Effect of Word Complexity on L2 Vocabulary Learning

Kevin Dela Rosa
Language Technologies Institute
Carnegie Mellon University
5000 Forbes Ave. Pittsburgh, PA

kdelaros@cs.cmu.edu

Maxine Eskenazi
Language Technologies Institute
Carnegie Mellon University
5000 Forbes Ave. Pittsburgh, PA

max@cs.cmu.edu

Abstract

Research has shown that a number of factors, such as maturational constraints, previous language background, and attention, can have an effect on L2 acquisition. One related issue that remains to be explored is what factors make an individual word more easily learned. In this study we propose that word complexity, on both the phonetic and semantic levels, affect L2 vocabulary learning. Two studies showed that words with simple grapheme-to-phoneme ratios were easier to learn than more phonetically complex words, and that words with two or fewer word senses were easier to learn that those with three or more.

1 Introduction

There is much computer-assisted language learning (CALL) literature that explores effective methods of teaching vocabulary. In recent studies conducted using the REAP system, which finds documents from the internet to teach vocabulary, we have shown that speech synthesis reinforces written text for learning in reading activities (Dela Rosa et al., 2010), and we have also shown that context-sensitive dictionary definitions afford better vocabulary learning for L2 language students (Dela Rosa and Eskenazi, 2011).

One issue that remains to be explored in this context: determining what factors make an individual word easier to learn. We propose that word complexity, on both the phonetic and semantic levels, can affect how easily an L2 vocabulary word can be learned.

In this paper we first discuss past work on factors that impact vocabulary acquisition in intelligent tutoring environments, and then explore work on defining the complexity of a word with respect to vocabulary learning. Next we describe two classroom studies we conducted with ESL college students to test the effect of word complexity on L2 vocabulary learning. Finally we examine our results and suggest future research directions.

2 Background

Many studies have been conducted to investigate the relationship between different variables and second language learning. For example, the age of the foreign language learner is often pointed to as a major factor in determining whether an individual will be successful in learning a new language (Marinova-Todd, 2000).

In the domain of L2 vocabulary instruction, researchers have shown that factors such as maturational constraints, attention, previous language background, and order of acquisition, can all affect L2 vocabulary acquisition (Oxford and Scarcella, 1994). Additionally, another factor that affects L2 vocabulary learning is the number of exposures of a practice item that a student receives during learning activities. In a study on the effects of spacing and retention of vocabulary pairs, Pavlik and Anderson (2005) showed that each time an item is practiced, it receives an increment of

strength, but these increments decay as a power function of time. Furthermore, it is generally accepted that reading is beneficial to vocabulary acquisition (Perfetti, 2010).

One group of factors in foreign language vocabulary instruction that has often been overlooked is at the level of the individual word, such as word complexity. In sections 3.2 and 3.3, we describe two simple measures of phonetic and semantic word complexity that were examined during our classroom studies. There have been work on defining the complexity of a word, such as Jakielski's (1998) Index of Phonetic Complexity, but we do not know of work that measures the effect of word complexity on L2 vocabulary learning.

3 Classroom Study Setup

In order to determine the effect that word complexity, in both the phonetic and semantic levels, have on L2 language learners, we conducted two in-vivo studies with ESL students at the English Language Institute of the University of Pittsburgh. The first study focused on the effect of phonetic word complexity on vocabulary learning. The second study explored the effect of semantic word complexity, in the form of the number of senses a word has, on vocabulary learning. Both studies and the tutoring system that was used are described in the next sections.

3.1 Overview of the Tutoring System

The tutoring system, REAP, is a web-based language tutor developed at Carnegie Mellon that harvests documents from the internet for L2 vocabulary learning and reading comprehension (Heilman et al., 2006). It has been used as a testing platform for cognitive science studies. This system has the ability to provide reader-specific passages by consulting profiles that model a reader's reading level, topic interests, and vocabulary goals.

The system's interface has several features that enhance a student's learning experience. One key feature is that it provides users with the ability to listen to the spoken version of any word that appears in a document, making use of the Cepstral Text-to-Speech system (2001) to synthesize words on the fly when clicked on. Additionally, students can look up the definition of any of the words they encounter while reading the documents using an embedded electronic dictionary. The system also automatically highlights focus words, i.e. the words targeted for vocabulary learning in a particular reading.

3.2 Study 1: Phonetic Complexity

In Study 1, we looked at the effect that phonetic complexity, one measure of a word's complexity, has on learning a word, and whether this complexity causes a word to be learned more easily when multimodal input is provided in the form of written text accompanied by spoken text generated through speech synthesis. To measure a word's phonetic complexity, we used the ratio of a word's graphemes to phonemes, where words with a ratio closer to 1 were simpler than those with a ratio much greater or less than 1. Note that for this study, simple letters have been used as the grapheme units.

For example, the word *cat* has a simple one-to-one mapping between its graphemes and phonemes (C A T vs. K AE T), while other words like *borough* and *index* have a more complex relationship (B O R O U G H vs. B ER OW, and I N D E X vs. IH N D EH K S), with grapheme-to-phoneme ratios greater than 1 and less than 1 respectively.

For this study, there were 21 intermediate-level ESL college students at the University of Pittsburgh's English Language Institute whose native languages included Arabic, Chinese and Spanish. Weekly group readings were given as class activities, centered on a total of 18 focus words, followed by practice closed cloze questions (multiple-choice fill-in-the-blank with 5 answer choices provided, and distractors coming from the Academic Word List or words that are similar but do not fit the blank properly) on the focus words that appeared in the particular reading. The focus words used in this study were taken evenly from the following word groups:

- Words with grapheme-to–phoneme ratio equal to 1 [6 words]
- Words with grapheme-to–phoneme ratio greater than 1 [6 words]
- Words with grapheme-to–phoneme ratio less than 1 [6 words]

A pre-test was administered at the beginning of the study, consisting of closed cloze questions about the focus words. A similar set of questions

was presented to the students during the post-test, which occurred one week after the last reading activity. Between the pre-test and post-test, 6 reading activities were administered, one per week, each focused on a single document. This activity typically took students 20-30 minutes to complete.

3.3 Study 2: Semantic Complexity

In Study 2, we investigated the effect that multiple word-senses, another measure of word complexity, have on learning a word. There were 21 intermediate-level ESL college students at the University of Pittsburgh's English Language Institute, whose native languages included Arabic, Chinese, Korean, and Spanish. As in Study 1 there was a pre-test, a post-test, and a series of weekly documents to be read featuring the focus words. In total there were 26 focus words, all of which were taken from the Academic Word List and 7 weekly reading activities.
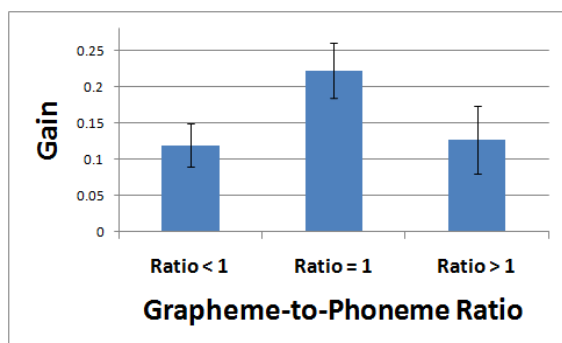

Figure 1: Impact of phonetic complexity on the improvement between pre-test & post-test in Study 1
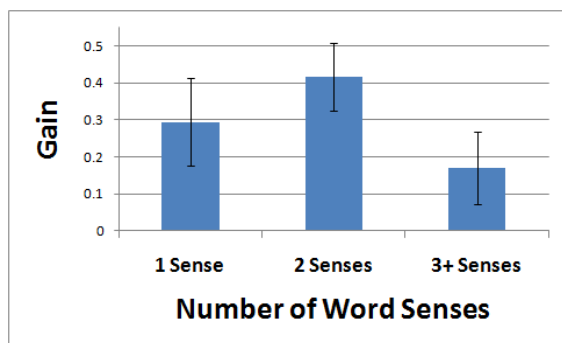

Figure 2: Impact of word sense complexity on the improvement between pre-test & post-test in Study 2

With respect to word complexity, the focus words were divided into the following groups:
- Words with 1 sense [8 words]
- Words with 2 senses [10 words]
- Words with 3 or more senses [8 words]

4 Results

The results of both of our studies showed that the use of the tutoring system significantly helped students improve their performance on the vocabulary tests, as made evident by the average overall gains between the pre-test and post-test ($p < 0.001$). Note that the error bars shown in this section show the standard error. Also note that normalized gain, the measurement being used to describe improvement in both studies, is given the by the following:

If the *post-test score* is greater than the *pre-test score,* then

Normalized gain = (post-test score − pre-test score) / (maximum-possible-score − pre-test score)

Otherwise,

Normalized gain = (post-test score − pre-test score) / (pre-test score)

In Study 1, the average normalized gain between the pre-test and post-test was 0.2563 (± 0.0466). Figure 1 illustrates the differences in vocabulary gain when the gains are separated by word condition type. The average gains per condition are 0.2222, 0.1270, and 0.1191 for the conditions of grapheme-to-phoneme ratio = 1, grapheme-to-phoneme ratio > 1, and grapheme-to-phoneme ratio < 1 respectively.

In Study 2, the average normalized gain between the pre-test and post-test was 0.5323 (± 0.0833). Figure 2 illustrates the impact of word sense complexity on vocabulary gains. With respect to word sense complexity, the average gains per condition are 0.2495, 0.4163, and 0.1699 for the 1-sense, 2-senses, and 3-or-more senses conditions respectively.

5 Discussion

The results of both studies tend to confirm our initial hypotheses and suggest that word complexity, in the forms of phonetic complexity and the number of word senses a word has, does make a significant difference in how easily an L2 vocabulary word is learned.

In Study 1, we see that the 'simple' words (those with grapheme-to-phoneme ratios equal to 1), afford more learning than the more 'complex' words, as made evident by the difference in gains between the pre-test and post-test ($p < 0.04$) shown in Figure 1. This result suggests that the phonetic complexity of a word may play a role in learning that word in an intelligent tutoring environment.

In Study 2, the words with many senses (3 or more) have significantly lower gains than words with 1 or 2 senses ($p < 0.05$). There was no significant difference in gains between words with 1 word sense and words with 2 word senses, as shown in Figure 2. This result seems to suggest that words with 2 or fewer word senses are generally easier for L2 students to learn than those with 3 or more word senses. This could be because a student has a harder time choosing the correct meaning of a word amongst many choices. Fewer choices seem to afford more learning than showing just the right one, which may indicate that by comparing two meanings with the meaning in the document, the student is actively constructing her knowledge of the word. Dela Rosa and Eskenazi (2011) found that giving students only the correct meaning of a polysemous word afforded less learning than giving them several meanings in a ranked order.

6   Conclusion and Future Directions

This paper demonstrates that word complexity can affect how easily an L2 vocabulary word can be learned. We proposed two dimensions of word complexity, one based on the complexity of a word's grapheme to phoneme ratio, and another based on the number of meanings a word has. Two in-vivo studies were conducted with ESL college students to test our hypothesis. Our results suggest that word complexity on both the phonetic and semantic level does have an effect on L2 vocabulary learning.

A future research direction that this work suggests is the search for other measures of word complexity, such as a more complex measure of grapheme to phoneme ratio, for example taking into account the ambiguity of a particular grapheme, or more complex measures of semantic complexity, like one that may take the average number of synonyms a word sense has, to determine their effect on learning using an intelligent tutoring system. This information could help define different ways to teach different words, providing more scaffolding for harder words, for example.

We would also like to investigate whether the average aggregate vocabulary learning trends of different native language groups correlates with different measures of word complexity, and thus might reveal a relation between the structure of L1 and difficulties in L2 vocabulary learning.

Finally we would like to investigate whether providing examples of focus word usage prior to or following a reading activity is beneficial to vocabulary learning.

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Appendix A. Words Used in Studies

Words from Study 1: condominium, exotic, boost, escapism, yearning, asylum, blatant, denizens, partisan, expats, influx, levy, taxes, lucrative, sector, ostracism, taunts, withdrawal

Words from Study 2: established, incorporated, intervention, coherent, facilitate, induce, relax, designed, flexible, inspected, registered, category, enforce, illustrations, accumulate, hypothesis, period, qualitative, simulations, conducted, debate, domestic, found, concentrate, depression, register