# The Effect of Unknown Vocabulary Density on EFL Learners' Reading Comprehension of Nonfiction General English Texts

**Mohammad Hossein Keshavarz**
**Vali Mohammadi**

## Abstract

*Reading comprehension plays a central role in nonfiction general English university courses in different EFL situations and one of the important factors affecting it is vocabulary size. Accordingly, the present study aimed at investigating the effect of unknown vocabulary size on EFL learners' reading comprehension. To this end, 40 TEFL freshmen were selected to participate in this study on the basis of their scores on Nation's Vocabulary Levels Test (VLT) (2001). They were then given five versions of the same text with different densities of unknown vocabulary, i.e. 80%, 90%, 95%, 98%, and one intact version. A one-way ANOVA and a regression analysis were used to analyze the obtained data. The results showed that different densities of unknown academic vocabulary resulted in significant differences in comprehension of nonfiction general English texts and there was a vocabulary coverage level which acted as a threshold between adequate and inadequate comprehension of these texts. The findings are interpreted to have implications for EFL teachers and university instructors as well as syllabus designers and materials developers. The significance of the present study lies in the fact that unlike many previous studies it is conducted on nonfiction texts, namely nonfiction general English texts.*

**Keywords:** vocabulary density, reading comprehension, vocabulary coverage, adequate and inadequate comprehension

## Introduction

The importance of vocabulary has been a particular focus in the field of reading comprehension (Davis, 1972; Hirsh & Nation, 1992; Laufer, 1992; Hu & Nation, 2000; Yamini & Golkar, 2007). As such, there has been continuing interest in whether there is a language knowledge threshold which marks the boundary between having and not having sufficient language knowledge for successful language use (Holly, 1973; Hu & Nation, 2000; Nation, 2001). One key factor affecting performance on reading comprehension is vocabulary

*Dr. Mohammad Hossein Keshavarz, Full Professor, Teacher Education University*
*Vali Mohammadi, Instructor, Parssabad University of Applied Sciences and Technology, Ardebil*

knowledge. This skill is highly sensitive to the text type and vocabulary size of the passage (Laufer, 1989).

## Reading Comprehension

Reading is a complex process; reading in a foreign language is even more complex. Reading comprehension, in both first language (L1) and second language (L2), is affected by many variables, the most researched areas being background knowledge, reading strategies, and vocabulary knowledge.

In language learning theories, for each construct such as reading comprehension, we have models based on which those constructs are studied. Here, the most prevalent models in reading comprehension are discussed. Then, the role of vocabulary in each model is touched upon.

The bottom-up theory of reading was a prevalent theory in the 1960s which was revived by Gough (1972). This model is usually described as a linear model of reading process. The reader starts with letters in the decoding process and then decodes words and sentences. It is a data driven process as it mainly uses the textual elements in constructing the meaning of a passage. For fluent readers, this process becomes so automatic that sometimes the reader is unaware of such a process. Since it emphasizes sight reading of words in isolation, rapid word recognition is important to the bottom-up approach.

Goodman (1967) introduced the top-down model of reading, in which reading was viewed as "a psycholinguistic guessing game." Another renowned advocate of the top-down model is Smith (1971). This model is a concept-driven model where readers' background knowledge and expectations guide them in their reconstruction of the meaning of the text. The readers start with having certain expectations about the text derived from background knowledge. This process is usually called sampling of the text. Describing the sampling process, Cohen (1990) maintains that "the reader does not read all words and sentences in the text, but rather chooses certain words and phrases to comprehend the meaning of the text" (p. 75).

The inadequacy of both the bottom-up and top-down models in explaining the reading process led to the emergence of the interactive approach to reading. The model espouses that neither bottom-up nor top-down models can by themselves describe the reading process. Introduced by the writings of Rumelhart (1977) and Stanovich (1980), the interactive model

suggests an interaction between bottom-up and top-down processes. Each type of processing is seen to contribute to the reconstruction of the message encoded in the text. In his interactive compensatory model, Stanovich (1980) suggests that poor readers tend to resort to high level processes more often than skilled or fluent readers. The use of top-down processes seems to compensate for poor readers' lack of recognition skills or bottom-up processes.

Schemas, or schemata, are seen as cognitive constructs by which we organize information in our long-term memory (Widdowson, 1983). Schemata, therefore, have been called "the building blocks of cognition" (Rumelhart, 1982) because they represent elaborate networks of information that people use to make sense of new stimuli, events, and situations.

Smith, (1994) states:

Everything we know and believe is organized in a theory of what the world is like, a theory that is the basis of all our perceptions and understanding of the world, the root of all learning, the source of hopes and fears, motive and expectancies, reasoning and creativity. And this theory is all we have. If we make sense of the world at all, it is by interpreting our interactions with the world in the light of our theory. The theory is our shield against bewilderment. (p. 8)

Research on the theory of schema had great impact on understanding reading comprehension in first and second language. It made clear the case that understanding the role of schema in the reading process provides insights into why students may fail to comprehend text material. Most, if not all, research in this area seem to agree that when students are familiar with the topic of the text they are reading (i.e. possess content schema), are aware of the discourse level and structural make-up of the genre of the text (i.e. possess formal schema), and are skillful in the decoding features needed to recognize words and recognize how they fit together in a sentence (i.e. possess language schema), they are in a better position to comprehend their assigned reading. Deficiency in any of the above schemata will result in a reading comprehension deficit.

Based on the major reading models discussed above, it can be concluded that vocabulary knowledge is an important component of these models. In the bottom-up model of reading, rich vocabulary knowledge makes decoding and word recognition quicker and more efficient. Reading fluency and automatic decoding would not be achieved without a strong

knowledge of the meaning and form of words in the text. In the top-down model, vocabulary knowledge is part of the content and linguistic schemata required for successful reading. In the interactive model of reading, vocabulary knowledge seems to be the most important factor as it relates to both bottom-up and top-down processes. Finally, in the schema theory of reading, vocabulary plays the role of core part as related to formal and language schemata. Eskey and Grabe (1988) maintained that although vocabulary knowledge is regarded as an important component of all reading models, it is recognized as "a prerequisite for accurate reading in the interactive model of reading" (p. 226).
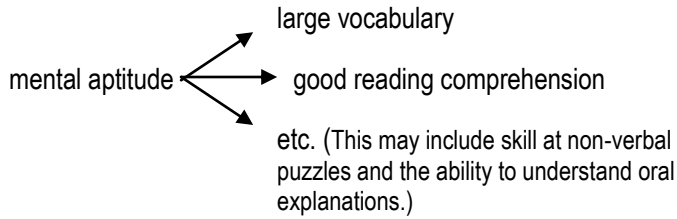
## The Role of Vocabulary in L1 Reading

Unanimous support for a strong correlation between overall lexical competence and reading comprehension can be found in pertinent L1 research (e.g. Davis, 1972). However, those studies are fairly descriptive rather than explanatory and there has been little agreement on the reason for the strong link between the two. Anderson and Freebody (1981) proposed three hypotheses to explain this relationship – the instrumentalist, knowledge, and aptitude hypotheses. The instrumentalist hypothesis claims that knowing the word is essential and is a causative factor in text comprehension. Schematically this view is as follows:

vocabulary knowledge     ⎯⎯⎯⎯⎯▶     reading comprehension
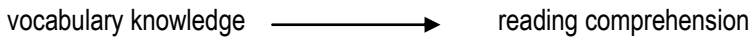
The knowledge hypothesis suggests that background is important for text understanding and that large vocabulary is merely a by-product of a large body of background knowledge. That is to say, it is the learning of concepts, not just of word meanings, that determines reading comprehension.

knowledge and experience    ⟍   ▶ reading comprehension

vocabulary knowledge
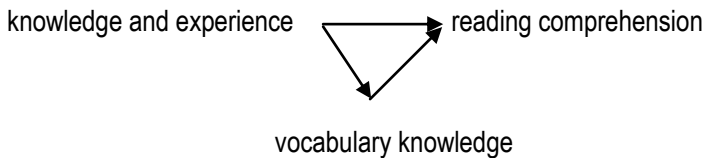
The aptitude hypothesis suggests that vocabulary knowledge reflects verbal aptitude and that this verbal aptitude is the crucial factor in reading comprehension.

large vocabulary

mental aptitude → good reading comprehension

etc. (This may include skill at non-verbal puzzles and the ability to understand oral explanations.)

Instead of accepting the idea of fixed capacity (i.e. the aptitude view), Mezynski (1983) added the fourth hypothesis, the *access view*, believing that the reading comprehension may involve several *trainable skills* such as accessing word meanings and applying meta-cognitive strategies, and that the amount of practice is the key to improve them.

Which viewpoint is the most tenable, then? As Anderson and Freebody (1981) noted, no serious scholar holds any one of these views to the exclusion of the others. In other words, none of them are considered mutually exclusive or incompatible. Nevertheless, among these viewpoints, Anderson and Freebody (1981) regarded the instrumentalist perspective as embodying "unquestioned tenets rather than hypotheses in need of verification" (p. 83). The instrumentalist view has the most direct implications for instruction. Consequently, the instrumentalist view appears to provide the best account of the role of vocabulary knowledge and reading comprehension in L1 research. Vocabulary has been consistently proved to be associated with reading comprehension and some studies have even supported a causal relationship. When it comes to L2 studies, researchers have specified certain type of vocabulary knowledge and explored its role in reading comprehension; however, investigations on the impact of the different aspects of vocabulary knowledge on reading comprehension are imbalanced.

## The Role of Vocabulary in L2 Reading

Second language learners and researchers seem to invariably recognize the role of vocabulary in L2 learning in general and L2 reading comprehension, in particular. Research has confirmed that second and foreign language learners consider vocabulary the biggest obstacle in reading when compared with syntactic and textual difficulties (Krashen, 1989; Zheng, 2002). For instance, Zheng (2002) found that EFL learners in China believe that vocabulary knowledge plays a tremendous role in their reading comprehension. This belief seemed to weaken as the students acquired the 3000 most common words of English vocabulary. Krashen (1989) also

suggests that language learners are aware of their need for vocabulary, and therefore attribute their linguistic deficiencies to inadequate vocabulary. As a consequence, those learners usually carry dictionaries around while learning a second or a foreign language. In fact, most first and second language reading researchers consider vocabulary knowledge an important variable that affects reading comprehension (Nation & Coady, 1988; Laufer, 1992).

In the L2 language instruction arena, in her review of several first and second language studies, Bernhardt (2000) maintained that "syntactic complexity does not necessarily predict text difficulty" (p. 797). This, of course, should not be taken to mean that grammatical knowledge has no impact on L2 reading. The crux of the discussion is that although both grammatical knowledge and vocabulary knowledge have their recognized role in L2 reading comprehension, it is the latter that more accurately predicts L2 reading ability.

## Vocabulary Density and Coverage

Several studies have attempted to determine the amount of vocabulary needed by a second language learner in order to be able to read with reasonable comprehension and without lack of vocabulary knowledge becoming a major burden (Hirsh & Nation, 1992; Laufer, 1989, 1992). One approach to this has been to take a commonsense view of the issue and to see how the density of unknown vocabulary and vocabulary size are related in various kinds of texts. This approach makes assumptions about desirable and undesirable densities. Table 1 provides the basis for these assumptions.

**Table 1 – The number of unfamiliar tokens per 100 tokens and the number of lines of text containing one unfamiliar word (adopted from Hu & Nation, 2000)**

| Text coverage % | Density of unfamiliar in familiar tokens | Number of text lines per 1 unfamiliar word |
|---|---|---|
| 99 | 1 in 100 | 10 |
| 98 | 1 in 50 | 5 |
| 97 | 1 in 33 | 3.3 |
| 96 | 1 in 25 | 2.5 |
| 95 | 1 in 20 | 2 |
| 90 | 1 in 10 | 1 |
| 80 | 1 in 5 | 0.5 |

Table 1 shows, for example, if learners have 80% coverage of the running words or tokens in a text, then one in every five running words is likely to be an unknown word. This is the same as there being two unknown words per line, if a line contains an average of about ten words. A density of two unknown words per line, particularly two unknown content words, would make reading very difficult and would probably result in low levels of comprehension. One of the most important features of Table 1 is the way that each small percentage change in coverage makes a greater change in the density of unknown words. That is, with 95% coverage, this density drops to one in 20, and with 99% coverage it drops to one in one hundred.

## Language Threshold

The features discussed about coverage have led several researchers to consider that there may be a threshold where vocabulary knowledge becomes sufficient for adequate comprehension (Read, 1988; Laufer & Nation, 1999). If the learner is on the one side of the threshold, vocabulary knowledge is not sufficient for adequate comprehension. If the learner is on the other side, other things being equal, then the learner knows enough vocabulary to gain adequate comprehension of the text.

We may now consider how text coverage and vocabulary size are related. The assumption that lies behind this discussion is that vocabulary learning is strongly affected by word frequency (Hu & Nation, 2000). That is, words which occur frequently in the language tend to be learned before words that occur less frequently. There is plenty of evidence to support this view. For example, Read (1988) in a study of the Vocabulary Levels Test (Nation, 1983) found that second language learners' scores on the various levels of the test decreased from the high frequency levels to the lower frequency levels. That is, the test had strong implicational scaling. Laufer and Nation (1999) found a similar effect in their comprehensive study for productive knowledge.

The relationship between text coverage and vocabulary size is strongly affected by the kind of text that is looked at. The high frequency words of English (West, 1953) provide poorer coverage of academic text than that of fiction, for example. Table 2 gives coverage figures for various kinds of English texts.

**Table 2 – Vocabulary size and text coverage (adopted from Hu & Nation, 2000)**

|  | 1st 1000 | 2nd 1000 | Academic vocabulary* | Others* |
|---|---|---|---|---|
| Conversation | 84.3% | 6.0% | 1.9% | 7.8% |
| Novels for younger learners | 84.8% | 5.9% | - | 9.3% |
| Fiction | 82.3% | 5.1% | 1.7% | 10.9% |
| Academic | 71.4% | 4.7% | 10.0% | 13.9% |

*"Academic" includes the words from the Academic Word List, a sub-technical vocabulary.
*"Others" includes low frequency words and proper nouns.

Table 2 above indicates that academic words constitute around 10% of the running words in each academic text. With regard to the present study, it is clear from the above table that academic words cover a reasonable amount of words in any nonfiction general English texts in academic settings, hence a good justification for conducting the present research.

## Research Findings on Vocabulary Density

Vocabulary knowledge seems to have an obvious and distinct role in L2 reading comprehension. Nation and Coady (1988) emphasize the fact that although vocabulary knowledge is not the only factor contributing to reading comprehension, vocabulary can be an 'accurate predictor' of the difficulty of certain texts. In fact, ESL vocabulary researchers sometimes debate the amount of vocabulary second language readers need to achieve adequate comprehension of reading texts. The required vocabulary knowledge seems to differ according to the genre of the text. What follows is an account of empirical research done in this area.

Holly (1973) looked at the effect of the density of the unknown words on vocabulary learning, comprehension, and learners' perception of difficulty and enjoyment. Time taken to read the text was also recorded. The subjects were learners of German as a foreign language. Seven versions of the same 750 word text were prepared, each with a different density of unknown words. The densities ranged from 1 unknown word in 150 (99.3% coverage) to 1 unknown word in 15 (93.3% coverage). Subjects were allowed 30 to 40 minutes to read the text and study the words. This represented a reading rate of around twenty words per minute, which is very slow. The meanings of the

words were provided in a glossary that accompanied the text. The subjects did not have to guess from context and had plenty of time to study the words as well as read the text. Holly found that in terms of raw number of words learned, the number kept increasing as the density increased. He maintains that this was not surprising as there were more words that could be learned as the density increased (5-50) and there was plenty of time to study them with their given meanings. Holly's experiment then probably did not necessarily measure the effect of unknown word density on learning and comprehension, but may have measured rote learning, and comprehension of texts containing known and glossed items. He found no significant difference between the densities for comprehension. Holly's densities of unknown words were all trivial, especially when viewed in terms of the percentage coverage of known words (93.3% - 99.3%). Heavier densities of one unknown word in five (80% coverage) and one unknown word in ten (90% coverage) also need to be looked at.

In a later study, Laufer (1989) wanted to see what percentage of word tokens (running words) needed to be understood in order to ensure 'reasonable' reading comprehension of the text. She found that the group that scored 95% and above on her vocabulary measure had a significantly higher number of successful readers than those scoring below 95%. The 90% level did not result in significant differences between those above and below 90%. A comparison of the 95% and above group with the 90-94% group revealed a significant difference in comprehension scores.

But what vocabulary size (number of word types, lemmas, or families) will provide 95% coverage of academic texts? Again in a similar study, Laufer (1992) looked at the relationship between reading comprehension score and vocabulary size, as measured by the Eurocenter Vocabulary Test (Meara & Jones, 1990). She concluded that the minimal vocabulary level of 3000 word families (around 5000 lexical items) is needed to have proper understanding of a text. Moreover, Laufer presented results from her previous studies proposing a vocabulary threshold of 3000 word families for effective reading and incidental vocabulary learning from context. According to Qian (2002), Laufer's research on the relationship between vocabulary knowledge measured by receptive vocabulary size and reading comprehension showed a high correlation between these two constructs ranging from 0.50 to 0.75. The variation in the correlation coefficients might have been caused by differences in research methodology and participants' characteristics in different studies.

Likewise, Hu and Nation (2000) found that adequate comprehension of fiction works requires knowing 98% of the words in that type of text. Where

80% of the running words in the text were familiar to the readers, none gained adequate comprehension. Where 90% and 95% of the tokens in the text were familiar to the readers, some gained adequate comprehension but most did not. In a recent study by Yamini and Golkar (2007), it was found that there is a high correlation between the learners' vocabulary knowledge on the one hand and proficiency and reading comprehension ability on the other hand.

These research findings show a very strong relationship between ESL/EFL students' vocabulary size and reading comprehension. The impact of vocabulary is so profound that researchers have been able to provide estimates of the size of vocabulary needed for successful comprehension. An important implication of these findings is that ESL/EFL students' language proficiency at the word level should receive the most attention at beginning and intermediate levels of language learning for their reading skills to develop.

Nation (2001) believes that language learners need a minimum vocabulary size of 2000 word families and a good knowledge of academic vocabulary to cover about 90% of unsimplified English texts. Even with this vocabulary size, the learners may need to deal with a number of unfamiliar words, comprising 10% of the words in the text. Although the ratio of the required vocabulary differs according to the nature of the text, e.g. fiction works call for the use of a larger variety of vocabulary items; a minimum vocabulary size of 3000 word families seems to be the threshold for successful L2 reading comprehension. It needs to be noted that the concept of unknown vocabulary size postulates that each learner, in a specific level of education, has a predictive number of vocabulary repertoire. Beyond that level, the words are regarded (probably) unknown. For example, Chall (1987) suggests that native speakers of English entering school have approximately a vocabulary of 5000 word families.

Therefore, based on the reviewed empirical studies, the present study examined the above-mentioned heavier densities of unknown vocabulary size (i.e. 2%, 5%, 10%, and 20%) on the performance of Iranian EFL learners. Furthermore, the purpose of the present study was to bridge the gap between the research conducted on fiction texts compared to nonfiction texts. For this purpose, the following research questions and corresponding null hypotheses were formed:

*Q1:* Do different densities of unknown academic vocabulary result in significant differences in EFL learners' comprehension of nonfiction general English texts?

***Q2:*** Is there a vocabulary coverage level which acts as a threshold between adequate and inadequate comprehension of nonfiction general English texts?

# Method

In order to find appropriate answers to the posed questions, the researchers followed certain procedures and made use of certain instruments, which are reported in this section.

## Participants

The participants were chosen from among the first-year students studying ELT at Shahid Rajayi Teacher Training University in Tehran. From among two intact classes (around 60 students), 40 students were selected based on their scores on the Vocabulary Levels Test (VLT) adopted by Nation (2001. The subpart of VLT given to the participants was the 5$^{th}$ level in order to extract a homogeneous group of subjects. Then, the subjects were randomly divided into five equal groups, each containing eight subjects. Each group subsequently, took one of the five formats of the reading comprehension tests that will be discussed in the following section.

## Instrumentation

In this study two kinds of tests were used. First, the VLT was used to estimate the vocabulary size of L2 learners of general or academic English by measuring single meanings of content words at different frequency levels with a word-short definition matching format. The 5$^{th}$ level of this test which was used in this study was the level with 5000 most frequent word families. All in all, 36 words were tested in each level with more frequent words coming at the beginning and the less frequent ones at later steps.

The VLT has been accepted by a number of L2 researchers as an appropriate measure of vocabulary size (e.g. Laufer, 1992; Laufer & Paribakht, 1998; Qian, 1999). Qian (1999) obtained a reliability of 0.92 for the measure.  As a result, this test has become widely used both in vocabulary research and as a vocabulary assessment for L2 learners. The vocabulary

selected for the university word level comprises words frequently appearing in university textbooks (Nation, 2001).

The second instrument was a reading comprehension test with five variable formats piloted among a group of students similar to the subjects of this study. The first test included the intact text, but in the second test, 2% of the less frequent academic words of the chosen text were replaced with nonsense words which were similar in form to English words. In the third reading comprehension test, the percentage of loaded nonsense vocabulary was 5%, in the fourth test 10%, and finally in the fifth one, it was 20%. The idea behind replacing these vocabulary items was that some learners may have been familiar with the less frequent words by having encountered them in their self-studies. Therefore, by using nonsense words the effect of background vocabulary knowledge vanishes (Nation, personal correspondence, January, 2008). In a similar approach, Waring and Takaki (2003) changed the spelling of words in their tests to ensure that each test item was unknown to their subjects. It needs to be pointed out that the reading comprehension tests included 10 multiple-choice items for each version of the reading test containing different percentage of unknown words.

## Procedure

First, the VLT was administered in order to extract a homogenous group of subjects for the study. From among 60 subjects, 40 were selected based on their scores on this test. Then, the selected subjects were randomly divided into five groups, each containing eight participants. Each of the above-mentioned reading comprehension tests was subsequently given to one of the five groups. Then, the participants were assessed according to their performance on a multiple-choice test made based on the selected text and the scores they got.

# Results

In this study, the performance of the subjects on different versions of the same reading comprehension test was the dependant variable and the unknown vocabulary size was the independent variable. Form among two intact classes (around 60 students), 40 students were selected based on their scores on the VLT. Those participants, who scored 80% of the total score, i.e. scored eight items right out of 10 items, were chosen as the ultimate

subjects of the present study. The adequate comprehension of the reading test was considered to be 80%, hence the justification for eight out of 10 items (Nation, personal correspondence, January, 2008). Then, the selected subjects were randomly divided into five equal groups and each group took one of the reading comprehension tests. The descriptive statistics of the five tests illustrated above is presented in Table 3.

**Table 3 – Descriptive statistics of the five tests**

|  | N | Mean | SD | Std. Error | 95% Confidence Interval for Mean | | Min | Max |
|---|---|---|---|---|---|---|---|---|
|  |  |  |  |  | Lower Bound | Upper Bound |  |  |
| TEST1 | 8 | 9.00 | .926 | .327 | 8.23 | 9.77 | 8 | 10 |
| TEST2 | 8 | 8.50 | .535 | .189 | 8.43 | 8.82 | 8 | 9 |
| TEST3 | 8 | 8.12 | .835 | .295 | 7.43 | 8.82 | 7 | 9 |
| TEST4 | 8 | 4.00 | 1.309 | .463 | 2.91 | 5.09 | 2 | 6 |
| TEST5 | 8 | 1.75 | .886 | .313 | 1.01 | 2.49 | 1 | 3 |
| Total | 40 | 6.00 | 2.900 | .459 | 5.07 | 6.93 | 1 | 10 |

As Table 3 shows, the highest mean was of those subjects taking the intact test (test 1), then those who took the format of the reading comprehension test with 2% unknown vocabulary (test 2: the text with the lowest unknown vocabulary density). However, the lowest mean belonged to those taking the 20% unknown vocabulary variant (test 5: the text with the highest unknown vocabulary density).

In order to compare the performance of the subjects on the five given texts as tests, a one-way ANOVA was needed for comparing the variances of the five sets of scores (Dornyei, 2007). However, in order to legitimize the ANOVA, the homogeneity of variances of the tests and the normality of the distribution of the scores had to be checked. Levene's and skewness tests were used to fulfill these requirements. Table 4 shows the result of the Levene's test of homogeneity of variances. The non-significant Levene's statistic of 0.593 ($p = 0.670 > 0.05$) demonstrated that the distributions enjoyed homogeneous variances.

**Table 4 – Levene's test of homogeneity of variances**

| Test of Homogeneity of Variances 0% | | | |
|---|---|---|---|
| Levene Statistic | df1 | df2 | Sig. |
| .593 | 4 | 35 | .670 |

In addition to Levene's test, test of skewness was run. As the results of this test are demonstrated in Table 5, all obtained values of skewness divided by the standard error of skewness were within the range of -1.96 to +1.96, and thus the distributions were considered as normal (Dornyei, 2007).

**Table 5 – Skewness test for the five distributions of scores**

| | N | Skewness | |
|---|---|---|---|
| | Statistic | Statistic | Std. Error |
| **Test1** | 8 | .000 | .752 |
| Valid N (listwise) | 8 | | |
| **Test 2** | 8 | - .277 | .752 |
| Valid N (listwise) | 8 | | |
| **Test 3** | 8 | - .277 | .752 |
| Valid N (listwise) | 8 | | |
| **Test 4** | 8 | .000 | .752 |
| Valid N (listwise) | 8 | | |
| **Test 5** | 8 | .615 | .752 |
| Valid N (listwise) | 8 | | |

Since the requirements of ANOVA were met, the test was run to compare the performances of the participants on the five tests. The results of the one-way ANOVA are displayed in Table 6.

**Table 6 – One-way ANOVA between the five tests**

| | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| NELSON | Between Groups | 294.750 | 4 | 73.688 | 77.566 | .000 |
| | Within Groups | 33.250 | 35 | .950 | | |
| | Total | 328.000 | 39 | | | |

As can be seen, the F value was 77.56. The difference among the groups came out to be significant. ($F_{(4,35)}$ = 77.566, $\rho < 0.05$). Therefore, it can be concluded that there were significant differences among the EFL learners' performance on the five tests. Thus, the first null hypothesis stating that

different densities of unknown academic vocabulary do not result in significant differences in comprehension of nonfiction general English texts was rejected. In order to locate the differences among the five tests, a Scheffe's Test was run. The results are demonstrated in Table 7.

**Table 7 – Post hoc Scheffe's test**

| (I) VAR00001 | (J) VAR00001 | Mean Difference (I-J) | Std. Error | Sig. | 95% Confidence Interval | |
|---|---|---|---|---|---|---|
| | | | | | Lower Bound | Upper Bound |
| 1.00 | 2.00 | .875 | .487 | .530 | -.71 | 2.46 |
| | 3.00 | 1.875(*) | .487 | .013 | .29 | 3.46 |
| | 4.00 | 5.000(*) | .487 | .000 | 3.42 | 6.58 |
| | 5.00 | 7.250(*) | .487 | .000 | 5.67 | 8.83 |
| 2.00 | 3.00 | 1.000 | .487 | .394 | -.58 | 2.58 |
| | 4.00 | 4.125(*) | .487 | .000 | 2.54 | 5.71 |
| | 5.00 | 6.375(*) | .487 | .000 | 4.79 | 7.96 |
| 3.00 | 4.00 | 3.125(*) | .487 | .000 | 1.54 | 4.71 |
| | 5.00 | 5.375(*) | .487 | .000 | 3.79 | 6.96 |
| 4.00 | 5.00 | 2.250(*) | .487 | .002 | .67 | 3.83 |
| * The mean difference is significant at the .05 level. | | | | | | |

Referring to Table 3 that was presented before, the highest mean was obtained on test 1 and the lowest on test 5. The results of Table 7 demonstrates a significant difference between test 1, 3 ($\rho$ = 0.013 < 0.05), 4 ($\rho$ < 0.05), and 5 ($\rho$ < 0.05). However, there was no significant difference between test 1 and test 2 ($\rho$ = 0.53 > 0.05). This means that comprehension of the intact test did not significantly differ from the comprehension of the text loaded with 2% unknown vocabulary, pointing to the insignificance of the 2% density. But densities higher than 2%, resulted in significantly lower comprehension.

Moreover, the mean obtained on test 2 was significantly higher than test 4 ($\rho$ < 0.05), and test 5 ($\rho$ < 0.05). However, there was no significant difference between the means obtained on test 2 and test 3 ($\rho$ = 0.394 > 0.05). These findings indicated that densities of 2% and 5% did not have any significantly different impact on the reading comprehension of the participants. However, densities of 10% and 20% had significantly different impact compared to the 5% density.

Furthermore, there was a significant difference between the obtained means on test 3 and test 4, and test 3 and test 5 ($\rho$ < 0.05). Finally, the mean obtained on test 4 was significantly higher than test 5 ($\rho$ < 0.05). These results proved that densities of 5%, 10%, and 20% significantly differed with respect to their impact on the comprehension of candidates.

Next, a regression analysis was run using the stepwise method to find out which test would predict test 5 most clearly since test 5 with 80% vocabulary coverage was the most difficult test because it contained the most unknown words. Therefore, it is predictable that those who performed well on this test would outperform on the other simpler tests with lower levels of vocabulary coverage. As displayed in Table 8, the test with 95% vocabulary coverage was the single variable that entered into the regression equation.

**Table 8 – Model summary**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate |
|---|---|---|---|---|
| 1 | .724(a) | .524 | .445 | .660 |
| a Predictors: (Constant), 95% | | | | |

The test with 95% vocabulary coverage has a correlation coefficient of 0.72 with test 5. The R squared, i.e. 0.52 shows that test 3 can predict 52% of the variance in test 5. Therefore, regarding the second null hypothesis which states that "there is not a vocabulary coverage level which acts as a threshold between adequate and inadequate comprehension of nonfiction general English texts", it can be claimed that this null hypothesis is safely rejected as well because there is a level of vocabulary coverage, i.e. 95% predicting the subjects' reading comprehension.

The ANOVA table (Table 9) illustrates the linearity of the regression analysis. Since the F value of 6.61 has a probability of 0.042 (< 0.05) it can be concluded that the regression model is linear.

**Table 9 – ANOVA results**

| Model | | Sum of Squares | df | Mean Square | F | Sig. |
|---|---|---|---|---|---|---|
| 1 | Regression | 2.885 | 1 | 2.885 | 6.618 | .042(a) |
| | Residual | 2.615 | 6 | .436 | | |
| | Total | 5.500 | 7 | | | |
| A Predictors: (Constant), 95% | | | | | | |
| B Dependent Variable: 80% | | | | | | |

Table 10 shows the regression coefficients. The standard Beta came out to be -0.724 and the significant *t* value ($t$ = 3.374, $\rho$ = 0.015 < 0.05) indicates that if a student's score on the 95% test increases, his/her score increases on test 5, as well.

**Table 10 – Regression coefficients**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | t | Sig. |
|---|---|---|---|---|---|---|
| | | Beta | Std. Error | Beta | | |
| 1 | (Constant) | 7.231 | 2.143 | | 3.374 | .015 |
| | 95% | -.769 | .299 | -.724 | -2.572 | .042 |
| a Dependent Variable: 80% | | | | | | |

# Conclusion

Second language acquisition researchers have come to recognize the central, or even preconditional, role of the lexical dimension for fluent language use whatever skill concerned (Nation, 2001). Many applied linguists have demonstrated, for instance, that the nature of the language threshold for reading is largely lexical. Anderson and Freebody (1981) reported high correlation between tests of vocabulary and reading comprehension as a consistent finding in L1 reading research. Laufer (1989, 1992) showed that the same applies to second language acquisition. She emphasized the importance of having a vocabulary large enough to provide coverage of 95% of the words in a text. Reading is an important part of most language programs, no matter whether they are aimed at beginners or intermediate and advanced learners. According to Laufer, learners whose target vocabulary is not large enough to have 95% coverage do not reach an adequate level of comprehension of the texts and are unable to transfer their reading skills from their L1 to their L2.

To understand a text, a reader needs to know much of the words used in that excerpt, i.e. s/he must have a vocabulary size needed to cover that text in order to have a better understanding (Nation, 2006). Therefore, the present study attempted to examine the effect of different densities of unknown vocabulary size on the reading comprehension performance of Iranian EFL learners.

Results of the present study indicated that the subjects' performance on reading comprehension tests and subsequently, their text comprehensions was highly sensitive to densities of unknown vocabulary size in nonfiction general English texts with academic words as a point of departure. One limitation of this study, however, was that the number of participants in each group (8 participants in each group) and the number of items of comprehension check on each reading comprehension text (10 items on each text) were limited. Therefore, although the findings of this study have limited generalizability, they provide further confirmation for the results of the

previous studies which concluded that vocabulary was an influential and determining factor in reading comprehension (Davis, 1972; Holly, 1973; Hirsh & Nation, 1992; Laufer, 1989, 1992; Hu & Nation, 2000; Yamini & Golkar, 2007).

According to Carver (1994), "when the subjects read a text which exactly matches their vocabulary level, they show a high level of comprehension and understanding" (p. 413). In this study, this level and all the running words were set at the 5th level of VLT, i.e. 5000 most frequent word families. This means that all the words in these texts fell within this range. With 98% of vocabulary size, the subjects gained a high level of comprehension, not significantly different from the intact text. This, too, can be attributed to the low level of unknown words, since just 2% of the running words in this test were unknown. The third level was a critical one, because its function was two-fold. First, the subjects had an adequate comprehension of reading tests, with the mean score of 8.12 out of 10. Second, it was the level acting as the threshold level between adequate and inadequate comprehension of the text. Therefore, based on these findings it seems that our university students may need, at least, 95% knowledge of words in each text they read for obtaining adequate comprehension. With a 90% of vocabulary coverage, the subjects in the present study gained little comprehension. When the coverage was 80%, none of the subjects performed adequately on the reading comprehension test.

The findings agree to some extent with a study on native speakers by Carver (1994) who concluded "when the material being read is relatively easy then close to 0% of the words will be unknown. When the material is relatively hard then around 2% or more of the words will be unknown. Furthermore, when the difficulty level of the material is approximately equal to the ability level of the individual, then around 1% of the words will be unknown" (p. 413). The findings of this study also supported Nation's (1983) claim that the knowledge of vocabulary facilitates reading comprehension in English.

However, the results of this study indicated that there was no significant difference between the impact of the intact text and the one with 2% densities of unknown words. This result was in line with the results of the regression analysis that indicated the 5% density was the threshold, showing that below 5%, no significant impact could be observed on the participants' comprehension, but above 5%, their comprehension would significantly decrease.

The text used in this study was a nonfiction general English text carefully chosen to nearly match the level of students. Other text types, particularly newspapers, might place greater demands on the reader. Compared to Hu and Nation's study (2000) in which it was found that adequate comprehension of fiction texts required knowing 98% of the words in those texts, the results of the present study were more promising and encouraging in that with a vocabulary size of 95% of running words, the students could manage reading academic texts without facing major problems.

A word of caution, however, is needed here. This conclusion must not be interpreted as saying that the mere 95% coverage of vocabulary guarantees efficient reading performance and no other skills or knowledge are needed to gain adequate comprehension. All of the subjects in this study, who were readers in their first language and had considerable knowledge of English grammar, were experienced in reading English and brought considerable background knowledge to their reading. These all contributed to their skill in comprehending text and account for the fact that some learners read the 90% version and obtained high scores. However, as readability studies show, vocabulary knowledge is a crucial component in reading comprehension. Teachers and instructors should keep the findings of this study in mind when guiding learners in choosing books for their extensive reading in order to improve their reading ability for their future professional studies.

Through understanding students' vocabulary knowledge, i.e. their vocabulary size, the teachers and instructors can arrange appropriate curriculum and choose suitable materials in the classroom. Once teachers understand the importance of vocabulary knowledge in the classroom, they can help their students select the texts that match their present English ability to read independently. In this way, the inconsistency between the students' reading ability level and the required vocabulary size lowers and better comprehension is achieved.

## The Authors

*Mohammad Hossein Keshavarz* is full Professor of Applied Linguistics at Teacher Education University. He has published on various topics in several international journals including *Language in Society* and the *International Journal of Applied Linguistics*. He has also presented papers in professional conferences such as AILA and Bilingualism Symposia. Professor Keshavarz's main areas of research interest include sociolinguistics, bilingualism, discourse analysis, and phonology.

***Vali Mohammadi*** holds an MA degree in TEFL from Teacher Education University and is currently an instructor at Parsabad University of Applied Sciences and Technology, Ardebil, and also a high school English teacher. He has co-authored a book on English vocabulary and is currently writing another series of vocabulary books. His areas of research interest include teaching methodology, corpus linguistics, and vocabulary teaching and learning.

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