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Models of EFL Learners' Vocabulary Development: Spreading Activation vs. Hierarchical Network Model

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Abstract
Semantic network approaches view organization or representation of internal lexicon in the form of either spreading or hierarchical system identified, respectively, as Spreading Activation Model (SAM) and Hierarchical Network Model (HNM). However, the validity of either model is amongst the intact issues in the literature which can be studied through basing the instruction compatible with the principles of each model. In a bid to fill this gap, this study was designed to empirically verify the effectiveness of SAM compared to HNM in both developing and retention rate of vocabulary knowledge. To this end, 67 Iranian EFL learners were divided into two experimental groups (34 and 33) and one was exposed to HNM-based while the other to SAM-based vocabulary instruction for 10 sessions. In the light of group-comparison experimental design, the participants' both immediate achievement and long-term storage were measured through an immediate and a delayed post-tests, respectively. The parametric statistical analyses showed that the group being exposed to HNM-based instruction outperformed the other group in both the immediate and delayed post-tests. The findings bear two distinct messages: yielding support to more validity of HNM as a model of internal lexicon organization and supporting the educational implications of cognitively compatible instruction of language components.

Keywords: Hierarchical network model, Internal lexicon, Spreading activation model, Vocabulary development, Vocabulary retention

INTRODUCTION

Vocabulary is the core component of language proficiency. It provides much of the basis of how well learners speak, listen, read, and write (Richards & Renandya, 2002). Similarly and even more emphatically, Dewey (1910) calls it "very important and critical to learn, since it is a tool to express the meaning beyond a thought" (as cited in Bintz, 2011). Vocabulary is associated with meaning, so its learning fundamentally means learning the meaning of the words (Bintz, 2011). Vocabulary learning is a continual process of encountering new words in meaningful and comprehensible context (Harmon, Wood,

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Hedrick, Vintinner, & Willeford, 2009), and is a nonstop process. It is noteworthy that children are able to develop it at the rate of approximately 2000 to 4000 words per year without any instruction (Bintz, 2011).

Moreover, vocabulary learning is subject to multiple external and internal variables ranging from contextual to internal lexicon organization parameters. As to the former category, Pulido (2004) examined the effects of topic familiarity and passage sight vocabulary on lexical inference and retention, which revealed a robust effect of them on lexical inference, its difficulty, retention and translation. Prince's (1996) examination of context versus translations as a function of proficiency on vocabulary learning revealed a superiority of translation learning in terms of quantity. Grace's (2000) study on the effect of L1 translation accessibility on L2 vocabulary retention, indicated a positive effect. Kitajima's (2001) comparison of the effects of input and output condition on vocabulary retention also showed a robust effect of output on vocabulary development and retention. Min's (2008) comparative study of vocabulary enhancement activities and narrow reading on vocabulary development revealed their positive effects on vocabulary retention and development. Aghlara's (2011) study about the effect of digital games on vocabulary acquisition and retention, Chiu and Liu's (2013) study of using printed dictionaries, among many other studies, revealed the significant effects of many different parameters on both learning and retention of the lexical items.

The pupil's mother tongue also plays a significant role in EFL learning in general and in lexical development in particular. The studies by He and Deng (2015) on Chinese speakers and Kavitha and Kannan (2017) on Indian speakers yield support to the role of L1 in this process. Another important parameter is the learner's background knowledge. In line with this claim, Webb and Chang (2015) exercising spreading activation model in an extensive reading program found contributory role of background knowledge in enhancing learning rate.

Parallel to vocabulary learning, vocabulary retention rate has also be subject to various studies. Soyoof et al. (2014) looking into the issues form psycholinguistic perspective, examined the effect of learners' brain hemisphericity on vocabulary retention. Their study indicated that the learners with active whole brain perform better on the memorization and, therefore, on the retention of lexical items. In the same line, Boers (2000) indicated that the lexical organization in the context of metaphoric expressions facilitates retention of unfamiliar figurative expressions. However, dearth of research on the latter parameter seems convincing enough to address the nature of internal lexicon and its mental organization.

Richards and Renandya (2002) focusses on vocabulary learning through incidental learning, described as learning vocabulary within a context as a by-product of reading or listening. Incidental learning is to some extent useful for people with all levels of proficiency (Daskalovska, 2014); however, it works better on people with higher level of proficiency and with greater vocabulary bank in their mind (Pulido, 2003).

Internal lexicon and Mental Organization of Vocabulary

Internal lexicon or word knowledge is defined as "representation of words in permanent memory" (Carroll, 2006), and it is generally characterized by some dimensions including phonological knowledge, morphological knowledge, syntactic knowledge, and semantic knowledge. Previously registered words in the mind are related to each other in one's internal lexicon, in such a way that presentation of one lexical item leads to the activation of the other related ones. In other words, a semantic network of interconnected elements is activated altogether, node by node and due to registered relations. This process, where properties of a particular word or related knowledge areas are activated, is called lexical access. The words are represented as nodes and connected to each other by various connections and construct a semantic network (Beckage & Colunga, 2016), in which "nods" refer to the common features that exist among two or more words, and lead to their reciprocal activation (Carroll, 2006).

Access to internal lexical or human's mental organization of vocabulary has been subject to some studies. For example, Chen (2012) in his a master thesis explored the developmental changes in lexical organization and access to mental lexicon among Mandarin-speaking participants. Balota and Chumbley (1985) examined the effect of the frequency on lexical access and lexical production, separately. The results revealed that the time differences, elaborating the effect of lexical access versus lexical production, were 2900 milliseconds and they indicated that the lexical activation is a prompter process. Jastrzembski (1981) revealed the relationship between the lexical access and the number of the meaning of a word which indicated that more meaning count for one word, the faster it leads to lexical access. Forster's (1981) study on the effects of frequency blocking on lexical access time showed that all words are listed in the single lexicon regardless of their frequency, but activation trait starts from the most frequent en- tries in the list.

Internal Lexicon Models

Besides the areas of word knowledge, the manner in which such areas are mentally organized is of paramount importance. Semantic network approaches view organization or representation of internal lexicon in the form of either spreading or hierarchical system identified respectively as Spreading Activation Model (SAM) and Hierarchical Network Model (HNM) (Collins & Loftus, 1975; Collins & Quillian, 1972). For the purpose of clarification, both models are briefly described.

Hierarchical Network Model (HNM)

According to this model, words are organized hierarchically in the form that some elements of the network stand above (supersets), while some elements stand below (subsets). For example, in the sentence "a dog is an animal" the word "animal" is a superset and the word "dog" is a subset. There is a regular hierarchical relationship among the nodes of the network. There are some relations within those hierarchies including **(1) hyponymy, (2) Hypernymy, (3) Coordination, (4) Taxonomy**, and (5) **Attributive**.

Collins and Quillian (1972) argued that the common attributes among the supersets and subsets must be stored only in nodes in which the supersets are located. Therefore, some capacity in subset nodes is released in order to save their particular attributes which is called cognitive economy. They developed a task in the form of "an A is a B", in which the participants were presented with the sentences to distinguish whether the sentences are true or false. For example, when they were exposed to

• A lion is an animal
• Banana is an animal

, they answered the question very rapidly, indicating that the time duration is an indicator of the distance among the nodes. But, when they received

• A reptile is an animal
• An animal is a reptile

, it was revealed that two nodes were activated simultaneously, taking in fact no time. So the time duration differs in processing or better to say in the retrieval of the semantic organization of the words (Collins & Quillian, 1969). On the other hand, the two sentences are processed differently in terms of time duration:

• An animal is an animal.
• A reptile is an animal.

The reason is that for the first sentence one must move from a subset to a superset and reach to an intersection, then check the intersection with internal lexicon, while in sentence two there is no requirement for such a traverse. This trait is called category size effect. That is "In the statement of the form An A is a B, the higher the location of the B in the hierarchy in relation to A, the longer the reaction times would be."

Landauer and Freedman (1968) examined whether the name of an object (for example a collie) is an instance of a larger category (for example dog) or not. They found out that it took less time to understand a particular name when it belongs to smaller categories rather than bigger ones (for example animals). In the same vein, Collins and Quillian (1969) proposed a model for semantic information model which is in a computer memory. In this model, "each word is stored with it a configuration of pointers to other words in the memory; this configuration represents the word's meaning"(Carroll, 2006). They hold that there are three assumptions concerning the time retrieval:

1. Retrieval time for a property and moving up one level is significant;
2. Each step is additive to one other step, so each step will advance to one or several other steps.
3. Retrieval time for a property is based on nodes, so different properties show different retrieval time.

It is held that HNMs is a strictly rigid model since it emphasizes on just hierarchical relations. Therefore, there are some relations among the words that cannot be well explained by HNMs. Then, the Spreaidng Activation Model (SAM) was suggested as an alternatve.

Spreading Activation Model (SAM)

Supporting the introduction of SAM as an alternative or a modified version, Collin and Loftus (1975, p. 408) claimed that:

"A concept can be represented as a node in a network, with properties of the concept represented as labeled relational links from the node to other concept nodes. Links can have different criteria which are numbers indicating how essential each link is to the meaning of the concept in the form of nodes.......... From each nodes linked to a given node, there will be links to other concept nodes",

According to Carroll (2006), in this model, the relationships among the nodes are like a network. In other words, there is an interconnected network among the nodes and the distance among the nodes is based on structural characteristics or such as taxonomic relations, or considerations such as typicality and degree of association among the words. Unlike the HNMs, the semantic retrieval among the nodes is not intersectional rather interconnection. While a given concept is retrieved, the other semantic concepts which are related to it are also activated. This trait of semantic activation attenuates over the distance, which is closely related concepts are more likely to activate.

These two models are not categorically distinct from each other as the SAM is an extension of the HNM. As a proof, Jones, Willits, and Dennis (2015) claim that:

Collins and Quillian (1969) originally proposed a hierarchical model of semantic memory in which concepts were nodes and propositions were labeled links (e.g., the nodes for dog and animal were connected via an "is a" link). The superordinate and subordinate structure of the links produced a hierarchical tree structure (animals were divided into birds, fish, etc., and birds were further divided into robin, sparrow, etc.), and allowed the model to explain both conceptual and propositional knowledge within a single framework. Accessing knowledge required traversal of the tree to the critical branch, and the model was successful in this manner of explaining early sentence verification data from humans (e.g., the speed to verify that "a canary can sing"). A later version of the semantic network model proposed by Collins and Loftus (1975) deemphasized the hierarchical nature of the network in favor of the process of spreading activation through all network links simultaneously to account for semantic priming phenomena—in particular, the ability to produce fast negative responses. Early semantic networks can be seen as clear predecessors to several modern connectionist models, and features of them can also be seen in modern probabilistic and graphical models as well.

Being as the models of semantic network, they are in fact models of memory organization. In other words, their implementation may have certain effects on memory and its retrieval and ultimately the retention capacity. To shed light on this issue, various studies have been conducted.

In a bid to study the influence of spreading activation on memory retrieval in Sequential Diagnostic Reasoning (SDR), Böhm and Mehlhorn's (2009) showed that in an SDR task, each piece of this information has the same potential to activate associated knowledge from working memory. Moreover, Miyake, Joyce, Jung, and Akama (2007) cite from Widdow, Cederberg, and Dorow (2002) that graph visualization is a particularly powerful tool for representing the meanings of words and concepts. They themselves have tried to assign cognitive role for these associative models in relating them to thinking system. Citing from Jung et al. (2006), they have additionally reported that The Associative Composition Support System (ACSS) seeks to promote associative thinking ability, and so, in turn, to foster language learning and creativity. ACSS is developed based on a database that makes it possible to retrieve three types of associative information such as word-based, concept-based and group-based associations. Such associative information is apparently sufficient to support system users in improving their associative thinking and creativity by encouraging them to move beyond literal, direct and superficial aspects to richer and freer dimensions. For them the variety of links between words can foster free, flexible, integrative, and imaginative thinking, while simultaneously encouraging users to discover the implicit relevance of words and even to occasionally fill in the semantic gaps between words with imaginative creations.

Further research on the semantic network models logically assign information retrieval role to them. In line with this research trend, Crestani (1995) cited from Preece (1981) "that better retrieval results can be obtained by a SA process". Preece's work can be considered one of the first attempts to use associative search by SA in IR. He examined in depth the SA approach to associative retrieval. He argued that most of the classical approaches to IR could be explained in terms of different SA processing techniques on a network representation of the document collection". Similarly, Shovel (1981), developed in parallel to Preece's one, is an attempt to implement interactive query expansion using SA on a Semantic Network. Again this approach is quite simple compared to the most recent ones, however we must consider it a seminal work whose directions are still followed by current research. Reporting from the related studies they claim that "the use of constrained SA for the application they were considering gives reasonable values of recall and precision1.

Semantic network models enjoy implications for many other fields. According to Grestani (1995), Croft, Crigean and Willet (1988, 1989) "implemented a retrieval paradigm called “multiple sources of evidence” using these constraints on the basic SA model. Their experiment showed "the possibility of improving the performance of a generic IR system based on the sole use of nearest neighbor and citation information".

Evidently, semantic network models of any type including SAM or HNM amongst many others are closely connected to the way information is processed, stored, retrieved, learned, and used. Even, they can contribute to one's thinking system. Though the literature is rich enough in terms even statistical research on the nature of these models, it suffers from their empirical application in the process of learning for. Additionally, it is most likely that the way knowledge is organized determine the manner of internal access and ease of retrieval (Carroll & White, 1973; Juhasz, 2005). In other words, the nature of organization or representation of internal lexicon either facilitates or hinders the nature of finding access to the pertinent knowledge. However and similarly, the literature is mainly characterized by either discrete studies examining each model by itself or descriptive speculations on the nature of each model such that no particular study could be traced to assign pedagogical values or empirically investigate the educational validity of either model to see whether teaching lexical items based on the principals of either model can lead to better learning or retention of lexical items in either L1 acquisition of L2 learning processes. Motivated by such a sharp gap, this study was designed to address the following research questions:

1. Is there a significant difference between the effect of spreading activation model and hierarchical network model on EFL learners' vocabulary learning?
2. Is there a significant difference between the effect of spreading activation model and hierarchical network model on EFL learners' vocabulary retention?

METHODS

Participants

The study was conducted with 67 male and female beginner adolescent EFL learners from Shokouh Language Institute in Tehran. Given the nature, age and level of the EFL learners enrolling the Institute, it was impossible to screen them on the basis of standardized language proficiency tests. So, the participants were identified as elementary based on the oral and written tests designed and administered by the Institute based on which those who score below 10 are conventionally categorized as elementary.

Instrumentations

In order to collect the required data, two separate researcher-made tests were constructed and validated for the purpose of both pre- and post-treatment measurements as follows:

Diagnostic Test (pre-test)

In a bid to measure the participants' vocabulary knowledge of the target items, the productive test consisting of 40 lexical items was designed; composed of the lexical items supposed to be included in the mainstream of the treatment. Productive test in the sense that the participants were asked to write the required responses rather than recognize a response or select an alternative. Due to low level of proficiency and limited sources of word knowledge in particular, the participants were asked to write down the meaning of each word in Persian. This way, their pre-treatment knowledge of the lexical items could be considered and measured. Their performance on the Diagnostic test was employed as a platform for selecting and including word list for the syllabus. Meanwhile, its reliability was estimated based on KR-21 formula showing an index of .85 which ensures a reliable diagnostics test.

Achievement Tests: Immediate and Delayed Post-Tests

The achievement test consisting of 40 multiple choices, recognition type items was constructed. The choices were ion Farsi out of which the participants were supposed to select the best choice expressing the meaning of the stem lexical item. The test was assured in terms of the content validity based on the panel of experts' judgment but its reliability was estimated based on KR-21 formula showing an index of .94 which ensures a reliable achievement test. The test was employed for both immediate measurement purpose to assess the learning rate and as a delayed post-test in order to assess the retention rate. The tests held in two parts, the same for both treatments:

Validity Indices: Construct Validity

A factor analysis through varimax rotation was also carried out to explore the underlying construct of the tests administered. The assumptions of sampling adequacy and lack of multicollinearity were met (statistical details are removed due to space limitations).

Procedure

Word List Selection

The bases for the word list selection for the Diagnostic Test was the lexical items included in the Institute's syllabus for the elementary level. Then, the participants' performance on the Test was in turn used as a platform for the lexical items to be included for the experimental purposes in this study as presented in Figure 1. Not only does the list include two levels of hierarchical network relations, but also it shows spreading relations, too. Animal category was used due to its research proof of being interesting these purposes.

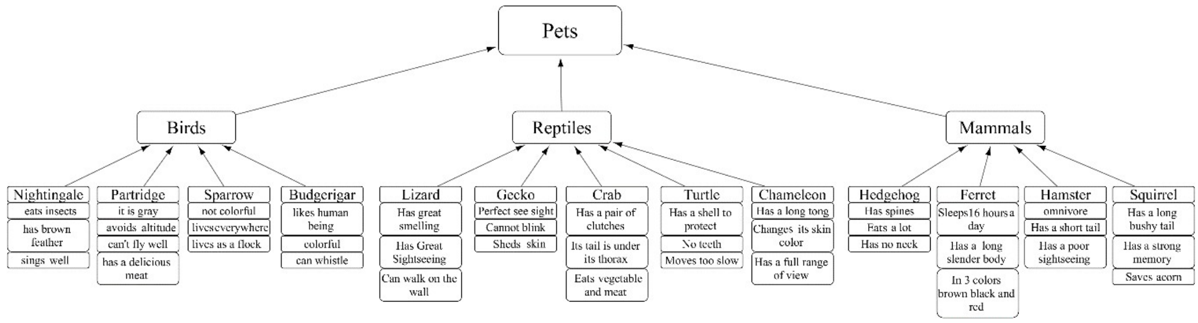

Figure1. Hierarchy of animals: pets

Figures 1 to 4 depict the hierarchical relations between the animals and also define a set of characteristics for each category. Figure 5 also shows a schematic view of the spreading relation between the animals via the most important categories.

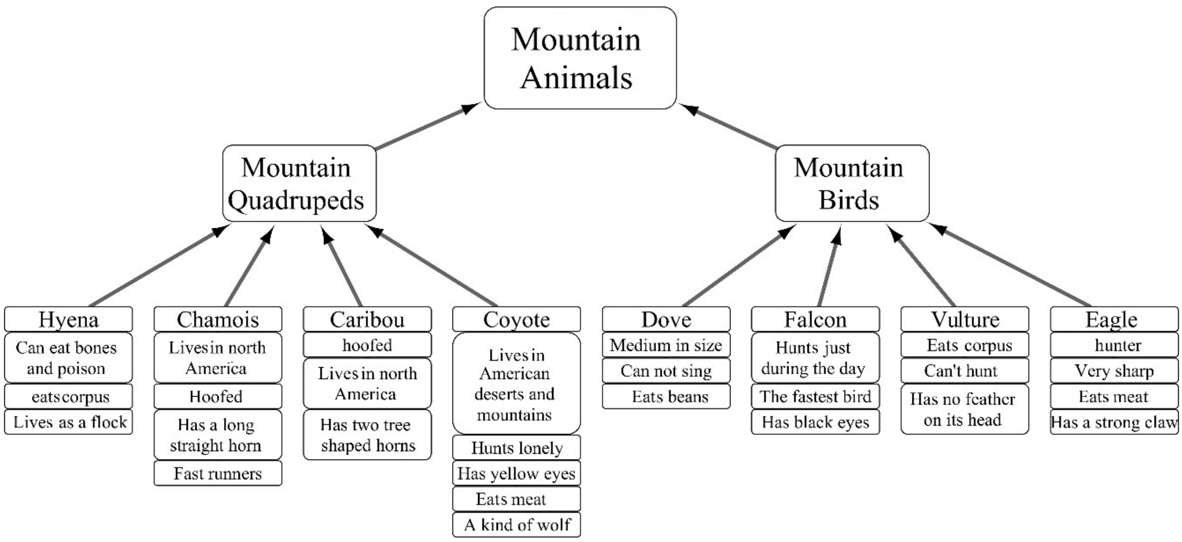

Figure 2. Hierarchy of animals: mountain animals

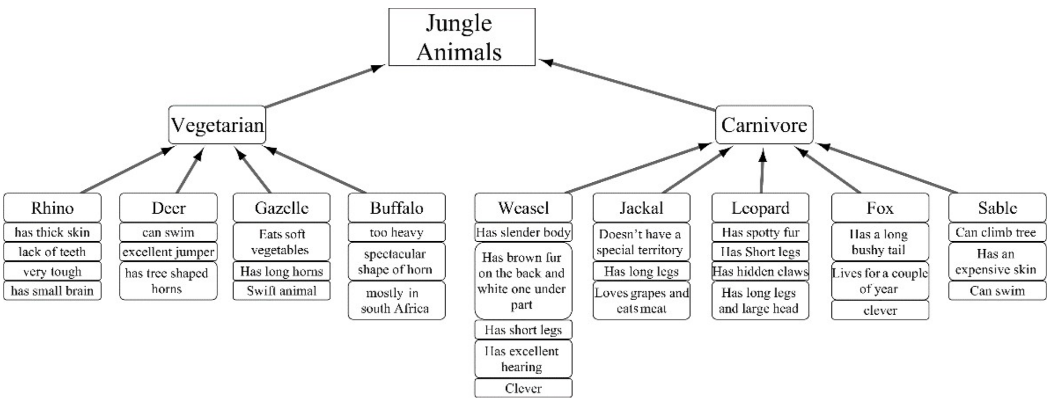

Figure 3. Hierarchy of animals: jungle animals

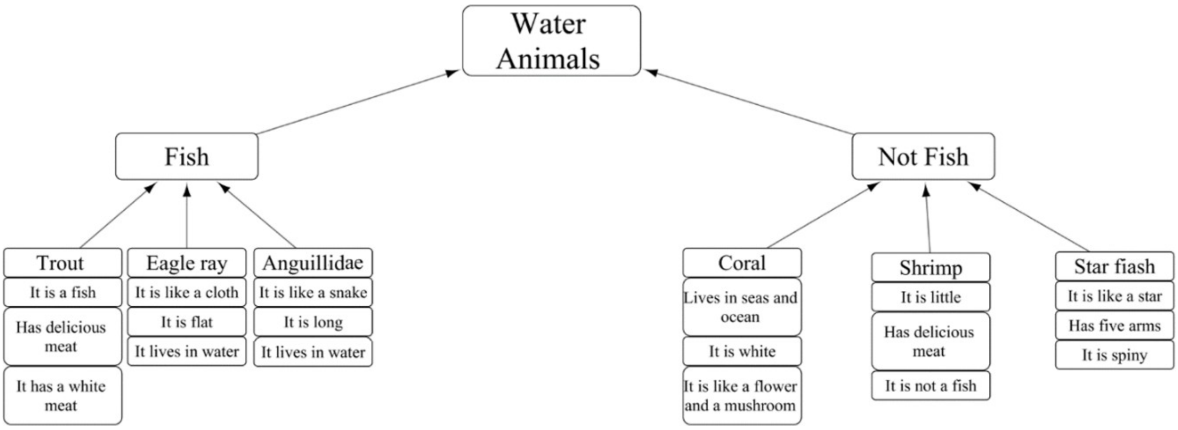

Figure 4. Hierarchy of animals: water animals

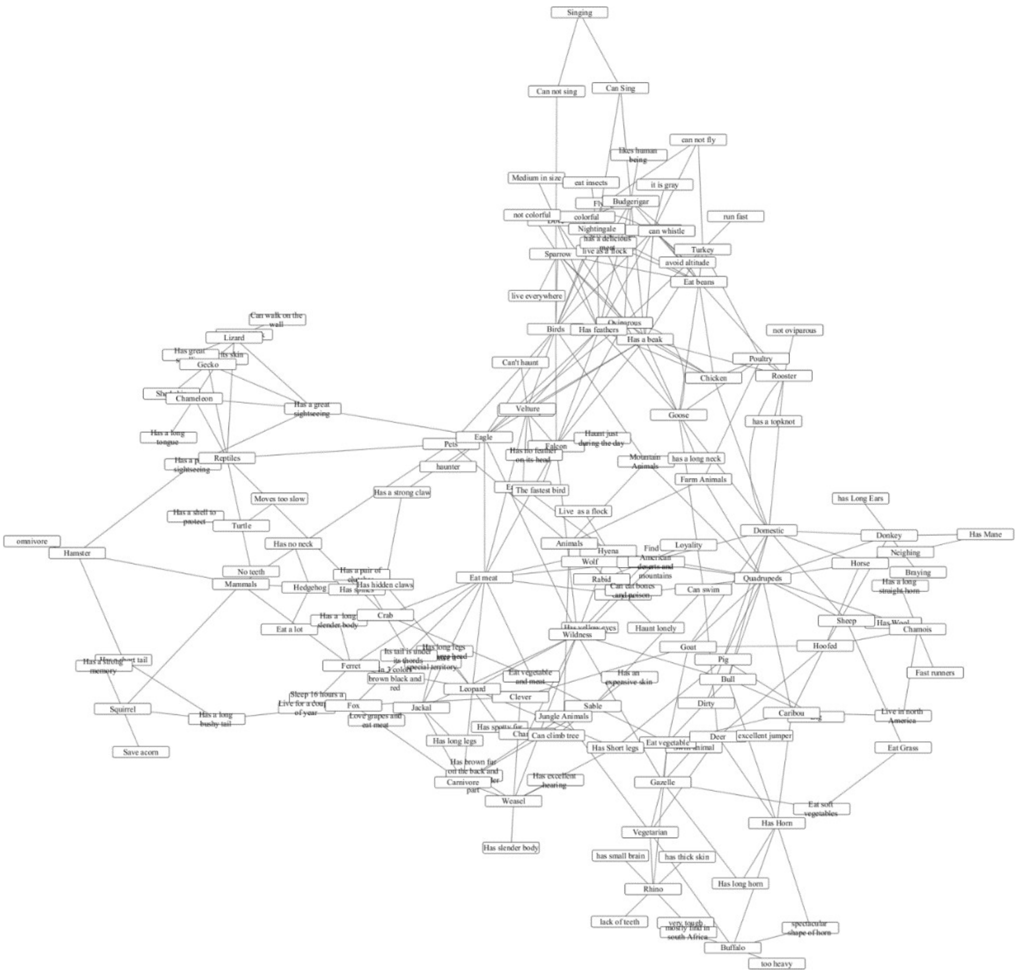

Figure 5. Schematic spreading relation between animals

Sampling selection: The sample was selected based on convenient sampling but the 67 EFL learners divided into two experimental groups.

As already mentioned, their language proficiency was measured based on their performance on the Institute's oral and written exam commonly used as a criterion to conventionally categorize the candidates for the mainstream EFL program.

Diagnostic Test Administering: The test was administered prior to the treatment to screen the leaners' word knowledge and identify those lexical items unknown to them to be included in the syllabus for treatment purpose.

Treatment: the members for each group were the collection of learners from three classes as organized by the Institute for ease of instruction. Each group received instruction following the principles of the respective model both just for 20 minutes in each session as part of the mainstream Conversation Course.

The focus of instruction for HNM was the superset and subsets relations. For example, the teacher said a category (Jungle animals: quadrupeds) and asked the learners to try to retrieve the animals associated with this category in response to “Which animal is quadruped? Can you name a quadruped jungle animal? Have you seen an animal which leaves in jungle and is a quadruped?” After a pair of trial and errors, the teacher elicited their words and added her own previously prepared words and then taught all of them to the learners. The common words between all three classes were included in the achievement test. This relation sometimes was in the reverse order, which means teacher mentioned an animal and asked the pupils to retrieve the category to which the animal might be related.

For the SAM-based instruction the teacher asked the learners to think about the characteristics of the target animal in response to “What does this animal remind you of? What characteristics? Size? Shape? What does it eat?” For example by mentioning “dog” as an animal, pupils responded “It has a tail. It barks. A dog eats meat.” Having elicited the required features from the learners, she added the prepared characteristics and taught all of them to the pupils.

Achievement Test Administering: immediately following both treatments, all participants received the Achievement Test followed by its re-administration as a delayed post-test one week after. Of course, multiple formative repeated assessments were carried out throughout the treatment sessions as part of the main research; excluded to be reported in this article due to relevance and space considerations.

RESULTS

This study comparatively investigated the effects of SAM and HNM on the Iranian EFL learners’ learning and retention of vocabulary items. To this end, first the data were checked in terms of normality assumptions and homogeneity of variance. It was revealed that the ratios of skewness and kurtosis over their standard errors were lower than +/- 1.96, hence indicating normality of the present data.

Pretest of Vocabulary

An independent t-test was run to compare the SAM and HNM groups’ means on the pretest of vocabulary in order to prove that they enjoyed at the same level of vocabulary knowledge prior to the main study. Based on the results displayed in Table 1, it can be claimed that the SAM (M = 11.65, SD = 5.13) had a slightly higher mean on the pretest of vocabulary than the HNM group (M = 9.96, SD = 5.35).

Table 1.
Descriptive Statistics; Pretest of Vocabulary by Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Pretest	SAM	38	11.65	5.134	.833
	HNM	39	9.96	4.354	.697

The results of the independent t-test (t (75) = 1.56, p = 0.123, r = 0.17 representing a weak effect size) (Table 2) indicate that there was not any significant difference between the two groups’ mean scores on the pretest of vocabulary. Thus, it can be claimed that they enjoyed partially the same level of vocabulary knowledge prior to the main study.

Table 2.

Independent Samples Test, Pretest of Vocabulary by Groups

	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
Equal variances assumed	0.755	0.388	1.561	75	0.123	1.691	1.084	-0.468	3.850
Equal variances not assumed			1.557	72.405	0.124	1.691	1.086	-0.474	3.856

Note: The negative 95 % lower bound confidence interval of -.46 indicated that the difference between the two groups' means on the pretest of vocabulary could have been zero. Thus, the above mentioned conclusion as no significant difference between the two groups' means was correctly made.

It should be noted that the assumption of homogeneity of variances was met (Levene's F = 0.775, p = 0.388). That is why the first row of Table 3, i.e. "Equal variances assumed" was reported.

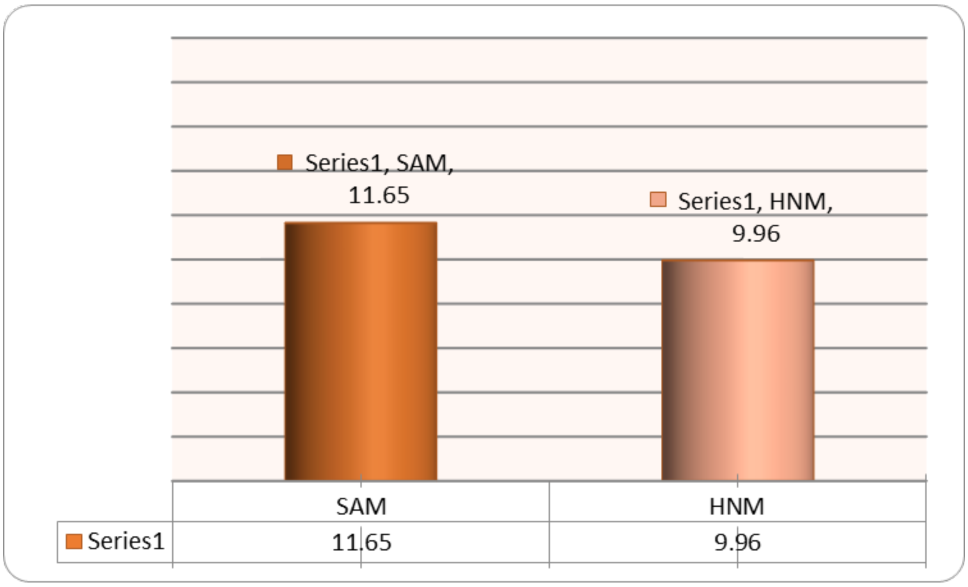

Figure 6. Pretest of Vocabulary by Groups

Addressing the Research Questions

First Research Question

The first research question addressed if there is a significant difference between the effect of SAM and HNM on EFL learners' vocabulary learning. To do this, an independent t-test was run to compare the groups' means on the achievement test (posttest). The results, as shown in Table 3, revealed that the HNM group (M = 78.95, SD = 14.60) had a higher mean on the achievement test (general posttest) than the SAM group (M = 68.64, SD = 16.94).

Table 3.

Descriptive Statistics; Achievement Test (General Posttest) by Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Posttest	HNM	36	78.95	14.606	2.434
	SAM	32	68.64	16.948	2.996

The results of the independent t-test (t (66) = 2.69, p = 0.009, r = 0.31 representing a moderate effect size) (Table 4) indicate that there was significant but moderate difference between the two groups' mean scores on the achievement test (general posttest) in favor of HNM. Thus, the first null-hypothesis was rejected, although the results should be interpreted cautiously due to the moderate effect size value of 0.31.

Table 4.
Independent Samples Test, Achievement Test (General Posttest) by Groups

	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
Equal variances assumed	0.992	0.323	2.695	66	0.009	10.312	3.826	2.672	17.952
Equal variances not assumed			2.671	61.645	0.010	10.312	3.860	2.595	18.030

It should be noted that the assumption of homogeneity of variances was met (Levene's F = 0.992, p = 0.323). That is why the first row of Table 4, i.e. "Equal variances assumed" was reported.

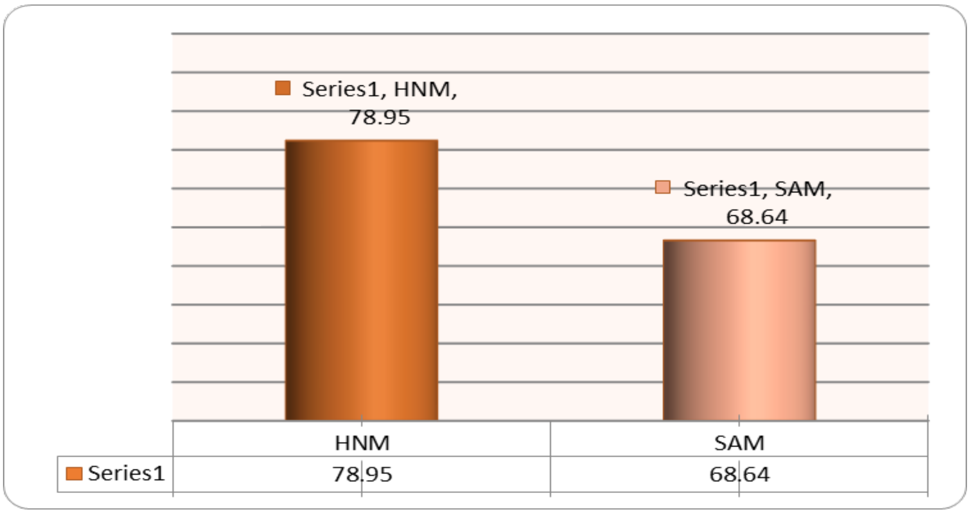

Figure 7. Achievement Test (General Posttest) by Groups

Second Research Question

The second research question addressed if there is a significant difference between the effect of SAM and HNM on EFL learners' vocabulary retention. To this end, an independent t-test was run to compare the groups' means on the vocabulary retention. Based on the results displayed in Table 6, it can be claimed that the HNM group (M = -2.94, SD = 9.83) had a lower loss of vocabu-lary than the SAM group (M = -15.12, SD = 14.92).

Table 5.
Descriptive Statistics; Vocabulary by Groups

	Group	N	Mean	Std. Deviation	Std. Error Mean
Retention	HNM	36	-2.94	9.832	1.639
	SAM	32	-15.12	14.925	2.638

The results of the independent t-test (t (52) = 3.92, p= 0.000, r = 0.48 representing an almost large effect size) (Table 6) indicate that there was significant but moderate difference between the two groups' mean scores on the vocabulary retention. Similarly, the second null-hypothesis was rejected in favor of again the HNM.

Table 6.
Independent Samples Test, Vocabulary Retention by Groups

	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
Equal variances assumed	4.752	0.033	4.015	66	0.000	12.178	3.033	6.122	18.235
Equal variances not assumed			3.921	52.597	0.000	12.178	3.106	5.948	18.409

It should be noted that the assumption of homogeneity of variances was not met (Levene's F = 4.75, p = 0.033). That is why the second row of Table 6, i.e. "Equal variances not assumed" was reported.

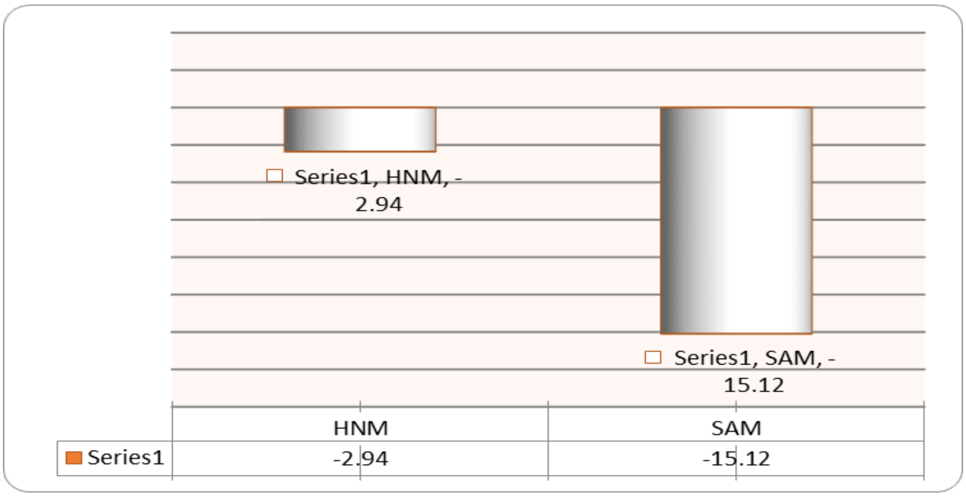

Figure 8. Vocabulary Retention by Groups

DISCUSSION AND CONCLUSIONS

The first research question comparatively addressed the two models of treatment using an independent t-test. The results indicated that those who received the HNM-based vocabulary treatment had a better performance (78.95 ± 14.60) indicating further learning or development compared to those who received SAM-based treatment (68.64 ± 16.94) significantly ($P = 0.009$). In other words, the HNM proved to be more consistent with the way the pupils' cognitive system processes lexical items. These results are consistent with what Richards and Renandya (2002) have claimed regarding incidental learning. As mentioned before, in incidental vocabulary learning, pupils face a word in different contexts; therefore, their brains enhance their vocabulary network and add the desired word to their internal lexicon. Moreover, the higher effectiveness of the HNM over the SAM questions the claim in favor of rigidity of the former and flexibility of the latter (Carroll, 2006). Moreover, the findings add to the controversy of claiming that the organization of internal lexicon is not strictly hierarchical and the distance between the nodes is "determined by both structural characteristics such as taxonomic relations and considerations such as typicality and degree of association between related concepts" (p. 115)

To answer the second research question addressing the models were compared in terms of their effectiveness in the vocabulary retention rate. The delayed post-test yielded similar results as the immediate post-test in favor of the advantages of the HNM over SAM as the vocabulary dismissal rate among the HNM-oriented group was less than that of the SAM-oriented group; -2.94 and -15.12, respectively ($P < 0.001$). This finding can be justified on the grounds that SAM network needs a wide range of vocabulary items to be remembered by a pupil. If one node of this network is missed, there is a great chance for the whole network to be divided into two subnetworks and have no inter-relations anymore. For example, assume that a pupil forgets the meaning of the word "horn", then not only he forgets the meaning of the respective word, but also the relation between other related words (animals in this research) is broken too. On the contrary, in HNM networks each word has one definite parent and by remembering other co-level words in the hierarchy, the pupil can understand and remember the lexical item. Though SAM seems to offers more advantages and opportunities for the learners either to remember or activate the related concepts, even if some nodes are not accessible, as there are some other indications or links to be resorted to, it seems that SAM may suits more for more advanced learners who can take the advantages of wider mechanisms. On the contrary, as the findings of this study emanated from the low level learners show, HNM seems to be more compatible with their cognitive organization.

Regardless of the HNM priority over the SAM as revealed in this study, the findings first and foremost may yield support to non-categorical distinction of the models as Jones, Willits, and Dennis (2015) cited from Collins and Quillian (1969). On the other hand, effectiveness of either model as the effect size reported in this study is not that much large to prove significant distinction of the models, is an indication of the validity of semantic nature of lexical items in internal lexicon as already empirically proved by Böhm and Mehlhorn's (2009) in theirSDR task experiemt and by Widdow, Cederberg, and Dorow (2002) in calling graph visualization asa powerful tool for representing the meanings of words and concepts. Besides, the effectivmess of the HNM is the retention rate also is in line with attributing information retrieval role to the semantic network models as claimed by Preece (1981) and Shovel (1981) reported in Grestani (1995).

The findings enjoy both theoretical and pedagogical contributions. As to the former one, the findings fill the gap of empirical study trying to validate and approach the HNM and SAM in terms of educational utilities as to vocabulary instruction. Additionally, the findings open a new horizon by generating further research questions as superiority or flexibility of SAM is questioned and offer new orientations to approach the organization of internal lexicon and its access models in relation to learners' variables including mainly their language proficiency level amongst many other.

Pedagogically speaking, the results suggest that successful vocabulary learning and development strongly depends first on the instructor's knowledge on lexical access models and their organization in pupils' brain. And second, teaching and testing strategies based on proper lexical access model help learners to develop and recall lexical items easily. Moreover, this study proves that selecting the proper lexical access model both maintains successful learning and ensures higher retention. Besides, the study tentatively explored that given most probably the level-dependent organization of internal lexicon and access to it, instructional planning should be done in regards to learners" variables including their proficiency level.

Despite the contributions suggested, this study, as any other research studies, suffers from certain limitations undermining the validity of its findings. The measurement instrument used for early proficiency screening as commonly used by the Institutes enjoyed conventional validity rather than empirically proven construct validity. Moreover, it is too difficult to control many intervening such as intrinsic motivation or other aspects of the learners which might influence internal validity of any research including this study.

References

Aghlara, L., & Tamjid, N. H. (2011). The effect of digital games on Iranian children's vocabulary retention in foreign language acquisition. *Procedia-Social and Behavioral Sciences, 29*, 552-560.

Balota, D. A., & Chumbley, J. I. (1985). The locus of word-frequency effects in the pronunciation task: Lexical access and/or production? *Journal of Memory and Language, 24*(1), 89-106.

Beckage, N. M., & Colunga, E. (2016). Language networks as models of cognition: Understanding cognition through language *Towards a Theoretical Framework for Analyzing Complex Linguistic Networks* (pp. 3-28): Springer.

Bintz, W. P. (2011). Teaching vocabulary across the curriculum. *Middle School Journal, 42*(4), 44-53.

Boers, F. (2000). Metaphor awareness and vocabulary retention. *Applied linguistics, 21*(4), 553-571.

Böhm, U., & Mehlhorn, K. (2009). The influence of spreading activation on memory retrieval in sequential diagnostic reasoning. In *Proceedings of the 9th International Conference on Cognitive Modeling. Manchester, UK.*

Carroll, D. W. (2006). *Psychology of language*: THOMSON.

Carroll, J.B., & White, M.N. (1973). Age-of acquisition norms for 220 picturable nouns. *Journal of Verbal Learning and Verbal behaviour*, 12, 563-576.

Chen, S. M. (2012). *Lexical organization in Mandarin-speaking children: Insights from the semantic fluency task*. The University of Iowa.

Chiu, L.-L., & Liu, G.-Z. (2013). Effects of printed, pocket electronic, and online dictionaries on high school students' English vocabulary retention. *The Asia-Pacific Education Researcher, 22*(4), 619-634.

Collins, A. M., & Loftus, E. F. (1975). A spreading-activation theory of semantic processing. *Psychological review, 82*(6), 407.

Collins, A. M., & Quillian, M. R. (1969). Retrieval time from semantic memory. *Journal of verbal learning and verbal behavior, 8*(2), 240-247.

Collins, A. M., & Quillian, M. R. (1972). How to make a language user.

Crestani, F. (1997). Application of spreading activation techniques in information retrieval. *Artificial Intelligence Review,* 11(6), 453-482.

Daskalovska, N. (2014). Incidental vocabulary acquisition from reading an authentic text. *The Reading Matrix: An*

International Online Journal, 14(2), 201-216.

Forster, K. I. (1981). Frequency blocking and lexical access: One mental lexicon or two? *Journal of verbal learning and verbal behavior, 20*(2), 190-203.

Grace, C. A. (2000). Gender differences: Vocabulary retention and access to translations for beginning language learners in CALL. *The Modern Language Journal, 84*(2), 214-224.

Harmon, J. M., Wood, K. D., Hedrick, W. B., Vintinner, J., & Willeford, T. (2009). Interactive word walls: More than just reading the writing on the walls. *Journal of Adolescent & Adult Literacy, 52*(5), 398-408.

He, H., & Deng, Y. (2015). The mental lexicon and English vocabulary teaching. *English Language Teaching, 8*(7), 40.

Jastrzembski, J. E. (1981). Multiple meanings, number of related meanings, frequency of occurrence, and the lexicon. *Cognitive psychology, 13*(2), 278-305.

Jones, M. N., Willits, J., Dennis, S., & Jones, M. (2015). Models of semantic memory. *Oxford handbook of mathematical and computational psychology*, 232-254.

Juhasz, B.J. (2005). Age-of -acquisition effects in word and picture identification. *Psychlogical Bulletin*. 131, 684-712

Kavitha, V., & Kannan, S. P. (2017). Investigating the Lexical Networks in the Vocabulary of Indian ESL Learners. *IUP Journal of English Studies, 12*(1), 21.

Kitajima, R. (2001). The effect of instructional conditions on students' vocabulary retention. *Foreign Language Annals, 34*(5), 470-482.

Landauer, T. K., & Freedman, J. L. (1968). Information retrieval from long-term memory: Category size and recognition time. *Journal of verbal learning and verbal behavior, 7*(2), 291-295.

Min, H. T. (2008). EFL vocabulary acquisition and retention: Reading plus vocabulary enhancement activities and narrow reading. *Language Learning, 58*(1), 73-115.

Miyake, M., Joyce, T., Jung, J., & Akama, H. (2007). Hierarchical structure in semantic networks of Japanese word associations. In *Proceedings of the 21st Pacific Asia Conference on Language, Information and Computation* (pp. 321-329).

Prince, P. (1996). Second language vocabulary learning: The role of context versus translations as a function of proficiency. *The Modern Language Journal, 80*(4), 478-493.

Pulido, D. (2003). Modeling the role of second language proficiency and topic familiarity in second language incidental vocabulary acquisition through reading. *Language learning*, 53(2), 233-284.

Pulido, D. (2004). The relationship between text comprehension and second language incidental vocabulary acquisition: A matter of topic familiarity? *Language Learning, 54*(3), 469-523.

Richards, J. C., & Renandya, W. A. (2002). *Methodology in language teaching: An anthology of current practice*: Cambridge university press.

Soyoof, A., Jokar, M., Razavizadegan, M. A., & Morovat, E. (2014). The Effects of Learners' Brain Hemisphericity on their Degree of Vocabulary Retention: A Case Study of Iranian High School Students. *Procedia-Social and Behavioral Sciences, 98*, 1844-1849.

Webb, S., & Chang, A. C.-S. (2015). How does prior word knowledge affect vocabulary learning progress in an extensive reading program? *Studies in Second Language Acquisition, 37*(4), 651-675.

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