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Effect of Emotional Valence, Frequency and Gender on L2 Word Recognition Time: An Eye Tracking Study

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Abstract

Emotional words are assumed to have a processing advantage over neutral words due to their emotional content. Meanwhile, this advantage depends on other word features such as frequency and the characteristics of the processor and context of learning. Accordingly, the current study investigated the simultaneous impacts of L2 words' emotional valence and frequency, and L2 user's gender on word recognition time in a natural reading context. 43 intermediate EFL learners read 36 sentences in a coherent text for comprehension while their eye movements were recorded by eye-tracker. The findings revealed that participants processed the positive, negative, and neutral words identically based on eye fixation time. However, the frequency effect was attained for both valenced and neutral words. Also, no significant gender differences were approved in terms of recognition time though male participants tended to process all word types slightly faster than female ones. The lack of processing difference between valenced and neutral words is attributed to the disembodiment of L2 emotional words and learning experience of the participants as late EFL learners. These learners have been deprived of affective socialization and the affective sensory experience in their development of L2 emotional words. The absence of valence/frequency interaction is attributed to the L1/L2 relationship in terms of the target words. Although witnessed gender effect did not reach a significance level, it is suggested that the processing of emotional words be viewed in a multidimensional framework where the characteristics of the word, the processor, and the learning context are taken into account.

Keywords: emotional words, eye tracking, frequency, gender, lexical processing, valence

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1. Introduction

The psycholinguistics of emotional language vis-a-vis non-emotional language has attracted the researchers' interest in the last two decades. It has been indicated that emotional language is represented, stored, and processed differently on the mind (Altarriba & Basnight-Brown, 2015). Regarding the fact that emotional language constitutes an enormous part of our language on a daily basis (Heredia & Altarriba, 2014), the processing of emotional lexicons in both L1 and L2 has been an important subject in studying bilingual processing (Pavlenko, 2005).

Emotional words are generally assumed to be processed differently than neutral words (Sheikh & Titone, 2016). A variety of cognitive tasks such as priming, emotional stroop, lexical decision, ERP, etc. have been adopted as research tools to substantiate such a difference. Most of these studies have looked at the processing of emotional words in isolation from natural circumstances of language use through tasks such as lexical decision. However, there have been some attempts in recent years to trace the temporal course of emotional word processing within the context of natural reading. For this purpose, eye-tracking is a technique that has been effectively utilized to examine the natural processing of real texts with a high level of precision. These studies have focused on the effect of valence (positive, negative, and neutral words) on word recognition time during reading (Knickerbocker et al., 2014; Knickerbocker et al., 2019; Scott et al., 2012; Sereno & Rayner, 2003). One more aspect of emotion words that has turned out to affect the processing of emotional words is their frequency (Hand et al., 2010; Scott et al., 2009; Sereno & Rayner, 2003).

On the other hand, Altarriba and Basnight-Brown (2015) have asserted that individual difference factors related to language processors such as their proficiency level, age of acquisition of words, and gender can affect emotional lexical processing in a mixed way. However, the field seems to be in need to examine word processing speed as simultaneously affected by emotional words' features and individual characteristics of L2 learners when they get engaged in natural reading tasks. Hence, the main objective of the present study was to investigate the effect of emotional valence and word frequency on L2 word recognition time in a natural reading comprehension context, taking into account the individual factor of reader's gender to develop a better understanding of the influential factors involved in emotional lexical processing. This study includes novelty in two respects. First, it attempts to observe the temporal aspect of word recognition within a natural

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process of reading comprehension. Furthermore, it combines the individual learner characteristic of gender with emotional features of words in examining the time course of lexical processing.

2. Literature Review

The representation and processing of mental lexicon make up an important aspect of psycholinguistics of second language. L2 learners have a mental lexicon in which they store words' information such as spelling, pronunciation, semantic meaning and part of speech. Lexical processing occurs when we see a string of letters and can tell forthwith whether it's a word or not, and if it is, what it means. This processing is facilitated due to the automaticity involved in word recognition (Jiang, 2018). The type of information invoked by each lexical item, including its linguistic, cognitive, and affective associations can determine the quality of lexical processing. Some of these features are simply properties of words while some other factors are related to individual characteristics of L2 users as language processors. Word frequency, concreteness, imageability, word length, and emotional word properties are some features of words that can affect the facility with which the lexicon is processed. A word like "good" can have a high frequency, while a word like "lawsuit" has a low frequency. High-frequency words have usually been responded to with an advantage compared to low-frequency words. This advantage is known as Frequency Effect (Jiang, 2018).Concreteness is a semantic property of words. Words with higher levels of concreteness are responded to faster when other variables are controlled (Altarriba & Baur, 2004; Altarriba et al., 1999).

L2 learners' gender, level of proficiency and Age of Acquisition (AOA) of a word are among the individual learner differences that have been deemed relevant to lexical processing. AOA is related to frequency effect as well. When words are acquired earlier, they are often of high-frequency and responded to with an advantage. Another essential phenomenon in word recognition is the Context Effect which has been defined as the linguistic context of a word in which it appears. Words take less time to be recognized when they appear in the later part of a sentence than in an early part of a sentence. In other words, when more contextual information is available, it's easier to recognize a word (Marslen-Wilson & Tyler, 1980).

Emotional properties of words such as their valence and arousal have also been

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considered as a significant source of difference in lexical processing. As an instance, Ayciceyi and Harris (2004) reported an enhanced recall and recognition for emotion words compared to neutral words in second language. Studies reveal that not only emotional words are stored and processed differently compared to neutral words, but also emotional words are affected by different cultures in languages exerting differences between emotional word processing in L1 and L2.

With the introduction of positive psychology to SLA studies (MacIntyre & Mercer, 2014), the role played by emotional aspects of the language learner and the language being processed gained additional prominence. According to Broaden-and-Build Theory (Fredrickson, 2001), positive emotions facilitate the exploring and playing capacity of language learners' mind (Broaden) and help establish better social bonds (Build) during SLA. Therefore, studying all emotional features present in SLA context including learners' emotional state, emotional properties of the language being processed, and the emotional aspects of the activities and tasks can provide new insights into understanding how L2 is learned and used. One such area involves the processing of emotional words.

A great portion of research on differential processing of emotional words have resorted to such common cognitive tasks as lexical decision and emotional stroop to examine L1 and L2 word recognition time in decontextualized processing conditions (e.g., Degner et al., 2012; Kousta et al., 2009; Sutton et al., 2007). Nevertheless, the temporal course of word recognition within the context of sentence processing has attracted some researchers' attention recently (Knickerbocker et al., 2014; Knickerbocker et al., 2019; Scott et al., 2012; Sereno & Kayner, 2003).

Emotional words carry the two basic dimensions of emotions, i.e., valence and arousal. While valence has been remarked as an index of an emotion's pleasantness and whether it is positive or negative, arousal is interpreted as the intenseness of the emotion and whether it is exciting or calming (Barrett & Russell, 1998). These aspects of emotional words have been investigated in relation to lexical processing in L2. While some research has attested to the difference between L2 emotional and neutral word processing (e.g., Sutton et al., 2007), a number of studies indicate identical processing in this regard (e.g., Degner et al., 2012).

The type of task utilized for word recognition seems to be a relevant factor in explaining some occasionally-contradicting results. For example, findings from emotional stroop tasks have indicated that emotional words have a hampered

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processing compared to neutral words (McKeana & Sharma, 1995; Nasrallah et al., 2009). Meanwhile, in lexical decision tasks, both positive and negative emotion words were processed in a shorter time compared to unemotional words (Kousta et al., 2009). In a lexical decision task, Kousta et al. (2009) indicated that it took a shorter time for both negative and positive emotional words to be recognized than neutral words regardless of polarity. They even controlled the intermixing effect of word arousal through regression analysis, the results of which showed no intermixing effect of arousal. Their finding was in contrast with some theoretical arguments, such as Delayed Disengagement Hypothesis (Estes & Verges, 2008) that assume an advantage for negative emotion words over positive words.

Empirical research has advocated a privilege for emotional words in their time course of processing during reading activities. (Knickerbocker et al, 2014; Knickerbocker et al, 2019; Scott et al., 2012; Sereno & Rayner, 2003; Sheikh & Titone, 2016). In an outstanding query on recognition time of positive, negative and neutral words during reading sentences, Scott et al. (2012) reported an overall advantage for both positive and negative lexicon over neutral ones.

One consideration in these investigations when observing the differential effects of valence on word processing has been the distinction between two types of emotional words, i.e., emotion or emotion-label words vs. emotion-laden words (Pavlenko, 2008). Emotion-label words represent an emotional state of mind (e.g., joy or anger), and emotion-laden words (e.g., coffin, harassment) simply express an association with an emotional state. While in Scott et al.'s (2012) study, there was an intermixing of emotion words and emotion-laden words, Knickerbocker et al. (2014) delimited their study to emotion words and compared the processing timeline of emotion words. The results demonstrated easier processing of positive and negative emotion words relative to neutral words. Knickerbocker et al (2019) focused specifically on the processing timeline of emotion-laden words and indicated a remarkable privilege for both positive and negative words over neutral words though the latter effect was reported to be less robust.

Another feature of emotional words that has been remarked as relevant to their temporal processes in natural reading is word frequency. Regardless of their emotionality, high-frequency words are deemed to be recognized with higher speed than low-frequency words in natural reading (Hand, et al., 2010; Sereno & Rayner, 2003). Furthermore, the combined impact of valence and frequency on word recognition during receptive processing of sentences has been the subject of a

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number of investigations in this area. In an attempt to observe this simultaneous effect, Scott et al. (2012) resorted to eye-tracking technique. The results showed that both positive and negative-valenced words were faster to recognize than unemotional words. However, the facilitative effect of valence was moderated by word frequency. High-frequency positive emotion words were processed faster than neutral words while negative and neutral high-frequency words were recognized with identical speed. For low-frequency items, words on both ends of emotional polarity were similarly processed faster compared to their neutral counterparts.

The interaction effect between valence and frequency had already been reported by studies examining word recognition time through other types of tasks (e.g., lexical decision task) than in reading context (Kuchinke et al., 2007; Scott et al., 2009). Scott et al. (2009) utilized ERP to see the intermixing influence of emotional valence and word frequency in lexical decision tasks. The results showed both positivity and negativity effect with low frequency words. In contrast, the processing speed of positive words was significantly higher than both negative and neutral words in the case of high-frequency words. Kuchinke et al. (2007) examined native German speakers' performance on a lexical decision task. The results indicated main and interaction effects for frequency and valence.

An additional subject of inquiry in relation to the processing of emotional lexicon is the way individual characteristics of the L2 user can possibly affect this processing. In this regard, a number of L2 learner characteristics including L2 learners' level of proficiency, L1, gender, age of acquisition (AOA), learning experience and affective states such as mood and anxiety have been remarked as influencing the differential processing of positive, negative and neutral words (Altariba & Basnight-Brown, 2015). Conrad et al. (2011) demonstrated a facilitated processing of positive emotion words by low-proficiency bilinguals, an advantage that was not observed for negative words. The finding of this study seems to be in contrast with the other studies reviewed here which can be attributed to the level of proficiency of the participants in the research.

Knickerbocker et al. (2014) brought an interesting aspect of learner characteristics into investigation in relation to emotional word processing. Their study indicated an interaction between learners' anxiety state and negative valence in affecting the word processing speed in reading. Readers with higher scores of anxiety had smaller recognition time for negative words in comparison to neutral words. Such an effect for anxiety was not observed in the case of positive valence.

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In a similar study, Sereno et al. (2015) probed the interactive effect of word emotionality and frequency with learners' positive, negative and neutral mood as induced by treatments involving different types of music. The results indicated interaction effects between valence and frequency as well as valence and mood. The observed interaction between emotion words and comprehenders' mood comprised an irregular pattern of variability which was in contrast with Mood Congruency theory (Bower, 1981). Although the overall pattern depicted a facilitated processing of emotion words in both positive and negative mood compared to neutral mood conditions, the congruency between learners' positive and negative mood on the one hand and positive and negative emotion words on the other was not observed.

Level of proficiency is another L2 learner variable that is supposed to be associated with the processing of emotional words. El-Dakhs and Altarriba (2019) reported a divergence between the performance of pre-intermediate and advanced level university students with English as their L2 on a free recall task. High proficiency learners outperformed their low-proficiency counterparts in processing both emotion-laden and emotion-label words. They also referred to Arabic as learners' L1 as a source of variability in the processing of emotion words.

Based on the research background reviewed here, the research on the nature of the processing of emotional words must take the following dimensions of this processing into account in order to ascertain a comprehensive image in this regard:

1. The type of emotional word, e.g., emotion-laden vs. emotion-label
2. The type of task used to elicit word recognition, e.g., reading comprehension, lexical decision, etc.
3. Word features such as frequency, length, valence, arousal, etc.
4. Affective state of the language user, e.g., anxiety, mood and other emotions
5. Individual characteristics of the language user such as gender, level of proficiency and age of acquisition

The current study aimed to account partially for the processing of emotion words within such a context. Eye-tracking was employed to measure the eye fixation time as an index of word recognition speed in natural reading context. Accordingly, the following questions were devised to guide the research to this end:

1. Does emotional valence have any effects on word recognition time in L2 reading?
2. Does word frequency have any effects on word recognition time in L2

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reading?

3. Is there any interaction between emotional valence and frequency of words in affecting word recognition time in L2 reading?

4. Is there any difference between male and female learners' recognition time of high frequency and low frequency L2 words in reading?

5. Is there any difference between male and female learners' recognition time of positively valenced, negatively-valenced and neutral L2 words in reading?

3. Methodology

The current study aimed to examine the processing of emotion words within sentences during silent reading by English L2 speakers, with one methodological improvement compared to previous research that the reading sentences here were interrelated and made up a storyline in the form of a cohesive and coherent text which is more conformant with normal and natural contextualized reading compared to individual unrelated sentences which had previously been employed in several studies (e.g., Scott et al., 2012; Sheikh & Titone, 2016). Since the focus of the study was on the temporal aspects of emotion words' recognition, eye-tracking technique was found appropriate and compatible with the nature of the stimuli and the purpose of the study regarding the fact that measuring eye movements during natural reading can provide helpful data on temporal course of processing emotion words in relation to both features of the word and characteristics of the processor.

3.1. Participants

The participants were selected from Multimedia Faculty of Tabriz Art University undergraduate students taking their General English course at the time of research. Initially, a sample of 64 participants (30 female, and 34 male; mean age = 22 years) who were late Persian-English bilinguals took part in this research on a convenience sampling basis. All of the subjects took Preliminary English Test (PET) to rate their proficiency in English and to see if they were eligible to participate in the study. After analyzing the results of PET, those who scored 1SD above and below the mean were selected from both groups of female and male students. Besides, 4 students were dropouts so that the number of the remaining participants was reduced to 43 (23 female, and 20 male). No neurological disorder was reported, and the visions of the participants were normal or corrected-to-normal. The participants

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were granted academic credits in compensation for their participation.

3.2. Apparatus

The device used to observe and record the eye fixation time of the participants while reading the given text was Tobii Eye Tracker 4C. The eye-tracking device used in this research was attached to the bottom of the monitor and had no equipment to be attached to the participants. Since the participants had already been told to sit still and not to change their position while reading the texts, they maintained it throughout the experiment. It must be noted that the lack of equipment such as chinrest would let the experiment run like a natural reading. Before presenting the stimuli, an initial calibration of the eye-tracking system was conducted. A calibration display appeared at the beginning of each trial. In the calibration display, participants were instructed to look at the spots displayed on the screen and keep looking at them till the eye-tracking system recognized their eyes. Then, in three seconds, some spots were displayed on the screen, participants were told to keep track of them till they popped off, and then the calibration was perfectly and thoroughly done. The signals from the eye tracker sampled every frame, and the eye movements' recording was binocular. Participants sat in 50 cm distance from the monitor.

3.3. Design and Materials

The design used was 3 (Positive, Negative, Neutral emotionality) × 2 (Low, High frequency) × 2 (Male, Female). Following Scott et al. (2012), the target words (emotion and emotion-laden) were obtained from the Affective Norms for English Words (ANEW) which is a lexical data of 1000 words (Bradley & Lang, 1999). ANEW defines words in terms of valence, arousal, and frequency. Valence ranges from 1 (signifying lowest negative) to 9 (signifying highest positive meaning), and arousal ranges from 1 (signifying low-intensity) to 9 (signifying high-intensity). The criteria for the selection of target words were based on valence, frequency, imageability (concreteness), and word length. Valence values and frequencies were acquired from ANEW (Bradley & Lang, 1999). And imageability norms were based on the Bristol Norms (Stadthagen-Gonzalez & Davis, 2006) and Brysbaert, et al., (2014).

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Totally 36 words (12 words from each type of positive, negative, and neutral) were obtained from ANEW, 18 words of which were chosen from the high frequency words, and other 18 words were chosen from the low frequency words. The valence values were 1-4, 4-6 and 6-9 for neutral, negative and positive words respectively. Two texts comprising 18 neutral sentences were structured including the target words. The number of the valenced items other than the emotion target words in the sentences was minimized to provide neutral sentences. One text contained 18 HF target words (6 words for each type of emotionality), and the other text contained 18 LF target words (6 words for each type of emotionality). Hence, two texts including 36 sentences were displayed on a Unity (game engine) in Times New Roman font. The sentences comprised 8 slides, 4 slides for each text.

The means of valence, frequency, imageability and word length of HF and LF target words were controlled to be pretty the same. The order of sentences including the target words was controlled in a way not to have two sentences containing the same type of target word sequentially. (e.g., the sentence having the positive word was followed by a sentence having either negative or neutral target word). Each text included cohesive, coherent and meaningful sentences about a subject. The target lexicon were placed around the middle point of the sentences, for when words appear in a later part of a sentence it takes less time for them to be recognized (Marslen-Wilson & Tyler, 1980). In other words, the number of the pre-target characters, and post-target characters was pretty the same. Participants were told beforehand that they should read the texts carefully in order to answer some reading comprehension questions afterward. Participants answered a total of ten true-false questions (five questions for each text).

In addition, Preliminary English Test (PET) was utilized to determine learners' English proficiency so that their homogeneous eligibility to participate in the research would be recognized. The PET included five parts of reading containing thirty-five reading comprehension questions. Due to the fact that the nature of the stimuli was in the reading format, the reading section of the PET was considered as an appropriate criterion for the measurement of English proficiency.

3.4. Procedure

The participants first took Preliminary English Test (PET) to allow rating their general reading proficiency in English and ensuring homogeneity. Once the

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participant selection was completed, they were invited to attend the eye tracking session individually according to a prepared time plan. The participants were individually tested; meanwhile, one of the researchers was present to monitor the participants' performance on the task. They were asked to read two separate texts, and press the designated key to go to the next slide when done with reading the sentences. The texts were made distinct by titles at the top of them (Reading 1, Reading 2). Participants were warned that they were not allowed to go back to the previous slide. They were requested to read the texts as carefully as possible to be able to answer some true false questions about the text afterward. The comprehension questions were expected to enhance readers' focus on meaning. However, the participants were unaware of the research purpose.

4. Results

Participants read all the sentences as described before. The results of the eye-tracker demonstrated the eye fixation time every participant had on the target words (positive, negative, and neutral). Three participants (2 male and 1 female) lost the track so their eye movements were not analyzed. Thus participants' number was reduced to forty-three. The output of the eye-tracker was in frames, and it was set to 60 frames equaling 1 second. Then, they were converted to milliseconds using this formula: *Word recognition time/60×1000*. The calculated amounts for word recognition time were assigned to statistical analysis to answer the research questions.

4.1. The Effect of Emotional Valence on L2 Word Recognition Time

Target words were grouped into three categories according to their emotional valence (positive, negative, and neutral). Eye fixation time of the reader on the three word categories was measured. As indicated in Figure 1, neutral words were processed faster than negative words, and negative words were recognized faster than positive words.

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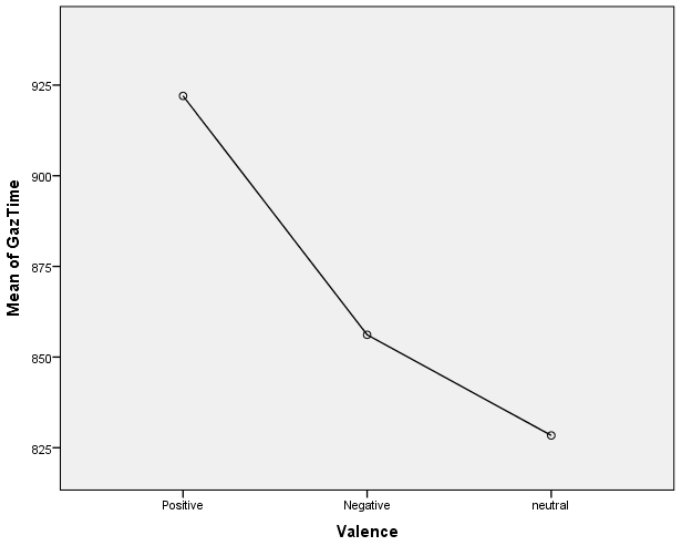
Figure 1
Means of Word Recognition (gaze) Time by Emotional Valence



To probe whether the observed differences reached significance level, the word recognition mean time of the three word groups were compared through one-way analysis of variance. Despite the relative processing advantage observed for positive and negative words over neutral words, the difference did not reach statistical significance ($p > .05$, $F (2, 33) = .63$ $p = .535$). Accordingly, the effect of the emotional valence on word recognition time was not approved.

Table 1
The Effect of Valence on Word Recognition Time

	Sum of Squares	df	Mean Square	F	Sig
Between Groups	55517	2	27759	.637	.535
Within Groups	1439083	33	43609		
Total	1494601	35			

4.2. The Effect of Frequency on L2 Word Recognition Time

The word recognition mean times of words with distinctive frequencies are reported in Table 2. As demonstrated, high-frequency words have lower word recognition mean time compared to low-frequency words.

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Table 2
Means of Recognition Time for High/Low Frequency Words

Frequency	N	Mean	Std. Deviation	Std. Error Mean
Word RT High	18	782.15	150.722	35.526
Low	18	955.56	221.994	52.324

To study the effect of frequency on L2 word recognition time, the mean time of the two word groups were compared conducting the Independent Samples T-Test.

Table 3
Comparing Word Recognition Time of High and Low Frequency Words

		Levene's Test for Equality of Variances		t-test for Equality of Means						
		F	F Sig.	t	f	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									ower	Upper
Word RT	E. V. assumed	3.227	.081	-2.7	34	.010	-173	63	-302	-45
	E. V. not assumed			-2.7	30	.010	-173	63	-303	-44

According to the Sig. value of Levene's Test for equality of variances, the assumption of equal variances has not been violated, $p > .05$, $p = .081$, and the difference between word recognition mean time of high ($M = 782.15$, $SD = 150.722$) and low frequency ($M = 955.56$, $SD = 221.994$; $t(34) = (-2.742)$, $p = .010$, two-tailed) words was statistically significant. Consequently, word frequency turned out to be effective in L2 word recognition time in reading.

4.3. The Interaction Between Emotional Valence and Frequency

To explore the interactive effect of frequency and valence on word recognition time, a two-way ANOVAwas performed based on a 2×3 design. The descriptive data for each word type is provided in Table 4.

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Table 4
Means of Word Recognition Time Based on Frequency and Valence

Frequency	Valence	Mean	Std. Deviation	N
High	Positive	799	186	6
	Negative	754	198	6
	Neutral	793	44	6
	Total	782	151	18
Low	Positive	1045	198	6
	Negative	958	314	6
	Neutral	863	99	6
	Total	956	222	18
Total	Positive	922	222	12
	Negative	856	272	12
	Neutral	828	82	12
	Total	869	207	36

The result of the analysis does not provide proof for any interaction effect between valence and frequency (Table 5).

Table 5
Interaction Between Valence and Frequency

Source	Type III Sum of Squares	f	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	376907[a]	5	75381	2.02	.10	.25
Intercept	27176553	1	27176553	729	.00	.96
Frequency	270628	1	270628	7.26	.01	.19
Valence	55517	2	27759	.74	.48	.08
Frequency*Valence	50761	2	25380	.68	.51	.04
Error	1117694	30	37259			
Total	28671154	36				
Corrected Total	1494601	35				

a. R Squared = .252 (Adjusted R Squared = .128)

Figure 2 demonstrates that the strength of the interaction effect between frequency and valence was not statistically approved, F (2, 30) = .68, p > .05, p = .51.

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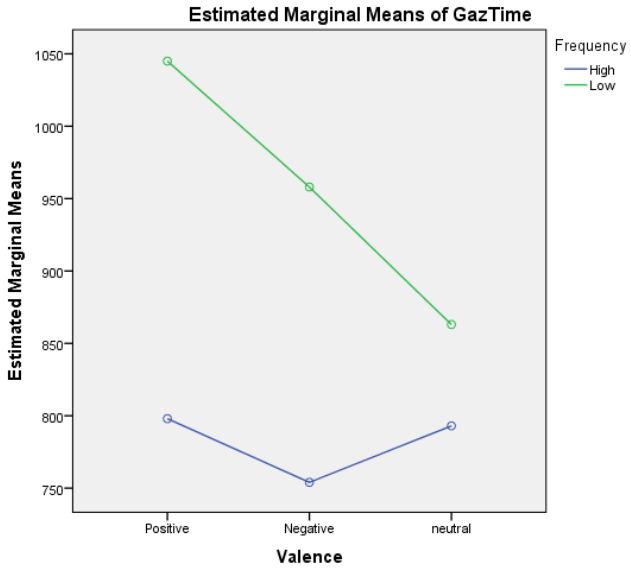
Figure 2

The Interaction of Valence and Frequency



4.4. Gender Differences in Processing High and Low Frequency Words

Descriptive statistics related to eye fixation times in processing the words of distinctive frequencies by male and female L2 learners is indicated in Table 6.

Table 6

Recognition Time for High Frequency and Low Frequency Words by Male and Female learners

	Gender	N	Mean	Std. Deviation	Std. Error Mean
RTHF	Male	20	692	321	72
	Female	23	861	374	78
RTLF	Male	20	896	359	80
	Female	23	1007	417	87

To investigate gender differences, independent-samples T-Tests were conducted. As shown in Table 7, there was no significant difference in high frequency word recognition time for males (M = 692.62, SD = 321) and females (M = 861, SD = 374; t (41) = -1.58, p = .122, two-tailed, p > .05).

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Table7

Difference Between Male and Female L2 Learners in Processing High and Low Frequency Words

		Levene's Test for Equality of Variances		T-Test for Equality of Means						
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
									Lower	Upper
RTHF	E. V. assumed	.505	.48	-1.58	41	.122	-169	107	-385	47
	E. V. not assumed			-1.60	41	.118	-169	106	-383	45
RTLF	E. V. assumed	.001	.97	-.93	41	.359	-111	120	-352	131
	E. V. not assumed			-.94	41	.354	-111	118	-350	128

Similarly, there was no significant difference in low frequency words' recognition time for males (M = 896, SD = 359) and females (M = 1007, SD = 417; t (41) = -.927, p = .359, two-tailed, p > .05). Therefore, gender was not a relevant factor in distinctive processing of high-frequency and low-frequency words.

4.5. Gender Differences in Processing Positive, Negative and Neutral Words

An important concern of the current study was to inquire into any gender differences in recognition times of emotional words during reading activity. The descriptive data regarding eye fixation times in the processing of positive, negative and neutral words by male and female L2 learners is demonstrated in Table 8 below.

Table 8

Recognition Time for Positive, Negative and Neutral Words by Male and Female Learners

	Gender	N	Mean	Std. Deviation	S. Error Mean
RTPos	Male	20	802	394	88
	Female	23	1026	405	84

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	Gender	N	Mean	Std. Deviation	S. Error Mean
RTNeg	Male	20	794	341	76
	Female	23	910	496	103
RTNeu	Male	20	785	339	76
	Female	23	866	342	71

To seek for gender differences, three independent-samples T-tests were conducted. As displayed in Table 9, there was no significant difference in positive words' recognition time for males (M = 802, SD = 394) and females (M = 1026, SD =405; t (41) = -1.8, p = .07, two-tailed, p > .05).

Table 9

Male and Female Learners Processing of Positive, Negative and Neutral Words

	Levene's Test for Equality of Variances		T-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
RTPos	E. V. assumed	.023 .88	-1.8	41	.07	-224	122	-471	23
	E.V. not assumed		-1.8	41	.07	-224	122	-470	22
RTNeg	E. V. assumed	1.90 .17	-.9	41	.38	-116	132	-382	150
	E. V. not assumed		-.9	41	.37	-116	129	-376	144
RTNeu	E. V. assumed	.23 .63	-.77	41	.44	-80	104	-290	130
	E. V. not assumed		-.77	41	.44	-80	104	-290	130

The comparison of recognition time of negative words by male and female participants failed to reveal any significant difference in negative words' recognition time for males (M = 794, SD = 341) and females (M = 910, SD = 496; t (41) = -.9, p = .385, two-tailed, p > .05). Identical results were obtained for gender differences regarding the recognition time of the neutral words (Table 9). There was no significant difference in negative words' recognition time for males (M = 785,

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SD = 339) and females (M = 866, SD = 342; t (41) = -.771, p = .44, two-tailed, p > .05). In all three cases, the mean differences were not big enough to testify to gender differences.

5. Discussion

The aim of the present study was to probe into simultaneous effects of emotional valence, frequency, and participant's gender on L2 word recognition time in natural reading. The results demonstrate that the L2 emotion words were processed similar to neutral words. There was no significant difference between male and female students in terms of recognition time of neither valence nor frequency categories of words. However, the frequency effect was observed for the three word groups of valence. Thus, emotional valence and gender didn't have any effects on L2 word recognition time in reading while the frequency effect was statistically approved.

The absence of difference in the processing of positive and neutral words during reading is in contrast with a number of related researches (Knickerbocker et al, 2019; Scott et al., 2012; Sheikh & Titone, 2016). Positive words were processed slower than both negative and neutral words which doesn't support the Positivity Effect (Mergen & Kuruoglu, 2017). Furthermore, the absence of the privilege for negative words is in contrast with Bradley's (2000) Approach-Appetitive Theory according to which negative words are recognized faster than neutral words because survival requires withdrawal from threatening situations implied by negative emotions. Nevertheless, recent studies have testified to the lack of advantage for negative emotion words compared to neutral words which is compatible with the findings here.

Researchers of emotionality effect on L2 word processing have resorted to Pavlenko's (2005) Theory of Language Embodiment to explicate polarity effects in word processing. The Language Embodiment Theory (Pavlenko, 2005, 2012) asserts that affective socialization occurs in early childhood, and the formal information of words is integrated with the autobiographical and affective information perceived through five senses at this phase of life. When exposure to L2 words occurs beyond this phase, the words are disembodied. According to Sheikh and Titone (2016), negative emotion words in L2 have been disembodied as a result of L2 learners in an EFL context being deprived of opportunities to use those words in L2 contexts that provoke enriched emotional experience. Disembodiment provides an explanation for the absence of emotional effect for L2

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negative words in their processing during reading. One might conceive of a similar explanation regarding positive emotion words.

According to Sheikh and Titone (2016), what keeps positive words from disembodiment is Positivity Bias concerning L2 emotional words. However, the results of the current study have countered this argument; in spite of the fact that positive words were processed slightly faster than neutral words, the difference was not large enough to reach statistical significance. This is a proof that the participating L2 learners of English in this study might have also been subject to disembodiment with regard to positive emotion words just like negative ones. Based on this reasoning, because participants of the current study were late learners of English, they hadn't been through the affective socialization process which occurs in early childhood; besides, participants had all learned the L2 in decontextualized language classrooms that are unnatural settings. Consequently, English as the second language of the participants was not provided with many opportunities to integrate with all sensory modalities. Hence, English as the L2 of the participants was disembodied language and low in emotionality (Dewaele, 2004, 2008, 2010; Pavlenko, 2005, 2012).

Furthermore, Emotional Context of Learning Theory proposed by Harris et al. (2006) states that emotional distinctiveness of a language depends on its context of learning and use. While first language acquisition context is highly emotional, the context of L2 learning is not always emotional (Schumann, 1997). Participants of this study had learned English as the foreign language in such contexts at schools or foreign language institutes which are formal and neutral contexts. Hence, the language learned and stored in an unemotional context would lack the emotion that the L1 context would provide the learners with. Therefore, the emotion words learned and stored in an unemotional context would be stored similar to neutral words. Consequently, the findings of this study can be explained by both the Emotional Context of Learning Theory (Harris et al., 2006) and Language Embodiment Theory (Pavlenko, 2005), consistent with studies that found no differences in processing emotion and neutral words in L2 (e.g., Degner et al., 2012).

As to the effect of frequency on the processing of emotion words, the results showed that, consistent with previous research, generally, high-frequency words were recognized faster than low-frequency words. Although there was no significant interaction between valence and frequency in contrast to Scott et al. (2012), comparing the word recognition time of high frequency and low frequency

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words supported the frequency effect for all three word groups, with high frequency words having shorter fixation time compared to low frequency words. This result is compatible with studies using both lexical decision task (Kuchinke et al, 2007; Scott et al., 2009), and eye movement in reading (Hand et al., 2010; Scott et al., 2012; Sereno & Rayner, 2003).

However, checking out the mean time of word recognition in three word groups (positive, negative, & neutral), it was revealed that positive words have the slowest recognition time followed by negative and neutral words in LF word group, while in HF group positive words have the slowest recognition time followed by neutral and negative words. In the absence of statistical significance, a closer examination of mean times indicates that neutral words' recognition was relatively faster than positive and negative words in LF word group, and faster than negative words in HF word group. This result is not consistent with studies in which there was a processing advantage for positive words over neutral words of both high and low frequency or negative words over neutral words in terms of low-frequency words (Kuchinke et al., 2007; Scott et, al., 2009; Scott et al., 2012). Although the overall patterns of mean recognition times of valence/frequency crosspoints in the current study corresponds with the findings of these studies, the differences indicated only a tendency and they did not reach a significance level. One possible explanation for this result might be related to the nature of the 36 target words selected for this study. Three of the neutral target words (method, poster, and theory) are already loanwords in Persian. This could have increased the level of frequency effect which could in turn lead to shorter fixation time.

Finally, analyzing the word recognition time of male and female participants, it was revealed that there was no significant difference between male and female participants. However, an interesting pattern of insignificant gender differences was witnessed in relation to both valence and frequency (Tables 6 and 8). Male learners clearly tended to process all word types remarkably faster compared to female participants. Since the participants' level of English proficiency was already controlled and there was not a significant difference in terms of proficiency level between male and female learners, the obtained results shed light on another dimension of emotional word processing, i.e., the processor's gender. El-Dakhs and Altariba (2019) have emphasized that individual difference factors such as L1 background and L2 development conditions must be observed alongside word features related to emotional words in order that a comprehensive view of emotional

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word processing is achieved. Further studies are recommended in this regard.

6. Conclusion

The results of this study indicated that positive and negative words were not recognized faster than neutral words in a natural reading comprehension task, a phenomenon which is imputable to the disembodiment of L2 emotion words in the foreign language context. Taking into account that emotional language is intertwined with the settings in which it was first learned, new L2 words could be embedded into context in order to elicit learners' feelings and reactions so that their sensory associations could be engaged while learning the new items. This elicitation of feelings and reactions can lead to physiological reactions to the objects and events resulting in a better and deeper encoding of new words, unlike the standard rote memorization (Heredia & Altarriba, 2014).

The advantage attributed in the literature to emotional words must be viewed more cautiously as the emotionality advantage seems to be dependent on a wide range of variables. The first variable is the type of emotional word due to the fact that emotion-laden and emotion-label words seem to behave differently in this regard (Altarriba & Basnight-Brown, 2011). Other aspects of word features, including the well-studied frequency effect, concreteness and imageability play their part. Another important set of variables in this respect is the characteristics of the processor. The L2 user's learning experience, L1, age of acquisition, gender, and emotional state are among the individual differences with some potential to affect the processing of L2 emotional words.

An overarching understanding of emotional word processing requires observing all above-mentioned factors alongside each other. As an illustration, one explanation provided in this study for the lack of negative word advantage over neutral words pertained to the relationship between L1 and L2; since the neutral words were common loan words borrowed from English into Persian, it was argued that they must have improved the overall processing rate of neutral words. As another example, Knickerbocker et al. (2014) indicated an association between L2 learner' anxiety state and the processing of negative words. Therefore, learners' emotional state at the time of reading is another variable that needs to be examined when studying emotional word processing. By focusing on L1 effect, El-Dakhs and Altariba (2019) drew the researchers' attention towards the learning experience of

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L2 learners, including the conceptual differences established by different cultures (Pavlenko, 2008). This can itself be a further proof that emotion word processing research needs to be carried out in different linguistic and cultural backgrounds to provide a comprehensive platform for further studies. The processing of emotional words is a multidimensional phenomenon.

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