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The Effect of Encoding Modality and Rehearsal Strategy on Foreign Language Vocabulary

Recall

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## Abstract

Experience with a foreign language is considered a valuable skill in workplace and school settings alike. However, recent studies in the field of psychology exploring the process of acquiring a second language have limited applicability, especially for adults with English as a first language. This study sought to explore the relation between encoding modality (auditory, visual, or visual and auditory; based on Baddeley's model of working memory) and rehearsal strategy (active or passive, based on Craik and Lockhart's Level of Processing approach and Roger's Self-Reference Effect) in the recall of foreign language vocabulary words. Vocabulary words were the target information in this study because vocabulary has been shown to be a crucial component of second language acquisition (Masoura, 2005). Adult participants were assigned to one of six different conditions based on the interactions between the different encoding modalities and rehearsal strategy (e.g., auditory-active, auditory-passive, visual-active, etc). It was hypothesized that those participants in the combined auditory/visual condition that were given active processing instructions would recall a higher number of words than participants in other conditions. The results indicated that encoding modality was significant, with those in the visual and visual/auditory conditions recalling more words than those in the auditory condition. However, there was not a significant difference between active and passive rehearsal strategy, which does not match pre-existing research in the field. These findings add to the current literature on foreign language vocabulary learning and demonstrate that visual encoding modality can be considered a crucial component of the vocabulary learning process.

### The Effect of Encoding Modality and Rehearsal Strategy on Foreign Language Vocabulary Recall

Acquiring a foreign language is a difficult process regardless of the age of the learner. According to the Critical Period Hypothesis of language learning, for someone to properly acquire a language they must be exposed to certain aspects of the language, such as unique letters, syllables and tongue movements, prior to puberty (Lenneburg, 1967). This hypothesis is applicable not only to native languages, but to second and subsequent languages as well. While language learning studies from a psychological approach have begun to investigate the mechanisms and strategies behind foreign language acquisition, researchers typically have not chosen native English speaking adults as their population of interest. Past studies have focused either on language acquisition in children, seeking to support or critique the Critical Period Hypothesis, or the acquisition of English as a foreign language for adult learners (de Abreu, 2012; Masoura, 2005; Papagno, 1995).

Acquisition of English as a foreign language for adult learners is relevant and important research. However, native English speaking adults could also benefit from research into the process of acquiring a foreign language after the critical period of language. For example, colleges often include some form of language requirement in order for students to graduate. If students have never experienced a language prior to the beginning of their college career, whether they are a traditional student or not, they would theoretically struggle to learn the language because the acquisition occurs after puberty.

Research into this experience would have practical significance. In many foreign language classrooms, the focus tends to be on decontextualized grammar rather than vocabulary, even though vocabulary acquisition has been shown to be a crucial determinant of second

language learning (Martel, 2015; Masoura, 2005). In foreign language literature, recent studies focus on elements of language learning at the college level, such as comparing online to classroom learning, examining teaching styles, and the importance of writing exercises in these courses. While these studies acknowledge the importance of vocabulary and the variation in foreign language teaching styles, they stem from the field of foreign language studies and do not investigate the psychological mechanisms at work during the encoding and recall of the material (Bernhardt, Lin, Molitoris, Romeo, & Valderrama, 2015; Martel, 2015; VanPatten, Trego, & Hopkins, 2015).

One learning and memory model that has been used to describe the mechanisms of language acquisition (both native and nonnative) from a psychological approach is Baddeley's model of working memory (Baddeley, 2003). This model consists of four components: the visuospatial sketchpad, phonological loop, episodic buffer, and central executive. The visuospatial sketchpad encodes and integrates visual and spatial stimuli, such as pictures or written words. The phonological loop encodes auditory stimuli, such as spoken words or music. The episodic buffer combines small pieces of information from both the visuospatial sketchpad and the phonological loop into chunks (or "episodes") to improve retention and recall. All of these subparts are connected and controlled by the central executive. According to this model, all four areas play a role in language acquisition and recall. However, the phonological loop and visuospatial sketchpad seem to do the most work during the encoding of new information, while the episodic buffer combines and stores in information for later recall by the central executive.

The literature historically suggests that the phonological loop plays a large role than the visuospatial sketchpad in language acquisition. It has been found, however, that in certain populations the visuospatial sketchpad can significantly help or hinder the acquisition of a

language. In these populations, such as those with Williams Syndrome, the visuospatial sketchpad plays a larger role than the phonological loop (Baddeley, 2003; Bellugi, Wang, & Jernigan, 1994). Based on the existing literature from both the fields of psychology and foreign language, it is generally assumed that the most ideal method for encoding new vocabulary words would be a combination of auditory encoding (through the phonological loop) and visual encoding (through the visuospatial sketchpad). However, there is not much research available to verify this claim.

Another theory of learning and memory in cognitive psychology, the levels of processing approach ( Craik & Lockhart, 1972), may also be valuable in describing language acquisition. Craik and Lockhart proposed that the level at which information is encoded plays a role in recall. While there are different labels for the levels, the most commonly referenced are shallow and deep. Shallow (or physical) levels of processing include simply examining the physical characteristics of the word or experiencing the word without context or prompting for further thought. For example, counting the number of letters in the word *CAT* or merely repeating the word *BAT* over and over would be considered shallow processing. Deep (or semantic) processing examines features associated with the word as a whole, such as a rhyme, or identifying what broader category the word belongs to. For instance, asking a student if the word *CAT* rhymes with *VAT*, or asking if *CAT* is a type of animal would indicate a deeper level of encoding (Sternberg, 2006). The overall theory suggests that deeper levels of processing generate significantly higher recall than shallow processing. Studies exploring levels of processing tend to focus on recalling words within a native language, but some have examined the effect on recall of foreign language vocabulary with similar results; deeper encoding processes resulted in higher rates of recall than shallow processes. However, this research only focused on recall of words

that the participant was familiar with before taking part in the experiment, rather than incorporating the process of acquiring new vocabulary word pairs (Bird, 2012).

In everyday life, these levels manifest themselves in the types of rehearsal, or repetition of information, students use while studying. Maintenance rehearsal, or simply repeating the information over and over, is a practical use of shallow processing. Elaborative rehearsal, or making the material meaningful, harkens back to deep processing. A more generalized way of referring to these methods is passive or active rehearsal. While these terms do not have a strict psychological definition, they are typically operationally defined using principles such as shallow processing and rote memorization for passive rehearsal and deep processing and elaborative rehearsal for active rehearsal.

The goal of the present study was to examine the ability to correctly recall newly acquired foreign language vocabulary from a psychological perspective, using terminology, models, and theories from the field of cognitive psychology. By combining both Baddeley's model of working memory and Craik and Lockhart's levels of processing approach, this study explored the effects of both the modality and rehearsal strategy on foreign language vocabulary recall. Based on the existing research, it was hypothesized that the combination of visual and auditory encoding using active rehearsal prompts would produce the highest rate of recall, followed by visual and auditory at a passive level. The combination of a visual modality at a passive level of processing was predicted to generate the lowest levels of recall.

## Method

### Participants

There were one hundred and ten adult (ages 18-58) participants in this study, including 93 females, 14 males, and 3 participants who did not identify as male or female. One hundred and three participants had previous experience learning a foreign language, ranging from one semester to nineteen years. Additionally, two students considered themselves bilingual in English and a language other than Welsh. Participants were recruited on-line via social media and via invitations to participate circulated by willing professors. The students were randomly assigned to one of six conditions produced by crossing the three levels of encoding modality with the two levels of rehearsal strategy (ie., visual-passive, visual-active, auditory-passive, auditory-active, visual/auditory-passive, visual/auditory-active) (Appendix A) and viewed a video designed to specifically pair with each condition.

### Procedure

Participants watched a video that introduced ten new English-Welsh word pairs (Appendix B). Welsh was used as the experimental language because it uses the same characters as English, but is different enough that participants could not find cognates during the acquisition process (Bisson, van Heuven, Conklin, & Tunney, 2013). While other studies investigating second or foreign language acquisition have utilized concrete words, such as “horse” or “cat,” the present study utilized abstract terms in order to prevent unintentional interference of the visuospatial sketchpad during auditory conditions. For example, if a participant had heard the word “dog,” they would have likely had a mental image associated with it that would

automatically surface and provide a visual and auditory encoding condition. An abstract term, such as loneliness, does not typically have a mental image quickly associated with it.

Six different videos were created for this experiment to correspond with the six different conditions, but each followed the same order of words presented and experienced the word pairs for the same length of time (twelve seconds). Those in the Visual/Passive condition simply saw the word pairs. Visual/Active participants saw the word pairs and were prompted to apply the word to their life. The Auditory/Passive group heard the word pairs twice before moving on to the next pair. Auditory/Active participants heard the pairings twice and were prompted to apply the word to their life. Those in the Visual and Auditory/Passive group saw the word pairings and heard the pairings twice. Visual and Auditory/Active participants saw the pairings, heard the pair twice, and were shown a related image.

Participants were asked to view the video once and were instructed not to take notes. After the learning or acquisition period, participants completed a ten-question quiz to test their recall of the word pairs. Participants were prompted with the Welsh word and were instructed to type the English word that was paired with it in the video. Recall ability was determined by the number of words correctly recalled during the ten question assessment, with the highest possible score being 10 and the lowest being 0.

## **Results**

The mean number of words recalled for the entire sample was 4.49 ( $SD = 2.92$ ) with a range of 0-10. Due to the wide age-range of participants, a Pearson correlation was calculated to explore a possible association between age and recall performance.

It was hypothesized that encoding modality and rehearsal strategy would interact to influence the number of vocabulary words correctly recalled, specifically, with higher rates of recall experienced for those participants in the visual/auditory-active group. To explore the effects of encoding modality and rehearsal strategy on recall for foreign language vocabulary words, a 2 (active or passive rehearsal) x 3 (auditory, visual, or visual-auditory encoding) between-subjects factorial ANOVA was calculated comparing the number of words correctly recalled in each condition. The results of this analysis revealed a main effect for encoding modality,  $F(2,104) = 24.55, p < .001, \eta^2 = .321$ . The results of a Tukey's HSD to determine the exact location of the differences indicated the significant differences between the visual and auditory conditions ( $MD = 3.80, p < .001$ ) and the auditory and auditory/visual conditions ( $MD = 2.78, p < .001$ ). However, the visual and auditory/visual conditions were not significantly different from each other ( $MD = 1.02, p = .20$ ). Beyond the significant main effect for encoding modality, no other effects were found. Specifically, there was no main effect for rehearsal strategy,  $F(1,104) = .012, p = .912$ , nor was there a significant interaction effect between encoding modality and rehearsal strategy,  $F(2,104) = .383, p = .683$ .

### Discussion

The purpose of this study was to investigate the effect of encoding modality (visual, auditory, or visual and auditory) and rehearsal strategy (passive or active) on foreign language vocabulary word recall. It was hypothesized that participants in the visual/auditory condition given the active rehearsal instructions would demonstrate the highest number of words recalled. The results indicated a significant effect for encoding modality, with the conditions including a visual component generating significantly higher levels of recall than the purely auditory conditions. However, neither rehearsal strategy nor the interaction between rehearsal strategy

and encoding modality explained significant variance in number of words recalled. Expecting an interaction between encoding modality and rehearsal type to influence number of words recalled, the primary hypothesis for this study was only partially supported. Those participants in the visual and auditory conditions, as well as those participants in the visual condition, recalled more words than participants in the auditory condition. Although this result was not predicted, it is understandable given the nature and characteristics of this study's design.

However, the null finding regarding the rehearsal type (active vs. passive) was unexpected given the wealth of literature and anecdotal evidence praising the value of "active" processing and elaborative rehearsal. Based on past research, the more actively or deeply one engages with the material, the more likely one is to be able to recall it ( Craik & Lockhart, 1972; Sternberg, 2006). One possible explanation for these conflicting results stems from the study's design and procedural methodology. In an attempt to maintain consistency as possible across all six conditions, every participant experienced the word pairs for twelve seconds. While that could have been sufficient time for encoding via a passive rehearsal strategy, the prompting for more active rehearsal may have taken away from the basic learning of the word pairs in the three active rehearsal conditions. Additionally, the actual prompt for active rehearsal may have contributed to a lower level of recall. Participants in these conditions were asked to engage more actively with the material through a single line of text that asked, "Can you relate this word to your life?" This may have been too vague, and given the limited amount of time the participants had with the word pairs, they may have struggled to come up with something meaningful in the time frame.

Another possible explanation is a lack of motivation to actively rehearse the word pairs. There was no incentive for completing the survey, so there was no incentive to put more effort

into making a meaningful connection with the material. Participants knew at the onset of the survey that it would only take ten minutes to complete, so a passive rehearsal strategy would work well for the short term storage of the word pairs. If the task were incentivized or was performed further apart, active rehearsal strategies may have been more likely to be employed, thereby generating higher levels of recall.

One finding in this study that has direct applicability in the real world is the significant difference between visual and auditory encoding modalities and their rates of recall. Some styles of teaching a foreign language include lectures in the foreign language, which will often include words students have never experienced or seen. If these students are then expected to recall these words in a listening task or on a written exam, according to the findings of this study they will struggle to remember what the word means or how to pronounce or spell it having never seen it during the encoding process.

### **Future Research**

This low level of recall in purely auditory conditions mentioned above could be accounted for by the assessment of recall itself. That is, all six conditions took the same test and were all prompted with the *written* version of the vocabulary word, rather than prompting with written, spoken, or a combination of the two to match the encoding modality used while studying. This shortcoming, that all encoding modality conditions completed assessments using written forms of the words, was a limitation of the computer program available for use in the current study. In the future, it would be ideal to have an assessment procedure that would match the encoding modalities, prompting with either visual, auditory, or visual and auditory forms of the

Welsh word, rather than encoding with a purely auditory representation of the word pairs and then expecting them to recognize it in a purely visual form on an exam.

There are several potential routes for further investigation into this topic. In addition to making the aforementioned adjustments to the methodological procedure to ensure an accurate investigation into the effect of rehearsal strategy and the potential interaction between it and encoding modality, other manipulations can be made to take the research in a new direction. There are also smaller changes that could be made within the procedure to take the research in new directions. For example, *abstract* terms were utilized in this study to prevent unconscious visual representations of the words during the passive and auditory conditions. However, it would be interesting to compare the rate of recall for abstract words compared to *concrete* words while learning a foreign language to see if concrete words would be recalled at a higher rate, as they are in the native language.

Another small addition that would allow for more applicability and a new avenue for research would be the participant's self-perceived learning style. Students may not perform as well in a condition that does not match their self-perceived learning style, and so a study that considers this factor would allow for an examination of the effects of both the encoding modalities and learning styles on acquisition of a foreign language. Finally, as the literature is replete with sex differences in language acquisition (Huttenlocher, Haight, Bryk, Seltzer, & Lyons, 1991) and the current study did not include a sufficient number of men to make a valid comparison, future research could explore sex differences in recall performance of vocabulary words under these varying encoding and rehearsal strategy conditions.



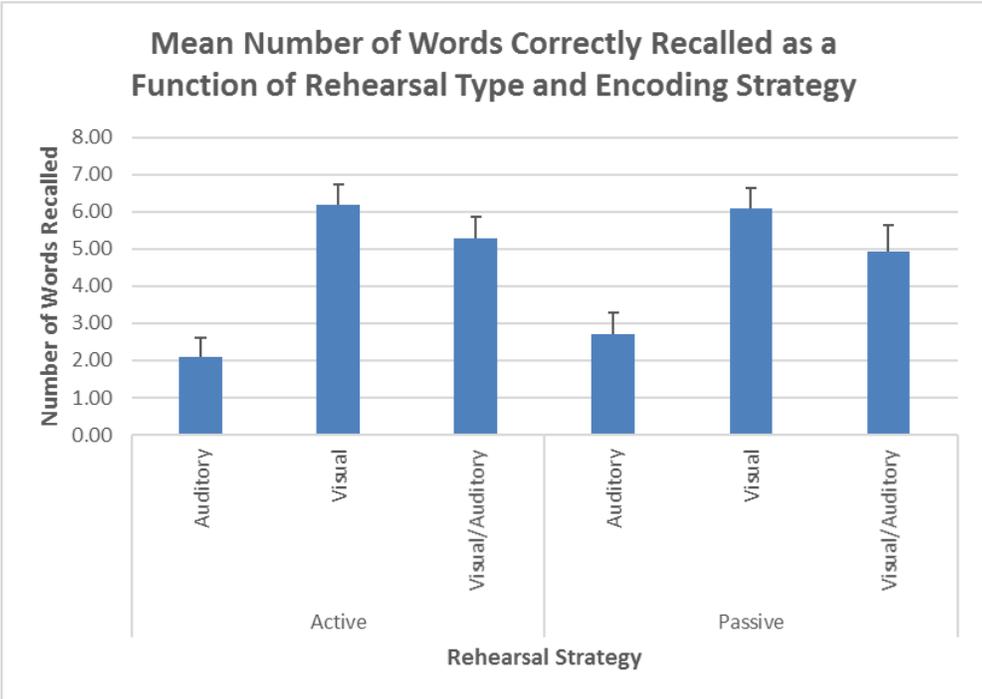
**Appendix A**

	Visual	Auditory	Visual & Auditory
Passive	1	2	3
Active (Self-Reference)	4	5	6

**Appendix B**

<b>Justice</b>	<b>Cyfiawnder</b>
<b>Sadness</b>	<b>Tristwch</b>
<b>Hope</b>	<b>Gobaith</b>
<b>Cold</b>	<b>Oer</b>
<b>Confusion</b>	<b>Dryswch</b>
<b>Loneliness</b>	<b>Unigrwydd</b>
<b>Wealth</b>	<b>Cyfoeth</b>
<b>Speed</b>	<b>Cyflymder</b>
<b>Childhood</b>	<b>Plentyndod</b>
<b>Envy</b>	<b>Eiddigedd</b>

Appendix C



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