

Addressing Cognitive Differences in the Memorization of L2 Vocabulary

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Working memory, once thought of only as short-term memory, in fact refers to the cognitive resources required to store or maintain and process or manipulate information during complex cognitive activity. Learners of English demonstrate cognitive differences in their capacities for storing L2 vocabulary. When learners engage in tasks that deplete existing working memory capacity, such as L2 lexical retrieval, they typically process information slower. Methods for vocabulary instruction incorporating repeated exposure to new information in verbal, visual, and spatial forms give diverse learners the ability to store and manipulate information needed to complete complex cognitive activities in L2. Familiarity with a variety of vocabulary teaching and learning strategies can enable instructors to best address the cognitive diversity found in L2 learners in the area of storing and retrieving vocabulary.

Key words: cognitive differences, diversity, academic language, vocabulary instruction, working memory, lexical retrieval

I. Introduction

Working memory, while once thought of merely as short-term memory, in fact refers to the cognitive resources required to store or maintain and process or manipulate information during any type of complex cognitive activity. Learners of a second language demonstrate cognitive differences in their capacities for storing L2 vocabulary. When these learners are engaged in tasks that deplete their existing working memory capacity, such as L2 lexical retrieval, they typically process information slower, a luxury that may not be available in all situations. To address these needs, this paper investigates methods for selecting, teaching, and rehearsing L2 vocabulary with diverse learners.

In selecting vocabulary for instruction, it is important to select items that will benefit learners and make efficient use of working memory. This paper discusses several methods for carefully and intentionally selecting vocabulary items for direct instruction.

Instructional methods incorporating repeated exposure to new information in verbal, visual, and spatial forms provide diverse learners with multiple opportunities to store and manipulate information needed to complete complex cognitive activities in L2. While no one method can be said to be

the perfect match for all learners, training students in a variety of strategies allows all learners to use those strategies that work best for them in autonomous learning.

One strategy created to meet the needs of diverse learners is the Vocabulary LINCS strategy, developed by Edwin Ellis at the University of Kansas in response to the needs of learners with learning disabilities; this strategy is effective for language learners as well. It uses a system of mnemonics connected with stories and images to help learners store and later retrieve vocabulary information.

With the awareness that working memory is not only storing information, but also manipulating it, another research-based strategy is found in Margarita Calderon's Seven Steps to Language Learning. This method provides language learners with multiple opportunities to store information, culminating in activities designed to process information as well.

An additional strategy for developing memory capacity in diverse learners is the method of loci, or memory palace strategy, used in ancient Roman and Greek times but still relevant today, connecting information through spatial and visual mnemonics.

Through an examination of these methods and their results, strategies to best address the cognitive diversity found in L2 learners in the areas of storing and retrieving vocabulary are identified.

II. Literature Review

1. Working Memory and Language

According to Alan Baddeley (2003), working memory refers to the storage and further manipulation of information that is needed to complete complex cognitive activities. The components of working memory include the phonological loop, or verbal-acoustic system, the visuospatial sketchpad, the central executive, and the episodic buffer.

The phonological loop is a temporary storage system: information stored here tends to decay after only a few seconds. It can, however be refreshed through the use of a subvocal rehearsal system (Baddeley, 2003). Baddeley has also acknowledged that due to the interplay between these two parts of the phonological loop, in learning and memorizing words, similarity of meaning is in fact more important than phonological similarity (1966).

The visuospatial sketchpad integrates information from spatial, visual, and possibly kinesthetic or motor input for temporary storage and manipulation. While results depend on the memory task being demanded, this component of working memory permits the language learner not to be disrupted by other sources of task-irrelevant input.

The central executive system, overseeing attentional control, is, according to Baddeley (2003), the one factor that most contributes to individual differences in working memory span. This predicts performance on complex cognitive skills, including reaching comprehension.

The episodic buffer is a component of working memory that stores information by binding together information from a variety of sources and modalities into chunks, or episodes, allowing for future retrieval of this information. (Baddeley, 2003)

2. Working Memory in Science Learning

Yuan et al (2006) identify working memory as a system for temporary maintenance and manipulation of information during a cognitive task, encompassing both storage and control functions. There is, however, a limit to the amount of information that can be processed during a cognitive task, as both task-relevant and task-irrelevant information are held in working memory.

While simple memory tasks may rely primarily upon the storage component of working memory, more complex problem-solving tasks that involve manipulation and re-use of learned information usually call upon the control function as well.

All learners have a set working memory capacity which effectively limits the quantity of information that can be processed. When the cognitive load for a particular task exceeds the individual's working memory capacity, their learning is adversely affected.

According to Yuan et al, content-area instructors can reduce the cognitive load of learners by presenting content area information in a way that is easy to understand and providing examples and models of the expected final production (2006). This helps prevent learners from the pitfall of splitting their attention between task-relevant and task-irrelevant information, which can decrease their working memory capacity for the task at hand. If instructors can reduce the extraneous cognitive load on learners, it is likely to result in improved learning of the targeted content.

Yuan et al recommend strategies to improve working memory capacity, such as practice or rehearsal, explicit instruction in memory strategies that establish associations between pieces of information, and cognitive training (2006).

3. Working Memory in L1 and L2

Sagarra and Herschensohn agree that working memory refers to those cognitive resources necessary for learners to temporarily store and process information during complex cognitive tasks in both L1 and L2 learning (2010). There exist individual differences in this working memory capacity.

Working memory is closely associated with lexical retrieval and processing demands affect knowledge of new information. More involved tasks that deplete working memory capacity tend to result in reduced storage of lexical information and extended processing times.

Sagarra and Herschensohn found that individuals who demonstrate higher working memory are also exhibit increased accuracy in comprehension tasks (2010). This helps explain why learners with additional cognitive demands struggle to achieve native-like proficiency in a second language. As learners advance into an intermediate stage of L2 language development (ACTFL 2012), they become more sensitive to L1/L2 differences, and they may in fact require more processing time.

However, in their study, Sagarra and Herschensohn found that students who have learned to use not just morphosemantic cues, but also lexical, semantic, and pragmatic cues in L2 comprehension exhibit faster processing times (2010).

4. The English Language Learner Brain

According to Sousa (2011), the young human brain is innately rewired to acquire vocabulary, and to recognize phonemes of the native language while ignoring foreign sounds. This propensity tends to wane around puberty: while adolescent and adult L2 learners certainly can acquire vocabulary, it takes much greater mental effort.

III. Selecting Vocabulary for Instruction

In selecting vocabulary for instruction, it is important to select those items that will most benefit learners, making most efficient use of their working memory.

In grouping words for instruction, it is preferred to organize terms by similarity in meaning, rather than phonological similarity, for increased retention (Baddeley 1966).

Sousa (2011) identifies knowledge of 2,000-3,000 word families as sufficient for understanding conversational English; to comprehend a wide variety of texts, he recommends 8,000-9,000 word families be learned. L2 learners need teacher guidance as to which items to learn as well techniques for learning vocabulary.

We can consider tiers of vocabulary for the purposes of selecting words for instruction. Tier I words are basic vocabulary, sometimes called sight words or Dolch words (developed by Edward Dolch in 1936), or the General Service List first 1000 words. This is the basic vocabulary that all L2 learners should acquire first, and the foundation for Sousa's 2,000-3,000 words necessary to comprehend conversational English.

Tier II words are academic vocabulary found across the content areas, often with multiple meanings depending on the academic context. These words are found in Averill Coxhead's Academic Word List, originally published in 1998. Tier III words include content-specific vocabulary, sometimes called off-list words. These are those terms that are very important within a specific and limited field of study, but rarely occur elsewhere.

Sousa claims that native speaker intuition in regards to word frequency is often severely limited (2011). One tool to use to identify vocabulary for instruction in a principled way is Tom Cobb's Web Vocabprofile, an adaptation of Healey et al's Range program.

By copying and pasting a text into the Web Vocabprofile site, words will be sorted into the first 1000 and 2000 most frequent words in English, Academic Word List words, and off-list words.

Beginning L2 English learners need to learn the Tier I most frequent words first. This includes frequent function words, such as *and*, *by*, *this*, and *while*, and also frequently-occurring content words, like *activity*, *family*, *important*, and *understand*.

At the higher Intermediate stage of language development, instructors should be focusing on Tier II or Academic Word List words to make best use of learners' working memory capacity; these words will be used repeatedly in academic English contexts, regardless of discipline, with differences in meaning depending on the context. This can include words such as *component*, *process*, *resource*, and *strategy*.

Tier III, or off-list words might be better taught by content-area instructors teaching through the medium of English. This might include items such as *absorption*, *coalition*, *photosynthesis*, or *tariff*: critically important for comprehension in their particular academic domains, but rarely encountered elsewhere.

IV. Methods

Sousa agrees that L2 learners benefit from direct instruction of vocabulary embedded in a meaningful context, with frequent opportunities for repetition and use (2011), focus on form and meaning, and exposure to the words in their natural contexts to help learners acquire information about use.

Intentional direct vocabulary instruction, according to Sousa, has been shown to result in increased word learning and reading comprehension, with research-based strategies being effective for a variety of diverse learners, both native speakers and L2 learners (2011).

1. Calderon's Seven Steps

One strategy for explicit vocabulary instruction is Margarita Calderon's seven-step vocabulary teaching process, one component of the *Expediting Reading Comprehension for English Language Learners* program (2014.) Calderon emphasizes the necessity of explicitly teaching vocabulary: vocabulary knowledge correlates with reading comprehension, while reading comprehension correlated with procedural and content knowledge. Comprehension of a text required knowledge of between 90% and 95% of the words found in the text; less than this and the reader is unlikely to gain information from the text.

Calderon's 7 steps are:

1. The teacher says and shows the word. Students repeat three times.
2. The teacher reads and shows the word in a context sentence from the text.
3. The teacher provides the dictionary definition in formal English.
4. The teacher explains the meaning using learner-friendly language and examples.
5. The teacher highlights one difficult aspect of the word: grammar, spelling, false cognates, polysemy, or word parts.
6. The teacher engages learners in a speaking activity to elicit use of the word and develop concept.
7. The teacher explains how and when learners will be accountable to use the word in future reading/writing activities or assessments. (2018)

Calderon recommends identifying 5-6 words to pre-teach in a session, spending at most 12-15 minutes on vocabulary instruction at the beginning of class (2014). Sousa, similarly, recommends that a total of 10-12 words be taught per week (2011).

This explicit vocabulary instruction strategy is effective for L2 learners with a range of cognitive abilities as it ensures repeated exposure to print and verbal modalities and multiple opportunities for production practice. While heavily teacher-centered, this method is invaluable for front-loading the vocabulary necessary for learners to comprehend a lesson taught in the L2.

2. Ellis's LINCS Vocabulary

Ellis recognizes that success in content classes depends on learners understanding what they hear and read, speaking about content, and ultimately responding to test questions about content. (2000).

His LINC S vocabulary strategy proposes to make students active in learning the vocabulary necessary to acquire and express content, as well as teaching them memory strategies they can utilize in their own independent vocabulary learning by connecting new learning to their current knowledge.

While the LINC S vocabulary strategy was developed in response to the needs of learners with learning disabilities, it can also be used effectively to meet the needs of cognitively diverse English learners without any disability.

For this strategy as described in Ellis 2000, learners:

1. Use an index or memory card, divide both sides in half by drawing a line or folding the card.
2. Write the vocabulary word to be learned on the top half of one side and circle it.
3. On the top of the other side, write the definition. This may be a dictionary definition, but should ideally be summarized by the learner, rather than copying the dictionary entry verbatim.
4. On the bottom half of the first side, write a reminding word. This word should be similar in sound or spelling to the targeted vocabulary word. A rhyming dictionary may be helpful for students who are learning this strategy.
5. On the left-hand side of the bottom half of the back of the card, write a short LINCing story. For L2 English learners, this seems most effective with the story contains the targeted word and the reminding word, and is at least one complete sentence. Stories that evoke strong emotion, whether positive or negative, are especially memorable.
6. On the right-hand side of the bottom half of the back of the card, the sketch a quick drawing to accompany the LINCing story.

By creating these cards, students create mental links to help them store and retrieve information about new vocabulary words. They can use these cards as a resource for further self-study and review.

In Ellis's 2000 research, he administered a vocabulary pretest in a content-based social studies class. In one class of mixed students with and without disabilities, the students with learning disabilities scored 53% on the pre-test, while their typical peers scored 84%. After using the LINC S vocabulary strategy, students with learning disabilities scored 77% on a post-test; the students without disabilities scored 92%. This demonstrates the power of this strategy for all diverse learners: this activity should not be treated merely as an intervention, but also a form of challenge or enrichment as well. In the control class, which did not receive the LINC S vocabulary strategy

intervention, the mean score was 86% on the pre-test and 85% on the post-test. Without intentional interaction with the vocabulary, their comprehension may even dwindle as words are not retained in working memory.

The LINC Strategy is an excellent choice for instruction with cognitively diverse L2 learners. It is very student-centered, as learners personalize their own connections based on their previous knowledge. Students create visual and linguistic hooks to remember vocabulary for short-term and longer-term use.

3. Method of Loci or Memory Palace

This ancient method is commonly attributed to Simonides of Ceos in 6th century BCE Greece (Mallom 2017), the sole survivor of a building that collapsed during a dinner he attended. While all other attendees were crushed beyond recognition, Simonides was able to identify the dead by remembering the locations where they had been sitting. Thus was born the method of loci, sometimes also called a memory palace.

Ancient Roman and Greek orators often gave speeches that lasted for hours; these were expected to appear extemporaneous, not read from a prepared script. By mentally placing the key points of a lengthy speech in locations along a familiar route through a city or palace, these speakers were able to visualize a walk along the same journey as they gave their speech, retrieving each item representing the next key point they planned to talk about.

To perform the method of loci, Luciano Passuelo (2008) gives a version of this technique:

1. Choose a memory palace. This should be a place you know well, such as your own home or the route you take to school or work.
2. List distinctive features of this location, a series of objects like doors, tables, or wall hangings that you can picture in your mind as you walk through the location.
3. Imprint the memory palace on your mind by practicing mentally walking through the location in your mind, taking note of all the features of the room in a logical order.
4. Given a list of things to remember, like vocabulary items or points in a speech, make a visual association of each item in order with a feature of the location.
5. Finally, to recall the memorized items, mentally revisit your memory palace, walking through it in the usual order, recalling each item in order.

The method of loci is a mental memorization strategy, and as such cannot be easily observed or assessed in the classroom. Used in conjunction with other vocabulary teaching, learning, and memorization strategies, it activates the

visuospatial sketchpad with possible kinesthetic or motor connections to store and maintain vocabulary information. Learners create their own visual associations between new information and that already stored in memory. Qureshi et al (2014) conducted research to determine whether the method of loci could be used by endocrinology students to learn and recall new topics. They discovered significantly better performance on a multiple-choice assessment of content among learners who listened to didactic lectures and created memory palaces than among those who attended the lectures and completed other self-directed learning tasks, with mean scores of 9.31 among learners who were trained in the method of loci, compared to 8.10 in the other group. The method of loci enables learners to arrange, recall, transfer, and apply memorized content for future success.

V. Conclusion

By intentionally selecting vocabulary for instruction and learning for cognitively diverse L2 English learners, instructors can help their students deal with the limitations of working memory capacity when using their new language in complex cognitive activities.

When learners are trained in and have opportunities to utilize methods such as Calderon's seven steps, Ellis's LINC'S vocabulary strategy, and the method of loci, they create connections across a range of modalities, enabling them to experience success in more complex cognitive tasks that require them to retrieve and manipulate lexical information. As learners demonstrate cognitive differences in the area of vocabulary storage and retrieval, they will also gravitate towards different preferred vocabulary memorization strategies. Maintaining these and other strategies in their instructional toolkit empowers instructors of English to meet the needs of their diverse language learners.

References

- American Council on the Teaching of Foreign Languages. (2012). *ACTFL Proficiency Guidelines 2012*. American Council on the Teaching of Foreign Languages, Alexandria, Virginia.
- Baddeley, A. (1966). The influence of acoustic and semantic similarity on long-term memory for word sequences. *Quarterly Journal of Experimental Psychology*, 18, 302-209.

- Baddeley, A. (2003). Working memory and language: an overview. *Journal of Communication Disorders*, 36, 189-208.
- Calderon, M & Slakk, S. (2018) *Teaching Reading to English Learners, Grades 6 - 12: A Framework for Improving Achievement in the Content Areas*. Thousand Oaks, CA: Corwin.
- Calderon, M., Carreon, A., Noyola, E., Cantu, J., Bishop, A., Minaya-Rowe, L., & Trejo, M. (2014). *Expediting Reading Comprehension for English Language Learners (ExC-ELL) Training Manual* (2nd ed.), Washington, DC: Margarita Calderon & Associates.
- Cobb, T. (2002). *Web Vocabprofile*. Available from lextutor.ca/vp, an adaptation of Heatley, Nation & Coxhead's (2002) *Range*.
- Coxhead, A. J. (1998). An academic word list (English Language Institute Occasional Publication No. 18). Wellington, New Zealand: Victoria University of Wellington.
- Dolch, E. W. (1936). A Basic Sight Vocabulary. *The Elementary School Journal*, 36(6), 456-460.
- Ellis, E. (2000). *The LINC'S Vocabulary Strategy*. Lawrence, Kansas: Edge Enterprises.
- Heatley, A., Nation, I.S.P. & Coxhead, A. (2002). *Range* program. Available at wgt.ac.nz/lals/resources/paul-nations-resources/vocabulary-analysis-programs.
- Mallow, J. (2017). Method of loci. *Thinkkniht*. Available at thinkkniht.com/memory-tutorials/method-of-loci.
- Passuelo, L. (2008). Develop perfect memory with the memory palace technique. *Litemind*. Available at litemind.com/memory-palace.
- Qureshi, A., Rizvi, F., Syed, A., Shahid, A., & Manzoor, H. (2014). The method of loci as a mnemonic device to facilitate learning in endocrinology

leads to improvement in student performance as measured by assessments.

Advances in Physiology Education 32(2), 140-144.

Sagarra, N. & Herschensohn, J. (2010). The role of proficiency and working memory in gender and number agreement processing in L1 and L2 Spanish.

Lingua 120, 2022-2039.

Sousa, D. (2011). *How the ELL Brain Learns*. Thousand Oaks, California: Corwin.

Yuan, K., Steedle, J., Shavelson, R., Alonzo, A., & Oppezzo, M. (2006).

Working memory, fluid intelligence, and science learning. *Educational Research Review*, 1, 83-98.