International Journal of Research in English Education (IJREE)

Original Article **Published online: 20 March 2023.**

EFL Learner's Crystallized Intelligence and Mental Lexicon

Mona Tabatabaee-Yazdi

* Correspondence:
tabatabaee.mona@gmail.com
English Department, Tabaran Institute of Higher Education, Mashhad, Iran

Received: 22 June 2022
Revision: 22 July 2022
Accepted: 1 November 2022
Published online: 20 March 2023

Abstract

How easily people are able to initially learn foreign language vocabulary depends on a number of different factors including effective variables such as motivation, anxiety, the cognitive processes involved in utilizing different strategies, and most relevant to the present study, linguistic features of the words themselves which is also known as mental lexicon. Thus, one of the major problems learners face in language learning either in EFL or ESL settings is the issue of vocabulary or the mental lexicon that has been changing constantly over time. Therefore, the current study aimed to find out if EFL learners' crystallized intelligence can significantly correlate with their mental lexicon. To this aim, 80 EFL learners were asked to fill out a C-test which is a reliable instrument to measure crystallized intelligence, and the Lex30 word association test to measure their mental lexicon. Moreover, the study aimed at finding any significant differences between male and female EFL learners concerning their mental lexicon and crystallized intelligence. To analyze the data, Pearson Correlation and Independent sample T-Test were run. The results showed that there is a significant positive relationship between crystallized intelligence and mental lexicon with no significant differences between males and females. This research has some implications for teachers, supervisors, as well as syllabus designers in a way to achieve better language acquisition.

Keywords: crystallized intelligence, c-test, mental lexicon, vocabulary knowledge, word association

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

1. Introduction

Learning a second language can be affected by many factors in today's contemporary world which is characterized by growing linguistic and cultural diversity (Henia, 2020). It is the human ability to communicate that makes social life possible. Central to the communicative process stands the use of language and, in any language, knowing words is at the heart of communicative competence (Roux, 2013). Among these, one can mention learners' age, motivation, earlier learning experiences, and types and amount of contact with the language (de Bot, Lowie, & Verspoor, 2005), that is to say, the amount of vocabulary that learners are exposed to. However, despite its importance to the second language (L2) learning, vocabulary had been in the past an overlooked part of second language acquisition. Richards (1976) and Meara (1982) are the ones who brought it back to the forefront in L2 learning.

The mental lexicon is "a person's mental store of words, their meaning, and associations" and a construct used in linguistics and psycholinguistics to refer to individuals' lexical, or word representations" (Richards & Schmidt, 2002, p.327). Brown (2006) offers a more modern metaphor, comparing it to the Internet and World Wide Web. He believes that the information in the mental lexicon, like a library or computer, is always being updated, new words are added, new connections to existing words are made and unused words may be forgotten. Accordingly, the mental lexicon is an essential part of our human intelligence, highlighted by the fact that vocabulary is almost always found to be the most significant part of general intelligence when compared with other cognitive function tests (Johnson, Bouchard Jr, Krueger, McGue, & Gottesman, 2004; Kan, Wicherts, Dolan, & van der Maas, 2013). Furthermore, lexical ability is a strong predictor of academic achievement at the undergraduate level (Pluck, 2019), suggesting a wide role in intelligent behavior.

Crystalized intelligence, as the learners' verbal information which is acquired through experience and particularly education (Kan et al., 2013), is contrasted with fluid intelligence, the ability that deals with novel problem-solving in the present, in Cattel's influential theory (Cattell, 1963, 1967, 1973). In other words, crystallized intelligence refers to the ability to utilize skills and knowledge acquired via prior learning (Horn, 1969).

Therefore, concerning the two above-mentioned variables, the present study was an attempt to expand the current understanding of the possible role that crystallized intelligence may have in the mental lexicon of Iranian English as a Foreign Language (EFL) learners by proposing the following research questions:

1. Is there any significant relationship between Iranian EFL learners' crystallized intelligence and their mental lexicon?

2. Does gender have any significant effect on Iranian EFL learners' mental lexicon?

3. Does gender have any significant effect on Iranian EFL learners' crystallized intelligence?

1.1 Statement of the Problem

One of the strong predictors of academic achievement, which has a wide role in human behavior, is considered to be intelligence (Pluck, 2019). Accordingly, the mental lexicon is an essential part of human intelligence which is highlighted by the fact that vocabulary is almost always found to be the most significant part of general intelligence when compared with other cognitive function tests (Johnson, Bouchard Jr, Krueger, McGue, & Gottesman, 2004; Kan, Wicherts, Dolan, & van der Maas, 2013). The use of crystallized intelligence involves the recalling of pre-existing information as well as skills. Besides, vocabulary is a crucial component of language, an idea eloquently expressed by Wilkins (1972, p. 111) who stated that "while without grammar little can be conveyed, without words nothing can be conveyed."

Thus, learning English vocabulary is a tedious task for most EFL learners, who must master an unfamiliar alphabet and phonetic system in addition to new lexical and morphosyntactic notions such as articles, phrasal verbs, and case endings. These individuals may often feel that English words are "difficult to learn and easy to forget." Moreover, how easily individuals are able to initially learn foreign language vocabulary depends on a number of different factors. These include effective variables such as motivation (Gardner, Lalonde, & Moorcroft, 1985; MacIntyre, 2002), anxiety (Dewaele, Petrides, & Furnham, 2008; MacIntyre & Gregersen, 2012), the cognitive processes involved in utilizing different strategies (Laufer & Hulstijn, 2001; Oxford, Cho,

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Leung, & Kim, 2004), and most pertinent to the present investigation, linguistic features of the words themselves (Peters, 2019; Pichette, de Serres, & Lafontaine, 2012; Puimège & Peters, 2019).

Due to differences in life experience, interests, and skills, students are likely to differ in the size of their native language vocabularies and also structure (Brysbaert, Stevens, Mandera, & Keuleers, 2016). Differences in lexical knowledge should lead to many variations in listeners' and speakers' ability to use language in spoken and written communication (Banks, Gowen, Munro, & Adank, 2015; Rodríguez-Aranda & Jakobsen, 2011; Yap, Balota, Sibley, & Ratcliff, 2012). Therefore, Cameron (2001) stated that assessing students' vocabulary knowledge lets teachers set the language objectives for the course within communicative language teaching. It also helps teachers and researchers to better understand the cognitive processes involved in reading and vocabulary acquisition.

Supervisors and curriculum developers can design their curriculum in a way that pays more attention to vocabulary learning and as a result, achieve better language acquisition. Accordingly, in the current study, the researcher makes an endeavor to fill the gap in the psycholinguistic field and education system by speculating the probable relationship between Iranian EFL learners' crystallized intelligence and their mental lexicon. Therefore, the present study is an attempt to expand the current understanding of the possible role that crystallized intelligence may have in the mental lexicon behaviors of Iranian EFL learners and vocabulary acquisition.

2. Literature Review

2.1 Mental Lexicon

Knowing a vocabulary means knowing many characteristics and dimensions of a word. Psychologists have agreed that vocabulary knowledge resides in the long-term memory of language users (Gathercole, Willis, & Baddeley, 1991; Xiang & Nam, 2022).). This kind of knowledge is stored and organized in a dictionary-like form, which is metaphorically referred to as the mental dictionary or mental lexicon (Aitchison, 2012). However, this mental lexicon is not organized as a regular dictionary in alphabetical order but is also considered as a network or a web type (Blumstein, 2022; Sousa & Gabriel, 2015). It refers to how words and their associative properties are stored in the human mind and in what ways they are accessed.

Moreover, studying vocabulary knowledge in relation to the mental lexicon does not include only the surface aspects of vocabulary items such as spelling, pronunciation, and parts of speech, but it goes beyond these aspects to include the organization, storage, and retention of words from the memory. Thus, since the traditional methods and approaches of teaching and learning vocabulary seem insufficient to handle the main purpose of learning vocabulary which is making language users learn and use their words correctly when they practice the language, this network or web type storage-a learner's mental lexicon-which is considered a crucial part of developing English language skills, is a tempting component that has an important role in EFL teaching and learning.

The idea of a mental lexicon was first proposed by Treisman (1960) as a repository of all the information a reader or a listener has attained about the words of his language. He suggested that in every speaker's mind there is a well-organized system of lexical representation, where each word's spelling (orthography), sound (phonology), and meaning (semantics) are assumed to be stored as unique entities. The mental lexicon is a mental system that organizes language in learners' minds. Richards and Schmidt (2002) suggested that it is a mental system that involves all the information a person knows about words. Such properties include the meaning of the word, its pronunciation and spelling, its relationship with other words, and the related information. McCarthy (1990) has linked the mental lexicon to a dictionary, a thesaurus, an encyclopedia, a library, a computer, or a network.

Bonin (2004, p.1) also defines the mental lexicon as "the mental repository of all representations that are intrinsically related to words." Correspondingly, Bonin (2004) declares that the mental lexicon contains several types of representations including phonological, semantic, morphological, and orthographic. Hopp (2018) in the same line with Bonin (2004) notes that mental knowledge contains four kinds of features (1) the specification of the item meaning, (2) a syntactic property, (3) the morphological characteristic of the item, and (4) phonological information for the entry. As Hopp (2018) holds, these four kinds of information are interrelated systematically. Take the word painter as an example. Its meaning is related to its morphology 'paint' 'er' and the '- er' refers to an agent in the world. There are other specifications stored with an item as Randall (2007) notes such as pragmatic, stylistic, and effective features that make the context of discourse more tangible.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

2.1.1 Word Association Test

Word association was first developed as a research instrument by Galton (1879) to find a link between a person's intelligence quotient (IQ) and word associations and was subsequently developed by Jung (1910) as a clinical diagnostic tool to explore complexes in the personal unconscious. Galton introduced the first-word association test to psychology. Besides, works by Read (1993), Schmitt (1998), Söderman (1993), Sökmen (1993), and others are indicative of a clear belief among second language researchers that word association patterns can inform us in some way about L2 word knowledge, and about how the mental lexicon operates. However, there is some debate about how these patterns should best be interpreted. Meara (1996) has described vocabulary knowledge as consisting of three dimensions: size (or breadth), depth, and accessibility (or structure).

Accordingly, word association data have been used at various times to illustrate all three. Word association tasks have also been called upon to shed light on the depth of an individual's vocabulary knowledge (see, Read, 1993). Wolter (2001) discusses his word association study findings in terms of both breadth and depth of knowledge but goes on to suggest that they indicate a difference in structure, too, between the L1 and L2 lexicons. Wolter (2001) hypothesizes that the way in which the lexicon is structured is in fact a function of the quality of word knowledge.

The implication running through the research outlined above is that word association behavior can tell us about the size, depth, and organization aspects of the lexicon. The extensive use of association tasks in investigations of the first language (L1) in childhood (Entwisle et al., 1964; Ervin, 1961) shows that they can also be used to identify developmental changes in the lexicon. Perhaps it is a logical extension, then, to use the same tools to investigate the developing L2 language system, and in particular to draw inferences about proficiency levels from association behavior, which is also the main aim of the present study, too.

As to what this mental lexicon organization is like, different experiments have given clues as to its organization. Pranoto and Afrilita (2019) gave some testees the definition of some words which are of low frequency and asked them to provide the name of the items. Not all test takers answered the questions, but for the researchers, the answers on the tip of their tongues were of great importance. Some of the answers were erroneous; however, they were phonetically close to the given words. The findings revealed that basic to lexicon and involved in its organization is an interrelated phonological system, a system of meaning relations, and a spelling system which are interrelated. Accordingly, Benmalek (2020) aimed at exploring the effect of using word association tests on English foreign language learners' mental lexicon. The Hypothesis of the study suggested that word association tests would have a positive effect on EFL learners' mental lexicon. The findings revealed that word association tests can help learners to improve their vocabulary competency in an easy and entertaining way, and words are meaningfully connected in the mental lexicon and should be taught accordingly.

Boddaert et al. (2021) also aimed to investigate the integration of newly learned L2 words into the mental lexicon modulated by the vocabulary learning method. For this purpose, an L2 word-learning paradigm was designed with two learning methods: L2 words were paired with videos in the first one and their translation-equivalent L1 words in the second. To test L2 word integration, a lexical decision task associated with form priming was administered before and after the learning phase. The L2 words to be learned were used as primes. Before learning, a facilitation effect was obtained with pseudowords (not already learned L2 words) as primes and L1 words as targets. After learning, L2 words no longer facilitated L1 word recognition when learned with the video method, while they still had this effect when learned with the L1 words. This absence of a facilitation effect indicated that L1 words and L2 words are involved in a lexical competition process common to the two languages.

Accordingly, Xinnian (2021) aimed to investigate the basic morphological units stored in the mental lexicon for Chinese as second language learners (L2) and Chinese native speakers (L1). Meanwhile, the modulation of Chinese morpheme property (bound or free) in lexical processing was examined. The results revealed that for intermediate-level L2 learners, Chinese words could be accessed through either whole-words or morphemes, while advanced-level learners and Chinese natives might employ a whole-word pathway. This might suggest that as language proficiency and reading experience develops, learners tend to rely more on whole-words as a processing strategy. Regarding the morpheme property effect, bound morphemes reported a greater priming effect than free morphemes in lexical decision tasks for both L1 and L2 speakers, which was interpreted with an interactive-activation framework.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

2.2 Crystallized Intelligence

Individual differences have long attracted researchers' attention as an influential factor in learning a second or foreign language (Gregersen, MacIntyre, & Meza, 2014; Mercer & Ryan, 2016). Traditionally, intelligence was assumed to have considerable impacts on analytical skills rather than language learning skills. Nevertheless, some studies have displayed only a moderate correlation between learners' intelligence and their language learning capabilities (Biedroń & Pawlak, 2016). With the rise of the Multiple Intelligence Theory, Gregersen, MacIntyre, and Meza (2014) claimed that individuals who enjoy a higher level of verbal-linguistic intelligence are believed to think in words more than others and this helps them to apply both written and spoken language more efficiently.

According to Cattell (1978) who introduced the Fluid and Crystallized Intelligence Theory, students who are equipped with Fluid and Crystallized intelligence might be more successful in language learning. Fluid intelligence (Gf), known as General Factor for intelligence, was characterized as the capacity to reason and take care of new issues and troubles autonomously by recently obtained information. On the other hand, Crystallized memory is another type of intelligence that is required for instructive tasks and can be characterized as the data retained and fixated in the memory and should be restored instantly. According to Cattell (1978), Crystallized Intelligence in psychology is considered as an indication of general cognitive skills and relies on the acquired knowledge and information added to the memory. Crystallized Intelligence remains stable during life, i.e., adults are better at defining words and answering questions that rely on general world knowledge, detecting spelling errors, and carrying out skills related to jobs they have held for many years (Horn & Donaldson, 1976).

2.2.1 C-Test

The C-Test is a variation of the cloze test, an integrative test suggested as an overall measure of general language proficiency (Oller, 1979). The history of the C-Test and its predecessor, the cloze test, as intelligence tests goes back to the late 19th century when the school board of Breslau assigned German psychologist Hermann Ebbinghaus (1987) to the task of developing some mental tests to find out the best time of study for school children (Hoffman, Bringmann, Bamberg, & Klein, 1987). He developed a sort of text completion test that he named Combinationsgabe, which is translated as the 'combination test' in English (Carroll, 1982). The test was similar to a modern cloze test or C-Test and was used to study the effect of fatigue on children's school performance. Ebbinghaus found that there were strong relations between children's scores on the completion test and their groupings based on class standing and teachers' ratings of brightness. Statistical methods of correlation to compute the exact coefficients and the strength of the associations were not available to him at the time (Carroll, 1993).

According to Terman (1909), Ebbinghaus considered his Combinationsgabe a reliable measure of intellectual ability. Nevertheless, Ebbinghaus is credited as being one of the first to have investigated human intelligence and devised a group intelligence test (Carroll, 1993). The completion test was reported to be an excellent test of general intelligence with a corrected loading of 0.97 (Ackerman, Beier, & Bowen, 2000). The method continues to be used in many modern-day intelligence and achievement tests. Accordingly, Baghaei and Tabatabaee (2015) asserted that the modern C-Test is a very close variation of Ebbinghaus's method and can be used as a measure of crystallized intelligence.

3. Methodology

3.1 Study Design

This study is done through a quantitative correlational research design. It is considered as quantitative since the study aimed at collecting and analyzing numeric data to explain and predict an outcome. And the study is a correlational one since its purpose is to find out the relationship between Iranian EFL learners' mental lexicon and their crystallized intelligence.

3.2 Participants

The acceptable number of participants for different statistical analyses depends on different factors such as power and probability level. A typical research study should have a significance level of 5%, an effect size of 50%, and statistical power of 80% (Hair, Hult, Ringle, & Sarstedt, 2014). Accordingly, the minimum required total sample size for a two-tailed correlational study, given the probability level of 0.05, the effect size (Cohen's d) of 0.5, and

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

the power level of 0.8, based on G-power (Faul, Erdfelder, Lang, & Buchner, 2007), would be 31. However, in this study, about 80 EFL learners of both genders (male=47.5%, female=52.5%) in different age groups (mean=16, SD=2.43) were selected through convenience sampling as the participants of the study. They are EFL learners who study English as a foreign language in different English language institutes.

3.3 Instruments and Materials

3.3.1 Word Associates Test (WAT)

In the first phase of data collection, Lex30 (Meara & Fitzpatrick, 2000) was used as a word association task (WAT). The Lex30 provided testees with a list of 30 stimulus words and required them to produce responses to these words. Since the test is developed to administer across a wide range of proficiency levels, all the words are deliberately selected from the high frequent Nation's first 1000 wordlist (Nation, 1984).

3.3.2 C-test

The second instrument that helps to assess learners' crystallized intelligence was a C-test. The C-test, which is a text completion test and a variation of the cloze test, is an integrative test suggested as a measure of crystallized intelligence (Baghaei & Tabatabaee, 2015; Oller, 1979). To fulfill the purpose of the study, Baghaei's (2011) C-test was used. This test consists of four short passages of 100 words with a total of 25 deleted blanks in each passage.

3.4 Procedure

This correlational study collected quantitative data through two different tests using an online platform (Adobe connect). To answer the WAT test, learners were asked to write a series of response words (at least three) for each stimulus word. Stimulus words were presented one at a time, and testees had 30 seconds to respond to each word. The entire test, therefore, took 15 min to be completed (Fitzpatrick & Meara, 2000). Due to the spread of the coronavirus, the process was done electronically through Adobe connect and using Google Forms. To score the WAT test, each testee's response was sorted according to the criteria described by Bauer and Nation (1993).

According to them, participants' responses are categorized based on four levels. Level 0 words (the high-frequency structure words, proper names, and numbers) and level 1 words (the 1000 most frequent content words in English) are scored as zero points. Any response which falls outside these two categories scores one point. However, words with affixes included in level 2 (Inflectional Suffixes) and level 3 (Most frequent and regular derivational affixes) are treated as instances of their base form (meaning that just the base morpheme is scored and affixes are ignored). For example, UNHAPPINESS contains two level 3 affixes, UN- and -NESS, and is scored as just HAPPY. HAPPY is a level 1 word, and therefore, UNHAPPINESS scores zero points. However, words with affixes that do not appear in these two levels were treated as separate words. For example, LAUGHABLE contains an affix -ABLE which is not included in the level 2 or level 3 lists. Thus, LAUGHABLE is not scored as just LAUGH, and although LAUGH is a level 1 word, LAUGHABLE is not, so it scores one point for the testee.

To assess learners' crystallized intelligence, the C-test (Baghaei, 2011) is distributed electronically through the Google Form link shared in Adobe connect platform. Participants had 20 minutes to complete the gaps. The exact word method (one for the correct answer, and zero for the wrong answer) was used to score the test.

3.5 Data Analysis

To analyze the data SPSS software (version24) was used. First, the demographic information of the participants was checked and summarized. After checking the psychometric properties of the scale such as normality and reliability, Pearson product-moment correlation was run to answer the first research question. Questions number two and three were measured by running an independent-sample t-test.

4. Results

The mental lexicon is a significant part of human intelligence as highlighted by the fact that vocabulary is almost always found to be the most important part of general intelligence compared to other tests of cognitive function (Johnson et al., 2004; Kan et al., 2013). Furthermore, the lexical ability is a strong predictor of academic performance at different educational levels (Pluck, 2019), suggesting a broad role in intelligent behavior.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Accordingly, crystallized intelligence is defined as the assimilated verbal information that is acquired through experience and in particular education (Kan et al., 2013). Consequently, crystallized intelligence refers to the ability to employ skills and knowledge acquired in prior learning and by remembering pre-existing information as well as skills (Horn, 1969).

Therefore, the present study is an attempt to develop the current understanding of the possible correlational role that crystallized intelligence may have in the Iranian EFL learner's mental lexicon. To this aim and to check the normality of data distribution, first, the Kolmogorov-Smirnov test was employed. The obtained sig value for both variables was higher than .05. Therefore, it can safely be concluded that the data are normally distributed across both variables.

Table 1 presents descriptive statistics of variables of the study (learners' crystallized intelligence and their mental lexicon) including the mean, standard deviation, maximum and minimum scores. The first column of the table shows that 80 students participated in the present study. As the Table indicates, the mean score of the overall mental lexicon is 52.51 with a standard deviation of 16.62. In addition, the mean score of overall crystallized intelligence is 71.04 with a standard deviation of 11.20.

Table 1. Descriptive statistics of variables of the study

	N	Minimum	Maximum	Mean	Std. Deviation
Mental Lexicon	80	21	95	52.51	16.62
Crystallized Intelligence	80	44	95	71.04	11.20

To answer the first research question which aims to find the relationship between Iranian EFL learners' crystallized intelligence and their mental lexicon, Pearson-product-moment correlation was used. The results (Table 2) showed that there is a positive significant relationship between overall Mental Lexicon and Crystallized Intelligence (r=.60, p<.05). Therefore, the first null hypothesis was rejected.

Table 2. Results of Pearson Correlation

		Crystallized Intelligence
Mental Lexicon	Pearson Correlation	.608**
	Sig. (2-tailed)	.000
	N	80

**Correlation is significant at the level of 0.01

To answer the second and third research questions aiming at examining whether learners' mental lexicon and crystallized intelligence differ significantly between genders, an independent-samples t-test was performed. As indicated in Table 3, there is no significant difference in the level of EFL students' Mental Lexicon (t=.44, P>.05) between male (mean= 53.39) and female (mean= 51.71) students. Besides, there is no significant difference in the level of EFL students' Crystallized Intelligence (t=-.24, P>.05) between male (mean= 70.71) and female (mean= 71.33) students. Thus, both the second and third research hypotheses were accepted.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Table 3. Results of the Independent-Samples T-Test for gender difference in mental lexicon

	t-test for Equality of Means				
	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference
Mental Lexicon	.44	78	.65	1.68	3.74
Crystallized Intelligence	-.24	78	.80	-.62	2.52

5. Discussion

The results of this study showed that there is a positive significant relationship between overall Mental Lexicon and Crystallized Intelligence which is in line with Wolter (2002) who designed a word association test to assess language proficiency and showed that a word association test can function as a means of assessing proficiency. Moreover, Alibabaee and Khazaeenezhad (2013) had an investigation to gain insight into the mental lexicon of L2 learners, with a focus on Iranian EFL learners. Generally, the findings of that study demonstrated that the mental lexicon of second language learners is highly organized. The results of this study have revealed that as L2 learners acquire more vocabulary knowledge during the language learning process and become more proficient, their responses in word association tests incline to paradigmatic relations and this paradigmatically dominant mental lexicon in the case of non-native speakers reflects the role of proficiency in association behavior of Iranian EFL learners.

Besides, Benmalek (2020), who aimed at exploring the effect of using word association tests on English foreign language learners' mental lexicon, revealed that word association tests can help learners to improve their vocabulary competency in an easy and entertaining way, and words are meaningfully connected in the mental lexicon and should be taught accordingly. In contrast with the present study Tajeddin and Chiniforoushan (2011) presented evidence to suggest the use of visual intelligence to improve L2 learners' lexical acquisition. The results ascertained that there was no significant correlation between learners' visual intelligence and their vocabulary reception and production.

The study's findings also showed that there is no significant difference between males and females in their overall Mental Lexicon which is in line with Mehrpour, Razmjoo, and Kian (2011) who studied the effect of gender on the learners' reading comprehension performance and vocabulary knowledge using a word association test. The results revealed that gender differences do not play a role in the learners' vocabulary knowledge and reading comprehension performance. Moreover, Kaufman et al. (2009) found that there is no significant difference between males and females emerged for reading, a measure of both word recognition and reading comprehension which can be known as the mental lexicon.

In contrast with the result of the study, Kaushanskaya et al. (2013) examined whether similar gender differences would be obtained in children, and tested whether semantic, as well as phonological familiarity effects in learning, would be sensitive to gender differences. Their findings suggest three noteworthy patterns. First, gender differences in word learning can be observed in children as young as 5–7 years of age. Second, girls outperform boys on word-learning tasks only when these involve learning familiar information. That is, the female advantage on word-learning tasks is constrained to situations where long-term knowledge of the language can support learning. And third, phonological and semantic familiarity effects appear to be stronger in girls than in boys.

The third question's results of this study showed that there is not any significant difference between males and females concerning Crystallized Intelligence which is in line with Kaufman et al. (2009) who proved that in contrast to the significant gender differences in math and writing, no significant difference between men and women emerged for reading comprehension as a measure of crystallized intelligence. Besides, Wechsler et al. (2014) attempted to investigate whether there were gender differences in crystallized intelligence that could be observed through tests of verbal ability. The analysis revealed no significant differences, thus demonstrating that gender does not influence crystallized intelligence. In contrast with the result of this study, Catalan (2003) reported sex differences in L2 vocabulary learning. Moreover, Steinmayr, Beauducel, and Spinath (2010) proved

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

that males scored significantly higher on the factor score estimates for fluid and crystallized intelligence as well as on numerical and figural intelligence. Females scored significantly higher on verbal intelligence.

6. Conclusion

In light of the learners' beliefs, all learners irrespective of their different learning environments place a high value on the role of vocabulary knowledge in English language learning and report high motivation to learn vocabulary (Cameron, 2001). Lexical knowledge that represents the mental lexicon is central to communicative competence and the acquisition of a second/foreign language and a lack of vocabulary knowledge is a drawback to learning. Accordingly, EFL learners are different in their needs, learning styles, etc. Therefore, before presenting the form or meaning of vocabulary items, teachers need to be aware of the type of vocabulary, the students' levels, age, level of education, characteristics, and intelligence. Besides, it has been demonstrated that words that share substantial phonological, semantic, and orthographic overlap with a known language are more easily learned than those that do not (Ringbom & Jarvis, 2009). Thus, students can merge this practice into their daily classroom routine. Lexicon can also shift over time.

Therefore, teachers have to acquire essential skills to put on the best approaches to teaching new vocabulary since better vocabulary acquisition causes a better structured mental lexicon which correlates significantly with learners' crystallized intelligence and their language proficiency. Thus, to conclude, this research can raise both learners' and teachers' awareness of the association and the significant correlation between learners' mental lexicon and crystallized intelligence. One of the most important implications of this study is for syllabus designers to put more focus on curriculum development regarding the way vocabulary is going to be learned or taught. Supervisors can also design their curriculum in a way that pays more attention to vocabulary learning and better language learning by providing facilities and instructional materials to support, activate, and motivate both teachers' and students' vocabulary learning and their intelligence.

References

Ackerman, P. L., Beier, M. E., & Bowen, K. R. (2000). Explorations of crystallized intelligence: Completion tests, cloze tests, and knowledge. *Learning and Individual Differences, 12*(1), 105–121. https://doi.org/10.1016/S1041-6080(00)00034-0

Aitchison, J. (2012). *Words in the mind: An introduction to the mental lexicon*. John Wiley & Sons.

Khazaeenezhad, B., & Alibabaee, A. (2013). Investigating the role of L2 language proficiency in word association behavior of L2 learners: A case of Iranian EFL learners. *Theory and Practice in Language Studies, 3*(1), 108-115. https://www.academypublication.com/issues/past/tpls/vol03/01/16.pdf

Baghaei, P. (2011). Optimal number of gaps in c-test passages. *International Education Studies*, *4*(1), 166-171. http://dx.doi.org/10.5539/ies.v4n1p166

Baghaei, P., & Tabatabaee, M. (2015). The C-test: An integrative measure of crystallized intelligence. *J. Intell, 3*(2), 46-58. http://dx.doi.org/10.3390/jintelligence3020046

Banks, B., Gowen, E., Munro, K. J., & Adank, P. (2015). Cognitive predictors of perceptual adaptation to accented speech. *The Journal of the Acoustical Society of America, 137*(4), 2015-2024. http://dx.doi.org/10.1121/1.4916265

Bauer, L., & Nation, I. S. P. (1993). Word families. *International Journal of Lexicography*, *6*(4), 253-279. http://dx.doi.org/10.1093/ijl/6.4.253

Benmalek, A. (2020). *Exploring the effect of using word association tests on English foreign language learners' mental lexicon* (Master thesis). Department of Foreign Languages, University of Biskra.

Biedroń, A., & Pawlak, M. (2016). The interface between research on individual difference variables and teaching practice: The case of cognitive factors and personality. *Studies in Second Language Learning and Teaching*, *6*(3), 395-422. http://dx.doi.org/10.14746/sllt.2016.6.3.3

Blumstein, S. E. (2022). Words, words, and more words: The mental lexicon. In *When words betray us* (pp. 41-54). Springer, Cham.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Boddaert, G., Cornut, C., & Casalis, S. (2021). Integration of newly learned L2 words into the mental lexicon is modulated by vocabulary learning method. *Acta Psychologica*, *212*, 103220. https://doi.org/10.1016/j.actpsy.2020.103220

Bonin, P. (2004). *Mental lexicon: Some words to talk about words*. New York: Nova Science Publishers.

Brown, D. (2006). *Vocabulary activities to enhance your textbook*. Paper presented at annual conference of the Japanese Association of Language Teaching (JALT), Shizuoka.

Brysbaert, M., Stevens, M., Mandera, P., & Keuleers, E. (2016). How many words do we know? Practical estimates of vocabulary size dependent on word definition, the degree of language input and the participant's age. *Frontiers in Psychology, 7,* 1116. http://dx.doi.org/10.3389/fpsyg.2016.01116

Cameron, L. (2001). *Teaching languages to young learners.* Cambridge: Cambridge University Press.

Carroll, J. B. (1982). *The measurement of intelligence*. In R. J Sternberg (Ed.), In *Handbook of human intelligence* (pp. 29–120). Cambridge, UK: Cambridge University Press.

Carroll, J. B. (1993). *Human cognitive abilities: A survey of factor-analytic studies* (No. 1). Cambridge University Press.

Catalan, R. M. J. (2003). Sex differences in L2 vocabulary learning strategies. *International Journal of Applied Linguistics, 13*(1), 54-77. http://dx.doi.org/10.1111/1473-4192.00037

Cattell, R. B. (1963). Theory of fluid and crystallized intelligence: A critical experiment. *Journal of Educational Psychology, 54*(1), 1–22. http://dx.doi.org/10.1037/h0046743

Cattell, R. B. (1967). The theory of fluid and crystallized general intelligence checked at the 5–6-year-old level. *British Journal of Educational Psychology, 37*(2), 209-224. http://dx.doi.org/10.1111/j.2044-8279.1967.tb01930.x

Cattell, R. B. (1973). *Cattell culture fair intelligence tests.* Champaign, IL: Institute for Personality and Ability Testing.

Cattell, R. B. (1978). A check on the theory of fluid and crystallized intelligence with description of new subtest designs. *Journal of Educational Measurement*, *15*(3), 139-164. http://dx.doi.org/10.1111/j.1745-3984.1978.tb00065.x

de Bot, K., Lowie, W., & Verspoor, M. (2005). *Second language acquisition: an advanced resource book*. (1st ed.). Oxon: Routledge.

Dewaele, J. M., Petrides, K. V., & Furnham, A. (2008). Effects of trait emotional intelligence and sociobiographical Variables on communicative anxiety and foreign language anxiety among adult multilinguals: A review and empirical investigation. *Language Learning, 58*(4), 911–960. http://dx.doi.org/10.1111/j.1467-9922.2008.00482.x

Entwisle, D. R., Forsyth, D. F., & Muuss, R. (1964). The syntactic-paradigmatic shift in children's word associations. *Journal of Verbal Learning and Verbal Behavior, 3*(1), 19–29. http://dx.doi.org/10.1016/S0022-5371(64)80055-4

Ervin, S. M. (1961). Changes with age in the verbal determinants of word-association. *The American Journal of Psychology, 74*(3), 361–372. http://dx.doi.org/10.2307/1419742

Faul, F., Erdfelder, E., Lang, A. G., & Buchner, A. (2007). G* Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior research methods*, *39*(2), 175-191. http://dx.doi.org/10.3758/BF03193146

Fitzpartick, T., & Meara, P. (2000), *Lex30: An improved method of assessing productive vocabulary in an L2 for applied language studies*. University of Wales Swansea, UK.

Galton, F. (1879). Psychometric experiments. *Brain, 2*(2), 149–162. http://dx.doi.org/10.1093/brain/2.2.149

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Gardner, R. C., Lalonde, R. N., & Moorcroft, R. (1985). The role of attitudes and motivation in second language learning: Correlational and experimental considerations. *Language Learning, 35*(2), 207–227. http://dx.doi.org/10.1111/j.1467-1770.1985.tb01025.x

Gathercole, S. E., Willis, C., & Baddeley, A. D. (1991). Differentiating phonological memory and awareness of rhyme: Reading and vocabulary development in children. *British Journal of Psychology*, *82*(3), 387-406. http://dx.doi.org/10.1111/j.2044-8295.1991.tb02407.x

Gregersen, T., Macintyre, P. D., & Meza, M. D. (2014). The motion of emotion: Idiodynamic case studies of learners' foreign language anxiety. *The Modern Language Journal*, *98*(2), 574-588. http://dx.doi.org/10.1111/modl.12084

Hair, J. F., Hult, G. T. M., Ringle, C. M., & Sarstedt, M. (2014*), A primer on partial least squares structural equation modeling.* Sage, Thousand Oaks, CA.

Hampshire, A., Highfield, R. R., Parkin, B. L., & Owen, A. M. (2012). Fractionating human intelligence. *Neuron, 76*(6), 1225-1237. http://dx.doi.org/10.1016/j.neuron.2012.06.022

Henia, S. (2020). L2 Proficiency, Word association and interlingual mediation among Tunisian M.A students of English. *International Journal of Humanities And Cultural Studies*, *7*(1), 121-142.

Hoffman, R. R., Bringmann, W., Bamberg, M., & Klein, R. (1987). Some historical observations on Ebbinghaus. In D.S. Gorfein & R.R. Hoffman (Eds.). *In memory and learning: The Ebbinghaus Centennial Conference* (pp. 57–76). NJ, USA: Lawrence Erlbaum: Hillsdale.

Hopp, H. (2018). The bilingual mental lexicon in L2 sentence processing. *Second Language*, *17*, 5-27. https://doi.org/10.11431/secondlanguage.17.0_5

Horn, J. L. (1969). Intelligence: Why it grows. Why it declines. *Trans-action, 4*(5), 23-31. http://dx.doi.org/10.1007/BF03180091

Horn, J. L., & Donaldson, G. (1976). On the myth of intellectual decline in adulthood. *American Psychologist*, *31*(10), 701-719. http://dx.doi.org/10.1037/0003-066X.31.10.701

Johnson, W., Bouchard Jr, T. J., Krueger, R. F., McGue, M., & Gottesman, I. I. (2004). Just one g: Consistent results from three test batteries. *Intelligence, 32*(1), 95-107. http://dx.doi.org/10.1016/S0160-2896(03)00062-X

Jung, C. G. (1910). The association method. *American Journal of Psychology, 21*(2), 219–269. http://dx.doi.org/10.2307/1413002

Kan, K. J., Wicherts, J. M., Dolan, C. V., & van der Maas, H. L. (2013). On the nature and nurture of intelligence and specific cognitive abilities: The more heritable, the more culture dependent. *Psychological Science, 24*(12), 2420-2428. http://dx.doi.org/10.1177/0956797613493292

Kaufman, A., Kaufman, J. C., Liu, X., & Johnson, C. K. (2009). How do educational attainment and gender relate to fluid intelligence, crystallized intelligence, and academic skills at ages 22–90 years? *Archives of Clinical Neuropsychology*, *24*(2), 153–163. http://dx.doi.org/10.1093/arclin/acp015

Kaushanskaya, M., Gross, M., & Buac, M. (2013). Gender differences in child word learning. *Learning and Individual Differences*, *27*(1), 82–89. http://dx.doi.org/10.1016/j.lindif.2013.07.002

Laufer, B., & Hulstijn, J. (2001). Incidental vocabulary acquisition in a second language: The construct of task-induced involvement. *Applied Linguistics, 22*(1), 1-26. http://dx.doi.org/10.1093/applin/22.1.1

MacIntyre, P. (2002). Individual differences and instructed language learning. In P. Robinson (Ed.), *Motivation, anxiety and emotion in second language acquisition*. New York, NY: John Benjamins Publishing Company.

MacIntyre, P., & Gregersen, T. (2012). *Affect: The role of language anxiety and other emotions in language learning in psychology for language learning*. Edited by Mercer Sarah, Ryan Stephen and Williams Marion. London: Palgrave Macmillan, pp. 103–18.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

McCarthy, M. (1990). *Vocabulary.* Oxford: Oxford University Press.

Mehrpour, M., Razmjoo, A., & Kian, P. (2011). The relationship between depth and breadth of vocabulary knowledge and reading comprehension among Iranian EFL learners. *Journal of English Language Teaching and Learning, 2*(222), 97-127. https://journals.tabrizu.ac.ir/article_635_fab1c9e8728137f413c8c18a4db48906.pdf

Meara, P. M. (1982). *Vocabulary in a second language* (Vol. 1). Specialised Bibliography 4, London: CILT.

Meara, P. M. (1996). *The vocabulary knowledge framework.* Unpublished discussion paper available at https://www.lognostics.co.uk/vlibrary/meara1996c.pdf

Meara, P. M., & Fitzpatrick, T. (2000). Lex30: An improved method of assessing productive vocabulary in an L2. *System, 28*(1), 19-130. https://doi.org/10.1016/S0346-251X(99)00058-5

Mercer, S., & Ryan, S. (2016). Stretching the boundaries: Language learning psychology. *Palgrave Communications*, *2*(1), 1-5. http://dx.doi.org/10.1057/palcomms.2016.31

Nation, I. S. P. (1984). *Vocabulary lists*. Victoria University of Wellington, English Language Institute, Wellington, New Zealand.

Oller, J. W. J. (1979*). Language tests at school.* Longman: London, UK.

Oxford, R., Cho, Y., Leung, S., & Kim, H. J. (2004). Effect of the presence and difficulty of task on strategy use: An exploratory study. *IRAL—International Review of Applied Linguistics in Language Teaching, 42*(1), 1–47. http://dx.doi.org/10.1515/iral.2004.001

Peters, E. (2019). *Factors affecting the learning of single-word items in the Routledge handbook of vocabulary studies*. Edited by Webb Stuart. New York: Routledge.

Pichette, F., de Serres, L., & Lafontaine, M. (2012). Sentence reading and writing for second language vocabulary acquisition. *Applied Linguistics, 33*(1), 66–82. http://dx.doi.org/10.1093/applin/amr037

Pluck, G. (2019). Preliminary validation of a free-to-use, brief assessment of adult intelligence for research purposes: The matrix matching test. *Psychological Reports, 122*(2), 709-730. http://dx.doi.org/10.1177/0033294118762589

Pranoto, B. E., & Afrilita, L. K. (2019). The organization of words in mental lexicon: evidence from word association test. *Teknosastik*, *16*(1), 26-33. https://www.researchgate.net/publication/340052491_The_Organization_of_Words_in_Mental_Lexicon_Evidence_from_Word_Association_Test

Puimège, E., & Peters, E. (2019). Learners' English vocabulary knowledge prior to formal instruction: The role of learner-related and word-related variables. *Language Learning, 69*(4), 943–977. http://dx.doi.org/10.1111/lang.12364

Randall, M. (2007). *Memory, psychology and second language learning*. Amsterdam: John Benjamin Publishing Co.

Read, J. (1993). The development of a new measure of L2 vocabulary knowledge. *Language Testing, 10*(3), 355–371. http://dx.doi.org/10.1177/026553229301000308

Richards, J. C. (1976). The role of vocabulary teaching. *TESOL Quarterly, 10*(1), 77-89. https://www.scirp.org/%28S%28vtj3fa45qm1ean45vvffcz55%29%29/reference/referencespapers.aspx?referenceid=2949368

Richards, J. C., & Schmidt, R. (Eds.). (2002). *Longman dictionary of language teaching and applied linguistics* (3rd ed.). London: Longman.

Ringbom, H., & Jarvis, S. (2009). *The importance of cross-linguistic similarity in foreign language learning in the handbook of language teaching*. Edited by Long Michael H. and Doughty Catherine J. Madden: Wiley-Blackwell, pp. 106–18.

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Rodríguez-Aranda, C., & Jakobsen, M. (2011). Differential contributions of cognitive and psychomotor functions to the age-related slowing of speech production. *Journal of the International Neuropsychological Society, 17*(5), 807-821. http://dx.doi.org/10.1017/S1355617711000828

Roux, W, P. (2013). Words in the mind: Exploring the relationship between word association and lexical development. *Polyglossia, 24*(8), 80-90. https://www.researchgate.net/publication/265294911_Words_in_the_Mind_Exploring_the_relationship_between_word_association_and_lexical_development

Schmitt, N. (1998). Tracking the incremental acquisition of second language vocabulary: A longitudinal study. *Language Learning, 48*(2), 281–317. http://dx.doi.org/10.1111/1467-9922.00042

Schmitt, N. (2008). Review article: Instructed second language vocabulary learning. *Language Teaching Research*, *12*(3), 329–363. http://dx.doi.org/10.1177/1362168808089921

Söderman, T. (1993). Word associations of foreign language learners and native speakers – different response types and their relevance to lexical development. In B. Hammarberg (Ed.), *Problem, process, product in language learning: Papers from the Stockholm-Abo Conference,* 21–22 October 1992, Stockholm, Sweden.

Sökmen, A. (1993). Word association results: A window to the lexicons of ESL students. *JALT Journal, 15*(2), 135–150. https://jalt-publications.org/files/pdf-article/jj-15.2-art1.pdf

Sousa, L., & Gabriel, R. (2015). Does the mental lexicon exist? *Revista De Estudos Da Linguagem, 23*(2), 335-361. http://dx.doi.org/10.17851/2237-2083.23.2.335-361

Steinmayr, R., Beauducel, A., & Spinath, B. (2010). Do sex differences in a faceted model of fluid and crystallized intelligence depend on the method applied? *Intelligence, 38*(1), 101-110. http://dx.doi.org/10.1016/j.intell.2009.08.001

Tajeddin, Z., & Chiniforoushan, N. (2011). Visual intelligence and lexical enhancement task: Their impacts on EFL learners' receptive and productive vocabulary. *Journal of Asia TEFL, 8*(3), 109-134. file:///C:/Users/SMA/Downloads/AsiaTEFL_V8_N3_Autumn_2011_Visual_Intelligence_and_Lexical_Enhancement_Tasks_Their_Impacts_on_EFL_Learners_Receptive_and_Productive_Vocabulary.pdf

Terman, L. M. (1906). Genius and stupidity. *Pedagogical Seminary*, *13*(7), 307–373. http://dx.doi.org/10.1080/08919402.1906.10534367

Treisman, A. M. (1960). The effects of redundancy and familiarity on translating and repeating back a foreign and a native language. *British Journal of Psychology*, *56*(4), 369-379. http://dx.doi.org/10.1111/j.2044-8295.1965.tb00979.x

Wechsler, S., Cassia Nakano, T., Domingues, S., Rinaldi Rosa, H., Ferreira da Silva, R., da Silva-Filho, J., & Moita Minervino, C. (2014). Gender differences on tests of crystallized intelligence. *European Journal of Education and Psychology, 7*(1), 59-72. http://dx.doi.org/10.30552/ejep.v7i1.98

Wilkins, D. A. (1972). *Linguistics in language teaching*. Australia: Edward Arnold.

Wolter, B. (2001). Comparing the L1 and L2 mental lexicon: A depth of individual word knowledge model. *Studies in Second Language Acquisition, 23*(1), 41–69. http://dx.doi.org/10.1017/S0272263101001024

Wolter, B. (2002). Assessing proficiency through word associations: Is there still hope? *System, 30*(3), 315–329. http://dx.doi.org/10.1016/S0346-251X(02)00017-9

Xiang, L., & Nam, H. (2022). L1 mediation in Chinese English learners' mental lexicon: Evidence from word association tests. *Language Teaching Research*, 13621688211066017. http://dx.doi.org/10.1177/13621688211066017

Xinnian, L. (2021). Types of word association in L2 mental lexicon of Chinese EFL learners. *현대영어영문학*, *65*(1), 331-351. https://doi.org/10.17754/MESK.65.1.331

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]

Yap, M. J., Balota, D. A., Sibley, D. E., & Ratcliff, R. (2012). Individual differences in visual word recognition: Insights from the English Lexicon Project. *Journal of Experimental Psychology: Human Perception and Performance, 38*(1), 53-79. http://dx.doi.org/10.1037/a0024177

[Downloaded from ijreeonline.com on 2026-11-22]

[DOR: 20.1001.1.25384015.2023.8.1.2.8]