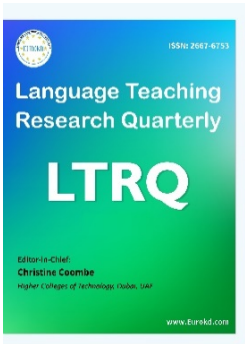

Language Teaching Research Quarterly

2024, Vol. 40, 46–60

Investigating the EFL Learners' Visual Word Recognition: Words' Frequency, Length, Regularity and Superiority Effects in Comparison

Zahra Neshatian, Mohammad Saber Khaghaninejad*

Department of Foreign Languages and Linguistics, Shiraz University, Shiraz, Iran

Received *26 August 2023* ***Accepted*** *27 November 2023*

Abstract

This study scrutinized the effects of words' superiority, regularity, frequency and length on the intermediate and advanced EFL learner's visual word recognition. Moreover, it attempted to check whether each of these parameters could be statistically a significant predictor on recognition tasks. Accordingly, 118 intermediate and 127 advanced adult EFL learners were selected randomly from English Language Institutes based on their performance on the McMillan Placement Test (MPT). The needed data was collected through a developed Visual Word Recognition Test (WORT) and the Peabody Picture Vocabulary Test (PPVT). The findings indicated that all the mentioned factors significantly affected both the intermediate and the advanced EFL learners' overall word recognition by varying degrees (words' frequency, length, superiority and regularity, respectively), however, the advanced learners' recognition was generally faster on both recognition tests. Moreover, words' regularity was found to play a more effective role for the intermediates than the advanced learners on recognition tasks. Furthermore, words' frequency, regularity and length were found to be proper predictors on comprehension tasks.

Keywords: *Visual Word Recognition, Word's Frequency Effect, Word's Length Effect, Word's Regularity Effect, Word's Superiority Effect, Word Comprehension Tasks*

Introduction

Word recognition, as one of the cognitive comprehension processes, is broadly recognized as the most determining activity involved in reading tasks; the most important, most studied, and yet most controversial issue in the field of reading comprehension (Han, 2015). Many studies have documented that fluent reading is impossible without precise and quick word identification (e.g., Ertürk, 2016; Stanovich, 2000) and many studies have focused on studying the possible factors modulating the process of word recognition (the studies which

* Corresponding author.
E-mail address: mskhaghani@shirazu.ac.ir https://doi.org/10.32038/ltrq.2024.40.03

focused on the words' frequency, regularity, length, orthographic consistency and, the age of acquisition and auditory/semantic neighbors) but still disagreements exist about the words' recognition as a complex, multi-stage and neural-based process (Davis, 2004; Jobard et al., 2003; Mechelli et al., 2003; Tamimy et al., 2022).

Recently, researchers have shown interest to detect various effective parameters on visual word recognition (VWR) and their impact sizes (Brysbaert et al., 2020). In contrast to the traditional claims about the whole-word analyses and recognition (e.g., Cattell, 1886), modern theories have documented the impacts of words' physical characteristics on the quality and the speed of VWR (Rayner, 2009; Yap et al. 2009).

Although Ouellette and Fraser (2009) demonstrated that providing the learners with semantic information would enhance learners' ability to recognize words more accurately than presenting words in isolation, seemingly, the words' frequency, regularity, length and superiority play roles for their recognition based on the literature (e.g., Grainger, 1990; Perfetti, 2017; Rayner, 2009). Regarding VWR although there have been numerous theoretical developments and empirical documentations (Yap & Balota, 2015), yet there exist many inconsistent findings particularly in EFL context (Andrews, 2006). Consequently, this study aimed at investigating the possible effects of word-frequency, word-length, word-superiority and word-regularity on the EFL learners' VWR. Moreover, the study has examined if the English proficiency of EFL learners plays a role in this respect.

As one of the first endeavors which focused on a set of possibly influential factors for the VWR of EFL learners with different language proficiency levels, this study attempted to respond to the following questions:

RQ_1: Do the English words' superiority, regularity, frequency and length significantly affect the EFL learners' visual word recognition? If yes, what is their order of effectiveness?

RQ_2: Can the English words' superiority, regularity, frequency and length be the predictors of words' comprehension for EFL learners?

RQ_3: How is the visual word recognition of intermediate and advanced EFL learners affected by the English words' superiority, regularity, frequency and length effects?

Literature Review

Word recognition, as a fundamental skill acquired during language learning, refers to the ability to identify lexical units. This involves matching a perceived stimulus to the representation in a learner's lexicon (Libben & Titone, 2009). Recent research has explored how the lexicon is accessed to determine whether this process relies on literal analysis or whether words are perceived as holistic patterns (Grainger & Dufau, 2012).

VWR is a dynamic field with significant theoretical developments and a substantial body of empirical studies (Yap & Balota, 2015). Empirical research in this area has extensively studied the influence of contextual, lexical, and semantic properties (Brysbaert & New, 2009; Khaghaninejad et al., 2021; Pexman, 2012). Recent approaches also consider the role of individual differences in the word recognition process, such as vocabulary knowledge, reading disabilities and even learning styles (David & Metsala, 2015; Joy & Kolb, 2009).

To gain a deeper understanding of the processes underlying VWR, researchers investigated how different characteristics, such as words' frequency, length and regularity, affected the learners' performance in recognition tasks (Roivainen, 2013). Various aspects of

words play a role in recognition, as indicated by studies examining words' characteristics. According to Perfetti (2017), word recognition predictors can be categorized into form, meaning, and exposure-related characteristics.

However, the findings about the possible effects of physical characteristics of words on their recognition are not very consistent; Sears et al. (2008) focusing on the positive role of extensive reading, asserted that learners who have low exposure to printed texts have a lower level of orthographic processing ability compared to those with a higher level of print exposure and this leads to their inefficient word recognition. Dehaene and Cohen (2011) revealed no effect of words' frequency on the activation of the words. Barber and Kutas (2007) concluded that linear effect of word length is well-established in the context of behavioral studies which have showed that long compared with short words substantially increase participants response times (i.e., in naming and lexical decision tasks) and viewing times. And Nation and Cocksey (2009) concluded that learner's familiarity with the phonological form of a lexical item can predict the ability to recognize the word. Most of the studies documented that a semantic analysis stage exists in the VWR process, however, the major theories of VWR claim that recognition is completed when a unique representation in the orthographic lexicon reaches a significant level of activation (e.g., Brysbaert et al., 2020).

Studies indicated a quadratic effect of word length on VWR latencies in adults and children (Schröter & Schroeder, 2018). Moreover, orthographic neighbors influence the pace of word recognition (Yap et al., 2012). Dutch studies show faster processing for words with shorter distances to the nearest neighbors (Brysbaert et al., 2018). Moreover, Van den Boer et al. (2012) found inhibitory effects of high-frequency neighbors on naming latency, especially for beginning and dyslexic readers. Exposure-related measures, such as word frequency, significantly predict word recognition. High-frequency words are recognized faster and by more individuals than low-frequency ones (Brysbaert et al., 2018). The impact of word frequency on recognition varies with age, being stronger for young readers than for adults (Davies et al., 2017).

Numerous scholars have explored the influence of word recognition on text comprehension. For example, Dong et al. (2020) conducted a meta-analysis to examine the relationship between word knowledge and text comprehension, revealing that vocabulary knowledge significantly contributed to variance in text comprehension. The importance of word recognition in reading comprehension cannot be underestimated as the "readers" are called extraordinary word recognizers, whether printed words are perceived through orthographic information or they recognized interactively by the activation semantic and phonologic information (Pallathadka, 2023). This is because "when they read, they actually focus visually on nearly all the words (both content and function words) that face in the passage" (Rayner, 2009, p. 23).

In contrast to a considerable number of word recognition studies done in L1 reading context, Mousikou et al. (2017, p. 37) contended that "word recognition, despite its significance, has received scant attention in L2 research". In a study in L2 context, Cain (2006) highlighted that VWR and reading comprehension are highly related, with correlations falling within the range of 0.35 to 0.83, signifying the substantial contribution of word recognition to reading comprehension among L2 learners.

According to the majority of research on L2 acquisition, effective comprehension of L2 texts relies not just on vocabulary size but also on the rate of access to L2 vocabulary. Therefore, L2 learners should allocate considerable time to enhance their fluency (Apisak, 2023; Washburn, 2023). However, studies revealed that for many learners, insufficient word identification skills stand as the primary cause of reading comprehension difficulties (Oslund et al., 2018). Word identification serves as the initial hurdle to comprehension, implying that word reading significantly contributes to text interpretation until a satisfactory level of word reading proficiency is attained (Adebayo et al., 2021; Jiang et al., 2022). Karageorgos et al. (2020) conducted a study to examine how word recognition accuracy can impact the speed of text comprehension among German learners as the second language. The findings underscored the pivotal role of word recognition accuracy in the text comprehension speed among L2 learners.

Much of the research on VWR conducted in laboratory over the last few years has been concerned with the relation between early sensory input and the perception of meaningful linguistic stimuli such as words and sentences; however fewer have addressed the effect of multiple word characteristics on EFL learner's word recognition accuracy and speed all together. Compared with a considerable number of L1 word recognition studies, VWR has only received minimal attention in EFL context. This study has focused on not only the possibly influential factors on word recognition but also attempted to determine and compare these factors' effectiveness for the intermediate and advanced EFL learners' word recognition capacities. Moreover, the prediction potential of these factors was estimated empirically on word recognition tasks.

Method

Participants

245 Iranian EFL learners whose first language was Farsi were selected randomly from the initial pool of the participants from English language institutes based on their scores on the McMillan Placement Test (MPT). Subsequently, 118 intermediate and 127 advanced male and female EFL learners who aged between 18 to 25 years were recruited. All the participants were adults and their consent was sought before the study's commencement.

Materials and Instruments

Firstly, *McMillan Placement Test (MPT)*, was employed to determine the proficiency levels of the participants. Based on their scores, the test takers can be classified from complete beginner to advanced. This test enjoys an acceptable reliability index (93%) which is reported in many studies (e.g., Brybaert et al, 2018; Khodadady et al, 2012).

In order to evaluate the effects of the influential parameters on words' recognition, a *researcher-made visual word recognition test (WORT)* was constructed via a software application (Com-Chron) which provided the learners with four options for each test item. The test included items which were frequent, long, regular, and some are less frequent, short and irregular, there were some non-words as well. The constructed items (100 items in total, 15 for each of the named factors plus 10 non-words), were accommodated into Com-Chron to examine the possible effects of these factors on the intermediate and advanced EFL learners' word recognition. The procedure was like presenting an English vocabulary (including one of

the factors of frequency length, regularity), and then a multiple-choice test item to check the participant's comprehension by selecting a synonym for the target word. The participants had a limited time to react to each item (20 seconds), afterwards, the application would jump to the next item automatically. In order to check the exact influence of the parameters of the study, it was attempted to keep other possible factors constant except for the factor for which the test item was designed for. The target words were chosen from two universally-valid vocabulary websites of "Word.tips" and "7.ESL". Then a pilot study was done on a group of 17 participants and consequently 13 items were either omitted or revised. The reliability of the test was also attested (r = 0.91) which was satisfactory.

For determining the prediction power of the study's parameters in word recognition, a parallel test with identical target words was employed. Due to the fact that *WORT* comprised of the items constructed based on the parameters in question the total score of *WORT* was not promising for determination of the predictive potential of the study's parameters. Hence, *Peabody Picture Vocabulary Test (PPVT),* a universally-accepted visual word recognition test, with the reliability of 0.87, was utilized to assess the participants' general VWR. After 5 preparatory items, 35 to 45 items were needed to be administered to evaluate the test takers' VWR; the test would be automatically stopped after successive 6 failures out of 8 items. The required time for the test was about 15 to 20 minutes.

Data Collection Procedure

After categorizing the participants based on their performance on MPT into intermediate and advanced learners, their VWR were assessed via two tests; the first for examining the influential factors on VWR (WORT), and the second for evaluating the prediction power of the words' frequency, length, regularity and superiority on the word recognition tasks (PPVT). For the word recognition test, the participants were able to see the words' definitions and the possible answers. Then, they were required to double-click on the correct answer in 20 seconds. The Participants had to be tested individually. Based on the number of correct responses, the effect size of the influential parameters of word recognition would be determined for EFL learners of different proficiency levels. Once the raw scores were calculated, they were converted to standardized scores to evaluate the examinee's visual word recognition ability.

By comparing the participants' performance on constructed test items, a hierarchy for the speed of recognition regarding different influential factors was proposed. The obtained data were fed into SPSS and more than the descriptive analyses, non-parametric statistical comparisons, correlation analysis and a regression analysis were employed to check the more influential parameters and the prediction potential of each factor for VWR of intermediate and advanced EFL learners**.**

Results

This study designed to investigate the effects of word's frequency, regularity, length, and superiority on the intermediate and advanced EFL learners' VWR. Hence, after the participants' categorization their performance on WORT and PPVT was contrasted to check for the possible differences. The normality of the participants' scores on WORT and PPVT

were checked; as Tables 1 and 2 depicts the gathered data was not normally distributed and consequently the non-parametric statistical techniques were employed to make comparisons.

Table 1

Descriptive Statistics of Scores and Skewness/Kortosis Ratios

							Skewness		Kurtosis
		Min.	Max.	Mean	SD	Statistic	S.E.	Statistic	S.E.
WORT	Frequent words	1	15	6.14	2.445	-.293	.287	-.726	.566
	Less frequent words	0	15	3.81	2.286	.565	.287	-.203	.566
	Short words	2	15	7.44	2.363	-.659	.287	-.377	.566
	Long words	1	15	6.89	2.887	-.735	.287	-.802	.566
	Regular words	1	15	6.80	2.204	-.683	.287	-.114	.566
	Irregular words	0	14	7.19	2.820	-.802	.287	-.581	.566
	Word superiority	0	15	4.20	3.255	.358	.287	-1.205	.566
	Total Score	16	99	42.47	15.188	-.261	.287	-1.293	.566
PPVT		23	96	62.21	21.729	-.267	.287	-1.318	.566

Table 2

Testing the Normality of Scores via Kolmogorov-Smirnov Analysis

		Kolmogorov-Smirnov		Shapiro-Wilk	
		Statistic	Sig.	Statistic	Sig.
WORT	Frequent words	.108	.040	.953	.010
	Less frequent words	.143	.001	.937	.002
	Short words	.174	.000	.893	.000
	Long words	.193	.000	.866	.000
	Regular words	.178	.000	.928	.001
	Irregular words	.211	.000	.863	.000
	Non-words	.165	.000	.911	.000
	Word superiority	.165	.000	.911	.000
	Total Score	.133	.004	.927	.001
PPVT		.123	.010	.924	.000

In order to investigate the effectiveness of the words' frequency, regularity, length and superiority, the performance of the participants on WORT was focused. For each part, a paired comparison was made between the participants' scores to each section and its counterpart (i.e., frequent vs. less-frequent; short vs. long; and regular vs. irregular; words vs. non-words). The following table presents the four non-parametric Wilcoxon Signed Ranks Tests run in this respect.

Table 3

Comparing the Participants' Scores on WORT for the Frequency, Length, Regularity and Superiority Effects

	Test Statistic	Standard Error	Z	Asymptotic Sig.(2-sided test)
Frequency	112.000	152.235	-6.309	.000
Length	580.000	126.485	2.178	.029
Superiority	675.987	118.657	-1.564	.034
Regularity	952.500	113.990	-1.842	.045

As discernible in Table 3, the participants ranked significantly (Z = -6.30, p = .029 < .05) better in recognizing frequent words compared to less-frequent ones. However, they ranked significantly higher (Z = 2.17, p = .000 < .01) in recognizing the long words compared to the short ones. It was also found that words were significantly recognized than the non-words (Z=-1.56, p = .03). Finally, it was revealed that a significant difference (Z = -1.84, p = .045 < .05) exists in recognition of regular and irregular words. Therefore, the findings implied that word frequency, length, superiority and regularity significantly affected the EFL learners' visual word recognition. Moreover, regarding the effectiveness of these parameters on EFL learners English words' recognition a hierarchy of words' frequency, words' length, words' superiority, words' regularity might be proposed.

Regarding the predicting potential of the words' frequency, length, regularity and superiority, first, the correlation of scores on WORT and PPVT was examined and then the linearity of relations can be confirmed, hence, the requirements for running a regression analysis were met.

Table 4

Correlation Scores between PPVT and WORT

			PPVT	WORT
Spearman's rho	Peabody Picture Vocabulary Test	Correlation Coefficient	1.000	.887**
		Sig. (2-tailed)	.	.000
		N	100	100
	Word Recognition (Total Score)	Correlation Coefficient	.887**	1.000
		Sig. (2-tailed)	.000	.
		N	100	100

Figure 1

Linearity of Relationships between the Pairs of Variables and PPVT

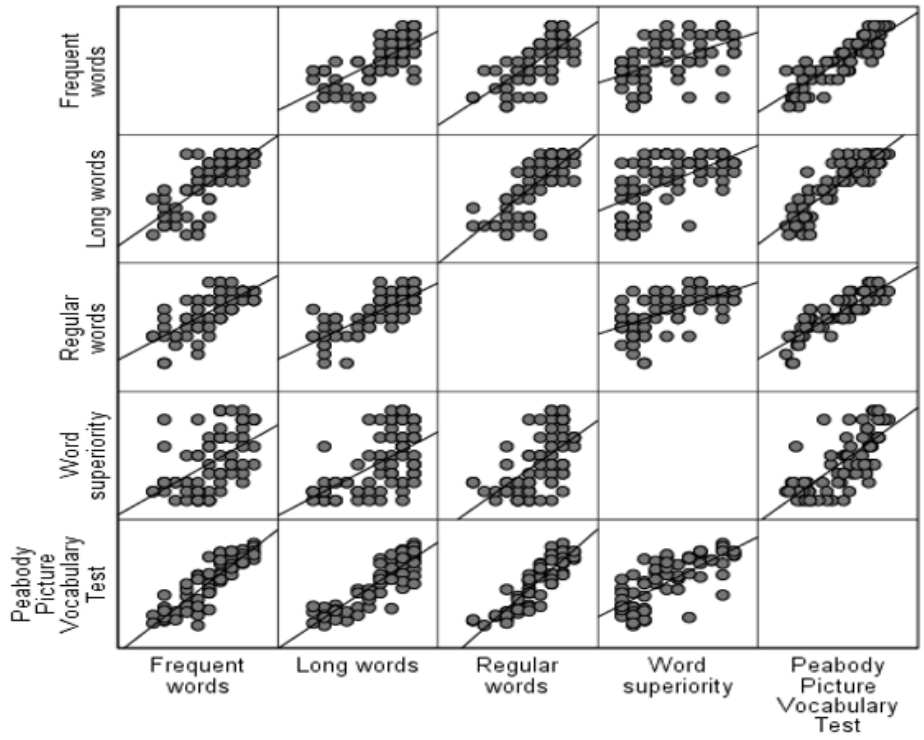

Figure 2

The Normal P-P Plot of Regression Standardized Residual

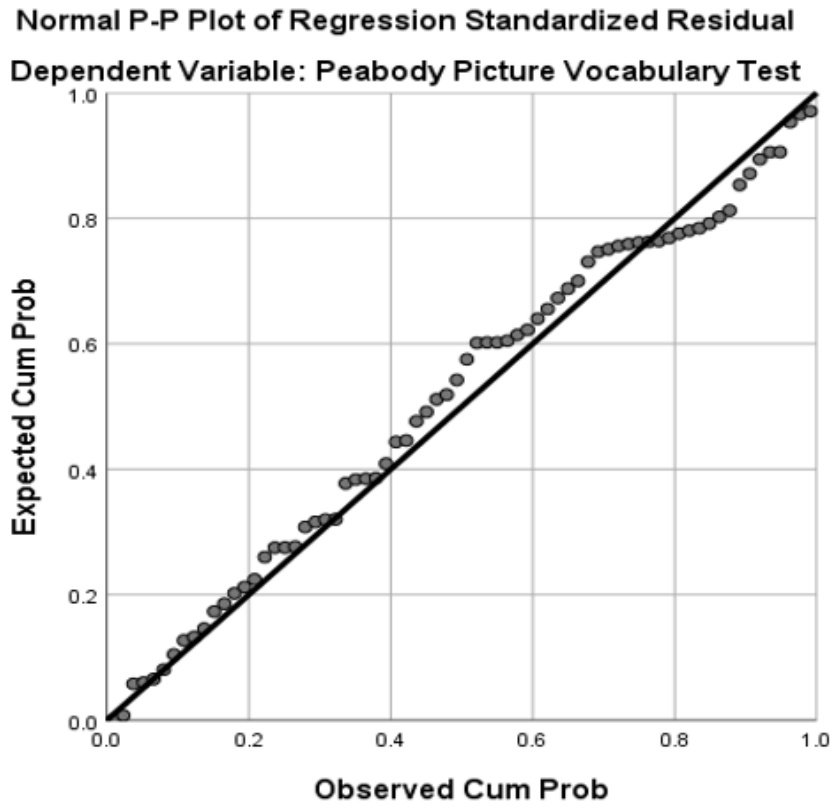

Table 5 depicts the regression summary and Table 6 presents the prediction potential of the variables individually.

Table 5

Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Durbin-Watson
1	.981[a]	.962	.960	4.361	2.090

a. Predictors: (Constant), word superiority, frequent words, long words, regular words
b. Dependent Variable: PPVT

Table 6

Regression Output: Predicting the Potential of the Variables on Word Recognition Tasks

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	
		B	Std. Error	Beta			Part Correlation
1	(Constant)	3.990	1.759		2.268	.037	
	Frequent words	2.850	.340	.321	8.377	.006	.202
	Long words	2.142	.316	.127	6.770	.045	.164
	Regular words	2.816	.419	.286	6.716	.009	.162
	Word superiority	1.623	.207	.043	7.838	.125	.189

As Table 6 depicts three variables made statistically significant contributions to the equation as their Sig. values are less than 0.05. The comparison of β values for the first model revealed that frequent words had the largest β coefficient (β = .321, t = 8.377, p = 0.001) and regular words (β = 0.286, t = 6.716, p = 0.009) and long words (β = 0.127, t = 6.77, p = 0.045) were the second and the third significant predictors of total PPVT scores, respectively, with a minor difference. Word superiority (β = 0.043, t = 7.838, p = 0.125) was not a predictor of recognition tasks statistically.

For examining the role of language proficiency level, the participants' word recognition scores were compared across their proficiency categories. Table 7 presents the descriptive statistics of the word recognition scores across two language proficiency levels and Table 8 illustrates the significance difference between the intermediate and advanced EFL learners' performance on the words' recognition test (WORT). Table 9 presents the effects of each parameter on their performance in a ranked order.

Table 7

Descriptive Statistics of WORT Scores across Language Proficiency Levels

		N	Minimum	Maximum	Mean	Std. Deviation
Intermediate	WORT	118	16	60	31.91	11.668
	PPVT	118	23	89	47.43	16.981
Advanced	WORT	127	20	67	53.03	10.127
	PPVT	127	31	96	77.00	14.822

Table 8

Comparing WORT Scores across Language Proficiency Levels

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
WORT	116.500	746.500	5.830	.000
PPVT	132.500	762.500	5.640	.000

a. Grouping Variable: Proficiency Level

Table 9

Words' Frequency, Length, Regularity and Superiority Ranks of Effect on the Intermediate and Advanced EFL Learners' Performance on WORT

Proficiency levels		Test Statistic	Standard Error	Z	Asymptotic Sig.(2-sided test)
Intermediate EFL learners	Frequency	98.98	76.23	-4.98	.000
	Length	126.87	45.31	-2.54	.021
	Regularity	234.09	76.54	3.65	.0349
	Superiority	654.12	49.54	-1.92	.0413
Advanced EFL learners	Frequency	89.00	87.25	-5.98	.000
	Length	234.06	65.45	1.98	.005
	Superiority	342.93	59.56	-1.00	.021
	Regularity	678.52	58.16	-2.87	.039

As reported in Table 9, the two groups showed significant difference on the visual word recognition test ($Z = 5.83$, $p = .000 < .01$) and PPVT tests ($Z = 5.83$, $p = .000 < .01$), the advanced learners significantly outperformed than their intermediate peers. Therefore, it can be concluded that language proficiency meaningfully affected the visual word recognition of the EFL learners. To be more specific, the advanced learners followed the effectiveness order of words' frequency, length, superiority and regularity while for the intermediates after the words' frequency and length, words' regularity played a more influential role than the words' superiority. This may imply that for the intermediate EFL learners, the words' correspondence between letters and phones plays a more determining role in words' recognition.

Discussion

Considering the undeniable role of words' recognition in texts' comprehension and regarding the inconsistent findings about influential parameters in VWR particularly in the EFL context (Brysbaert & Dijkstra, 2006; Han, 2015), this study attempted to check the effects of words' superiority, length, regularity and frequency on the intermediate and advance EFL learners' VWR simultaneously. In contrast to the traditional hypotheses which claim that words' recognition is a holistic process irrespective of the words' physical characteristics (Rayner, 2009), this study attested that words' physical specifications (i.e., length, regularity, superiority) in addition to its frequency play significant roles in the visual words' recognition task both for the intermediate and the advanced English learners. Furthermore, it was revealed that the learners' English proficiency level let to a significant difference in the participants' performance. Moreover, the words' regularity was found to be more important for the intermediate than the advanced learners; this may denote to the fact that as the language proficiency level increases, the need for the letter-phone correspondence decreases

for the words' recognition). Finally, the words' frequency, regularity and length were found to be predictors for the words' recognition tasks for the participants of both proficiency levels.

The findings were consistent with the previous studies as they can reflect the influence of multiple parameters that involve the process of VWR (Andrews, 2006). This study verifies the result of Yonelinas (2016) who observed that frequent lexical items are recognized faster and with more precision than non-frequent vocabularies. This result can also be explained from a neurological perspective. The previous studies comparing the effects of word frequencies on words' recalling and recognition from the neurological perspective have yielded some evidence that accounts for why frequency is important in this regard. These studies consistently denoted to a higher activation of the frontal gyrus of the left hemisphere when the learner is exposed to high-frequent words in comparison to low-frequent words (Farahani & Khaghaninejad, 2009; McDermott et al. 2003; Mechelli et al. 2005). However, the findings regarding the positive effect of word frequencies on VWR contrasts with what Dehaene and Cohen (2011) documented that word frequency had no significant effects on the mental activation patterns of words.

The observed length effect in this study was in line with Keulers et al., (2012), who concluded that the more time-consuming words to articulate are more challenging words to be recognized. Similarly, Schuster et al. (2016, p. 389) noted that "linear effect of word length is well-established in the context of behavioral studies which have showed that long compared with short words substantially increase participants response times (i.e., in naming and lexical decision tasks) and viewing times". What this study found about the role of word regularity in VWR aligns well with the assumptions proposed by Nation and Cocksey (2009) who concluded that learner's awareness about the phonology of a lexical item, can predict the efficiency of recognizing the word.

Although the possible impacts of words' length, regularity, superiority and frequency were reported for the VWR of both the first and the second/foreign languages (albeit inconsistently), this study depicted a hierarchy of influence among these parameters; for both the intermediate and the advanced EFL learners, words' frequency was the most influential parameter. Then, words' length, following by words' superiority and regularity were the influential factors respectively. While the four factors affected both the intermediate and the advance participants, few differences between the participants of different proficiency groups were observed. Advanced learners generally recognized words more quickly than intermediate learners. This expected difference among the intermediate and advanced learners performance indicated that an increase in language proficiency level can significantly affect VWR of the learners (Laufer, 1997). In line with Aghababian and Nazir (2000) this study certified that regularity might play a more significant role for the beginner and intermediate learners implying that reliance on the expected correspondence between letters and the phones they produce decreases as the language proficiency level increases. This piece of finding may refer to the fact that the connections between the letters and the sounds are more flexible for the advanced learners in comparison to the more rigid expectations of the beginners.

The findings of this study would suggest that due to the cognitive challenge that the lengthier, non-frequent and irregular vocabularies impose to be recognized, more time, elaboration and practice should be allocated to these words in the EFL context.

Conclusion

This study shed light on the effects of frequency, length, regularity and word superiority on VWR of intermediate and advanced EFL learners on a researcher-made word recognition test (WORT) and a standardized visual word recognition test (PPVT). The results indicated that words' frequency, length, regularity and superiority significantly affected the participants' performance on both tests. The learners' proficiency levels also showed a significant difference in their performance on the two tests, however, the words' regularity was found to play a more significant role for intermediate participants. Moreover, words' frequency, length and regularity were statistically to be the predictors of the participants" performance on word recognition tasks.

The findings confirmed that focusing on the non-semantic aspects of lexical awareness can help EFL learners read faster and more effectively. Indeed, as a complicated, multilayered skill, reading involves the decoding of lexical items and learners who are skilled at decoding the words given their frequency and length are more likely to process such words, leading to a better comprehension of the texts. Also, the combined effect of word frequencies, length, and regularity can help the learners to better work out the message of the texts. This is because they are equipped with techniques related to orthographic and phonological processing skills. Instructors relying on the findings of this study are recommended to focus on the characteristics of the words to be taught. They need to use a combined technique that involves the incorporation of lengthy, frequent words in the text. Indeed, educators and teachers should look at vocabulary items as a central component in L2 teaching, in that vocabulary plays an important role in communicative skills. EFL learners' vocabulary can be enriched by using materials and resources that are visually appealing to learners. This is because L2 learners would be more motivated, focusing on their learning process. Indeed, L2 learners should be able to appropriately connect the written and spoken words and recognize them to be able to communicate their message. Teacher trainers also need to raise the teachers' awareness toward the importance of the variables contributing to students' visual recognition of the words. They can provide the theoretical rationales for how the words' features influence students' visual recognition of words.

ORCID

https://orcid.org/0009-0006-3337-7180

https://orcid.org/0000-0002-6438-351X

Acknowledgements

Not applicable.

Funding

Not applicable.

Ethics Declarations

Competing Interests

No, there are no conflicting interests.

References

Adebayo, B., Robinson, L., & Durrant, S. (2021). Lexical quality, phonological awareness, and reading comprehension in English as an additional language. *Reading and Writing*, *34*(5), 1089-1113. https://doi.org/10.1007/s11145-021-10163-4

Aghababian, V., & Nazir, A. (2000). Developing normal reading skills: aspects of the visual processes. *Word Recognition, 76*(2), 132–150. 10.1006/jecp.1999.2540

Andrews, S. (2006). *From ink-marks to ideas: Current issues in lexical processing.* Psychology Press.

Apisak, S. (2023). The role of vocabulary size and access in second language reading comprehension. *Language Learning*, *72*(2), 376-394. https://doi.org/10.1016/04.tci-thaijo

Barber, H. A., & Kutas, M. (2007). Interplay between computational models and cognitive electrophysiology in visual word recognition. *Brain Research Reviews, 53*(1), 98–123. https://doi.org/10.1016/ j.brainresrev.2006.07.002

Brysbaert, M., & Dijkstra, T. (2006). Changing views on word recognition in bilinguals. In J. Morais & G. d'Ydewalle, (Eds.) *Bilingualism and second language acquisition* (pp.45-78). KVAB. http://www.kvab.be/Default_EN.aspx

Brysbaert, M., & New, B. (2009). Moving beyond Kučera and Francis: A critical evaluation of current word frequency norms and the introduction of a new and improved word frequency measure for American English. *Behavior Research Methods*, *41*(4), 977-990. https://doi.org/10.3758/BRM.41.4.977

Brysbaert, M., Longjiano, S., Dirix, N. & Hintz, F. (2020). Dutch author recognition test. *Journal of Recognition, 3*(1), 67-90. https://doi.org/10.5334/joc.95

Brysbaert, M., Stevens, M., Mandera, P., & Keuleers, E. (2018). The impact of word prevalence on lexical decision times: Evidence from the Dutch Lexicon Project. *Journal of Experimental Psychology: Human Perception and Performance, 42*(3), 441-458. https://doi.org/10.1037/ xhp0000159

Cain, K. (2006). Individual differences in children's memory and reading comprehension: An investigation of semantic and inhibitory deficits. *Memory*, *14*(5), 553-569. https://doi.org/10.1080/09658210600624481

Cattell, J. M. (1886). The time it takes to see and name objects. *Mind*, 11, 63-65.

David, A., & Metsala, J. L. (2015). Reading disabilities: A developmental language perspective. *Language Learning and Development*, *11*(4), 335-354. https://doi.org/10.1002/dys.1695

Davies, R. A., Arnell, R., Birchenough, J. M. & Grimmond, D. (2017). The impact of age on word frequency effects in speeded naming. *Quarterly Journal of Experimental Psychology*, *70*(11), 2240-2256. https://doi.org/10.1177/0963721417727521

Davis, F. D. (2004). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, *13*(3), 319-340. https://doi.org/10.2307/249008

Dehaene, S., & Cohen, L. (2011). The unique role of the visual word form area in reading. *Trends in Cognitive Sciences*, *15*(6), 254-262. https://doi.org/10.1016/j.tics.2011.04.003

Dong, Y., Wang, C., & Liu, J. (2020). The relationship between word knowledge and text comprehension: A meta-analysis. *Reading Research Quarterly*, *55*(4), 673-690. https://doi.org/10.3389/ fpsyg.2020.525369

Ertürk, Z. O. (2016). The effect of glossing on EFL learners' incidental vocabulary learning in reading. *Procedia - Social and Behavioral Sciences*, *232*(4), 373- 381. https://doi.org/10.1016/ j.sbspro.2016.10.052

Farahani, A., & Khaghaninejad, M. S. (2009). A study of task-based approach: The effects of task- based techniques, gender, and different levels of language proficiency on speaking development. *Pazhuhesh-e-Zabanha-ye- Khareji*, 49, 23-41

Grainger, J. (1990). Word frequency and neighborhood frequency effects in lexical decision and naming. *Journal of Memory and Language, 29*(2), 228–244. https://doi.org/10.1016/0749-596X(90)90074

Grainger, J., & Dufaua, A. M. (2012). Orthographic processing in visual word recognition: A multiple read-out model. *Psychological Review, 103*(3), 518–565. https://doi.org/10.1037/0033-295x.103.3.518

Han, F. (2015). Word recognition research in foreign language reading: A systematic review. *TESOL Quarterly, 45*(3), 57-91.

Jiang, L., Deacon, S. H., & Gruenenfelder, T. M. (2022). Contribution of lexical quality to the reading comprehension of Chinese children. *Reading and Writing*, *35*(1), 261-281. https://doi.org/10.1093/deafed/enac018

Jobard, G., Crivello, F., Tzourio-Mazoyer, N. & Anderson, R. (2003). Evaluation of the dual route theory of reading. *Neuro-imaging Studies*, 24, 56-89. https://doi.org/10.1016/S1053-8119(03)00343-4

Joy, S., & Kolb, D. (2009) Are there cultural differences in learning Style. *International Journal of Intercultural Relations, 33* (1), 69-85. https://doi.org/10.1016/j.ijintrel.2008.11.002

Karageorgos, P., Richter, T., Haffmans, J., Schindler, K., & Naumann, J. (2020). Word recognition accuracy predicts word recognition speed and text comprehension in elementary school children. *Reading and Writing, 33(5),* 1245-1271. https://doi.org/10.1016/j.cogdev. 2020.100949

Keulers, E. H. H., Goulas, A., Jolles, J., & Stiers, P. (2012). Maturation of task-induced brain activation and long range functional connectivity in adolescence revealed by multivariate pattern classification. *Neuro-image, 60*(2), 1250-1265. https://doi.org/10.1016/j.neuroimage. 2011.12.079

Khaghaninejad, M. S., Jafari, S. M., Eslami, M., & Yadollahi, S. (2021). An investigation into the application of "concluding transition signals" in academic texts: A corpus-based analysis. *Cogent Arts and Humanities, 8* (1), 1-15. https://doi.org/10.1080/ 23311983.2020.1868223

Khodadady, E., Alavi, M., Pishghadam, R., & Khaghaninezhad, M. S. (2012). Teaching general English in academic context: Schema-based or translation-based approach? *International Journal of Linguistics, 4(*1), 56-76. https://doi.org/10.5296/ijl.v4i1.1213

Laufer, B. (1997). The development of L2 lexis in the expression of the advanced learner. *The Modern Language Journal, 75*(4), 440-448. https://doi.org/10.2307/329493

Libben, G., & Titone, D. (2009). Bilingual lexical access in context: Evidence from eye movements during reading. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 35(*2), 381-390. https://doi.org/10.1037/a0014875

McDermott, K. B., Petersen, S. E., Watson, J. M., & Ojemann, J. G. (2003). A procedure for identifying regions preferentially activated by attention to semantic and phonological relations using functional magnetic resonance imaging. *Neuro-psychologia*, *41*(3), 293-303. https://doi.org/ 10.1016/s0028-3932(02)00162-8

Mechelli, A., Crinion, J. T., Long, S., Friston, K. J., Ralph, M., Patterson, K., & Price, C. J. (2005). Dissociating reading processes on the basis of neuronal interactions. *Journal of Cognitive Neuroscience*, *17*(11), 1753-1765. https://doi.org/10.1162/089892905774589190

Mechelli, A., Norvig, J., Balota, A., & Nazir, R. (2003). Neuroimaging studies of word and pseudo-word reading: Consistencies, inconsistencies, and limitations. *Journal of Cognitive Neuroscience,* 15, 260-271. https://doi.org/10.1162/089892903321208196

Mousikou, P., Sadat, J., Lucas, R., & Rastle, K. (2017). Moving beyond the monosyllable in models of skilled reading: Mega-study of disyllabic non-word reading. *Journal of Memory and Language*, 93, 169–192 https://doi.org/10.1016/j.jml.2016.09.003.

Nation, K., & Cocksey, J. (2009). The relationship between knowing a word and reading it aloud in children's word reading development. *Journal of Experimental Child Psychology*, *103*(3), 296–308. https://doi.org/ 10.1016/j.jecp.2009.03.004

Oslund, E. L., Deacon, S. H., Conrad, N. J., & Kwong, T. (2018). Identifying the nature of readers' decoding difficulties: A comparison of item-level and latent variable models. *Scientific Studies of Reading, 22*(2), 117-132. https://doi.org/10.1017/jse.2012.11

Ouellette, G., & Fraser, J. R. (2009). What exactly is a yait anyway: The role of semantics in orthographic learning? *Journal of Experimental Child Psychology*, *104*(2), 239–251. https://doi.org/10.1016/j.jecp.2009.05. 001

Pallathadka, N. (2023). Exploring word recognition in reading. *Journal of Applied Linguistics, 45*(3), 211-228. https://doi.org/ 10.1155/2022/4870251

Perfetti, C. (2017). Lexical quality revisited. In E. Segers & P. Van den Broek (Eds.), *Developmental perspectives in written language and literacy* (pp. 51-67). John Benjamins.

Pexman, P. M. (2012). Language and the development of conceptual knowledge. *Language and Linguistics Compass, 6*(10), 634-646. https://doi.org/10.1016/j.cogsys.2023.101151

Rayner, K. (2009). Eye movement and attention in reading, sense perception and visual search. *The Quarterly Journal of Experimental Psychology, 62*(8), 1457-1506. https://doi.org/10.1080/17470210902816461

Roivainen, E. (2013). Frequency of the use of English personality adjectives: Implications for personality theory. *Journal of Research in Personality, 47*(4), 417–420. https://doi.org/10.1016/j.jrp.2013.04.004

Schröter, P., & Schroeder, S. (2018). Spelling and sound predict the efficiency of visual word recognition in developing readers. *Journal of Experimental Child Psychology*, *16*(7), 1-16. https://doi.org/10.1080/10888438.2021.2020795

Schuster, S., Hawelka, S., Hutzler, F., Kronbichler, M., & Richlan, F. (2016). Words in context: The effects of length, frequency, and predictability on brain responses during natural reading. *Cerebral Cortex*, *26* (10), 3889–3904. https://doi.org/10.1093/cercor/bhw184

Sears, C. R., Siakaluk, P. D., Chow, V. C., & Buchanan, L. (2008). Is there an effect of print exposure on the word frequency effect and the neighborhood size effect? *Journal of Psycholinguistic Research*, *37*(2), 269-291. https://doi.org/10.1007/s10936-008-9071-5

Stanovich, K. E. (2000). *Progress in understanding reading: Scientific foundations and new frontiers*. CUP.

Tamimy, M., Zarei, L. S., & Khaghaninejad, M. S. (2022). Collectivism and individualism in US culture: An analysis of attitudes to group work. *Training, Language and Culture, 6*(2), 20-34. https://doi.org/10.22363/2521442X-022-6-2-20-34

Van den Boer, M., De Jong, P. F., & Haentjens-van Meeteren, M. M. (2012). Modeling the length effect: Specifying the relation with visual and phonological correlates of reading. *Journal of Experimental Child Psychology*, *112*(4), 362-380. https://hdl.handle.net/11245/1.400236

Washburn, E. K. (2023). Vocabulary learning and lexical access in second language reading comprehension. *Language Teaching Research, 26*(1), 42-61. https://doi.org/10.22108/are.2022.134377.1958

Yap, M. J., & Balota, D. A. (2015). Visual word recognition. In A. Pollatsek & R. Treiman (Eds.), *The Oxford handbook of reading* (pp. 26–43). Oxford University Press.

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. https://doi.org/ 10.1037/a0024177

Yap, M. J., Tse, C. S., & Balota, D. A. (2009). Individual differences in the joint effects of semantic priming and word frequency: The role of lexical integrity. *Journal of Memory and Language, 61*(3), 303-325. https://doi.org/10.1016/j.jml.2009.07.001

Yonelinas, A. (2016). Word Skipping in Reading English as a Foreign Language: Evidence from Eye Tracking. *East European Journal of Psycholinguistics*, *3*(2), 22–31. https://doi.org/10.29038/eejpl.2016.3.2