

A Comparison of the Effect of Text-Picture and Audio-Picture Annotations in Second Language Vocabulary Recall among Iranian EFL Learners¹

Una Comparación del Efecto del Uso de Anotaciones de Texto-Imagen y Audio-Imagen para Facilitar la Recordación de Vocabulario en Segunda Lengua en Estudiantes Iraníes de Inglés como Lengua Extranjera

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Abstract

The present study compared the effect of text-picture and audio-picture multimedia annotations in second language vocabulary recall among Iranian EFL learners. The participants were selected from two classes of 80 students who were studying advanced-level English at in a language institute in Iran. Their level of English proficiency was determined on the basis of their scores on the PET proficiency test. Sixty-two students were selected for the main procedure, and were then randomly divided into two experimental groups: the text-annotation and audio-annotation group; and a control group. After answering a vocabulary pretest, participants clicked on the highlighted unknown words to access available annotations while reading. The text-picture group was able to see textual explanation and pictorial description, and the audio-picture group was able to see pictorial description explanation and hear a spoken explanation. After reading, students completed the post-tests. The results of the study demonstrate that audio-picture annotation is more effective than text-picture

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annotation in facilitating immediate L2 vocabulary recall. The results suggest that providing audio or text annotation of new words can help recall of new vocabulary when reading.

Key words: Text annotation, audio annotation, multi-media annotation, vocabulary

Resumen

El presente estudio comparó el efecto del uso de anotaciones multimedia de texto-imagen y anotaciones de audio-imagen para facilitar la recordación de vocabulario en segunda lengua en estudiantes iraníes de inglés como lengua extranjera. Los participantes fueron seleccionados de dos aulas de clases de 80 estudiantes de nivel avanzado de inglés de un instituto de idiomas en Irán. El nivel de inglés de los participantes se determinó a partir de sus calificaciones en la prueba de proficiencia PET. Fueron seleccionados 62 estudiantes para el estudio general y posteriormente fueron divididos aleatoriamente en dos grupos experimentales: grupo de anotaciones de texto, grupo de anotaciones de audio y un grupo de control. Después de responder la prueba de vocabulario, los participantes hicieron clic en las palabras desconocidas para tener acceso a las anotaciones disponibles mientras realizaban la lectura. El grupo de estudiantes que utilizaron anotaciones de texto- imagen pudo visualizar la explicación textual y la descripción pictórica y el grupo que utilizó anotaciones de audio-imagen pudo ver la descripción pictórica y escuchar una explicación oral. Al terminar la lectura, los estudiantes finalizaron el examen final. Los resultados del estudio demostraron que el uso de anotaciones de audio-imagen es más eficaz que el uso de anotaciones texto-imagen para la recordación inmediata de vocabulario en segunda lengua. Los resultados sugieren que el proporcionar anotaciones de texto o audio de nuevas palabras puede ayudar a recordar vocabulario nuevo al leer.

Palabras claves: Anotación de texto, anotación de audio, anotación multimedia, vocabulario

Resumo

O presente estudo comparou o efeito do uso de anotações multimídia de texto-imagem e anotações de áudio-imagem para facilitar a recordação de vocabulário em segunda língua em estudantes iranianos de inglês como língua estrangeira. Os participantes foram selecionados de duas salas de aula de 80 estudantes de nível avançado de inglês de um instituto de idiomas no Irã. O nível de inglês dos participantes se determinou a partir de suas qualificações na prova de competência PET. Foram selecionados 62 estudantes para o estudo geral e posteriormente foram divididos aleatoriamente em dois grupos experimentais: grupo de anotações de texto, grupo de anotações de áudio e um grupo de controle. Depois de responder a prova de vocabulário, os participantes fizeram clique nas palavras desconhecidas para ter acesso às anotações disponíveis enquanto realizavam a leitura. O grupo de estudantes que utilizaram anotações de texto-imagem pôde visualizar a explicação textual e a descrição pictórica, e

o grupo que utilizou anotações de áudio-imagem pôde ver a descrição pictórica e escutar uma explicação oral. Ao terminar a leitura, os estudantes finalizaram a prova final. Os resultados do estudo demonstraram que o uso de anotações de áudio-imagem é mais eficaz que o uso de anotações texto-imagem para a recordação imediata de vocabulário em segunda língua. Os resultados sugerem que o proporcionar anotações de texto o áudio de novas palavras pode ajudar a lembrar do vocabulário novo ao ler.

Palavras claves: Anotação de texto, anotação de áudio, anotação multimídia, vocabulário

Introduction

Second language (L2) learners at all levels of ability encounter the problem of learning vocabulary. According to Nation (2001), a native speaker of English is aware of 20,000 word families. This poses a challenging task for English as a Second Language (ESL) learners. Vocabulary learning has generally been long overlooked within the field of Second Language Acquisition (SLA) (Nation, 2001, Zimmerman, 1997).

Recent years have observed augmented interest in L2 vocabulary research. According to Gass (1999), one relevant discussion is between incidental and intentional vocabulary learning. The difference between the two learning conditions involves the learning task, learner attention and the instructional context of the learning (Read, 2004). Both approaches have been found to aid the gradual learning of L2 vocabulary (Hulstijn, 2001). Second language research has also treated incidental vocabulary learning through reading (Nation, 2001). As Jacobs et al. (1994) states, this conforms to L2 learners' reports that vocabulary learning happens, in most cases, accidentally during reading or listening. However, L2 incidental vocabulary learning tends to be incremental and slow.

Jacobs, Dufon & Fong (1994), Joyce (1997) describe how annotation has been a standard characteristic in L2 reading, which aids in simplifying comprehension, and in which L2 vocabulary learning happens as a by-product. As an instructional intermediation, a note draws learner attention away from reading, and concentrates it on the form and meaning of the word, thus raising vocabulary learning and reading comprehension. This reflects the interactionist view of SLA (Long, 1996) and the depth of processing hypothesis. Rott, Williams, and Cameron (2002) and Watanabe (1997) describe how studies on the influences of text notation on L2 vocabulary learning and reading comprehension have produced mixed findings. Al-Seghayer (2001) stated that different from the traditional marginal notation, multimedia notations can draw vocabulary information in multiple modalities, including audio (sound) and visual (text, picture and video).

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Studies have also taken into consideration the effects of various kinds of multimedia notations on incidental L2 vocabulary learning, specifically, the utilization of picture notation and video notation accompanied with text notation (Al-Seghayer, 2001). According to Paivio (1990), these studies scaffold double-coding theory and accept the cognitive theory of multimedia learning (Mayer, 2001), which describes how meaningful learning involves learners in both verbal and visual cognitive processing systems. Yoshii (2000, as cited in Al-

Seghayer, 2001) represented double notation of text and picture or text and video are unanimously discussed to be better than single notations in simplifying incidental L2 vocabulary learning .

In addition, Svenconis and Kerst (1995) and Yeh & Wang (2003) stated that research suggests that that the increase of an audio element to dual annotations does not seem to have a deterministic effect on L2 vocabulary learning. One possible illustration is that the information sent at the same time through different modalities (audio, verbal and visual) might exceed the cognitive processing.

An overview of the studies on L2 vocabulary annotation, particularly multimedia annotation, offers that there is little information about how different dual annotations, specifically text-picture and audio-picture annotations, influence L2 vocabulary learning and reading comprehension in Iranian EFL context. This information is required to recognize the extent to which multimedia learning can be utilized in L2 reading teaching and the role of multimedia in L2 vocabulary learning in Iranian EFL context. The slight information on audio annotation in multimedia L2 learning in comparison to other multimedia annotations verdicts more examination. Furthermore, incidental and intentional vocabulary learning in a multimedia environment has never been studied. The influences of multimedia double notation using different modalities on L2 vocabulary learning and reading comprehension in incidental and intentional learning conditions remain unclear.

Motivated by prior studies on multimedia annotation and available slots in this literature, the overarching question considered in this study was how different dual annotations influence L2 vocabulary recall and reading comprehension in both incidental and intentional environments. This study was designed to expand our indelibility of the use of multimedia leaning in a second language acquisition setting through the framework of cognitive theory of multimedia learning to second language vocabulary learning and reading comprehension. It investigated the ways in which two different types of dual annotation, namely, text-picture and audio-picture, influenced L2 vocabulary learning and reading comprehension. Furthermore, it noticed the influential of multimedia annotation on L2 students' vocabulary learning in both incidental and intentional learning conditions.

This study was guided by the following research questions: 1) Does text-picture annotation play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners? 2) Does audio-picture annotation play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners? and 3) Is there any significant difference between the effect of text-picture and

audio-picture annotations in facilitating L2 vocabulary immediate recall among Iranian EFL learners?

Literature Review

Text Annotation and L2 Vocabulary Learning

In printed reading materials, text annotations are often placed in the margin, at the bottom, or at the end of the reading text. In multimedia texts, when students click on an annotated word, they can observe the meaning of the word in a certain place of the computer screen. In this part, debate will be first concentrated on text annotation in printed reading texts, followed by a review of text annotation in multimedia texts.

Hulstijn, Hollander, and Greidanus (1996) examined incidental vocabulary learning for second language learners. Their study showed the utilization of marginal text annotation as an influential method. Other studies accepted that text annotation in printed reading text could reinforce second language learners' retention of vocabulary (Hulstijn, 1992).

Dufon and Hong's (1994) study on L2 Spanish reading used three formats: (1) no gloss, (2) L1 gloss and (3) L2 gloss. Their results demonstrated that students who had access to glosses did better than students without glosses on the immediate vocabulary translation post-test. Therefore, the effectiveness of gloss was not discovered in the delayed post-test four weeks later. Due to this, Jacobs et al. noticed that although gloss is preferred over no gloss, gloss only has a potentially positive effect on vocabulary acquisition with sufficient L2 competence. Furthermore, certain proficiency level was requisite to make effective use of L2 gloss. In conclusion, the positive relation between gloss and vocabulary learning was held, at least for immediate retention if not for long-term retention.

In order to examine the possible distinction between L1 and L2 glosses, Ko (1995) utilized a similar design as Jacobs, Dufon and Hong (as cited in Al-Seghayer, 2001) with 189 Korean college students learning English as a foreign language (EFL). Students took a vocabulary pre-test and were asked to read an 854-word English text. Contrary to Dufon and Hong (1994), the multiple-choice vocabulary post-test immediately after reading displayed important difference between L1 and L2 gloss. In other words, students with access to L1 gloss significantly outperformed those with access to L2 gloss. The effect was found significant in the delayed post-test one week later.

The effectiveness of L2 over L1 gloss in vocabulary retention was also challenged by Laufer and Shmueli's (1997) study. Hebrew-speaking high school EFL students (N=128) were asked to read an English text in which 10 target words were glossed in Hebrew and another 10 in English. Multiple-choice assessment was used in both the immediate and delayed post-test five weeks later. Both tests showed that L1 gloss resulted in more vocabulary retention than L2 gloss. This conflicts with the finding by Jacobs et al. (1994), but students' level of the second language in Laufer and Shmueli (1997) might be used as an explanation. Certain proficiency of the second language was necessary to fully utilize glosses in L2.

Picture Annotation

Visual assists have long been hypothesized to profit second language learning. Tuttle (as cited in Omaggio, 1979) discussed that "foreign language students can profit from many kinds of visual material to be a rich resource in the foreign language classroom" (p. 9). The use of imagery display of foreign words by real objects or imagery was also displayed by Kellogg and Howe (1971) to facilitate children's vocabulary acquisition in a foreign language.

A number of researchers have also investigated the effect of visual stimuli on L2 vocabulary learning and reading comprehension. Kellogg and Howe's (1971) study contrasted written words and pictures as key words for oral acquisition of Spanish vocabulary by children. The pictures produced faster learning of new words than the written stimuli. The effect was also kept in the long term as displayed by greater recall of words represented in pictures. Terrel (as cited in Kost et al, 1999) suggested that combining the form and visual representation of unknown L2 vocabulary assisted learners to acquire concrete ideas and references. In reviewing the techniques used in learning L2 vocabulary, Oxford and Crookall (1990) expressed the effectiveness of visual imagery and maintained that "most learners link new information to notions in memory by means of meaningful visual images, and that visual images make learning more influential" (p. 17) and "the pictorial-verbal combination contains many sections of the brain, thus providing greater cognitive power" (p. 17).

Omaggio's (1979) study focused on pictorial contexts to French as a second language students such as advanced organizers. It was assumed that the preparation of the other visual context would simplify reading comprehension. The outcomes represented that students with a pictorial context did significantly better on the recognition test and

recall than those with access only to text. This supported evidence of the positive effect of pictures on reading comprehension.

In annotation studies, picture annotation has been used to clarify the meaning of those unknown words second language learners encounter in reading. According to dual coding theory, the way learners comprehend pictures differs greatly from that of comprehending textual information (Paivio, 1990). In other words, text is processed by the verbal cognitive subsystem, while a picture is processed by the non-verbal cognitive subsystem. Research has compared L2 vocabulary learning from text annotation, picture annotation, and a combination of text and picture annotation.

Audio Annotation

It is worth noting that little research has been done on audio annotation. Audio annotation gives pronunciation, a sample sentence, and definition or meaning of a target word in spoken form. It has never been studied separately from other annotation modes, but mostly as an additive component. The only format in which audio annotation has been studied is the pronunciation of target words. Findings on audio annotation are rather mixed and uncertain.

Svenconis and Kerst (1995) investigated the effectiveness of semantic mapping techniques in L2 vocabulary learning in a hypertext environment. The participants (N=48) were English-speaking high school students in grades 9 through 12 learning Spanish as a second language. The 72 target words were presented in word listing and semantic mapping. In the multiple-choice vocabulary post-test, no significant effect was found for the word presentation method, which suggested that semantic mapping does not necessarily lead to better vocabulary retention than the traditional word listing method. But the group of semantic mapping with sound produced the highest overall mean score, higher than the other three groups.

Chun and Plass (1996) challenged the positive effect of audio annotation. In their studies, an audio component was added to three different annotations types (text, text-picture, and text-video); that is, a German native speaker pronounced each target word. Of the three successive studies, participants from the first and second studies were asked to report their use of retrieval cues for vocabulary learning. The authors suggest that the audio component was not useful in learning vocabulary since it showed very limited importance as a retrieval cue.

Methodology

Research Design

Training program. The interactive multimedia program used in this study was designed by the researcher to help intermediate EFL students with vocabulary learning. The program provided students with annotations for unknown words via hypermedia links in two different modes: text-picture and audio-picture. The annotations were used to assist the learning of unknown words. The program was written in HTML. HTML was chosen as the programming language due to its user-friendly integration of hypermedia and its compatibility for both PC platforms. The picture annotations were processed with Adobe Photoshop 6.0 (Adobe, 2000), and the audio clips were processed with Vegas 4.0 (Sonic Foundry, 2003). The screen was divided into two frames. The left screen was used for the reading text with the title at the top, and the right screen was reserved for the annotation. In the text-picture version, when participants click on a highlighted word, the right screen offers a textual definition of the words together with a picture that describes the word. In the audio-picture annotation, when participants click on a highlighted word, they could see on the right screen a picture that depicts the meaning of the word and hear an audio clip that explains the meaning of the word.

Procedure. The study was conducted during the participants' regular class time, and required two consecutive 50-minute sessions. The participants were randomly assigned to a control and two experimental groups: text-annotation and audio-annotation groups. In the first 50-minute session, the researcher first gave a brief introduction of the study and answered any questions that the participants might have. Then, two neighboring students had access to different annotations, one text-picture and the other audio-picture. In the computer lab, the researcher gave a brief introduction of the online reading activity. Headsets were used for those who were in the audio-picture annotation group. During reading, the participants clicked the highlighted unknown words to access available annotations. The text-picture group was able to see textual explanation and pictorial description, and the audio-picture group was able to see pictorial description explanation and hear a spoken explanation. When they finished reading, they raised their hands to receive the post-tests.

Participants

The participants in the study were selected from two intact classes consisting of 80 students studying English in at advance level in Bandar

Abbas, Iran. They had a mean age of 24 and had been studying English Translation as their field of study. Their level of English proficiency was determined on the basis of their scores on the PET proficiency test. Based on the results of PET proficiency test, those participants placed between one standard deviation above and below the mean were regarded as the main participants. Finally, 62 students were selected for main procedure and data analysis based on the research question. Then they were randomly selected to two experimental groups including text-annotation group and audio-annotation group, and a control group. Because some of the students were absent during the implementation of one of the tests, they were excluded from the main subjects resulted in 38 participants in the respective experimental groups and 20 in the control group.

Data Collection Instruments

General English Proficiency Test. The PET proficiency test was utilized to assess the subjects' level of proficiency in English. This test included 30 multiple-choice vocabulary, grammar, and reading comprehension items. The researcher piloted the test with 27 students with the same level and similar characteristics to those of subjects of this study. It should be mentioned that the reliability of PET proficiency test estimated by KR-21 (Kudar Richardson) formula appeared to be .69.

Reading material. The reading text, "European Settlers of Australia," was written by the researcher based on three criteria: text length, syntactic complexity, and content. In terms of length, the text has 449 words (including the title). It consists of short, uncomplicated sentences and simple past tense is used throughout the text. There is an average of 6.8 sentences in each paragraph, and an average sentence contains 10.8 words. The percentage of simple sentences in the text is over 80%. With regard to the content, it seems reasonable to assume that ESL students knew more or less the same amount of general information about the European colonization of Australia and have comparable background knowledge of the reading text (i.e., since none has been to Australia and its history is foreign to all participants). The content of the text does not require any specific culturally related knowledge. The readability of the text is considered to be between grade level 5 and 6 based on the Flesch-Kincaid measure. It tells of the story of the European colonists in Australia in the 1800s. The text was given to experienced EFL instructors who teach reading/writing classes and was confirmed to be appropriate for advance students. The student's cloze score of 67% indicate that the reading text was appropriate for advanced students in terms of difficulty level.

Target words. The 20 target words were all nouns. They were selected for frequency. Based on the word frequency corpora of Francis and Kucera (1982), the 20 target words have a mean of 12.7 per million words. The reading text was modified into two different forms: a text with text-picture annotations, and a text with audio-picture annotations. The 20 target words were highlighted in both texts.

Word Recognition Test (WRT): The participants were asked to complete a Word Recognition Test (WRT) as pretest at the beginning of the study. In this test, the 20 target words were presented in their original context taken from the reading text. For each word, the participants were asked to choose one correct meaning out of four given choices. Of the four choices, one was the correct meaning, and the other three were distractors.

Data Analysis and Interpretation

Research question 1: *Does text-picture annotation play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners?*

In order to see whether we are able to use t-test as a parametric test, first we should check whether the data have been normally distributed or not. If the level of significance is more than 0.05, it indicates the normality of data distribution. Therefore, we can use parametric test for further data analysis.

Table 1. One-Sample Kolmogorov-Smirnov Test for text-annotation, audio-annotation and control group

		Pretest text annotation	Pretest audio annotation	Pretest control
N		18	20	20
Normal Parameters(a,b)	Mean	4.33	4.25	4.20
	Std. Deviation	1.680	1.446	1.240
Most Extreme Differences	Absolute	.245	.269	.264
	Positive	.245	.269	.264
	Negative	-.158	-.194	-.167
Kolmogorov-Smirnov Z		1.041	1.201	1.181
Asymp. Sig. (2-tailed)		.229	.112	.123

As it is evident from Table 1, the result of normality test shows that p values of three groups (.229, .112, and .123) are more than significance level (0.05). Therefore, we can accept the assumption of normality and we can use paired sample t-test for comparing the results of pretest and posttest in text-annotation, audio-annotation and control group.

Table 2. Paired sample test for pre- and posttest vocabulary knowledge scores for samples in in text-annotation, and control group

Group	Pair	Mean	SD	Std. Error Mean	t	df	Sig (2-tailed)
Text annotation	Pre- and posttest	-6.056	1.259	.297	-20.407	17	.000
Control group	Pre- and posttest	.350	1.268	.284	1.234	19	.232

As is evident from Table 2, there is a significant difference between pre- and posttest in text-picture annotation group in Iranian EFL context ($t=-20.407$; $P=.000$). In other words, participants scored higher in posttest ($M=10.39$, $SD=1.680$), when they were exposed to text annotation during their reading, than pretest ($M=4.33$, $SD=1.680$). With respect to this point, the first hypothesis (*text-picture annotation does not play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners*) is rejected. In other words, text-picture annotation could play a significant role in learning new vocabularies during reading text. Regarding the control group, there is no significant difference between the students' vocabulary knowledge during pre and posttest ($t=1.234$; $Sig=.232$).

Research question 2. *Does audio-picture annotation play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners?*

Table 3. Mean pre- and posttest of vocabulary knowledge scores for samples in audio picture annotation and control group

Group		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	Pretest for audio group	4.25	20	1.446	.323
	Posttest for audio group	12.55	20	1.731	.387
Pair 2	Pretest control	4.20	20	1.240	.277
	Posttest control	3.85	20	1.182	.264

As is evident from Table 4, there is a significant difference between pre- and posttest in audio-picture group in Iranian EFL context ($t=-16.496$; $P= .000$) when they were exposed to audio-picture annotation during reading. Further, it is clear from Table 3 that students learned new words better when they were exposed to audio-picture annotation (posttest) than the time they were not exposed to (pretest) (Mean=12.55 and 4.25, respectively). Therefore, the second hypothesis (*Audio-picture annotations does not play any significant role in facilitating L2 vocabulary immediate recall among Iranian EFL learners*) is also rejected. In other words, audio-picture annotation could play a significant role on increasing adult EFL learners' vocabulary knowledge. As far as the control group is concerned, as it is observed from Table 4, there is no significant difference between the students' performance in vocabulary knowledge after reading the text without any kind of annotation ($t=1.234$; $P= .232$).

Table 4. Paired sample test for pre- and posttest vocabulary knowledge in audio-picture and control group

Group	Pair	Mean	SD	Std. Error Mean	T	Df	Sig (2-tailed)
Audio annotation group	Pre- and posttest	-8.300	2.250	.503	-16.496	19	.000
Control group	Pre- and posttest	.350	1.268	.284	1.234	19	.232

Research question 3: *Is there any significant difference between the effect of text-picture and audio-picture annotations in facilitating L2 vocabulary immediate recall among Iranian EFL learners?*

In order to answer the third question, the vocabulary posttest in text-picture, audio-picture and control group were computed and then ANOVA was used to see whether there was any significant difference among the three groups in posttest stage. The following tables show the results:

The results of data analysis (ANOVA) in Table 5 below indicates that there is a statistically significant difference between text-picture group, audio-picture group and control group in the results of posttest because obtained F value of 181.376, was found to be significant at .001 level ($P=.000$). In other words, the third null hypothesis (*There is no significant difference between the effect of text-picture and audio-picture annotations in facilitating L2 vocabulary immediate recall among Iranian EFL learners.*) is confirmed.

Table 5. Results of ANOVA for mean posttest scores of samples in text-annotation, audio-annotation, and control group

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	816.377	2	408.189	181.376	.000
Within Groups	123.778	55	2.251		
Total	940.155	57			

In order to see where the difference stands, the post hoc Scheffe test (see Table 6) showed that the audio-picture group performed significantly better than text-picture group (Mean=12.55 vs. Mean=10.39). Finally, text-picture group performed significantly better than control group (Mean =3.78 vs. 10.39). The results indicated that the scores of audio-picture group increased at a significantly higher rate than the text-picture and control group. As a result, audio-picture annotation was recognized to be the best method for learning new words during reading comprehension text.

Table 6. Post hoc Scheffe Test

	Group	N	Subset for alpha = .05		
			1	2	3
Scheffe(a,b)	control	20	3.85		
	Text	18		10.39	
	Audio	20			12.55
	Sig.		1.000	1.000	1.000

Results

On the basis of the quantitative analyses, annotation provides an efficient way for learners to expand their vocabulary knowledge. Annotation can promote noticing of the target form, in semantic processing.

The first and second research questions addressed the effect of text type and audio type annotations. On average, participants retained 70% of the 20 target words on the Vocabulary Knowledge Scale. The average retention rates were comparable to previous multimedia annotation studies (e.g. Al-Seghayer, 2001; Yoshii, 2000). The results confirmed the impact of annotation in helping second language vocabulary learning. According to Paivio (1990), the main reason can be related to the dual-coding effect that words annotated with both verbal (text or audio) modes of information lead to effective vocabulary retention.

This study was designed to compare the effectiveness of text-picture annotation with audio-picture annotation on L2 vocabulary immediate recall. As shown by the above table, the audio-picture annotation group consistently outperformed the text-picture annotation group. The dual channel assumption, especially the modality principle, of the cognitive theory of multimedia learning can be used to explain this finding (Mayer, 2001). Mayer distinguishes the two separate channels for processing visual/pictorial and auditory/verbal information. The modality effect articulates that working memory has partially independent processors for handling visual and auditory information. The effective capacity of working memory could be increased by using both visual and auditory channels (Mayer & Moreno, 1998).

Text annotation and audio annotation are both verbally-presented information; thus both annotations contain a combination of verbal and non-verbal information. Based on the modality principle (Baddeley, 1999; Mayer, 2001), text annotation and picture annotation will be

processed by the visual channel, while audio annotation will be processed by the auditory channel. Therefore, in text-picture annotations, the simultaneous register of both text and picture caused the visual channel to be overloaded. This led to an information processing that was, at least initially, carried out solely in the visual working memory. Thus, the cognitive resources available in the visual working memory had to be divided between textual and pictorial information, whereas the auditory (phonological) working memory was left unused.

In comparison, in audio-picture annotations, the audio was registered by the auditory channel and processed in the phonological working memory, while the picture was registered by the visual channel and processed in the visual working memory. This combination allowed cognitive resources in both working memories to be used. In other words, more cognitive resources were utilized in audio-picture annotations than in text-picture annotations.

The preference of audio-picture annotation on L2 vocabulary immediate recall can also be explained with the split-attention principle (Mousavi, Low, & Sellar, 1995). Participants with access to text-picture annotations had to split their attention in the visual working memory between multiple visual resources (written text and picture). Participants with access to audio-picture annotations approached the audio as an auditory resource and the picture as a visual resource through auditory working memory and visual working memory respectively, which did not require an attention split in either of the working memories. In this way, effective working memory might be increased by presenting information in a mixed (visual and auditory) rather than a unitary mode (visual only). Hence, audio-picture annotation resulted in higher vocabulary immediate recall than text-picture annotation.

Conclusions

Previous studies have examined the effects of multimedia annotations on L2 vocabulary learning. These studies have supported the effectiveness of multimedia annotations in facilitating L2 vocabulary learning. However, no study in second language acquisition has examined audio annotation in combination with text as a dual multimedia annotation type. This study focused on this issue by comparing audio-picture annotation to text-picture annotation in their effects on L2 vocabulary immediate recall.

The results of the study demonstrate that audio-picture annotation is more effective than text-picture annotation in facilitating L2 vocabulary

immediate recall. The results suggested that providing the new words whether in audio and text annotation during reading comprehension can help recalling new words. Some scholars investigated the effect of presenting different words and the results were inconsistent. For example, McKeown (as cited in Read, 2004) suggests that current dictionary definitions are not effective even in initiating the process of understanding word meaning, at least for younger learners. Nagy and Scott (as cited in Read, 2004) indicated a chief strength of definitions because they provide explicit information about word meanings that is normally only implicit in context; therefore, if a student is to learn a word, giving the specific meaning of a word may provide the best chance for competence. It is possible that older students may have a better understanding of how explicit definitions work and how to manipulate the meaning into other contexts.

It is important to note that students will need to be prepared to read and use weak or insufficient clues to unlock the meaning of new words in a variety of texts. This study suggests the need to allow more instructional time to support different types of annotation and to identify stories with well-developed clues so that students can develop a repertoire of different strategies to unlock the meaning of words in the different contexts in which the words are encountered.

It is hoped that the findings of this study will shed some light on blurred issues of text annotation and audio annotation and its effect on reading comprehension performance. Regarding theoretical implications, the findings of this study suggest a number of implications and extensions for the classroom. Firstly, this study adds to the growing body of research in multimedia annotation studies in second language acquisition. Previous multimedia annotation studies have focused on the comparison of text-picture annotation to text-only annotation or picture only annotation (Yoshii, 2000) or on the differences between text-picture annotation and text-video annotation (Al-Seghayer, 2001). However, audio annotation, as a different sensory modality from visual (text, picture), has never been studied before. The present study fills this gap in the literature.

This study provided the much-needed information on the effect of audio annotation on L2 vocabulary learning. By comparing audio-picture annotation to text-picture annotation, it shed light on the use of different dual annotations for multimedia L2 learning. The thesis has established that audio-picture annotation is superior over text-picture annotation in facilitating L2 vocabulary immediate recall. This contributes to the extension of the cognitive theory of multimedia

learning to second language learning by verifying both the modality effect and split-attention effect.

In addition to the contributions and implications for the field of second language acquisition, especially in the area of multimedia annotation research, this study provides some insights for CALL material designers in choosing the right combination of modalities in facilitating L2 vocabulary learning. This study confirmed that the use of audio-picture combinations facilitates L2 vocabulary immediate recall in a more effective manner than text-picture annotation. In designing multimedia courseware or materials, this finding could be taken into consideration when making decisions about presenting information in different modes. This could also inform language teachers and administrators in making decisions about the most effective multimedia programs to enhance L2 vocabulary learning.

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