The relationship between neighborhood and retention of vocabulary

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Abstract

Numerous studies have been carried out to find the relation between neighborhood effect and retention of lexical items. This study was an attempt to find such a relationship among Iranian EFL learners. Participants, advanced second English learners, were chosen based on the Oxford Placement Test. Participants completed a lexical decision task that was designed and performed by a computer software. Results of this study support the idea that English language learners use the same strategies of lexical item retentions as native speakers. The results also support IAC and DRC models of word recognition.

Key terms: neighborhood effect, retention, lexical items

Introduction

The concept of N-metric was first introduced by Landauer and Streeter (1973) to refer to the number of words that can be created by changing a single letter of a target word. One of the first studies in this area was conducted by Coltheart, Davelaaar, Jonasson, and Besner (1977) who reported that classification of high-N non-words is slower than that of low-N non-words. The literature on neighborhood effect, however, is not without contradictory results. For example, Andrews, (1989) reported that high-N results in a better performance in lexical decision and naming tasks while Grainger et al (1989) reported that high-N results in slower classification than low-N. However, few studies have actually measured neighborhood effect on foreign language learners' lexical retention. The aim of this study is to move beyond first language and test current lexical retention models and methods on second language learners' lexical retrieval.

Word frequency effect is based on the idea that words that frequently occur in the printed language are easy to recognize. Whaley (1978) reported that the most important factor in lexical decision tasks (LDT) is frequency. A more recent term, 'neighborhood" closely related to frequency has received attention. Landauer and Streeter (1973) first defined neighborhood of a word as the number of orthographically related words or non-words that can be created by changing a single letter of the target word. Coltheart (1977) called this

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neighborhood size or metric (N-size/N-metric). Orthographic neighborhood has two features: first, the number of orthographic neighbors (the orthographic neighborhood density or size) (Samson & Pillon, 2004), commonly defined as the number of words that sound similar to a target word (Ziegler, Muneaux& Grainger, 2003) and second, the number of orthographic neighbors of higher frequency than the target stimulus (the orthographic neighborhood frequency). In simplified language, orthographic neighborhood is the number of the neighbors of a word and the frequencies of the neighbors (Snodgrass & Mintzer, 1993). Beside orthographic neighbors, there are five other kinds of neighbors: phonographic neighbors, phonological neighbors, body neighbors, lead neighbors and consonant neighbors (Peereman, 1997)

Research has reported that by using lexical decision task (LDT) high neighborhood non-words were classified more slowly than non-words with few word neighbors and there was no relationship between performance of words and N (Coltheart, Davelaar, Jonasson, &Besner, 1977). In 1989 two papers were published which were contradictory in their conclusions. Andrews (1989) reported that high neighborhood resulted in better performance in LDT and naming task. However, Grainger, O'Regan, and Segui (1989) reported that words with high-N are classified more slowly and LDT and eye fixation duration are longer in words with at least one high frequency neighbor. These contradictory results opened the flood gate of research in this field which attempted to evaluate current models of word recognition. A very comprehensive review of these papers was published by Andrews (1997).

Ziegler and Perry (1998) examined the role of body neighbors (BN) in facilitation or inhibition of LDT. They state that "when words were matched for N, the effects of BN were facilitative. In contrast when words were matched for BN, the effects of N were unviable with a tendency to inhibition. Surprisingly, BN had no inhibitory effects on non-word latencies." Research also has emerged examining neighborhood effect among mental patients. A study by Gordon (2002) on aphasic speech errors concluded that both lexical frequency and neighborhood density exert a facilitative effect on the accurate retrieval of words in aphasic speech production, just as they do in normal speech production. Westbury, et al (2002) moved beyond orthographic level providing a new insight into phonological neighborhood effect and phonological lexical organization. Westbury, et al (2002, p.639) suggested that "lexical activation spreads by both whole-word and sub-word units." Their findings implied that "sub-word phonological components may be active for some time. This could create a problem for text comprehension if it produced a number of conjunctions errors. However, the phonological/orthographic complexity of text or discourse combined with the constraints of semantics should make such errors unlikely."

Research shows that bilingual speakers try to keep interference of both languages at minimal level. The fact is, however, that interference is inevitable in both languages (Walter, et al., 1998). Their experiments provide evidence for parallel activation of words in an integrated Dutch/English lexicon. On the whole, their findings support the Bilingual Interactive Activation model (BIA).

Research Questions

Regarding the foregoing discussion, the study aims at answering the following research questions:

1) Does lexical neighborhood have any effect on retention of vocabulary items by Iranian advanced EFL learners?
2) Is there any relationship between orthographic neighborhood effect and retention of vocabulary items by Iranian advanced EFL learners?

Participants

Twenty eight (N = 28) bilingual boys and girls aged from 16 to 23 who were advanced EFL learners and whose native language was Farsi were recruited in this study. These students had passed OPT (Oxford Placement Test) and were graded as advanced EFL learners. Participants were randomly selected using simple random sampling from within participants who successfully passed OPT.

Materials

In English the number of words which have many orthographic neighbors and few body neighbors is limited. Furthermore, we encounter another problem which is that the number of words with many body neighbors but few orthographic neighbors is limited. Therefore, a perfectly orthogonal design of neighbors and body neighbors cannot be obtained in English. Thus, we had to limit our study to the ideal orthogonal design. Professor Conrad Perry kindly helped us in the materials and permitted us to use his method in this study. Thus, we used the design and items he had used in his studies (Ziegler & Perry, 1998). We manipulated body neighbors in two different approaches. In the first one we manipulated BN while keeping N constant and manipulated N while keeping BN constant in the second one. Words and non-words were manipulated in this way. Items were selected from computerized databases.

The stimulus collection of this study consisted of 160 items, 80 words and 80 non-words. Half of the items were five letters long and the other half were four letters long. According to the word frequency count that was established by Kucera and Francis (1967), all of the selected words were considered as low frequency. In the Body Neighbors (BN) manipulation, 20 words had few body neighbors (BN<3) and 20 words had many body neighbors (BN>14). For these 40 words N was kept constant and both groups were matched for word frequency and word length. In the N manipulation, 20 words had few orthographic neighbors (N<3) and 20 words had many orthographic neighbors (N>5). For these 40 words, BN was held constant. The non-word manipulation was done like word manipulation. In BN manipulation 20 non-words with few body neighbors and 20 with many body neighbors were used while keeping N constant. In N manipulation 20 non-words with few orthographic neighbors and 20 with many orthographic neighbors were used while keeping BN constant. Pseudo words were used as primes. Pseudo words have been suggested as stimuli because they prevent semantic priming effects in the course of experience (Harley, 2008).

Procedure

Participants were given a trial section in order to get familiar with the procedure. Participants were seated in front of an Asus Eee PC laptop computer screen (10 inches) and were given verbal instructions. This experiment used 15 trial items and 160 experimental items. The experimental and trial were presented in random order for each participant. The trial began with the presentation of an item at the center of the screen. After 1500ms the item in the case of no response was replaced with the next stimulus that remained on the screen until a response was given. Participants knew that they had to indicate as rapidly as possible whether that stimulus was a word or a non-word. When a participant was ready s/he pushed a button (Right SHIFT for words and Left SHIFT for non-words). Then the prime was removed. Participants did not receive any feedback. Reaction times were measured by the computer between the onset of the stimulus and each participant's response. After the experiment some participants reported that they saw a word several times, while the software was designed to show each word and pseudo-word just once.

Results

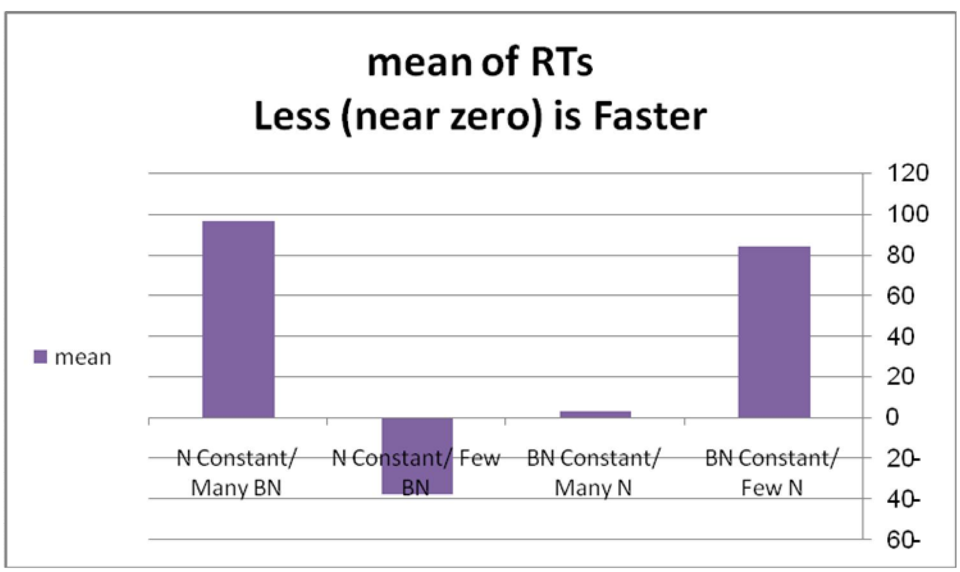
The results show that large body neighbors had an inhibitory effect on word recognition because when N is constant and BN is manipulated, mean word RTs for small BN is negative (-37), which means that participants made more errors. On the other hand, when N was manipulated, the effect is facilitative for BN Constant/Many N, which means that large N has a facilitative effect. It must be mentioned that these results are obtained based on orthographic neighborhood effect. Consistency of these results over other kinds of neighborhoods must be measured and could be subjects of other studies. The following table shows the mean correct response time (RT) latency of body neighbor (BN) and neighbor (N) manipulation of this study.

Table 1. Mean Correct RTs of BN and N manipulation

BN Constant/ Few N	Mean	84.1114
	Median	415.7550
	Variance	658282.053
	Std. Deviation	811.34583
BN Constant/ Many N	Mean	3.0846
	Median	341.1750
	Variance	669194.869

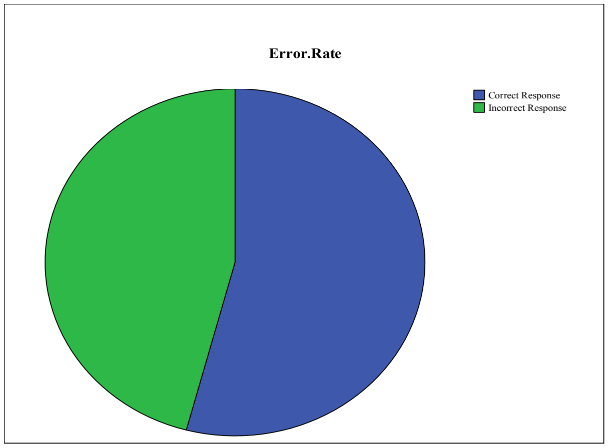
	Std. Deviation	818.04332
N Constant/ Few BN	Mean	-37.4853
	Median	-272.7100
	Variance	692099.362
	Std. Deviation	831.92509
N Constant/ Many BN	Mean	96.4196
	Median	425.9850
	Variance	653767.239
	Std. Deviation	808.55874

Figure 1:Mean of RTs



The results reveal that Iranian advanced second language English learners are more confident with words with fixed BN and large N (~3.08ms) and that this has a facilitative effect on word recognition. On the whole, participants showed difficulty in the cases of "N Constant/Few BN" (~ -37). In the case of "BN Constant/Few N" and "N Constant/Many BN", it seems the effect is "NULL" because for both of them inhibitory effect had the same effect.

Figure 2: Correct/Incorrect Response ERROR RATE



The figure illustrates error rates for correct and incorrect responses. Overall, as it is obvious correct responses are slightly larger in number than incorrect responses.

Table 2: T-Test (word/non-word)

Group Statistics

	Word.nonword	N	Mean	Std. Deviation	Std. Error Mean
RTs	word	2240	95.8481	801.51256	16.93504
	non-word	2240	-22.7830	832.36960	17.58702

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RTs	Equal variances assumed	13.864	.000	4.859	4478	.000	118.63109	24.41514	70.76536	166.49682
	Equal variances not assumed			4.859	4471.625	.000	118.63109	24.41514	70.76534	166.49683

Table ?? illustrates level of meaningful result calculated from F (Levene's test) is less than .05 or 5%, as equal variances for both groups (word and non-word) are not assumed. The results the t-test reveal that there is a significant difference (sig. is less than 5%) between word and non-word groups with confidence level of 95% in terms of establishing RTs.

Table 3:T-Test (Correct/Incorrect)

Group Statistics

	Error.Rate	N	Mean	Std. Deviation	Std. Error Mean
RTs	Correct Response	2425	727.7371	283.82063	5.76352
	Incorrect Response	2055	-779.1223	372.10140	8.20834

Independent Samples Test

		Levene's Test for Equality of Variances		t-test for Equality of Means						
									95% Confidence Interval of the Difference	
		F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	Lower	Upper
RTs	Equal variances assumed	203.424	.000	153.558	4478	.000	1506.85938	9.81299	1487.62107	1526.09769
	Equal variances not assumed			150.240	3796.616	.000	1506.85938	10.02971	1487.19524	1526.52352

The results of the t-test revealed that there is a significant difference (sig. is less than 5%) between correct and incorrect response groups with confidence level of 95% in terms of establishing RTs. Given that the significance of the Levene's test is greater than 0.05, the variances are equal in all four groups.

Table 5: ANOVA

ANOVA

RTs

			Sum of Squares	df	Mean Square	F	Sig.
Between Groups	(Combined)		13941332.680	3	4647110.893	6.953	.000
	Linear Term	Contrast	744.127	1	744.127	.001	.973
		Deviation	13940588.553	2	6970294.277	10.429	.000
Within Groups			2991471402.075	4476	668335.881		
Total			3005412734.755	4479			

Given that the sig. < .05, between RTs and groups, there is a significant difference with a confidence level of 95%.

Table 6: the mean differences between groups.

Multiple Comparisons

Dependent Variable: RTs
Scheffe

(I) BN.N.Manipulation	(J) BN.N.Manipulation	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
BN Constant/Few N	BN Constant/Few N					
	BN Constant/Many N	81.02679	34.54645	.139	-15.5840	177.6376
	N Constant/Few BN	121.59672*	34.54645	.006	24.9859	218.2075
	N Constant/Many BN	-12.30822	34.54645	.988	-108.9190	84.3026
BN Constant/Many N	BN Constant/Few N	-81.02679	34.54645	.139	-177.6376	15.5840
	BN Constant/Many N					
	N Constant/Few BN	40.56994	34.54645	.710	-56.0408	137.1807
	N Constant/Many BN	-93.33501	34.54645	.063	-189.9458	3.2758
N Constant/Few BN	BN Constant/Few N	-121.59672*	34.54645	.006	-218.2075	-24.9859
	BN Constant/Many N	-40.56994	34.54645	.710	-137.1807	56.0408
	N Constant/Few BN					
	N Constant/Many BN	-133.90495*	34.54645	.002	-230.5157	-37.2942
N Constant/Many BN	BN Constant/Few N	12.30822	34.54645	.988	-84.3026	108.9190
	BN Constant/Many N	93.33501	34.54645	.063	-3.2758	189.9458
	N Constant/Few BN	133.90495*	34.54645	.002	37.2942	230.5157
	N Constant/Many BN					

*. The mean difference is significant at the .05 level.

Table 7: Homogeneous Test

RTs

Scheffe[a]

BN.N.Manipulation	N	Subset for alpha = .05 1	2
N Constant/Few BN	1120	-37.4853	
BN Constant/Many N	1120	3.0846	3.0846
BN Constant/Few N	1120		84.1114
N Constant/Many BN	1120		96.4196
Sig.		.710	.063

Means for groups in homogeneous subsets are displayed.

a. Uses Harmonic Mean Sample Size = 1120.000.

As indicated in the first column (sig.> .05), "N Constant /Few N" and "BN Constant/Many N" are not significantly different (homogeneous). And the second column (sig.> .05) shows "BN Constant/Many N" and "BN Constant/ Few N" and "N Constant/Many BN" do not differ significantly. The highest mean is related to "N Constant/Many BN" and the minimum mean is related to "N Constant/Few BN".

Discussion

Our study of advanced Iranian Second language learners revealed that when BN is constant and N is manipulated, mean word RTs for large N are faster than large BN. This means that large neighbors have a facilitative effect on word recognition. On the other hand, the results showed that when we manipulate BN and keep N constant, the effect is inhibitive for few BN (i.e., Mean RTs are negative) which means that participants made more errors. For two categories of BN Constant/Few N and N Constant/Many BN the effect is Null, because the inhibitive effect played the same role for both of them. Coltheart, et al (1977) found the same Null effect by manipulating the number of word's neighbors (N). They found that N does not have any effect on lexical decision task. They reported that there is no relationship between performance of words and N showing that high N had an inhibitory effect and low N had facilitative effect.

Other studies (e.g., Andrews, 1997; Snodgrass &Minzer, 1993; Carreiras et al., 1997; Coltheart et al., 1977) found the same Null relationship between N numbers and retention. However, this study showed that large N has a facilitative effect on word recognition. Ziegler, et al (1998) reported that body neighbor manipulation has a facilitative effect on participants' word recognition. On the other hand, when N is manipulated, it has an inhibitory effect. They believe that these findings might be consistent in various studies because English has many body neighbors (BN). However, our study showed that few BN has inhibitory effect and large N has a facilitative effect. The reason why some studies reported that BN manipulation has a facilitative effect and N manipulation an inhibitory effect on words may be related to the body/time feature of English language. Andrews (1997) believed that this feature provides a link between orthography and phonology of words. During reading, this feature helps readers to disambiguate word phonology during reading. Our findings for Iranian advanced second language learners do not support this idea.

Words with high BN may speed up lexical access, because they look familiar to the participants and at the same time high BN reduces ambiguity. On the other hand there is an inhibitory effect when N is manipulated, because N manipulation increases competition between orthographically similar words. Andrews (1989) reported that N effect occurs for low frequency words in lexical decision tasks. This is contrary to our findings. The pattern for non-words recognition is different. Both BN and N manipulation show an inhibitory pattern over RTs. Mean RTs for non-words are high probably because people have a tendency to find the evidence of wordiness; if we do not find any evidence of wordiness, we would reject it, and this takes much longer for the mind to process. On the other hand, it may seem that the reason for this inhibition comes from the number of N and BN, because simply when the number of N and BN increases, the likeness of pseudo-words to words increases making them harder to reject.

The contribution of the results to models of word recognition is that at first spot Serial Search Model () does not account for our results because it suggests that words are categorized in mind by orthographic and phonological features into several bins. The Serial Search Model predicts that words with a high frequency are easier to recognize. However, as we saw in our results frequency has a facilitative (at least for N manipulation) rather than inhibitory effect. Another model of word recognition, the Interactive Activation and

Competition (IAC) model (), consists of three levels: input level with visual feature units, intermediate level where units are individual letters, output level where each unit is a word.

Units within the same level are connected with each other through inhibitory connections; therefore, they compete with each other in the case of recognition. English has a body/rime feature that IAC model does not support. On the other hand, based on predictions of this model it must be in such a way that words with high BN must be recognized slowly. As our results show BN has an inhibitory effect. Therefore, this model explains why BN has an inhibitive effect. Also, our results are in harmony with DRC model which predicts that BN manipulation must have an inhibitory effect. The results of our study, in line with the predictions of this model, show that similar words share common sublexical nodes with each other and these nodes become activated during word reading and recognition. Therefore, words with many letters shared with a target word are more active than words with an overlap (Plaut, McLelland, & Seidenberg, 1996).

The parallel distributing model () is not capable of explaining why the present study found that BN has an inhibitory effect. This failure comes from the fact that parallel distributing model predicts that words with the most shared letters are more active than others, and thus are more easily recognized. It is necessary to mention that our results are obtained based on orthographic neighborhood effect. The generalizability of these results to other kinds of neighborhoods must be examined by future research.

The implication of the results is that for teaching words, it is better to find texts that are somehow rhythmic or using songs. We can use songs to enhance neighborhood effect and increase the rate of vocabulary learning. There is evidence that using songs in the classroom is a great help to learning and retention of lexical items (Zhang, Wu, Wei, & Wang, 2011; Salcedo, 2002).

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