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The Efficiency of Priming Techniques for the Word Recognition and Sentence Comprehension of EFL Learners: Conceptual and Perceptual Priming in Comparison

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ABSTRACT

This study attempted to examine the impacts of conceptual and perceptual primes on the word recognition and sentence comprehension of beginner, intermediate and advanced EFL learners. Consequently, 246 EFL learners were recruited for study and categorized into three English proficiency levels. The needed data was collected via Lexical Decision Tasks (LDTs) and a constructed multiple-choice sentence comprehension test. The findings indicated that both priming techniques improved word recognition and sentence comprehension of the participants significantly, however the conceptual primes were more facilitative for both word recognition and sentence comprehension tasks. Moreover, language proficiency was found to be determinant of priming efficiency, in the way that, as the learners become more proficient their performance would be more positively affected by both conceptual and perceptual priming techniques. Finally, the pedagogical implications and suggestions are discussed in the light of the findings.

Keywords: Conceptual versus perceptual priming, Word recognition, Sentence comprehension, Lexical Decision Tasks

Introduction

Due to its rich psychological background and the promising findings, priming has been one of the fascinating experimental research fields in psycholinguistics (Harley, 2009; Henson et al., 2014). The prime can be presented through various means and modalities; the micro level of priming usually involves auditory (e.g., Bermeitinger et al., 2012), pictorial (e.g., Rohr et al., 2012), and visual stimuli (e.g., Grainger & Jacobs, 1999; Masson & Isaak, 1999). While significant priming effects have been demonstrated in cross-modality priming (Oppenheimer et al., 2008), the effect is reported to be maximized when it is in the same modality of the stimulus (Stella et al., 2018). In order to measure word recognition, visual priming was deemed the most appropriate modality since the prime and target would be both represented in written form (Aitchison, 2012). Word recognition is a critical phase in language comprehension and a significant step toward fluency in the latter stages of language learning (Yu, 2021). It is also considered one of the main components of proficient reading comprehension (Nobre & Salles, 2016). Word recognition further has been proven to improve other language skills, including listening and knowledge of vocabulary (Ouellette & Beers, 2010). Employing primes has exhibited remarkable results in improving word recognition regarding its speed and efficacy (Gulan & Valerjev, 2010). An essential feature of priming is that the primes' contribution relies on activation of component morphemes (Gabrieli et al., 1998). Moreover, the same result has been observed in semantic processing (Yap & Balota, 2015).

Apart from the implications for cognitive and social psychology, priming can take two general forms, such as increasing efficiency in processing a repeating stimulus (repetition priming) or spreading activation of associated concepts (conceptual priming) (Molden, 2014). *Repetition* priming is the most basic priming method and uses a completely identical prime and target pair in identical or different tasks with the purpose of improving the speed and accuracy of response to a task considerably as a result of the already existing experience (Schendan, 2017). In *repetition* priming, exposing the participants to a word can increase the probability of producing that word as an answer to questions that allow for a multitude of acceptable responses (Henik & Carr, 2002). On the other hand, *conceptual* priming is concerned with a deeper level of processing and pertains to meaning, category, and affiliation with other concepts (Nobre & Salles, 2016). In *conceptual* priming, words and concepts that share similarity in meaning and

category however, are habitually and frequently juxtaposed or used together, activate and prime each other. For instance, "salt" and "pepper" or "fish" and "chips", frequently appear together in the English language and are associated with each other. As a result, using one of the words as a prime leads to the activation of the other as a target and facilitates its processing.

Perceptual priming alternatively explores the superficial characteristics of the prime-target relation and has received significantly less attention and exposure until quite recently (Beyersmann et al., 2011). *Perceptual* priming functions based on the similar forms of the primed and the target words. For example, the word 'fight' will bring about a faster response when the word 'sight' is desired, since these two words are perceptually similar even though their meanings are nowhere close (Balota et al., 2007; Farahani & Khaghaninezhad, 2009; Voss & Paller, 2010). *Perceptual* priming aims to limit the degree of interaction and to facilitate the measurement of impact and properties of each prime-target relation separately during an experiment. Accordingly, instead of examining the case of homonyms (words with identical pronunciation and spelling), homophones (words with identical pronunciation but disparities in the spelling or written format) are usually adopted (Nunes et al., 2012).

While so dissimilar, *conceptual* and *perceptual* priming capitalize on fundamentally similar mental mechanisms; the experience of exposure to the first stimulus (prime) leads to a more efficient allocation of cognitive resources to activate the target lexical items (Taylor et al., 2013). These procedures limit the mental resources used by the extraneous tasks, allowing the brain to focus on the primary one, enhancing the performance. It should be considered that most types of priming, including conceptual and perceptual, are automatic responses that do not rely on awareness and conscious processing (Doyen et al., 2014). It can be implied that while priming in most cases results in quicker and more precise responses, it is a design that enables fast reaction and not necessarily the best or the most rational one; priming is usually considered an automatic, indirect process that happens unconsciously and independent of active attention (Doyen et al., 2014; Lorenzi et al., 2006; Tamimy et al., 2022). As a result, in order to indicate its influence, indirect and implicit measures should be employed (Sbicigo et al., 2017).

The majority of the research regarding priming effect is conducted either in the field of medical sciences (Khachatryan et al., 2019; Stella, 2018) or behavioral psychology (Friedman & Elliot, 2008) and priming mechanisms have not been explored enough regarding its practical applications, especially in educational settings and language learning (Streeb et al., 2018).

Seemingly, there is a lack of research examining and contrasting the impact of different priming techniques (e.g., conceptual versus perceptual) in

second or foreign language learning contexts. That is, while there are studies aiming at understanding the nature of these techniques and differences in their underlying processes, there is very few research concerned with the effect of employing different priming techniques in language education practical endeavors. In effect, although priming has been studied extensively by psycholinguists and linguists in recent years, the pedagogical implications have received less attention (Nobre & Salles, 2016). Moreover, considering the possibility that priming affects language learners differently, in this study, in addition to the efficiency of different priming types, the level of language proficiency was focused as a variable of interest and its role was investigated for beginner, intermediate, and advanced EFL learners.

In this article, after reviewing the related literature and the theoretical background, the research questions are proposed. In continuation, the participants are introduced and the research instruments in addition to the priming techniques and the study's measurements are described. Finally, the findings are presented and the implications are discussed.

Literature review

Conceptual versus Perceptual Priming

Cattell (1886) was probably the first researcher to observe that related words facilitate word recognition. He proposed that automaticity as a result of association can increase the speed at which an object can be recognized. However, it took almost a century for this effect to be distinctively recognized and studied. In 1971, Meyer and Schvaneveldt discovered that retrieval operations in pairs of words are dependent, and similarity assists in comprehension and recognition; this was the foundation of research in priming for the forthcoming years. Later studies found that this incident is not limited to word pairs. Alternatively, following the same protocol, pictures have the potential to prime for either pictures or words, i.e., identical or mixed pairs (Schreuder et al., 1984).

Generally, priming is associated with the idea of facilitation; however, by employing different priming techniques distinct results can be achieved. Scholars have classified 12 types of priming in learning psychology (Jin, 2015; Mayr & Buchner, 2007) from which conceptual and perceptual priming techniques are the focus of this study.

Scholars have proposed that the facilitation of *perceptual* primes is caused by selective reduction in activation of neurons in higher cognitive regions resulting from a slight processing decrease on the part of early sensory areas (e.g., Moldakarimov et al., 2010). As examined by Gahnepain et al, (2010) and Klatzky and Creswell (2014), priming the subjects with *perceptual*

stimuli leads to a honed connection between items and accurate allocation of evidential resources in the semantic system, resulting in enhanced error prediction and episodic encoding. It has also been documented that *perceptual* priming results have the potential to continually meliorate results up to 7 instances (Maljkovic & Nakayama, 1994), ascertaining that, *perceptual* priming is an extraordinary tool in education, specifically for subjects in which repetition is inevitable, such as syntax and semantics.

On the other hand, *conceptual* priming predominantly involves facilitation in the processing of the semantically related primes and targets regarding their meaning and category (Lowder & Gordon, 2006). The process is best demonstrated by *Semantic Network Model* in which words and their properties are stored and represented as concepts in nodes (Deyne et al., 2017; Kenett et al., 2017). The nodes in this conceptual network are linked to other nodes either directly – such as word class categories, i.e., super-ordinates and subordinates– or indirectly through the sub-class links. The links between nodes are more robust (or shorter) if the concepts are closely associated. Activation of one node (i.e., exposure to a stimulus) activates several other nodes, corresponding to their affiliation degree. The spreading activation continues until the intended node (concept) is accessed and retrieved. Priming in this sense pre-activates a node, leading to partial activation of closely linked or associated nodes and concepts; therefore, resulting in faster and more accurate processing of the target word.

In one of the first endeavors to test the efficiency of conceptual/perceptual priming techniques, Woltz (1996) addressed the relative involvement and nature of perceptual and conceptual priming in a semantically complex task. He found that conceptual priming (unlike perceptual priming) involved a direct access to the working memory for the meaning comparison processes. Marsh et al., (1999) also documented the efficacy of conceptual priming for language problem-solving tasks in comparison to other types of priming (e.g., perceptual priming). In another study Kim et al. (2014) examined the efficiency of conceptual priming within and across different modalities and demonstrated that target categorization was facilitated by the advanced presentation of conceptually related exemplars. In the same vein, Soler et al. (2014) evaluated the perceptual priming in fourth grade primary school children using a word-fragment completion task. They found that children with high reading speed were significantly better at word-fragment completion and showed a greater priming effect, in other words, the prior processing of the words from which the fragments came produced a greater benefit in the performance of the word-fragment completion task. In a recent study Ward (2023) suggested that conceptual and perceptual processes are not equally affected by ageing. She documented that priming effect was greater for young than the older adults

and on the perceptual than the conceptual test the age difference was only significant when the primes were perceptual.

Priming Effects in Implicit Memory Tasks

Implicit memory (sometimes referred to as unconscious memory or automatic memory) exploits the past experiences to remember things or concepts without consciously thinking about them, no matter how long ago those experiences occurred (Schreuder et al., 1984). Primes are the non-conscious instruments of implicit memory evaluation concerned with the conceptual and/or perceptual identification of concepts and objects (Bullemer et al., 1989). The priming effect, hence, refers to the positive (or even negative) impact of a rapidly presented stimulus on the processing of a target concept that appears shortly after. Generally speaking, the generation of priming effect depends on the existence of some meaningful relationship between the primed and the target stimuli.

For examining the efficiency of primes, implicit memory tasks are usually designed and employed based on the study needs considering the fact that implicit memory is both acquired and accessed unconsciously (Lorenzi et al., 2006). In the case of priming, it is assumed that feedbacks are essential for the cognitive system to retrieve events of the two (or more) presented stimuli. Accordingly, exposure to the prime sharpens the connection to the upcoming stimulus and consequently, the evidential input is distributed more precisely, leading to more significant error prediction and episodic encoding.

Many different implicit memory tasks are used to measure the efficacy of priming techniques; *implicit association task* (which investigates the unconscious associations people have between pairs of concepts), *category-instance generation task* (a task in which the learners are asked to name as many as words as they can from a determined category such as animals or body parts), *lexical decision task* (where the participants are asked to decide, as quickly and as accurately as possible, whether the word to which they are exposed, is a real word of his or her language or not), *word fragment completion task* (which is a test designed to measure memory of words presented to participants; words that were previously shown to participants are presented again in a fragmented form (i.e. missing letters) with the task of retrieving the missing letters to complete it), *word stem completion task* (a cognitive task in which the respondent is given the first few letters of a word and tries to complete the word as quickly as possible) and *anagram solution task* (a task in which the subjects are presented a sequence of letters and are required to produce a word that can be spelled using all and only the letters given) are among these measures (Lowder & Gordon, 2006). However, in order to have valid conclusions, more than considering the nature and the function of different

implicit memory tasks, the modality of the stimuli, their frequency and length and even their lexical neighborhood should be taken into account (Mayr & Buchner, 2007).

Lexical decision tasks, as an illuminating test of implicit memory have been widely employed in language-related experimentations. Yap et al. (2015) focusing on the potential of lexical decision tasks for determining the English non-words, explored the influence of different psycholinguistic variables on non-word lexical decision performance of the participants. Item-level regression analyses reveal that non-word response time was positively correlated with number of letters, number of orthographic neighbors, number of affixes, and base-word number of syllables. It was also found that the participants' higher vocabulary knowledge is associated with less sensitivity to the non-words number of letters but more sensitivity base-word frequency. In the EFL context, Momenian et al. (2015) also attested the effect of age in L2 lexical items acquisition order via lexical decision tasks. In another study, Laurence et al. (2018) revealed that lexical decision tasks can efficiently predict the judgment about L2 ambiguous sentences among advanced learners.

Priming and Second/Foreign Language Education

Although the priming effects are observed for foreign language learners, this does not necessarily denote to a similar word-level semantic processing of L1 and L2, and consequently to an identical priming effects in both languages (Shawn & Monica, 2012). However, many studies have attested that priming can be deemed beneficial in foreign language education (e.g., Jiang & Huang, 2015; Shen, 2015) both as a teaching tool and a mediator between word recognition to sentence comprehension and finally language proficiency. Considering the fact that, the learners of a foreign language steadily rely on different strategies to cope with the cognitive and information overload, priming techniques can be beneficial in elevating some of the imposed cognitive pressure in learning a foreign language (Yuan et al., 2010).

Many scholars have decided to take into account the role of priming in language learning and have done experiments on both syntactic and semantic priming. In one case, Silverberg and Samuel (2004) assessed the role of L2 acquisition age on the L2 proficiency and compared three types of bilinguals (Early L2 learners, Late highly proficient L2 learners and Late less proficient L2 learners) employing the lexical identification priming paradigm. They concluded that semantic and mediated form primes produced facilitative priming effects for the "Early" group, but not for either of the "Late" groups. Highly proficient "Late" learners showed inhibitory effects of form primes, whereas the less proficient group produced no priming effects

of any type. They also implied that the age of L2 acquisition has a major influence on how bilinguals represent and access words in their second or foreign language.

Trofimovich (2005) investigated to what extent auditory priming would influence L2 learning as a word processing mechanism. He observed that positive effect of auditory priming both for the L1 and the L2 as the participants' word production in reaction to repeated words was faster than the unseen words. It was also revealed that L2 auditory priming was hampered when learners attended to the word meaning especially when the repetitions were not similar. In another study, McDonough and Chaikitmongkol (2010), with the help of 42 Thai participants who were learning English as a foreign language (EFL), used syntactic priming. It was revealed that the primed participants were able to produce considerably more WH questions and structures.

In another study, Yuan et al. (2010) provided some participants with the L1 translation of selected L2 words for a short duration (100 ms). The results referred to a significant reduction in response time, as well as the comprehension errors. Yuan concluded that by priming the translation in L1, the constraints on working memory and cognition are removed; this allows the participants to process all the words in a sentence. Altarriba and Knickerbocker (2011) designed an experiment to assess the effect of priming on vocabulary acquisition. They presented Spanish words to monolingual English speakers followed by a lexical decision task. The experiment involved presentation of the Spanish vocabulary items in three different formats of color picture-word, black-and-white picture-word or word-word combinations. The results indicated that under all the three learning conditions priming had occurred; teaching new Spanish vocabulary items had been equally successful under all the three conditions. It was also found that the reaction times were significantly less for the words that had been learned under word-word condition.

Shen (2015) conducted a priming study in the Chinese context for English learners who were reportedly at the same level of proficiency. In the first stage, the participants were given a number of pictures they had to describe. Afterwards, they were divided into two groups in which they were either received the priming in the form of listen and repeat or gap filling, both containing relative pronouns and adverbials. Then, they were given a series of pictures to describe. This time the assumption was that learners would produce sentences containing the same grammatical features they had recently encountered. The results showed that the structural priming had worked very well for both groups but reported to be higher for the gap filling and writing group than for the listen and repeat group.

A recent study conducted by Khaghaninejad and Farrokhiyekta (2020) utilized three implicit memory tasks to measure the effects of visual priming on 90 advanced EFL learners' English word retrieval. All three memory tasks reported progress while the authors indicated a more significant influence on anagram solution and word stem completion than the word fragmentation tasks.

Considering the role of word recognition in reading comprehension which requires the deployment of several semantic, syntactic and memory resources (Brooks & Gibson, 2012) for the language learners, this study made an effort to compare and analyze the possible facilitative impacts of *conceptual* and *perceptual* visual primes for the recognition of the target words and the sentences constructed based on them via lexical decision tasks (LDTs) and a multiple-choice sentence comprehension test. Furthermore, the study investigated the efficacy of each priming technique with regard to the participants' English proficiency level and their possible interactions. Consequently, the following research questions were formed:

1. Is there a significant difference between the performances of EFL learners who experienced different priming techniques (conceptual versus perceptual) on word recognition tasks?
2. Is there a significant difference between the performances of EFL learners who were exposed to different priming techniques (conceptual versus perceptual) on sentence comprehension tasks?
3. Does the English proficiency level of EFL learners have any effects on the efficacy of conceptual or perceptual priming techniques?

Method

Participants

Although similar studies in this field had reported employing 20 to 30 participants (Gor, 2018), 246 participants were selected via convenience sampling procedure from English learning schools and recruited for the study. All the participants were undergraduates and speak Persian as their mother tongue. Before the study's commencement the participants' (including 128 male and 118 female Iranian EFL learners whose age ranged between 17 to 32 years, mean = 23) consent was gained. 126 randomly-selected participants were categorized into three groups of beginner (42 participants), intermediate (41 participants) and advanced (43 participants) as the experimental participants of the study based on their performance on the English proficiency test. Moreover, to avoid the role of memory (test-retest effect) and to check the genuine effects of priming techniques, 120

participants from the three different proficiency levels (40 participants for each proficiency level) were put in the non-primed groups as the control participants. The control participants were not primed either conceptually or perceptually for the target words and performed the lexical decision and sentence comprehension tasks without the priming phase. To check the efficiency of the primes, their performance was compared with that of the primed participants.

Materials and instruments

The study involved three independent experiments, henceforth three measurements were employed for collecting the needed data as follows:

*Cambridge Assessment English for Schools*_ In order to determine the proficiency level of participants and assign them into three proficiency levels, the Cambridge Assessment English was conducted. This is a standardized 30-minute test comprised of 45 items which is universally accepted as a valid English proficiency test whose reliability was reported as 0.89 by Khaghaninejad et al., (2021) and Kenett et al (2017). This test provides instant and automatic results and classifies language ability on a six-point scale from A1 to C2 based on The Common European Framework of Reference for Languages (CEFR). According to the official classification, a learner is a beginner if he/she has a score of 17 to 25 (A2), intermediate by scoring 26 to 35 points (B1 and B2) and advanced if the score is above 36 up to 45 (equivalent to C1 and C2).

*Lexical Decision Tasks (LDT)*_ Since the selected words were the basis of word recognition and sentence comprehension test items, the selection process was done carefully from the learners' course books. Accordingly, a list of 96 words (for constructing 90 lexical decision test items and six as clarifying examples) was created. Participants of each proficiency level were asked to respond to 30 items constructed specifically for their proficiency level from the lexical items of their course book. The word list strictly contained words that had 5 to 10 letters and did not share the same first few letters. The selection process was highly meticulous and took into account the data from multiple previous research such as Fugett-Fuller (2008) for the duration of the exposure to primes and Cheng (2016) for considering the neighborhood effect (the recognition of the words which have only one different sound compared with the target word) in order to avoid choosing target words which were highly frequent and thus nullify the priming impact.

For the priming phase, on the basis of the selected words, the experimental participants were exposed to a set of 10-second, self-paced animated pictures, containing both the primed word and a related image

simultaneously. The animated pictures were created in Microsoft PowerPoint and contained 90 primes that were either exclusively conceptual (45 primes) or perceptual (45 primes). For example, as an instance of conceptual primes, the beginner participants were presented with a 10-second animated picture of cars while the target word was "traffic". Immediately after the priming phase, a lexical decision task followed in which the participants were presented with a set of letter strings on their screens and were asked to judge whether they were words or non-words in five seconds. The participants' correct responses considered as the basis of evaluating the primes' efficiency.

*Sentence comprehension test*_ Based on the selected and primed target words for LDTs, a set of 80 short sentences were constructed and presented to the participants of different proficiency levels. In the way that, the accurate understanding of the target words' semantics, positively affected the comprehension of the sentences. Considering the fact that equal numbers of "nouns" and "adjectives" were selected as the target words to prime, 40 nouns and 40 adjectives were chosen for constructing the sentences for the comprehension test. The "noun" target words were all used as the subjects of the constructed sentences and the "adjective" target words were freely positioned to describe one of the NPs of the sentence. For assuring the roles that the target words play in comprehension of the constructed sentences, the length of the sentences and the frequency of the comprising words were also checked. All the constructed sentences were comprised of 8 to 10 content words (average of 9 words for each sentence). A specifically-designed software application (Com-Chron) was employed to record the comprehension accuracy of the participants while seeing the target sentences on their computer screens. Each sentence was shown only for thirty seconds and was followed by four options; the participants needed to choose the options which necessitated the proper interpretation of the sentences. The participants could not move back to previous items to revise or to change their answers. The performance of each participant was reported based on the number of the correct responses (Max = 80) by an Excel output for further analysis.

Data collection procedure

After the categorization of the participants into three proficiency levels attested by their performance on *Cambridge Assessment English for Schools*, the participants' word recognition was measured via LDTs after applying perceptual and conceptual primes. Based on the methodology of similar studies (Forster & Davis, 1991; Fugett-Fuller, 2008), the primed participants were exposed to a blank frame that remained on the screen for 1 second. The blank frames provided the participants with the opportunity to process the

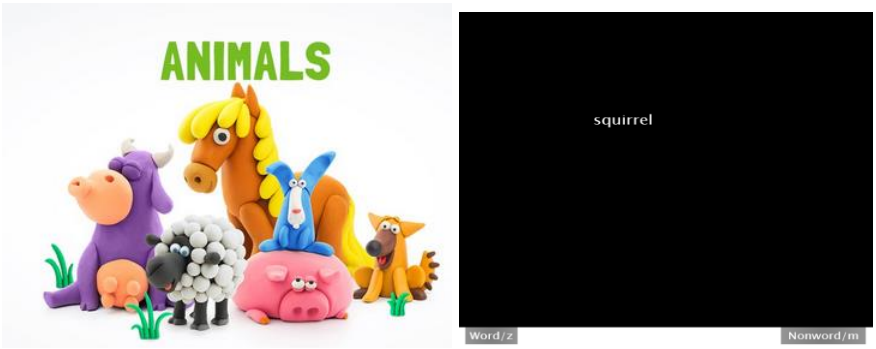
stimulus and relax their eyes. Immediately after the visual priming, LDTs were administered for the target words.

Regarding the perceptually primed words, the formal characteristics (orthography and length) of the target words and their non-word counterparts were considered. For example, for the target word of "boat", the non-word "taob" was employed. For the conceptually primed words the formal words' characteristics were not taken into account and accordingly, to the target word of "traffic", the non-word "qfictra" was paired.

After introducing the LDTs to the participants and doing the clarifying examples, the participants were asked to the do the LTDs and judge about the presented string of letters on the screen in 5 seconds for each item. If the judgment of the participants lasted more than 5 seconds the application automatically would jump to the next item and an incorrect response was considered for that item. Figure 1 depicts an instance of conceptual priming and the related LDT for beginner participants.

Figure 1

Conceptual prime for "squirrel" and the related LDT for beginner participants

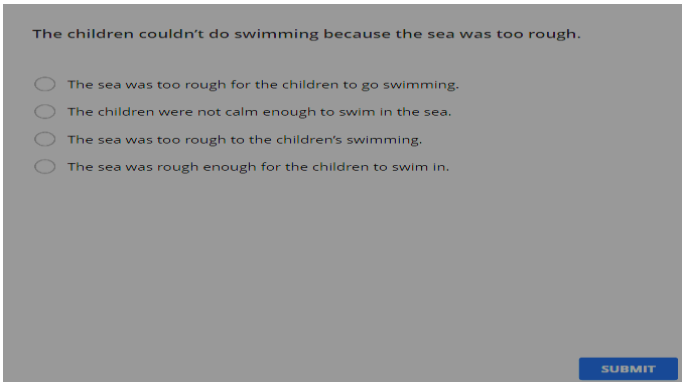


Regarding the sentence comprehension measure, participants were exposed to the experimental sentences constructed based on the target words. Based on the constructed sentences, four statements with roughly identical length and comprising words were designed to check the accurate comprehension of the constructed stems. The stem and the evaluating statements were all in English and visible simultaneously on the screen. Only one of the statements was precisely synonymous with the constructed stem. Through a computerized task, the participants were supposed to select the accurate interpretation in 30 seconds. Their scores (number of correct answers) which were the indicators of their comprehension accuracy were manually fed into SPSS with the aim of minimizing errors. In addition to the

descriptive statistics, inferential statistical analyses (including, ANOVAs and t-tests) were employed to make the comparisons. Figure 2 presents a sentence comprehension item constructed for the perceptually primed word "rough" for the intermediate participants.

Figure 2

A sentence comprehension item of the perceptually primed word "rough" for intermediates



Results and Discussion

Results

Before running the inferential statistical techniques, the descriptive statistics was calculated and the Levene's test of the variance homogeneity was conducted. Table 1 depicts the descriptive statistics of the primed and the non-primed participants' scores on word recognition and sentence comprehension tasks and Table 2 presents the output of Levene's test; as discernible, the null hypothesis of the homogeneity of population variance was rejected, indicating that the assumption for conducting analyses of variance (ANOVAs) was met.

Table 1

Description of participant in proficiency and priming groups

PTScoreN		Priming	Mean	Std. Deviation
Beginner	Word recog	Non-primed	29.66	6.61
		Primed	38.40	7.97
		Total	34.26	8.44
	Sentence comp	Non-primed	46.98	8.67

		Primed	64.98	9.67
		Total	56.09	9.98
Intermediate	Word recog	Non-primed	36.21	8.19
		Primed	39.61	12.24
		Total	37.85	10.28
	Sentence comp	Non-primed	43.78	15.87
		Primed	61.09	11.90
		Total	56.09	13.87
Advanced		Non-primed	44.70	13.31
	Word recog	Primed	61.50	11.78
		Total	53.10	14.96
	Sentence comp	Non-primed	52.09	17.04
		Primed	71.90	14.92
		Total	64.98	16.77

Table 2

Result of Levene's test of homogeneity of variance

		Levene's Statistic	**df1**	**df2**	**Sig.**
Scores	Based on Mean	1.859	11	60	.115
	Based on Median	1.022	11	60	.413
	Based on Median and with adjusted df	1.022	11	42.86	.417
	Based on trimmed mean	1.791	11	60	.128

Regarding the first research question, the performance of the participants was compared via a set of independent-samples t-tests to check whether priming had significantly different impacts on the participants' scores on the LDTs. As depicted in Table 3, the primed participants outperformed significantly on LDTs, however, the difference for the conceptual primes was more noticeable. The effect sizes of the differences were also estimated.

Table 3

Comparing the means of conceptual/perceptual priming techniques on LDTs

		F	Sig.	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	eta squared
Con-LDT	Equal variances assumed	7.21	.008	2.17	.003	5.87	1.70	0.02
	Equal variances not assumed			2.17	.004	5.87	1.70	

Per-LDT	Equal variances assumed	4.90	.031	3.01	.012	3.62	1.03	0.13
	Equal variances not assumed			3.02	.013	3.62	1.03	

Dealing with the second research question, through another set of independent-samples t-test the performance of the participants on comprehending the sentences constructed based on the words primed either perceptually or conceptually was compared. As Table 4 suggests, the comprehension of the sentences was significantly facilitated by both the conceptual and perceptual primes, however, similar to word recognition tasks, conceptual primes were found to be more efficient in this respect.

Table 4

Comparing the means of conceptual/perceptual primes on sentence comprehension test

		F	Sig.	t	Sig. (2-tailed)	Mean Difference	Std. Error Difference	eta squared
Con primes	Equal variances assumed	8.78	.012	1.897	.012	8.78788	1.780	0.14
	Equal variances not assumed			1.897	.014	8.78788	1.782	
Per primes	Equal variances assumed	11.38	.043	2.867	.043	5.87879	0.057	0.04
	Equal variances not assumed			2.867	.046	5.87879	0.059	

Regarding the third research question, a two-way between-groups analysis of variances (ANOVA) was conducted to investigate the impact of proficiency levels and priming techniques on the word recognition of the participants as measured by implicit memory tasks. There was a statistically significant main effect for proficiency level, F (2, 60) = 19.07, p = .00; moreover, the effect size was quite large (partial eta squared = .39). Post-hoc comparisons indicated that the mean score for the beginners (M = 34.26, SD = 8.4) was significantly different from that of the advanced learners (M = 53.10, SD = 14.97). Furthermore, the mean score for the intermediates was also significantly different from that of the advanced learners (M = 37.85, SD = 10.28). As discernible, the main effect for priming, (F (1, 60) = 13.94, p = .00) reached statistical significance. On the other hand, the effect size for priming was considered large (partial eta squared = .19), although it was smaller than the effect of proficiency level. The findings supported the notion

that while proficiency is the significant indicator of scores on word recognition, priming has also a large and significant facilitative effect, however, no meaningful interaction was found between participants' proficiency levels and the priming efficacy. Table 5 and Table 6 present the multiple comparisons and the significance of the differences regarding the participants' word recognition and sentence comprehension.

Table 5

Mean comparison of the performance of participants of different proficiency levels on LDTs and sentence comprehension tasks

Tests of Between-Subjects Effects						
Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	5895.824[a]	5	1179.165	10.985	.000	.478
Intercept	111800.431	1	111800.431	1041.549	.000	.946
Prof test	4093.531	2	2046.765	19.068	.000	.389
Word recog	1496.438	1	1496.438	13.941	.000	.189
Sentence comp	1789.096	1	1789.096	17.094	.000	.542
Prof test* word recog	515.844	2	257.922	2.403	.099	.074
Prof test* sent com	643.098	2	458.231	1.098	.132	.001
Error	6440.434	60	107.341			
Total	125673.000	66				
Corrected Total	12336.258	65				

Table 6

Comparison of mean differences of the participants of three proficiency levels on LDTs

Multiple Comparisons						
					95% Confidence Interval	
(I) PTScoreN	(J) word recog	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Beginner	Int	-3.587	3.103	.483	-11.04	3.86
	Adv	-18.838*	3.312	.000	-26.81	-10.86
intermediate	Beg	3.587	3.102	.483	-3.86	11.04
	Adv	-15.281*	3.057	.000	-22.57	-7.90
advanced	Beg	18.838*	3.312	.000	10.86	26.81
	Int	15.281*	3.057	.000	7.90	22.59

As Table 6 suggests, although the intermediate participants outperformed the beginners, their superiority was not statistically significant. Advanced learners on the other hand, had remarkably better performance than the beginners and the intermediates on word recognition. The superiority of advanced learners was also true on the sentence comprehension test. As Table 7 reveals, advanced learners performed significantly better then the intermediates and beginners on the sentence comprehension test. Intermediates were also significantly superior then the beginners for comprehending the experimental sentences. This may suggest that as the proficiency level increases the priming techniques became more promising and facilitative.

Table7

Comparing the participants of three proficiency levels' performance on sentence comprehension test

Multiple Comparisons						
					95% Confidence Interval	
(I) PTScoreN	(J) sent comp	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
Beginner	Int	-14.580*	3.336	.003	-11.041	3.861
	Adv	-21.128*	3.989	.000	-26.813	-10.860
intermediate	Beg	14.580*	3.356	.003	-3.865	11.041
	Adv	-15.008*	3.084	.000	-22.597	-7.902
advanced	Beg	21.118*	3.989	.000	10.860	26.813
	Int	15.098*	3.084	.000	7.902	22.123

Discussion

The results revealed that both priming techniques would improve both the word recognition and the sentence comprehension of the EFL participants. Moreover, it was found that participants would be affected differently based on their proficiency levels. To be more precise, as the learners become more proficient their performance would be positively affected by priming techniques, however, the outperformance of intermediate learners on LDTs was not statistically significant than the beginners. This may be due to the fact that the activation of the cognitive links between the primes and the target words happens rather similarly for the beginners and the intermediates while this activation occurs more efficiently for the advanced learners who benefit from the stronger cognitive links between the primes and the target words (Khachatryan et al., 2019). The findings of the study

share similarities to Kenett et al. (2017) and Sbicigo, et al. (2017) for the facilitative impact of conceptual priming and were in line with the findings of Kim and Humphreys (2010) and Meade and Coch (2017) for the perceptual primes.

Regarding the sentence comprehension, the findings were consistent with those of Angerbauer et al. (2015) and Viterbo et al. (2020) who claimed that priming techniques positively affect reading comprehension and in contrast with Shen (2015) who documented that priming would be effective just for limited number of comprehension tasks for beginners. Moreover, the positive effect of syntactic priming on comprehension was shown by Ledoux et al. (2007). In line with the results of this research, the positive influence of conceptual priming is also attested for the comprehension ability of learners with aphasia by Lee et al. (2019) and Giavazzi et al. (2018).

Language comprehension involves the activation of stored representations of different types of knowledge. Conceptual priming facilitates the processing of cognitively related stimuli which can be lexical items or even syntactic structures. Neurolinguistically speaking, as Newman et al. (2009) claimed, lexical priming (conceptual priming in particular) would result in a shorter mental reaction-time needed for accessing the related syntactic/compositional structures in the left hemisphere (BA 44 region). In the same vein, Yap and Balota (2015) revealed that conceptual primes by building cognitive associations between the target word and the related concepts and structural constructions can lead to both a better perception and retention of the texts' contents. Yufen (2017) also documented the positive effect of conceptual primes for the English sentences comprehension of Chinese bilinguals.

The results of this study implied that conceptual primes were more efficient than the perceptual ones both for the word recognition and the sentence comprehension probably due to the facilitative conceptual categorization of the mind (Balota, et al., 2007). That is why Marsh et al. (1999) documented that conceptual priming of cognitive tasks would positively affect the creativity of language learners. In the same vein, Yousaf and Popat (2015) suggested that conceptual primes can be employed an as effective and time-efficient intervention by language instructors to encourage learners to expand their lexical domain, comprehension proficiency and even communicative skills.

Putting the efficiency aside, it seems that conceptual primes have more enduring and consistent applicability to facilitate recognition and comprehension as Ward (2022) attested that conceptual primes function competently through the life span and documented that the effectiveness of perceptual primes is highly age-related, in the way that, the teenagers can be

benefitted more than the adults and the elderlies form the perceptually primed stimuli.

It is crucial to indicate that no data or similar research has explored the influence of level of proficiency on the effectiveness of priming or the possibility of an interaction effect. This study indicated that the level of proficiency has a significant effect on both word recognition and sentence comprehension of EFL learners, however, no significant interaction effect was observed between the level of proficiency and priming on the improvement of total scores. The findings suggest that priming has a more significant impact on more proficient participants; however, more data is required to validate or reject this assumption. The total score for the primed group of the advanced participants has increased exponentially. While the mean total score for the non-primed advanced was 44.70 out of 80, the primed group demonstrated a staggering 16.80-point improvement to 61.50.

One conceivable explanation for the obtained result is that less proficient participants have access to a remarkably minimal resource of vocabulary words. As a result, the priming input is processed more problematically, leading to either being processed as new information or a point of reference for the future items, or activation of a lesser number of concepts but with a rigorous effect (Yap & Balota, 2015).

Evidence also suggests that the primed beginner participants had superior performance compared to the non-primed intermediate EFL learners on both word recognition and sentence comprehension tasks, though the level of proficiency was found to be the determinant of success in the study's tasks. This unexpected result confirms the facilitative impact of priming on the EFL learners' recognition (Jin, 2015).

Pedagogical Implications

Priming effect as a psychological phenomenon, by influencing the implicit memory of the language learners, can lead to a subconscious recognition and/or production of the primed items (Shen, 2015). This effect can be exploited as a complementary aid in teaching new lexical items and retrieving the previously-taught ones in a foreign language learning context. Although vocabulary acquisition is one of the most significant aspects of learning a foreign language and learners may learn a large number of vocabulary items, many of these words will remain passive and the learners would not be able to use them properly.

Consequently, taking advantage of the prime-target paradigm, the L2 target vocabulary items can be primed conceptually to affect the learners' subconscious state of the mind and subsequently to complete their mental semantic networks gradually and meaningfully. Applying the conceptual

priming technique as a procedure to enrich the semantic networks of foreign language learners satisfactorily, would help learners access to context-related lexical items affluently (Kim & Humphreys, 2010). By designing pertinent vocabulary drills, even games and role-plays, the retrieval and production of the target primed words could be stimulated and encouraged unconsciously.

Employing the conceptual priming effect is also stressed for reading comprehension development via "priming", "reading", "form focus" and "recycling" steps by Dave and Willis (2007) who claimed that priming not only motivates the learners but also helps them predict the content of the texts. In the same vein Giavazzi et al. (2018) indicated that, like in sentence production, the positive impact of priming can be observed in sentence comprehension independent of participants' expectation.

Conclusion

The primary aim of this research was to investigate whether conceptual and perceptual primes have facilitative impacts on EFL learners' word recognition and sentence comprehension. Secondly, the role of the proficiency level was investigated as a factor that could enhance or inhibit the effect of priming techniques on the participants. LDTs were utilized to evaluate the efficiency of the two priming techniques and documented that both priming types caused statistically significant improvements, however, the facilitative effect of conceptual primes were more remarkable. The participants also demonstrated a better comprehension of the sentences constructed from the primed words either conceptually or perceptually. Additionally, the role of the level of proficiency was confirmed as a parameter that could influence the impact of priming.

The current study focused on improving word recognition and sentence comprehension which not only are crucial components in vocabulary acquisition but also play a significant role in the receptive skills of listening and reading comprehension which may cause the faster development and advancement of other language skills (Balota et al., 2007; Hensen, et al, 2014; Jiang & Huang, 2015). The results from this study can help preparing and developing lesson plans in which conceptual priming techniques are accommodated. This priming technique can be also utilized as warm-ups and preparation phases before reading, listening or vocabulary instruction to enhance the success chance of the learners.

This research managed to provide answers to the proposed research questions; nevertheless, there were limitations and restrictions. Firstly, the participants' performance was measured regardless of their gender and age. Although it was attempted to keep the participants completely focused during the lexical decision and sentence comprehension tasks, few of the participants

might have lost their concentration due to environmental inconveniences. Moreover, although the instructions were clear and had been presented multiple times and at different stages, it was still possible that the participants did not follow them thoroughly (due to their fascination to the animated images or their interest to finish the tests as soon as possible); hence, the findings should be generalized to other contexts cautiously. Although it was seriously attempted to draw conclusions based on unbiased data, the effects of task characteristics that may facilitate quicker access to words and consequently more accurate comprehension, the participants' prior L2 knowledge and their vocabulary size as the factors which could have affected the findings slightly should be acknowledged and recommended for future studies.

About the Author

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