

Comparing L2 Incidental Vocabulary Learning Through Viewing, Listening, and Reading

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Abstract—The aim of this study is to determine the most effective mode of input for L2 vocabulary learning by investigating three types of input: audiovisual input, audio input, and written input. Using a pretest-posttest-delayed posttest design, this study recruited 95 university EFL students who were randomly assigned to four groups. The same TV documentary was presented to each group in four different modes: viewing the documentary, listening to the documentary, reading the printed transcript, and a control condition in which no treatment was given. Vocabulary learning, which was operationalized as the receptive knowledge of the form-meaning connection of the target words was measured by checklist and multiple-choice tests. Two variables were considered in the investigation: prior vocabulary knowledge and the word frequency of occurrence. The findings suggest that participants learned vocabulary incidentally through viewing, listening, and reading. They also successfully retained vocabulary through the three modes of input. The study found no significant differences in vocabulary gains between viewing and reading on the posttests suggesting that vocabulary gain and retention are similar through these types of input modes. The study found a significant impact of prior vocabulary knowledge and frequency of occurrence on vocabulary learning. As the results suggest that viewing is as effective as reading, this study provides further support for the use of television in L2 learning.

Index Terms—incidental vocabulary learning, L2 viewing, L2 listening, L2 reading

I. INTRODUCTION

Through viewing, listening, and viewing, the different modes of audiovisual, audio, and written L2 input contribute to incidental vocabulary learning. However, some studies found that EFL learners, especially young population prefer audiovisual materials to written materials in learning English outside of the classroom (e.g., Lindgren & Muñoz, 2013; Peters, 2018; Peters et al., 2019). Peters (2018), for example, found that young adult Flemish learners (ages 16 and 19 years) were exposed to large amounts of English language input outside of the classroom including songs, TV programs, movies, and computer games. Interestingly, she found that 40% of the participants watched L2 television and movies several times a week compared to only 1% of them who read L2 books to the same extent. In another survey study, Lindgren and Muñoz (2013) reported that participants spent an amount of time listening to songs and viewing television and movies that was more than three times that of reading. In fact, there is an increasingly supported evidence that L2 viewing of TV yields incidental vocabulary learning and improves vocabulary learning through increasing the amount of meaning-focused spoken input (e.g., Montero Perez et al., 2018; Peters & Webb, 2018; Puimège & Peters, 2019; Webb, 2009).

Vocabulary learning is deemed incidental when learning occurs during reading or listening to a meaningful input without paying attention to vocabulary items. Also, incidental learning has been operationalized in terms of test announcement (Hulstijn, 2003; Peters & Webb, 2018; Rodgers & Webb, 2020) when students are not informed of a vocabulary test. Incidental learning of vocabulary occurs when unknown words are encountered repeatedly in meaning-focused input and refers to learning vocabulary from context when the focus is usually on comprehension not on vocabulary acquisition (Gass, 1999; Hulstijn, 2001; Schmitt, 2010) making it different from the direct intentional learning of vocabulary. Learning vocabulary from context means that learning occurs during activities such as reading or listening to a language input while students' concentration is on the content of the input be it brief or extended (Schmitt, 2010). Thus, learning from context includes learning from various types of language activities including extensive reading, being involved in conversations, listening to stories and the radio, and viewing television. As stated by Nation (2001), most of our first language vocabulary learning occurs through incidental learning during reading and listening times.

Whereas the impact of reading on L2 vocabulary learning has been empirically established (e.g., Pellicer-Sanchez & Schmitt, 2010; Waring & Takaki, 2003), more research efforts are still needed to show the impact of other modes of input on vocabulary acquisition. Two main cognitive theories have been suggested for vocabulary learning through viewing; The Multimedia Learning Theory (Mayer, 2001) and the Dual Coding Theory (Sadoski, 2005; Sadoski & Paivio, 2001). The first theory proposes that processing channels for words in working memory are different from channels responsible for processing pictures. The second theory is based on the idea that there are two coding systems in human cognition, a verbal system that deals with items that are formulated in verbal mode, and an imagery system

that deals with items formulated in nonverbal mode. These two theories assume that better learning occurs when information is presented both in verbal and pictorial forms. Therefore, we suggest that viewing might yield better vocabulary learning than reading and listening. To the best of our knowledge, Feng and Webb (2020) is the only empirical study that compared the three input modes in their most-frequent encountered ways, that is, viewing without captions, listening only, and reading only. The purpose of the current research is to follow up Feng and Webb (2020) study which suggested comparing the three input modes with participants from different backgrounds and different contexts to find out whether their findings can be generalized across different demographic characteristics of L2 learners.

II. LITERATURE REVIEW

A. *Incidental Vocabulary Learning through TV Viewing*

Recent studies on L2 vocabulary have suggested that viewing TV plays an important role in L2 incidental vocabulary learning (Ahrabi Fakhri et al., 2021; Arndt & Woore, 2018; d'Ydewalle, 2002; Feng & Webb, 2020; Peters et al., 2016; Peters & Webb, 2018). One of the most common and effective types of L2 input is television because of the increased popularity of audiovisual input (TV shows, movies, documentaries, and so on) and the spread of streaming services, smartphones, and computers (Peters, 2019). Peters (2018) found that L2 watching of TV without captions contributed to vocabulary learning in secondary-school and university level learners. L2 watching might have the same potential for L2 vocabulary learning as reading because TV programs are popular among young L2 learners and are easily accessible nowadays. There are several advantages of audiovisual input compared to written and audio inputs: (1) it is motivating, (2) it contains visual support, and (3) it recycles low-frequency words (Peters, 2019). As opposed to written and audio inputs, the key feature of audiovisual input is that aural text and visual images are combined together. In his explanation of the theory of multimedia learning, Mayer (2014) argues that "people learn more deeply from words and pictures than from words alone" (p. 1).

Recent research shows that TV provides multiple exposures to the more-frequent words as well as less-frequent words and that regular viewing of TV would likely contribute to L2 lexical development (Rodgers & Webb, 2017; Webb, 2015; Webb & Rodgers, 2009). There is a support for this claim in studies that investigated incidental vocabulary learning through watching TV programs. For example, Peters and Webb (2018) found that L2 learners were able to recognize almost 14% of the unknown words after watching one full-length television documentary. Similarly, Rodgers and Webb (2020) found that L2 learners could learn 25% percent of the unknown unfamiliar target words after watching 10 episodes of a TV series. In the same vein, Puimege and Peters (2019) reported that TV viewing had an effect on learning unknown lexical items (single words as well as formulaic sequences). All in all, there is growing evidence that L2 vocabulary can be picked up incidentally through TV viewing and that the influence of extensive viewing of L2 television, i.e., viewing a large amount of L2 programs for pleasure could be similar to the influence of extensive reading on vocabulary development (Webb, 2015).

B. *Incidental Vocabulary Learning through Listening*

A large number of studies have indicated that listening to aural input (e.g., songs, podcasts, academic lectures, and recordings of graded readers) can contribute to L2 incidental vocabulary learning (Arndt & Woore, 2018; Brown et al., 2008; Feng & Webb, 2020; Pavia et al., 2019; van Zeeland & Schmitt, 2013; Vidal, 2003, 2011). Similar to other modes of input, learners need multiple encounters to learn new words through listening. Learners might need different contexts in order to acquire different aspects of vocabulary knowledge including the spoken forms of unknown words, their grammatical functions and collocations, and their meanings (Webb & Nation, 2017). Therefore, the value of listening for learning words is influenced by the amount of spoken input; a larger amount of input likely yields more robust learning of words because words will be met more times (Feng & Webb, 2020). As opposed to reading; however, research showed that L2 incidental vocabulary learning through listening requires a higher number of encounters with unknown words.

Interestingly, the comparison between L2 vocabulary learning gains through reading and listening has revealed that listening can be as effective as reading. For example, Brown et al. (2008) who compared words learned from graded readers through reading only, listening only, and reading-while-listening found that gains from reading were significantly higher than that from listening, yet word retention from listening was better than that from reading. Vidal (2011) also compared incidental vocabulary gains from reading and listening to academic texts. Their results demonstrated that words were incidentally picked up through both input modes, the reading mode resulted in significantly higher scores than the listening mode, and word retention from listening was better than that from reading. Taken together, these studies suggest that listening might be inferior to reading for incidental vocabulary learning. Possible reasons why written input might contribute to larger vocabulary gains than aural input are related to the complexion of spoken versus written language: aural input requires quicker cognitive processes likely making it difficult for listeners to pay enough attention to unfamiliar words because they have less time than readers to focus on individual words (Goh, 2000; Renandya & Farrell, 2011; van Zeeland & Schmitt, 2013). Also, aural input is continuous

and, as opposed to the written, there are no obvious boundaries between words input likely making it more difficult to segment new words encountered (e.g., Goh, 2000).

C. Incidental Vocabulary Learning through Reading

Research has demonstrated the efficacy of reading for incidental learning of L2 vocabulary (e.g., Feng & Webb, 2020; Pellicer-Sanchez & Schmitt, 2010; Pigada & Schmitt, 2006, van Zeeland & Schmitt, 2013; Waring & Takaki, 2003). When unknown words are encountered repeatedly in meaning-focused input, such as reading, incidental learning might occur. Word knowledge achieved by reading includes knowledge of written form, part of speech, and collocation, and the word meaning from the context. As knowledge of encountered words is likely to accumulate when words are met in various contexts, the value for incidental vocabulary learning through reading happens through reading a large amount of written input which can be achieved through extensive reading. Extensive reading refers to an L2 approach in which learners read a large amount of materials for pleasure for an extended period of time. The value of extensive reading for improving L2 vocabulary knowledge has been shown in empirical research (Horst, 2005; Pigada & Schmitt, 2006; Webb & Chang, 2015). The rationale for extensive reading is that it provides multiple encounters of words across texts.

Regarding the role of frequency of occurrence, various thresholds have been suggested for incidental vocabulary learning through reading. For instance, studies such as Waring and Takaki (2003) and Pigada and Schmitt (2006) who used graded readers have suggested that more than 20 encounters with words were needed for vocabulary knowledge to be retained. On the other hand, there are studies that have suggested fewer encounters. For example, the results obtained by Webb (2007) who used sets of short sentences as research materials suggest a minimum of 10 encounters was enough to ensure a relatively large increase in vocabulary knowledge through reading. Also, in a study examining incidental word learning using self-composed short stories as reading materials, Chen and Truscott (2010) found that learning rates for words that have several occurrences in the text were significantly higher than those of the words that had only one occurrence. Overall, it appears that it is difficult to draw a conclusion on the threshold of frequency of word occurrence by which vocabulary learning can be ensured because learning occurred with words that have a few occurrences but it didn't occur with other words with many occurrences.

D. Comparing the Three Modes of Input

There are a great deal of studies that compared written and audio modes of input (e.g., Brown et al., 2008; Vidal, 2011; Webb & Chang, 2015), but Feng and Webb (2020) are the first and remain the only study that included audiovisual input in the investigation along with the other two modes of input. Seventy-six university students learning English in China participated in the study that used a pretest-posttest-delayed posttest design at one-week intervals. The same full-length television documentary was presented to the participants in three different modes: viewing the documentary without captions, listening to the documentary, and reading the printed transcript. Incidental learning of target words was assessed by checklist and multiple-choice tests. The results indicated that L2 incidental vocabulary learning occurred through viewing, listening, and reading and no significant differences were found across the three modes. The researchers suggested that each mode of input should yield similar vocabulary learning gains. The study also found that vocabulary learning was significantly influenced by prior vocabulary knowledge, but not by frequency of occurrence.

However, the finding that listening and reading led to similar amounts of vocabulary gain contrasts previous findings from earlier studies (e.g., Brown et al., 2008; Vidal, 2011). Brown et al. (2008) found that EFL learners incidentally learned more words from graded readers through reading than through listening. In a similar vein, Vidal (2011) used academic reading texts and academic listening lectures in a study with undergraduate students in an ESP course. He found that the Reading participants made greater vocabulary gains than the Listening participants. Due to these differences in findings, Feng and Webb (2020) suggested that more research comparing these two modes of input is needed. Another surprising finding in their study is that viewing did not result in superior vocabulary learning gains to listening and reading given that multimodal input should yield greater vocabulary learning than unimodal input as it is suggested by the Multimedia Learning Theory (Mayer, 2001) and Dual-Coding Theory (Sadoski & Paivio, 2001). One explanation for the contrast, as proposed by the researchers, lies in the speculation that EFL Chinese students' experience in learning through viewing is much more limited than learning through reading and listening largely because L2 television is not a common way for teaching English in China whereas reading and listening are the regular modes used in schools.

E. Prior Vocabulary Knowledge and the Three Modes of Input

Regarding the impact of prior vocabulary knowledge on vocabulary gain through viewing, Rodgers (2013) examined the effects of viewing ten TV episodes on incidental vocabulary learning. Significant correlations were found between prior vocabulary knowledge and vocabulary learning as assessed by two tests measuring knowledge of form-meaning connection at differing sensitivities. Montero Perez et al. (2014) examined the effects of viewing video clips in French by Dutch-speaking learners of French at a Flemish university. They found that the vocabulary size correlated significantly with vocabulary test scores. Peters and Webb (2018) conducted a study with Dutch-speaking EFL learners to explore the influence of viewing a single full-length TV program on incidental acquisition of target vocabulary. They also found that incidental vocabulary learning was affected by prior vocabulary knowledge. More recently, Ahrabi

Fakhr et al. (2021) examined prior vocabulary knowledge and incidental learning of target words through viewing a full-length captioned episode of an English TV program by Iranian EFL students. They found that learning was affected by prior vocabulary knowledge and its effects persisted after 3 months.

The relationship between prior vocabulary knowledge and vocabulary learning through reading was examined in a few studies as well. Webb and Chang (2015) used 20 graded readers with 60 EFL learners over 37 weeks to study how prior word knowledge affected vocabulary learning progress in an extensive reading program. They found a significant relationship between prior vocabulary knowledge and word gains through extensive reading. Feng and Webb (2020) also found a significant positive relationship between prior vocabulary knowledge and vocabulary learning through reading. The explanation suggested by researchers for the impact of greater vocabulary knowledge on learning more vocabulary than limited vocabulary knowledge is that greater vocabulary knowledge should yield better comprehension of the text which makes the context easier for guessing meanings of unfamiliar vocabulary (Liu & Nation, 1985; Schmitt et al., 2011; Webb & Paribakht, 2015).

Listening studies; however, found no relationship between prior vocabulary knowledge and vocabulary learning. Zhang and Graham (2020) investigated the influence of prior vocabulary knowledge and listening proficiency on word gains through listening on EFL Chinese learners. Research materials were three different kinds of spoken vocabulary explanations. The study found that learners' listening proficiency was a more important factor influencing vocabulary learning through listening than their prior vocabulary knowledge. Similarly, Feng and Webb (2020) found no significant positive correlations between prior vocabulary knowledge and vocabulary learning for the Listening group. Two explanations for the lack of a significant correlation between prior vocabulary knowledge and word learning through listening have been presented by Feng and Webb (2020). The first explanation has to do with the inaccuracy of the vocabulary size test that often measured knowledge of written form-meaning connections rather than the spoken form meaning connections of words, the way in which they were tested. The second explanation takes into consideration the impact of other factors such as understanding of the characteristics of L2 spoken input, the ability to process fast speech, and the load of connected speech on vocabulary learning.

III. THE PRESENT STUDY AND RESEARCH QUESTIONS

The differences and contradictions in findings in the abovementioned studies demand more research in this area. The primary aim of this study then is to compare vocabulary learning through viewing, listening, and reading. An English-language TV documentary was used as the research material for three experimental groups: Viewing Group who viewed the documentary, Listening Group who listened to the audio of the documentary, and Reading Group who read the transcript of the documentary. This research design ensured a direct comparison of vocabulary learning in different modes of input by controlling the input, i.e., the same input was presented to participants across the three groups. This study is necessary because if TV viewing should be used in L2 classes as promoted by some researchers (e.g., Peters & Webb, 2018; Rodgers & Webb, 2020; Webb, 2015; Webb & Nation, 2017), understanding its effectiveness in relation to the other modes of input is necessary. To that end, the present study attempts to answer the following research questions:

1. To what extent is vocabulary knowledge learned and retained through viewing audiovisual input, listening to aural input, and reading input written?
2. How do vocabulary acquisition and retention compare across audiovisual, aural, and written input?
3. In each input mode, is there any relationship between vocabulary learning and prior vocabulary knowledge and frequency of word occurrence?

IV. METHODOLOGY

A. Participants

This quasi-experimental study was conducted in an EFL context with 95 male Arabic-speaking students ($M_{age} = 19.33$ years, $SD = .41$). The participants were students in an English program in a Saudi public university. Participants had been studying EFL for a minimum of seven years in public schools. Their English proficiency levels were considered to be pre-intermediate to intermediate according to an in-house English proficiency exam. They were in four similar-size classes that were randomly assigned by the program. The Viewing Group had twenty-six participants; the Listening Group had twenty-three participants; the Reading Group had twenty-five participants; and the Control Group had twenty-one students. Data collection took place during their class time and their preassigned classes were used as the experimental groups.

The participants were administered the updated Vocabulary Levels Test (VLT; Webb et al., 2017) at the 1,000-, 2,000-, 3,000-, 4,000-, and 5,000-word levels to assess their prior vocabulary knowledge. The total possible score for all five sections of the test is 150 marks (30 marks for each section). According to Webb et al.'s (2017) suggestion, the results obtained from the test indicated that all participants knew the most frequent 1,000 words, 82 (86.31%) of them knew the most frequent 2,000 words, and 57 (60%) of them knew the most frequent 3,000 words. Participants' scores on the VLT were used as an indicator of their vocabulary knowledge. ANOVA ($F(2, 92) = .726, p = 2.40$) indicated no

significant difference between the groups on the VLT scores. This result indicated that participants' vocabulary levels were equivalent among the four groups. The VLT results are shown in Table 1.

TABLE 1
PARTICIPANTS' AVERAGE SCORES ON THE VLT

	Viewing Group	Listening Group	Reading Group	Control Group	All Groups
<i>N</i>	26	23	25	21	95
<i>M</i>	122.12	118.40	120.91	122.03	120.86
<i>SD</i>	10.02	14.33	12.28	13.93	12.64

B. Source of Input

One full-length, 51-min documentary episode titled "Building Sea City" uploaded on YouTube by Spark was used as the research materials. The documentary follows a team of engineers on the ground in Kuwait where they have to build a futuristic sea city. The transcript contained 7,088 running words and was examined to ensure that it was not different from the vocabulary in the video. The transcript was analyzed through Cobb's Lextutor's VocabProfile using the BNC/COCA word lists to statistically ascertain its vocabulary load, i.e., the percentage of words found across different frequency vocabulary lists. The analysis showed the most frequent 3,000-word families provided 95.1% coverage of the words found in the documentary. The vocabulary load of the transcript was believed to be at an appropriate level for all participants.

C. Target Words

The target words were chosen based on their frequency levels in the BNC/COCA word lists and their frequency within the documentary. Words that were from the most frequent 1,000, and 2,000-word families were not selected because there was a reasonable chance that the participants had a sufficient knowledge of most of these word levels. The frequency of the vocabulary was determined by running the transcript in Cobb's Lextutor's VocabProfile. Lextutor also sorted the vocabulary in the documentary in relation to their inclusion in the BNC/COCA twenty-four 1000-word frequency lists. Word types that most commonly occurred from the word families in the documentary were used as the vocabulary test items. Thirty-eight vocabulary items were selected from the documentary as target words. The range of frequency of the target words was from 1 to 23 occurrences. Table 2 provides the target words, their word-family levels, and their number of occurrences in the documentary.

TABLE 2
TARGET WORDS AND THEIR OCCURRENCE FREQUENCY IN "BUILDING SEA CITY"

Target word (Word family)	Word list (1,000)	Frequency of occurrences	Target word (Word family)	Word list (1,000)	Frequency of occurrences
1. assess	3	3	20. peg	6	3
2. circulate	3	5	21. groin	7	2
3. impact	3	6	22. gush	7	1
4. vast	3	5	23. hydraulic	7	3
5. unique	3	5	24. ingenious	7	1
6. marine	3	17	25. lagoon	7	23
7. monitor	3	3	26. throttle	7	1
8. align	4	2	27. silt	8	8
9. ambition	4	3	28. stagnant	8	4
10. compact	4	9	29. stagnate	8	2
11. flush	4	17	30. stockpile	8	2
12. habitat	4	4	31. dyke	10	1
13. excavate	4	6	32. bulkhead	10	1
14. grid	4	2	33. legume	11	1
15. creek	5	3	34. mangrove	11	5
16. override	5	2	35. impound	12	3
17. quarry	5	3	36. vestry	12	1
18. reef	5	1	37. dewater	17	2
19. patronage	6	1	38. revetment	19	8

V. DATA COLLECTION

A. Checklist Test

Feng and Webb's (2020) study was followed in the design of the checklist test. The paper-and-pencil test required participants to write *yes* or *no* next to each target word to assess their knowledge. Following Meara's (1992) *yes/no* EFL vocabulary test, 50 word items were included in the test: the 38 target words, 7 easy words that are believed to be familiar to all participants, and 5 fake words. The 12 easy and fake words were excluded from the analysis. The inclusion of 7 familiar words was hoped to encourage the participants to complete the test. The five nonwords were selected from the ARC Nonword Database developed by Rastle et al. (2002). The rationale for using nonwords was to reduce the limitation of overestimation of participants' vocabulary knowledge produced by the VLT or caused by not

taking the test seriously. When “yes” is given to a nonword, the response receives a “false alarm” but when “yes” is given to a real word, the response receives a “hit.” The percentage of known words is estimated by the following formula proposed by Anderson and Freebody (1983) and Shu et al. (1995): the proportion of hits on real words minus the proportion of false alarms on nonwords, divided by one minus the proportion of false alarms on nonwords. Each word was read twice and there was a five-second pause between the items.

B. Multiple-choice Test

The multiple-choice test measured the receptive knowledge of the form-meaning connection of the target words. The test included the same 50 items from the checklist test and consisted of a key word and three distractors in the participants’ L1 (Arabic) and in English. Distractors shared aspects of form or meaning with the correct answer to raise its difficulty. To reduce the effect of guessing, an ‘*I don’t know this word.*’ option was included as a fifth option. The same 12 easy and nonwords from the checklist test were also included in the multiple-choice test for the same purposes, but were excluded from the analysis. Table 3 shows how items appeared on the test by taking Item #28 as an example.

TABLE 3
EXAMPLE OF THE MULTIPLE-CHOICE TEST; ITEM #28

Target word	Stagnant				
Options	A. مائل	B. ثائر	C. راكد	D. نقي	E. لا أعرف هذه الكلمة.
English translation	A. Diagonal	B. Eruptive	C. Still	D. Pure	E. I don’t know this word

VI. RESULTS

A. Preliminary Analyses: Descriptive and Inferential Statistics

Descriptive statistics were first calculated for the checklist test and multiple-choice test at the three test times (see Table 4 and Table 5). The common measure of reliability, i.e. Cronbach’s alpha, which is based on a correlation matrix, was calculated to assess reliability between the tests. The Cronbach’s alpha coefficient was considered acceptable, $\alpha = .79$. From the pretest to the immediate posttest, all groups (including the Control Group) showed higher mean scores both on the checklist test and on the multiple-choice test. On the delayed checklist and multiple-choice posttests, experimental participants’ average scores had increased, while the Control Group failed to increase their scores on both tests. From immediate posttest to delayed posttest, the Viewing, Reading, and Control groups showed relatively little lower mean scores on both tests, while the Listening Group had increased their average scores only on the multiple-choice test. Inferential analyses (Repeated Measures ANOVA, one-way ANCOVA, and Pearson’s *r* correlation) were then performed to examine the statistical significance of the observed differences.

TABLE 4
MEANS (M) AND STANDARD DEVIATIONS (SD) OF THE SCORES ON THE CHECKLIST TEST

Group	N	Pretest		Posttest		Delayed posttest	
		M	SD	M	SD	M	SD
Viewing	26	0.518	0.346	0.677	0.125	0.659	0.978
Listening	23	0.497	0.834	0.576	0.903	0.519	0.265
Reading	25	0.481	0.118	0.648	0.482	0.635	0.537
Control	21	0.503	0.226	0.514	0.740	0.499	0.091

Note: 1 is the maximum possible score (100%).

TABLE 5
MEANS (M) AND STANDARD DEVIATIONS (SD) OF THE SCORES ON THE MULTIPLE-CHOICE TEST

Group	N	Pretest		Posttest		Delayed posttest	
		M	SD	M	SD	M	SD
Viewing	26	15.72	7.12	20.05	5.03	19.45	4.86
Listening	23	17.86	8.23	19.74	7.49	20.16	5.38
Reading	25	16.93	6.87	20.91	5.57	20.10	4.77
Control	21	15.90	3.81	16.01	2.59	15.13	2.72

Note: Maximum score is 38.

B. Research Question 1: To What Extent Is Vocabulary Knowledge Learned And Retained Through Viewing Audiovisual Input, Listening To Aural Input, And Reading Input Written?

Repeated Measures ANOVA was carried out to provide an answer to the first study question. Results of ANOVA indicate that the interaction of Time and Treatment had a significant effect on the scores both of the checklist test, ($F(3.49, 153.61) = 43.17, p < .001, R^2 = .72, \eta^2 = .72$) and of the multiple-choice test ($F(3.82, 151.92) = 46.83, p < .001, R^2 = .68, \eta^2 = .68$). The results of the Wilcoxon tests corrected with Bonferroni showed where the divergences between Time across the experimental groups.

For the checklist test, the results showed that the experimental groups had significantly higher scores on the immediate and delayed posttests ($p < .001$ for the Viewing and Reading Group; $p < .05$ for the Listening Group), but no significant differences were detected for the Control Group ($p > .05$). The experimental groups' scores on the delayed posttest were not significantly different from their scores on the immediate posttest scores ($p > .05$). Regarding multiple-choice test data, the same results were obtained. Scores on the immediate posttest and delayed posttest were significantly higher than the pretest scores for all the experimental groups ($p < .001$ for the Viewing and Reading Group; $p < .05$ for the Listening Group) but no significant differences were detected for the Control Group ($p > .05$). The scores on the delayed posttest were not significantly different from scores on the immediate posttest scores for all the experimental groups ($p > .05$).

C. Research Question 2: How Do Vocabulary Acquisition and Retention Compare Across Audiovisual, Aural, and Written Input?

To provide an answer to the second question, ANCOVA was used to assess which mode of input yielded significantly better vocabulary acquisition and retention after controlling for the pretest scores. Results obtained from ANCOVA revealed that the scores on the posttest were significantly different between groups after the pretest scores were controlled both for the checklist test ($F(3, 90) = 22.66, p < .001, R^2 = .43, \eta^2 = .43$) and for the multiple-choice test ($F(3, 90) = 28.14, p < .001, R^2 = .36, \eta^2 = .65$). Scores of the delayed checklist and multiple-choice posttests were not significantly different from those of the immediate posttests across the groups ($p > .05$). A Bonferroni post-hoc test of the immediate posttest revealed that the experimental groups had significantly higher scores both on the checklist posttest and on the multiple-choice test than the Control Group ($p < .001$ for the Viewing and Reading Group; $p < .05$ for the Listening Group). Also, the post-hoc test revealed that the Viewing Group and the Reading Group both had significantly higher vocabulary gains ($p < .05$) than the Listening Group both on the checklist and on the multiple-choice posttest after controlling for the pretest scores.

D. Research Question 3: In Each Input Mode, Is There Any Relationship between Vocabulary Learning and Prior Vocabulary Knowledge and Frequency of Word Occurrence?

To investigate if there was a statistically significant association between prior vocabulary knowledge (the VLT scores) in the three experimental groups and their posttest scores, Pearson Correlation (r) correlation was computed. The direction of the correlation was significantly positive only for the Viewing and Reading Group, which means that students' VLT scores were correlated with the immediate posttest and delayed posttest scores both on the checklist and on the multiple-choice tests. The significance levels (p) were $< .001$ for the Viewing and Reading Group and $> .05$ for the Listening Group. This suggests that the more vocabulary the students knew when viewing or reading a text, the greater their vocabulary learning gains.

To answer the second part of the question and to explore the effect of frequency of occurrence on incidental vocabulary learning, learning rates (number of students who learned each word) were calculated to assess vocabulary learning (Feng & Webb, 2020). Word occurrences had an average frequency of 4.45 ($SD = 4.87$). Pearson Correlation (r) correlation was computed and was used to investigate the relationship between frequency of occurrence and the learning rate of each word. The direction of the correlation was significantly positive, which means that frequency of occurrence was significantly related to incidental vocabulary learning in all the three modes. The significance levels (p) were $< .001$ for the Viewing and Reading Group and $< .05$ for the Listening Group. This means that the more a word occurs in a text, the greater vocabulary learning chance.

VII. DISCUSSION

A. Incidental Vocabulary Learning Through Different Modes of Input

The study found that significant vocabulary learning occurred through the different modes of input. This finding is consistent with previous studies where vocabulary knowledge was achieved incidentally through viewing audiovisual input (e.g., Ahrabi Fakhri et al., 2021; Feng & Webb, 2020; Montero Perez et al., 2014; Peters & Webb, 2018), listening to audio input (e.g., van Zeeland & Schmitt, 2013; Vidal, 2003), and reading written input (e.g., Waring & Takaki, 2003). With regards to retention, students successfully retained all gained words after one week of the treatment in all three modes of input. These findings are also consistent with earlier studies where gained words were retained one week after viewing audiovisual input (e.g., Ahrabi Fakhri et al., 2021; Feng & Webb, 2020), listening to audio input, and reading written input (e.g., Brown et al., 2008; Feng & Webb, 2020). More importantly, these findings provide an informed support of learning L2 vocabulary through viewing L2 television which is a common mode of L2 input by many EFL learners (Gieve & Clark, 2005; Peters & Webb, 2018; Rodgers, 2013). This is particularly important because previous research has been focused on incidental vocabulary through viewing short segments of videos (e.g., Montero Perez et al., 2014; Sydorenko, 2010) or specialized materials such as academic speeches (e.g., Vidal, 2003, 2011) which might be less favorable forms of viewing in many L2 contexts.

B. The Comparison of Vocabulary Learning across the Three Modes of Input

Our results showed that viewing and reading led to more vocabulary learning gains than listening. This suggests that the three modes of input are not equally effective for incidental vocabulary learning. This finding contrasts Feng and Webb's (2020) findings showing that viewing, listening, and reading led to similar vocabulary learning gains. Our findings are consistent with Brown et al.'s (2008) findings indicating that reading graded readers led to more incidentally word gains by EFL learners than listening to graded readers and with Vidal's (2011) findings showing that ESP students gained more vocabulary through reading academic texts than listening to academic lectures. These findings are consistent with Multimedia Learning Theory (Mayer, 2001) and Dual-Coding Theory (Sadoski & Paivio, 2001) that suggest that presenting information in verbal and pictorial forms together can improve learning. Therefore, as explained by previous studies (e.g., Peters et al., 2016; Peters, 2019; Peters & Webb, 2018; Rodgers & Webb, 2020) the combination of aural text and visual images could have influenced vocabulary learning through viewing. Listening was inferior to reading for incidental vocabulary learning in this study because spoken input requires faster processing and provides less time than reading to focus on individual words (Goh, 2000; Renandya & Farrell, 2011; van Zeeland & Schmitt, 2013). Also, there are no obvious boundaries between words in spoken input, making lexical segmentation more difficult (e.g., Goh, 2000).

C. *The Relationship between Vocabulary Learning and Prior Vocabulary Knowledge*

The results indicated that the relationship between prior vocabulary knowledge and incidental vocabulary learning was significant for the Viewing and Reading Group, but not for the Listening Group. This is consistent with earlier findings indicating positive correlations between prior vocabulary knowledge and vocabulary gain through viewing (Ahrabi Fakhri et al., 2021; Feng & Webb, 2020; Montero Perez et al., 2014; Peters & Webb, 2018; Rodgers, 2013) and through reading (Feng & Webb, 2020; Webb & Chang, 2015). There might be various reasons for the lack of a significant correlation between prior vocabulary knowledge and word learning through listening. The first explanation has to do with the fact that "the VLT measures knowledge of the written form of the word, whereas listening involves ability to recognize the spoken form of the word" (Stæhr, 2008, p. 148). The second reason takes into consideration the impact of other factors such as familiarity with L2 spoken input, tone of voice, speech rate, contextual information from gestures, and the amount of connected speech on vocabulary learning through listening.

D. *The Relationship between Vocabulary Learning and Frequency of Occurrence*

The findings showed that there was a significant relationship between frequency of occurrence and incidental vocabulary learning in all the three modes of input. This is supported by earlier findings indicating that the chance for incidental learning of a word increases when the number of encounters increases in viewing (Ahrabi Fakhri et al., 2021; Peters & Webb, 2018), in listening (Brown et al., 2008; Vidal, 2011), and in reading (Brown et al., 2008; Waring & Takaki, 2003). The correlation results showed that the effect of frequency of occurrence in listening was smaller than viewing and reading. This is also in line with previous findings. For example, Brown et al. (2008) found that listening yielded a 3% learning chance for words that had 15 to 20 occurrences, while reading yielded a 20% learning chance for words that had 10 to 13 occurrences. Again, the reason why there is a smaller effect of frequency of occurrence in listening for incidental vocabulary learning is that listening does not provide enough support to listeners who have to process words fast in real time.

VIII. CONCLUSION AND PEDAGOGICAL IMPLICATIONS

Regardless of the limitations, this study provides several implications for teaching. First, it is useful to learn new vocabulary in any of the three of the input modes. Teachers in classrooms are encouraged to train and support their students learning L2 vocabulary with a range of modes of input. When learners view, listen, or read large amounts of input outside of the classroom, meaning-focused input should enhance their L2 lexical development (Webb & Nation, 2017). Additionally, the fact that extensive reading has been promoted and introduced as the sole important resource for lexical growth, this study found that lexical development is also possible with extensive viewing and extensive listening. This study suggests that extensive viewing and extensive listening can be used together with extensive reading (Rodgers & Webb, 2017; Webb, 2015). In conclusion, the study found that L2 incidental vocabulary learning occurred through viewing, listening, and reading and that vocabulary gain was retained one week after encountering the input. However, these modes of input were not equally effective for incidental vocabulary learning. Vocabulary gains in viewing and reading modes were greater than the listening mode. A significant relationship between prior vocabulary knowledge and vocabulary learning gains and retention was found for the viewing and reading modes and between frequency of occurrence and vocabulary learning for the three modes. Finally, because extensive reading has long been supported and promoted by research for L2 learning, there should be programs developed based on extensive listening and extensive viewing.

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