3rd country					

3. Have you ever done part-time jobs using English?
    No.   Yes. (Please specify) 1)_____ 2)_____ 3)_____

4. Have you ever taken some English course(s) abroad or English summer camp (s) in English-speaking country?

No.   Yes. (Please specify) 1)_____ 2)_____ 3)_____

4.1 How long did you stay in each country?

Lengths Countries	Less than 1 week to 1 month	1 to 3 months	More than 3 months	More than 1 year
1st country				
2nd country				
3rd country				

4.2 During the stay (s) in the place (s) you reported above, which choice can indicate the average extent that you think you used English?

Lengths Countries	Never	Rarely (Mostly Thai)	Sometimes (Alternatively with Thai)	Often (Mostly English)	Always
1st country					
2nd country					
3rd country					

Appendix B
Experimental items used in the lexical decision task

Collocations		Non-collocations		Fillers	
prime	target	prime	target	prime	target
feel	pain	feel	drug	feel	gwane
call	police	call	point	call	corld
bring	water	bring	company	bring	shorst
turn	head	turn	case	turn	glamp
give	birth	give	park	give	granx
make	sense	make	type	make	volm
have	time	have	year	have	grourn
keep	track	keep	crime	keep	bract
need	help	need	page	need	twint
provide	support	provide	force	provide	jous
meet	demand	meet	scale	meet	phooze
read	books	read	room	read	steave
hold	hands	hold	home	hold	trox
watch	movies	watch	comment	watch	stilch
create	jobs	create	right	create	spact
build	bridges	build	finance	build	wrawpth
break	things	break	child	break	cuck
develop	skills	develop	club	develop	chigh
begin	video	begin	mistake	begin	swirst
grow	food	grow	paper	grow	vonx

spend	hours	spend	room	spend	chold
come	visit	come	truth	come	ghous
want	peace	want	gear	want	gloze
write	letters	write	health	write	gnuck
leave	town	leave	peace	leave	scoke
show	signs	show	garden	show	stromp
start	crying	start	climate	start	phryled
know	things	know	part	know	thwecs
help	people	help	month	help	oiced
hear	stories	hear	major	hear	chold

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