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The Role of Phonological Memory and Vocabulary in Second Language Acquisition

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Introduction

According to Dornyei (2005) and Segalowitz (1997) some learners are very successful at acquiring a second language, while many others find it much more difficult. There are a great number of possible reasons for each student's struggles, ranging from environmental to personal factors, so it is important to narrow these down to a few choice topics. One area of interest to the SLA community is the acquisition of vocabulary and how a proficiency in that area can lead to a better handling of a newly acquired language. There have been numerous arguments made that a robust vocabulary inventory can directly translate into successful second language acquisition (Nation, 2001; Folse, 2004). In addition, there is also strong evidence that cognition, or more specifically phonological working memory, is a major factor in a learner's ability to acquire and retain vocabulary.

This paper will illustrate how vocabulary is a critical, but often marginalized, component of SLA. Furthermore, it will present evidence of how phonological working memory helps facilitate a strong vocabulary. This will be achieved by looking at empirical evidence provided by various studies, with regards to their link to SLA. Once established, this paper will then show that phonological working memory can indeed be improved, instead of purely being an innate attribute that cannot be altered. This will then lead the way to the discussion of pedagogical techniques and methods that can be used to explicitly teach vocabulary.



Importance of Vocabulary in SLA

Smith (1926) claims that by the age of five a child, raised in a native English speaking environment, would have already acquired roughly 2000 vocabulary words (as cited in Baddeley & Gathercole, 1998, p. 159). Furthermore, Nagy and Herman (1987) add that they will learn up to 3000 words per year in their formal schooling. For these native English speakers, successful vocabulary acquisition is the most important factor in determining their future educational success. For non-native English learners, Service and Kohonen (1995) assert that vocabulary acquisition is directly related to later success in acquiring English

In second language instruction, grammar has traditionally been seen as the most important aspect of language learning. Looking at many syllabi across second language classes it is apparent that grammar is the main focus of instruction (Zimmerman, 1997). However, it can be argued that incorrect vocabulary would impede the transmission of an intended message much more than incorrect grammar can (Barcroft, 2004). An example of this is by saying ‘there are two shirt in the classroom’. Of course, the correct grammatical form of this sentence is ‘there are two shirts in the classroom’; with the direct object lacking the morpheme –s signaling a plural noun. However Barcroft (2004) points out that although the lack of grammatical knowledge here impedes the transmission of the message to a certain degree, the intended meaning largely remains intact. However, if someone were to say “there are two skirt in the classroom” (confusing the word “skirt” for “shirt”) the lack of vocabulary knowledge here clearly impedes the message more than the lack of grammatical ability, to the point where the entire message is completely altered. So it is valid argument that vocabulary is as every bit as important as grammar, if not more. As Wilkins (1972) so elegantly states: “While without grammar very little can be conveyed, without vocabulary *nothing* can be conveyed” (p. 111).

Case for Explicit Teaching of Vocabulary

Despite the argument that vocabulary should be given the same level of importance as grammar, learners still feel that they are given an insufficient amount of explicit vocabulary exposure. Students have longed professed that their lack of vocabulary knowledge has hindered their ability to become “native-like” (Arnaud & Savignon, 1997). This can be due to a lack of understanding of idiomatic phrases, which can be a struggle despite a good mastery of structure and grammar. Furthermore, surveys have shown that many students strongly desire an increased



amount of vocabulary instruction (Flaitz, 1998; James, 1996). As a matter of fact, these surveys revealed that when asked how to improve their classes; the want for more vocabulary instruction was second only to the desire for more speaking time in the classroom.

Explicit teaching of vocabulary is not emphasized enough in schools because it has always been thought to be easily acquired through incidental learning (Nation, 1990). However, Nation (2001) makes the case that this philosophy needs to be re-examined. Using the Francis and Kucera (1982) 1000-word frequency list, which contains the most commonly occurring words in written and oral English, Nation (2001) concluded in his research that a learner has to read or listen to 10,000 running words for a word from that list to be repeated again. He then added that when the 1000-word frequency list is expanded to 2000 words, a learner must then be exposed to 20,000 running words in order to have that word reoccur again. This shows that there is a considerable gap between the first and second exposure of a word and, depending on the type of instruction provided in the classroom, the time gap can be sizeable as well.

This finding is significant because Baddeley (1990) points out that for new words the time between repetitions has to be close together, while older words can be more spaced apart. However, there does not seem to be a consensus on the precise time frame of these repetitions. Nation (2001) points to two different studies by Elley (1989) and Brett, Rothlein and Hurely (1996) which state that memory loss occurs at three months and six weeks, respectively. Conversely, Chen and Truscott (2010) found in their study that repetitions should occur within two weeks in order to prevent memory loss of words.

While the lack of a definitive quantitative value for the timeframe of memory loss can be disconcerting, Nation (2001) notes that a key reason for this is that there are so many internal and external factors involved in memory. The way in which a word was presented, the surrounding environment and how receptive the students were to their instruction are just a few examples of factors that may have impacted the results. Regardless of the exact time a repetition needs to occur within, it is clear that a shorter time interval between word exposures is more desirable than longer ones. Although this may sound good in theory, the reality is that there may not be sufficient time in L2 classes to have these words repeated incidentally.

The length and meeting times of English classes vary across all schools, domestically and worldwide, and it is a real possibility that too much time can pass between the repetitions of a word. This is especially important in many EFL contexts. The Japanese Ministry of Education



Culture and Sports, Science and Technology (MEXT) conducted a survey in 2006 and 2007 pertaining to the amount of English instruction in elementary, junior and high schools. According to this survey, across those three school levels, Japanese students received only 18, 266.7 and 361.7 hours of total English instruction, respectively (Nakaniahi & Suzuki, n.d.). This averages to about one to one and a half hours a day for junior and high school students. Although it would be extremely difficult to gauge how many running words are introduced per class, it can be argued that the amount of class time provided is not sufficient enough to give ample opportunity for a particular word to be repeated again.

Clearly this calls for the need of explicit vocabulary instruction in the classroom. However, before delving into particular pedagogical recommendations, it is of interest to look at the empirical evidence surrounding how learners process vocabulary and the magnitude to which it impacts their overall L2 acquisition. In order to get a true understanding of working memory it is important to first look at Alan Baddeley's (1986) work in the *Working Memory Model* and to break down its components.

Background on Phonological Working Memory

As the field of second language acquisition has grown, linguists have increasingly looked to psycholinguistics and many present day studies on phonological short-term memory are modeled after his research and findings. In many of his works, Baddeley (1986) proposed a phonological working memory model which described a learner's ability to repeat a series of phonological input, after hearing them for a set period of time. This input consists of non-words, which Gass and Selinker (2008) describe as phonologically possible words that do not exist in any given language, but also do not violate any of that language's phontactics rules. These non-words were used to quantitatively measure the person's proficiency in this model. This system can be broken down into three separate parts: the central executive, the phonological loop and the visuospatial sketchpad.

According to Baddeley (1986), the central executive is a multi-functional attentional system responsible for directing attention to relevant information. Furthermore, the next two parts of the model (the phonological loop and the visuospatial sketchpad) are both considered to be slave systems to the central executive. The visuospatial sketchpad controls spatial and visual information, while the phonological loop is responsible for retaining audio information into



short-term memory through sub-vocal rehearsal. This sub-vocal rehearsal is what people many times do when trying to remember a sequence of numbers, such as a person's postal code or phone number. By constantly repeating the digits in one's head, either mentally or vocally, it will help prevent the decay of the information that is trying to be retained. This is the same concept for learners trying to acquire an unfamiliar word, especially in the case of learning a second language. The constant repetition of these words will allow for better memory and future retrieval.

Research Studies

The crux of the research done on phonological short-term memory was to find out whether there was a correlation between a learner's phonological memory and the ease with which a new language is acquired. Vocabulary was a critical part in the four studies discussed in this paper and lays the essential groundwork for developing pedagogical strategies to address the needs of not only the weaker students, but also the ones who do not seem to struggle as much. The four studies of special interest were those conducted by Speciale, Ellis and Bywater (2004); O'Brien, Segalowitz, Freed, and Collentine (2007); Kormos, and Safar (2006) and Payne and Ross (2005).

Study by O'Brien et al. (2007)

In this study, 43 English native speakers learning Spanish as their L2, were given an Oral Proficiency Interview (OPI). These college students did not have any Spanish speaking heritage nor did they have any Spanish spoken at home. This test was administered at the beginning and at the end of the semester. The study consisted of 18 students who were learning Spanish in their own native country and 25 who were studying abroad in Spain. The difference in the two scores was used to determine how much their oral Spanish proficiency had improved over the length of the semester. Also, a test measuring their phonological memory was given at the same time as their second OPI.

The phonological memory test was conducted by giving varying series of one syllable non-words. These were chosen among a list of 144 predetermined non-words. These examples were taken from the previous work of Gathercole, Service, Hitch, Adams, & Martin(1999). Examples of the non-words used in this particular study are listed in the following table:



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The nonwords used in the serial recognition task

Four-item lists (practice)	bɑ:tf tɪg nɑ:p gʊk kɪb dən pɑ:tf gɪd mɑ:t tʃɛn pɛd kɪg məd gɑ:p tæm pɪb
Five-item lists	tɛk kæm mɪtf bɑ:n dəp tʃum kəp lɑ:k nɑ:g gɑ:m pɪm tɑ:ɪg gæb bɑ:k tʃɛl gʊt bɑ:ɪg mən nɑ:k tɛp lɔ:g dʒɑ:l dɪtf kəm mɛb kɪtf dʒɑ:m mɛp tə:g bɪk kum tɑ:d mɑ:dʒ dʒɑ:p gɪk lɑ:d tɑ:dʒ dʒɪk nɑ:ɪb gɑ:m
Six-item lists	bɑ:dʒ tʃɑ:d nɪg dæk kɛb lɑ:m tədʒ dʒup lɛk nɑ:ɪg tʃɪm pɪb pɑ:m mæb dɑ:dʒ nɑ:g tʃɪm dʒɪt kən budʒ tɑ:d hɪg pæb dɑ:ɪt tɪdʒ mɑ:p tʃɛn gəb nɔ:g dɪt tɑ:m pæg jɛk dəb ɔ:l bɑ:p kɑ:p tɪb nʊl dʒɑ:k pɪm gətʃ pædʒ nɑ:p mɑ:n tʃɑ:t gub gɛd
Seven-item lists	tuk tʃæd hɪdʒ dʒə:g dɑ:p nɑ:ɪt gɑ:b kɑ:k nətʃ mɑ:ɪd tʃæm bul lɑ:b tɪp tʃɑ:m nɪg kɑ:m dʒɪl gædʒ ləb mɑ:n tɑ:b gæn dɑ:ɪtf tʃul dʒɑ:k nɑ:ɪd pɛm gɛl nə:g lɑ:d pɑ:k mɪtf dʊb dʒæt lɪm kɑ:g tʃɑ:dʒ dʒət kɛd dɑ:ɪp gɑ:k tʃɪg næm pɛb gɑ:p dʒutʃ lɑ:ɪt tɪd dʒɑ:m nɛb gəp tʃɑ:ɪg mæl tutʃ lɑ:n

O'Brien et al. (2006)

The students were audibly given a series of non-word utterances and then asked to listen, remember and produce the same exact non-words. The non-word utterances varied in sequence, length and in time with respect to the amount given in between repetitions. The findings of this test were then matched up with the findings from the OPI tests to find any correlation between the two.

After accounting for outliers in the experiment, the results of the study showed that the students who scored better on the non-word tests also did marginally better on the Spanish OPI tests. O'Brien et al. (2007) did note that there was a much bigger difference when only looking at the students who were studying abroad, as opposed to the students learning Spanish in their own native country. So learning context could have played a role in the final results, but when looking at the data holistically there was still a clear correlation between their serial non-word recognition scores and their OPI results. This study is significant because this shows that a good working memory is a strong indicator of the learners' ability to acquire a second language.

Study by Speciale et al. (2004)

The next study by Speciale, et al. (2004) followed the same idea, but used slightly different methods. The participants were 38 undergraduate students with no prior knowledge of the



German language. The test used 32 randomly, computer generated English language non-words and the students were asked to listen to and remember the words presented to them. Next, the students were given a series of English non-words from said list, and instructed to click yes and click no if they had not. However, this list also contained foil words along with the non-words from the original list of non-words. A foil word is simply a non-word that is never introduced in previous non-word lists. It is introduced strictly to see if the non-word from prior lists were truly remembered or, if they were merely being guessed.

The second part of the experiment consisted of the student listening to a set of words spoken in German, while their English translation was displayed on a screen. After four repetitions the students were audibly given some of the German words again and they were instructed to write down their English translations. Furthermore, the students were also visually shown a set of English words that they were exposed to before in the experiment and asked to verbally reproduce their German counterparts. The results were recorded and matched up against the student's memory test.

The differences in the ability to acquire non-words sequences were measured by using the Phonological Sequencing Index (PSI). The higher the PSI score, the better the subject was in retaining and producing the given sequences. The findings of this study showed that PSI was highly related to the task of German production (Speciale et al., 2004). It was also noted in their research that there was a low degree of freedom, so statistically speaking there may have been some flaws. However, one of the key findings from this study is that working memory is important in acquiring vocabulary for learners with no prior experience or knowledge of the language being learned.

Study by Kormos and Safar (2006)

The next study used similar methodology as the study conducted by O'Brien et al. (2007). Kormos and Safar (2006) studied 67 English students from the Hungarian dual language secondary school in Budapest. The students were grouped according to their proficiency in English and were given a non-word span test at the beginning of their academic year. 36 Hungarian non-words were used, ranging from one to nine syllables, and were presented to the students in a specific order. At the end of their term they were then given the Cambridge First



Certificate Language (CFCL), in order to assess their English proficiency in vocabulary and grammar.

The results of the non-word span test followed a normal distribution curve where 54% fell into range of the national average, while 20% fell below and 26% were above. When the data was matched up with the CFCL scores it showed that with the beginner students there was a weak correlation between their oral non-word test results and their English proficiency test scores. However, a stronger correlation was found when looking at pre-intermediate students. The students with stronger non-word repetition ability scored significantly better on the CFCL than the ones who did not. It was concluded that while working memory may play a large part in beginner students' success in L2 grammar and vocabulary, it may play an even bigger role in more advanced learners.

Study by Payne and Ross (2005)

The final study that will be discussed was conducted by Payne and Ross (2005). In this study, 24 third semester Spanish students, at a western United States university, were given an oral Spanish proficiency exam during the 3rd and 15th week of the semester and a working memory test during the second week of the semester. The Spanish proficiency exam, as described by Payne and Ross (2005), consisted of four topics (chosen at random) which the student had to speak about continuously for five minutes. If the speaker ran out of things to say, another topic would then be chosen. The exam was scored by one native Spanish speaker and one non-native speaker. There was no interaction between the listener and speaker during the duration of the exam, as the evaluators were instructed to only listen to and measure the speaker's fluency against that of a native Spanish speaker.

The working memory test used both a non-word and reading span. The non-word test that Payne and Ross (2005) used was a bit different than the other tests discussed in this paper in that it was given online, but the results fell in line with those of the other studies. Eight non-words were audibly given to each student in one second intervals, and the student was supposed to try to remember each word spoken. Next, each student was visually given 16 words (eight of which were foil words) and they had to check if they had heard that particular word before or not. This whole procedure was then repeated two more times.



The reading span test consisted of four sets of 15 sentences (60 sentences total). In each set, the student was given 15 sentences in seven second intervals. They were then asked to check whether or not that particular sentence made any sense and to remember the final word of the sentence. After each set had finished, the student was given a series of 15 questions which corresponded to the exact order of the sentence list. Each question contained the last word of each particular sentence and two foil words. The foil words could consist of words in the same semantic domain (e.g. for “woman” the foil words could be “girl” and “female”) or final words from the other sentences in the set.

The data for this particular study yielded interesting results. On top of concluding that working memory plays a role in language output, Payne and Ross (2005) found that the students with lower working memory span scores were actually the ones that produced the most utterances in the Spanish proficiency exams. They wrote that this may have been caused by a ‘bootstrapping effect’ where the low-span students had less of a cognitive burden and were freer to formulate longer and more elaborate utterances. One thing that should be noted about this particular study is that this study found the weakest link between working memory and L2 acquisition, among the four studies discussed in this paper. However, Payne and Ross (2005) admitted some limitations to their research due to the relatively small sample size they had, and that a larger group may have yielded more accurate results.

Impact of the Four Studies

The research articles discussed in this paper all followed the same basic methodology (with some degree of variance) and yielded similar results. Overall, the findings of all four studies found a correlation between the learner’s phonetic memory and their L2 proficiency. Across the board, the learners that showed the best phonetic memory also were the ones who had better L2 abilities. Phonetic memory, therefore, “appears to be an important skill necessary for the development of L2 speech production in an adult population” (O’Brien et al., 2007, p. 573) and “illustrates that the capacity of the short-term phonological store places constraints lexical acquisition” (Speciale et al., 2004, p. 314).

Another finding that emerges from the research is that all the non-words used were formed using L1 phonotactics and not L2. This is noteworthy because it would be reasonable to assume that since a non-word test only measures memory that it would not matter which language’s



phontactics are used (as long as the methodology was consist throughout the research). However as Gathercole et al. (1999) and Cheung (1996) posited in their research, prior knowledge of the target language's regularities and structure can influence L2 repetition ability (as cited in Kormos & Safar, 2006, p. 265). Whereas it is a safe assumption that everyone has basically the same handling of phontactics in their own native language, it provides a more even playing field. By using L1 non-words researchers would be getting a better picture of actual working memory and not have it skewed by the learners' possible prior L2 knowledge.

Going a step further, Kormos and Safar (2006) declare that "verbal working memory capacity influences the ability to apply linguistic rules automatically under time-constraints (i.e. during speaking)" (p. 112). Meaning that during any given exam the test taker has a time limit to complete all the tasks and questions, and the quicker they can retrieve and process information the greater likelihood of success on that exam. So, according to Kormos and Safar (2006) the students with higher verbal memory ability were able to quickly translate what they knew about the rule (declarative knowledge) into the application of the rule (procedural knowledge). This has rather large ramifications in the way people approach learning an L2 and can be applied to the way teachers approach teaching a second language.

Discussion

The results of all these studies confirm what had already been suspected about the link between phonetic memory and the ability to acquire a second language successfully. If a person can successfully listen to, retain and produce a series of utterances (that he or she has never heard before) then that person should have a relatively easier time acquiring vocabulary and, in turn, an L2. Phonological memory plays a key role in whether multiword utterances are a slow, controlled procedure or an automatic, effortless one (O'Brien et al., 2007). Meaning, the quicker a student can retrieve the L2 vocabulary from memory; the more fluent they will sound.

While the direct link between phonetic memory and vocabulary has been clearly established, these studies point to only innate ability of the individual learner as indicators of future L2 success. What is not clear from these particular studies is whether it is possible to improve on working memory. Klein and Boals (2001) point out that it is indeed possible for working memory to be improved through a number of exercises, which can be taught in the classroom. There are numerous strategies and techniques that can be utilized to bolster students'



vocabulary and this will have an enormous impact on how well students learn their L2 (Nation, 2001).

Pedagogical Strategies

As mentioned throughout this paper, some students are able to acquire and retain new words better than others. So, it is important to help those struggling L2 students develop new strategies to learn the words presented to them. The following pedagogical strategies are by no means an exhaustive list, but provide some of the more well-known and proven approaches to learning vocabulary.

Word Lists

One of the most useful techniques in the learning and retention of vocabulary is the use of word lists. Folse (2004) points out that word lists are an effective tool in learning new vocabulary. Word lists can be generated from a number of sources at the teacher's disposal. It may include: the University Word List (the most commonly used words in academic text), the Dolch List (220 sight words for elementary school students), and the General Service List (2000 most frequently used words in English). The word list can also be generated by the L2 teacher because teachers are more familiar with the needs of their students than anyone else (Folse, 2004). Thus, the type of list can be tailored to suit the level and the needs of the type of learners that are being taught and there is a certain level of freedom to the particular word list a teacher can provide.

Word Cards

Folse (2004) states that the use of flashcards is also a good and widely used learning method for students. Nation (2001) backs up this claim by saying the use of word cards can quickly build vocabulary via intentionally focused learning. He further states that this word card strategy is derived from different research on mnemonic techniques, associate learning and vocabulary learning.

Nation (2001) also goes further to mention that flashcards must be used properly in order to be effective in learning. He lists techniques for both making the cards and for using them. The techniques for making the flashcards include putting the word and meaning on different sides of the card, using pictures if possible and avoid putting words in the same lexical set (like colors,



synonyms and days of the week) to avoid interference. For example, the word “skirt” and “shirt” are part of the same lexical set, but can often be times confused with one another because of the similarities in their pronunciation. When using flashcards, he recommends periodically reshuffling the cards (while keeping the harder words at the beginning), reading them out loud and making conscious efforts to apply the words into meaningful use of the language. So, these types of techniques should be presented to all students in order to help them maximize their memory skills.

Keyword Technique

One of the best ways to learn something is to internalize the information. In other words, link it to whatever is already familiar. This is the core of the keyword technique. According to Nation (2001), this technique is executed by first understanding the meaning of the word in question. Once the meaning of the word has been determined, it is important then to find a word in one’s own L1 that sounds exactly or very similar to the first part of the unknown of the unknown word. An example of this is the Japanese word “*kino*”, which means “yesterday.” The beginning of the word sounds exactly like the word “key.” The next step involves creating a mental image connecting the L1 and L2 word. Staying with the “*kino*” example, a learner might create an image of a person that was looking around in his apartment, but could find *no key* yesterday. So that image alone will link the unfamiliar L2 word to the speaker’s L1 word, thus the meaning of the unknown word will be better internalized and more easily retrieved from memory.

The keyword technique is especially significant because according to Levin, Levin, Glasman and Nordwall (1992) it is effective for learners across different achievement levels. As this paper discussed previously, even high aptitude learners are in need of proven techniques to help them better acquire vocabulary and this is one of the most well-known and effective techniques for learning vocabulary (Folse, 2004).

Moderation is Important

Folse (2004) and Nation (2001) both agree that a heavy reliance on any one technique for vocabulary is not an effective strategy. Like with many other aspects of teaching, a balance must be struck between various approaches. Learners from a certain culture may embrace word lists,



but it may seem foreign to others. It is important for the teacher to understand the likes and dislikes of the students and tailor their classes accordingly. Again, the examples given in this section are by no means an exhaustive list of learning strategies, but can be used in conjunction with others at the instructors' discretion.

Conclusion

Vocabulary has been shown to clearly be an essential part of SLA. However, the explicit instruction of vocabulary is often ignored in L2 instruction because incidental learning has traditionally been accepted as a valid way to learn vocabulary. In an ideal environment with unlimited time this could be acceptable. However, as the data has shown, there is a significant time constraint in many classrooms and thus a more direct and systematic approach is called for. Many L2 students agree with the call for more explicit vocabulary instruction as well, with many professing that their lack of vocabulary hinders their ability to improve their ability to communicate.

Additionally, the way the mind handles vocabulary is vital because there is strong evidence that a good working memory plays a large role in how vocabulary is processed. As the four studies discussed in this paper illustrate, there is a positive correlation between working memory and vocabulary acquisition, which in turn will lead to better proficiency in acquiring an L2. However, for students who do not demonstrate a strong working memory there are various pedagogical strategies that can be implemented to allow them to better learn and retain vocabulary. It should be noted that there is no one "silver bullet" to addressing the vocabulary needs of L2 learners. Some of the students may seem to have a stronger aptitude than others, but it has been shown that high and low level learners alike would benefit immensely from direct instruction of not only the vocabulary words, but learning strategies as well. The pedagogical techniques described in this paper have all been proven to work, but total reliance on just one method can be counterproductive. A well-diversified approach is wiser and is solely up to the discretion of the instructor, since they are in the best position to gauge the needs of their students.

While this paper focused exclusively on vocabulary it should be noted that this must be balanced with other aspects of a language class (such as grammar, pronunciation, pragmatics, etc.). It was the goal of this paper to bring awareness to the importance of vocabulary and



understand how it is processed in the mind and how it can be applied to practical classroom practices. With this knowledge, researchers and instructors alike will have another piece of the SLA puzzle to use at their discretion.

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