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Input Enhancement, Noticing, and Incidental Vocabulary Acquisition

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Abstract

This study investigated the effect of input enhancement on vocabulary acquisition from reading at 98% known-word coverage. 47 intermediate EFL learners from 11 language backgrounds read a level-appropriate English story containing 12 nonwords under one of two conditions—with or without textual enhancement of the target words. The participants were tested on word noticing, word meaning recognition, and word meaning recall. Both groups showed large gains on all the tests: The enhanced reading group scored 58% correct on noticing, 43% correct on meaning recognition, and 24% correct on meaning recall, whereas the unenhanced reading group scored 65% correct on noticing, 39% correct on meaning recognition, and 25% correct on meaning recall. However, there were no significant differences between the groups on any of the tests, indicating that textual enhancement did not have any effect on either noticing or learning. Interviews with the participants confirmed that the learners in both groups had noticed many of the new words. Large variation was observed among the learners on vocabulary gains and among the words on pick-up frequency.

Keywords: incidental vocabulary learning, input enhancement, noticing

Introduction

Incidental vocabulary learning from reading is considered to be a major mode of vocabulary acquisition in a first language (Nagy, Herman, & Anderson, 1985; Sternberg, 1987). Similar claims have been made for second language (L2) vocabulary acquisition (Krashen, 1989; Nation, 2001). In the vocabulary acquisition literature, *incidental learning* is often defined as the accidental learning of vocabulary without an intention to learn (Hulstijn, Hollander, & Greidanus, 1996), or as a “by-product, not the target, of the main cognitive activity, reading” (Huckin & Coady, 1999, p. 182). In other words, it is a process that occurs naturally, during reading, while the learner’s attention is focused on overall text comprehension.

The L2 literature is replete with reports showing that reading for meaning leads to small but statistically significant vocabulary gains both in ESL (Cho & Krashen, 1994; Dupuy & Krashen, 1993; Horst, Cobb, & Meara, 1998; Knight, 1994; Pitts, White, & Krashen, 1989) and EFL (Day, Omura, & Hiramatsu, 1991; Webb, 2008) contexts. On the other hand, there is reason to believe that L2 reading for meaning does not automatically translate into vocabulary acquisition and that, at best, only *some* learners acquire *some* of the words *some* of the time. This is reflected primarily in the small pick-up rates associated with incidental learning of vocabulary. For example, in Cho and Krashen’s (1994) study, the two participants who did not use a dictionary acquired only seven and eight words per 70 pages read. Horst et al. (1998) reported a gain of five words for the 109 pages their learners had read. In Day et al.’s (1991) experiment with high school students, learners were able to recognize the meaning of only 0.9 words after reading for 30 minutes. Moreover, learners often fail to acquire new words from reading even after numerous encounters with these words (Horst et al., 1998; Waring & Takaki, 2003).

Could the outcome of incidental vocabulary learning be improved? For example, would enhancing vocabulary items in context—by bolding or underlining them—make them more noticeable to learners? More important, would this enhancement lead to greater vocabulary pick-up rates? This study is an attempt to answer these questions.

Research on Incidental Vocabulary Learning, Noticing, and Input Enhancement

What Variables Affect Incidental Vocabulary Learning?

Previous research has uncovered several factors that may influence the success of incidental vocabulary acquisition from reading. One such factor is the proportion of unknown words in the text because in order to learn new words from context, learners must be able to comprehend what they are reading. Several studies have investigated the relationship between known-word coverage and text comprehension. Laufer and Sim (1985), for example, estimated that learners need to have at least 95% coverage of the running words (i.e., one unknown word in every 20) to gain reasonable comprehension, which in their study was operationalized as a score of at least 55% on a reading comprehension test. Nation (2001), however, argues that one unknown word in every 20 is “still a heavy load of unknown vocabulary” (p. 233). Hsueh-chao and Nation (2000) found that even with a reasonably easy text, learners needed 98% coverage (i.e., one unknown word in every 50) to gain “adequate unassisted comprehension” (p. 422) and have reasonable success at guessing correctly from context. In their study, few learners reading at 95% coverage could fully comprehend the reading.

Another crucial factor in incidental vocabulary learning is word guessability. Because incidental learning does not assume any explicit instruction, words can only be learned through lexical inferencing, or by guessing their meaning from context. Previous research has shown that the presence in the context of sufficient linguistic and semantic clues is one of the most important determinants of word guessability (e.g., de Bot, Paribakht, & Wesche, 1997; Hulstijn, 1992) and learning (Webb, 2008). For example, in a recent study of the effects of context on incidental vocabulary learning, Webb found that learners who had seen target words in more informative contexts (i.e., in which few meanings were possible apart from the correct meaning, as in *He was not ill, and of course the beds in the ancon are for ill people*, where ancon means *hospital*) scored significantly higher on vocabulary recognition tests than did learners who had seen target words in less informative contexts. This finding implies that studies using natural readings, particularly in EFL contexts, may have underestimated potential vocabulary gains from reading because in natural prose, context often does not provide enough clues or provides misleading information about word meanings (Kelly, 1990; Schatz & Baldwin, 1986). Ehri (2002), for example, argues that on average, only 25-30% of words can be guessed correctly in natural readings; Nation (2001) gives a

much lower estimate—5-10%. Lexical inferencing may also be disproportionately difficult for EFL (as opposed to ESL) learners because of their small vocabularies (Hunt & Beglar, 2005).

Perhaps the most important variable in incidental vocabulary learning is reading comprehension, or the ability to extract meaning—both literal and interpretive—from printed text, which requires that the reader be able to decode and retrieve the meaning of each individual word in the text, put the meanings of these words together, and then interpret the whole phrase within the context of the sentence, paragraph, and the overall understanding of the text (Adams, 1990). Reading comprehension has been shown to be a significant determinant of the amount of incidental vocabulary learning from reading, at least in a first language (Swanborn & de Glopper, 1999, 2002). The relationship between reading comprehension and incidental vocabulary learning may be even more important in a second language because of a greater variability among learners, especially at lower levels of proficiency. Therefore, ascertaining reading comprehension in a study of reading in a second language is critical because learners who have failed to achieve successful reading comprehension—both at the level of literal comprehension and at the level of interpretation—can hardly be expected to demonstrate significant vocabulary growth. Unfortunately, the dimension of reading comprehension has been neglected in many second-language studies and it has often been assumed, rather than confirmed empirically, that learners have read and understood the text.

The Role of Noticing in Learning

Despite the importance of these conditions—adequate known-word coverage, word guessability, and text comprehension—to incidental vocabulary learning, they are clearly not sufficient. Previous research has shown that even when the known-word coverage is high and the target words are guessable from context, learners still often fail to learn them—in some cases, despite numerous encounters. For example, in Webb's (2008) experiment, although learners who met target words in more informative contexts outperformed those who saw the same words in less informative contexts, on the cognitively more demanding meaning recall test, the experimental group demonstrated an average gain of just one word. In Waring and Takaki's (2003) study, which used a story with 96% known-word coverage, at the immediate posttest, the scores for words occurring four or five times were near zero on all the tests.

One reason discussed in the literature (e.g., Hulstijn et al., 1996) for the modest vocabulary gains from reading for meaning is the apparent failure on the part of the learner to notice new words. This is an important observation because although the exact mechanism of incidental vocabulary learning is still not fully understood, many researchers (e.g., de Bot, Paribakht, & Wesche, 1997; Gass, 1988; Hatch & Brown, 1995) agree that input processing in incidental learning must involve an initial stage of *noticing* a new word.

The crucial role of noticing in language learning has been noted by many researchers. Schmidt (1990), for example, views noticing as “the necessary and sufficient condition” (p. 129) for input to become intake. Referring to vocabulary acquisition, he defines noticing as “conscious registration of the form...of a word” (Schmidt, 1995, p. 29) and argues that learning without noticing is impossible. Ellis (1995) maintains that noticing is important for the acquisition of both form and meaning of a new word and that it strongly facilitates the acquisition of new vocabulary.

Support for the facilitative effect of noticing on language learning comes primarily from the grammar acquisition literature. Leow (2000) found that noticing significantly facilitated L2 learners’ intake and written production of morphological forms: Learners who had noticed target forms were able to take in and produce significantly more of these forms than learners who had not noticed the target forms. Rosa and O’Neil (1999) exposed 67 learners to a Spanish conditional form and found that noticing had a significant effect on the learners’ ability to recognize the target structure. These results lend strong empirical support to a positive association between noticing and L2 learning. They may also at least partly explain the low acquisition rates often reported in incidental vocabulary research: If learning is contingent on noticing, then learners who fail to notice the presence of unfamiliar words in the input can hardly be expected to acquire them from the input.

Input Enhancement and Noticing

If noticing is an important—in fact, a first—condition for learning, then techniques that promote noticing may also improve learning. One such technique is textual enhancement, or the visual enhancement of items by bolding or underlining them in order to increase their perceptual salience. Several studies have found such techniques to be more effective for learning than purely communicative instruction or even

memorization. For example, Leeman, Arteagoitia, Fridman, and Doughty (1995) investigated the effect of a variety of focus-on-form techniques on language learning and found that enhancement techniques designed to draw learners' attention to the input were superior to purely communicative instruction for both accuracy and frequency of target-form production. Robinson (1997) compared grammar acquisition under different conditions including textual enhancement to promote focus on form and found that textual enhancement was superior to memorization and led to "generalizable, non-item-specific learning" (p. 239). Jourdenais et al. (1995) reported that input enhancement significantly improved the noticing of target forms and that noticing facilitated acquisition.

Recently, some researchers (e.g., Waring & Takaki, 2003) discussed input enhancement as a possible way to help learners notice and learn new words in reading for meaning. However, whether highlighting new words in a text would improve their noticing and, ultimately, their acquisition is still an open question. On the one hand, studies from grammar acquisition suggest that such techniques may be effective for both noticing and acquisition. On the other hand, it can be argued that the nature of attention as a limited capacity resource (Kahneman, 1973) may preclude learners from simultaneously carrying out two tasks—i.e., attending to form and processing content for meaning—if these tasks draw on the same pool of available resources. In fact, the idea that one's ability to perform two tasks concurrently depends on the kind and amount of resources required by each task (Wickens, 1980) was used by Bill Van Patten (1996) to argue that when processing foreign-language input, learners are often unable to attend simultaneously to form and meaning and, furthermore, that they are likely to allocate more attentional resources to meaning than to form. This argument, however, rests on an assumption that the processing of input for form and for meaning represents two different processes drawing on the same pool of cognitive resources. Some researchers (e.g., DeKeyser, et al. 2002), however, have argued that attending to form and meaning in communicative interactions should be conceived of as "a single task drawing on the verbal encoding resource pool" (p. 809). These researchers cite evidence from experimental studies of incidental learning showing that learners can, and do, acquire new forms during processing for meaning. In reading a text that is readily comprehensible and that contains only a small amount of unknown vocabulary, attending simultaneously to form and content may be particularly unproblematic. Under these conditions, textual enhancement may not provide any additional benefit because the task of reading for meaning will likely direct learners' attention to

unfamiliar words (Schmidt, 1990), particularly if they are deemed important for comprehension.

It has also been shown (e.g., Alanen, 1995) that textual enhancement does not always have an effect on performance. Arguably, this is because noticing of the input is not sufficient for learning: For new information to be learned, it must be processed sufficiently deeply. In fact, some learning models in cognitive psychology (e.g., Craik & Lockhart, 1972) and L2 acquisition (Laufer & Hulstijn, 2001) view the quality of information processing as a key factor that determines whether or not new information will be learned. From this perspective, the effectiveness of textual enhancement will depend on whether reading a text with highlighted words leads to more elaborate processing than does reading an unmarked text.

The Notion of Vocabulary Acquisition

A key issue in vocabulary research is what constitutes acquisition. Many earlier studies of incidental vocabulary learning have relied on a single, typically multiple-choice, test to establish vocabulary acquisition. However, as Waring and Takaki (2003) rightly point out, such tests may be far from an ideal measure of vocabulary knowledge because they measure only prompted recognition, which does not necessarily reflect the type of word knowledge that is needed for natural reading. Their own data suggest that less than half the words identified correctly on a multiple-choice test are available for unprompted recall.

An alternative to the multiple-choice format is a test of unprompted meaning recall, such as one asking learners to supply a translation or a definition of a target word. Although nowhere near as common as the multiple-choice test, tests of meaning recall have also been used in incidental vocabulary research (e.g., Hulstijn, 1992; Knight, 1994). However, such tests have been criticized for lacking sensitivity and for a potential underestimation of the actual vocabulary gains (Nation, 2001) because vocabulary gains from reading are often partial (Hunt & Beglar, 2005) and are made in stages (Curtis, 1987; Hendriksen, 1999; Paribakht & Wesche, 1997), ranging from word form recognition to prompted meaning recognition to unprompted meaning recall to production.

A better approach is to use several tests to allow learners to demonstrate partial acquisition of new vocabulary. The use of several tests also provides a better means of capturing potential vocabulary gains because different tests may be sensitive to

different aspects of word knowledge. On the other hand, the use of multiple measures must be tempered with the need to include dependent measures that are uncorrelated with one another, i.e., that measure separate, unrelated aspects of behavior (Tabachnick & Fidell, 2001). In this study, two types of vocabulary test were used, a multiple-choice test to assess prompted meaning recognition, and a word meaning test to assess meaning recall. It was hypothesized that these two tests measured somewhat separate facets of learning and were therefore unlikely to correlate highly. At the same time, the use of these two different tests improved the chance of capturing partial vocabulary gains.

Research Question

The purpose of this study was to determine the effect of input enhancement in reading for meaning on the noticing and subsequent acquisition of vocabulary. The following research question was formulated: What is the effect of the textual enhancement of unfamiliar words in a text on their (a) noticing (i.e., word form recognition), (b) prompted meaning recognition, and (c) unprompted meaning recall?

Method

Participants

Forty-seven EFL learners from three educational institutions—a university in Tokyo ($n = 21$), a graduate institute in Tokyo ($n = 18$), and a university in St. Petersburg, Russia, ($n = 8$)—participated in the study. The learners came from 11 language backgrounds: Japanese ($n = 20$), Russian ($n = 10$), Indonesian ($n = 4$), Chinese ($n = 4$), Korean ($n = 1$), Sinhala ($n = 2$), Uzbek ($n = 2$), Kyrgyz ($n = 1$), Azerbaijani ($n = 1$), Thai ($n = 1$), and Vietnamese ($n = 1$). Most of the learners were participants in a larger study to investigate cross-linguistic reading development and all volunteered to participate in the experiment described in this study. All had studied English for at least nine years and had intermediate to high-intermediate proficiency. For the non-Japanese students, this was determined on the basis of their TOEFL scores (i.e., all had scores above 500 on the pencil-and-paper TOEFL). Unfortunately, such data were not available for the Japanese students, and their level was determined on the basis of their language learning history and classroom observation. In addition, prior to the experiment, the participants were tested on receptive vocabulary knowledge using the *Vocabulary Levels Test* (Nation, 1983). All scored 30 out of 30 at both the

1st and 2nd 1000 word level and were judged to have adequate vocabulary to understand a text written at the 2000 word level.

Study Design

Participants were randomly assigned to one of two groups, Enhanced Reading (ER, $n = 24$) and Unenhanced Reading (UR, $n = 23$). Care was taken to ensure that the groups contained similar numbers of speakers of different languages. Learners in the ER group read a story with 12 nonsense words textually enhanced by bolding and underlining; learners in the UR group read the same story with unfamiliar words not marked in any way. The participants were then tested on reading comprehension and on three types of test: word form recognition, unprompted meaning recall, and prompted meaning recognition.

Target Words

In a study of incidental vocabulary learning, it is important to base the estimates of vocabulary acquisition from context on the *actual* words not known by the particular learners rather than on some hypothetical estimates of what the learners may or may not know (Nation, 2001). To ensure that the target words would not be familiar to learners before the reading, a common approach used in incidental vocabulary research is to substitute these words with nonsense words (also called *nonwords*). This approach guarantees that the demonstrated vocabulary gains can come only from the reading.

Twenty-two words were selected from the text as potential target words. The main criterion for selection was word guessability from the immediate and/or overall context of the story. These words were replaced with English-looking nonwords and pilot-tested on a group of advanced EFL learners ($n = 12$), who were asked to read the story and to judge the guessability of the nonwords and their plausibility and pronounceability in terms of English spelling conventions. Based on the results, 12 target words were selected. All represented concepts that were thought to be familiar to the participants. Two were nouns, one occurring twice and one occurring three times; three were adjectives, one occurring twice and two occurring once; one was an adverb, occurring once; and six were verbs, all occurring once. There were more verbs than other parts of speech because the pilot test had shown that they were easier to guess and were more important to the overall understanding of the story. Two of

the verbs were used in the Simple Past tense and were inflected as regular English verbs; one was used with the inflection *-s* (present tense, third person singular). These verbs appeared in the tests in the same form as in the text. Participants were not penalized for supplying only the base form of these verbs. The target words are shown in Appendix A.

Reading Materials and Reading Comprehension

The text used in the study was a narrative by William Caine about an artist who agrees to discredit the work of a younger artist in exchange for money but who secretly sends the money to the young artist to help him become independent. The text was shortened to ensure that it could be read in approximately 10 minutes and its vocabulary was screened to ensure that all of the words excluding proper names were within the most frequent 2000 words of English. All words in the text outside the 2000 word level were replaced with words or phrases within the 2000 level except one. The exception was the word *published*. This word was not replaced because it was not crucial to the overall understanding of the story and because many of the participants were likely to know it. The final version was 775 words long: 90% at the 1st 1000 word level, 3.7% at the 2nd 1000 word level, and 4.1% proper names, which were counted as familiar words. Thus, there was an expected known-word coverage of 97.8% of the running words. The 12 target words occurred in the text 16 times and accounted for 2% of the running words. The text is shown in Appendix B.

A reading comprehension test was used to measure comprehension of both main ideas and additional information in the story. The test consisted of three open-ended questions, five yes/no questions, and seven multiple-choice questions. The multiple-choice questions had two distractors, one correct answer, and an *I don't know* option. The answer choices were randomly placed in the first, second, or third position; the *I don't know* option was always in the final position. Six of the questions covered main ideas, and the remaining nine covered additional information. Fourteen questions dealt with explicit information and one required an overall understanding of the story. None of the questions contained any of the target words. Two points were awarded for each correct answer to a question covering a main idea and one point was awarded for each correct answer to a question covering additional information. The maximum number of points was 21. An arbitrary level of all correct answers on the main-idea questions and at least seven correct answers on the questions dealing with

additional information was set as a criterion for adequate text comprehension. This rather high level of comprehension was chosen to ensure that the participants had read the story and understood most of it.

Vocabulary Tests

On the multiple-choice test, each target word had one correct answer, four distractors, and an *I don't know* option. The distractors were syntactically the same as the target words but semantically different in order to allow the participants to demonstrate even modest vocabulary learning; all were plausible choices based on the context of the story. Participants were asked to circle the words with the meaning closest to that of the target words. They were told not to guess and to choose *I don't know* if they did not know the answer. The test was scored as the number of correctly identified target words.

On the word meaning test, participants were given a list of the 12 target words and were asked to supply a definition or provide a synonym for each word in English or in their native language. They were told that they could give several alternatives and that their answers could be as long as they liked. Correct answers were defined as all contextually acceptable answers even if they were not identical to the original words. Contextual acceptability was determined prior to scoring using the following procedure.

First, the story containing the nonsense words was given to a panel of eight judges (three native English speakers, two advanced-level Russian English speakers, and three intermediate-level Japanese English speakers), who were asked to come up, individually, with as many contextually possible alternatives for the nonsense words as they could. The alternatives produced by the panelists were then typed up on a list and the list was again presented to the panelists, who were asked to evaluate how closely each word fit the context. The words that were selected unanimously by the panelists as acceptable alternatives were then used to create a scoring sheet, which was used to score participants' responses on this test.

In the scoring procedure, all non-English answers were first translated into English. Only three participants chose to write their answers in their native language: Two wrote their answers in Japanese and one did so in Russian. The two Japanese learners defined one word each—the word *moop* as *sainoo*, which is the main dictionary definition of the word *talent*. The Russian learner defined three words: the

word *moop* as *talant* (*talent*), the word *quented* as *skazala "da"* (*said "yes"*), and the word *heefy* as *ochen' horoshii* (*very good*). The translations together with the English-language answers were checked against the scoring sheet and those that were deemed correct were awarded one point each. The participants were not penalized for supplying an incorrect part of speech (e.g., *talented* for *talent*). This rather loose definition of correct answers was used to give the participants credit for demonstrating even small gains in word knowledge. Previous research has shown that learners need to meet an unknown word many times before it can be learned (Horst et al., 1998; Waring & Takaki, 2003). In this study, most words occurred only once; it was therefore unrealistic to expect perfect responses on a meaning recall test.

Operationalization of Noticing

In studies conducted under the attentional framework, measures of noticing generally fall into two categories: online measures (i.e., think-aloud protocols) and offline measures (i.e., post-exposure tasks). Although online measures are considered more direct and higher in internal validity, offline measures are also appropriate if the goal is to “make inferences as to whether learners either paid attention to or became aware of targeted forms in the input” (Leow, 2000, p. 570), rather than to differentiate between degrees of awareness. Because the goal of this study was to establish noticing, post-exposure tasks were considered appropriate. Thus, noticing was equated with post-exposure word form recognition and operationalized as a score on a word-form recognition test administered immediately after exposure to input. The test consisted of the 12 target words and 12 distractors, which were also English-looking nonwords. The distractors did not look similar to the target words. The order of the words was randomized. Participants were instructed to circle the words that they had seen in the text. This test was scored using a procedure from Waring and Takaki (2003): One point was awarded for each correct answer, one point was awarded for each incorrect answer, and then adjusted means were calculated by subtracting the number of incorrectly recognized words from the number of correctly recognized words.

Procedure

Data were collected on multiple occasions during a 2-year period as part of a larger project to investigate reading-related abilities. All participants were tested individually or in small groups in a quiet room on school premises. The learners were told that the purpose of the study was to investigate reading-related abilities and that they would read a short story and answer some questions. They were not told about any vocabulary tests.

Two versions of the text were prepared, one with the target words bolded and underlined and one with the target words left unmarked. The groups were given the same instructions: To read the story for meaning and enjoyment. The participants were not told that there would be unfamiliar words in the story. Dictionaries were not allowed. As soon as the participants finished reading, the text was taken away from them and they were given the reading comprehension and vocabulary tests in this order: The reading comprehension test was given first and it was followed by the word form recognition, word meaning, and multiple-choice test. The word form recognition test required the least amount of word knowledge and the word meaning test required the greatest amount. The multiple-choice test was given last to ensure that the participants could not have remembered some of the word meanings from the word meaning test. As soon as a participant finished one test, the test was collected and another one was given. It took the participants approximately 10-20 minutes to finish the story and the tests.

After the completion of the tests, 20 participants (ten from each group) were interviewed. They were asked to indicate (a) the difficulty level and the extent of comprehension of the story, (b) whether they noticed any unfamiliar words, (c) whether they tried to infer the meaning of these words and how easy it was, and (d) how difficult it was to recall the target words on the tests. The interviews took about 5-10 minutes.

Results

Statistical Analyses

Analyses were carried out with SPSS version 10.0. Prior to analyses, *reading comprehension*, *word form recognition*, *meaning recall*, and *meaning recognition* were examined for accuracy of data entry, missing values, and the fit between the distributions of these variables and the assumptions of multivariate analysis of

variance (MANOVA). The variables were examined separately for each group. One participant in the ER group had a low z score on reading comprehension. This was surprising because this participant scored at ceiling on the *Vocabulary Levels Test*. It was therefore suspected that this person may not have read the story and this case was deleted. Another participant in that group left all the tests blank and this case was also deleted. To balance the number of cases per cell, one case was randomly deleted from the UR group. There were thus 22 cases per cell. All the remaining participants achieved the required level of text comprehension. There were no univariate or multivariate within-cell outliers at $p < .001$; results of evaluation of assumptions of normality, homogeneity of variance-covariance matrices, and linearity were satisfactory.

Table 1
Means and Standard Deviations on the Dependent Variables for the Two Groups

Text condition	Word form recognition		Meaning recall		Meaning recognition	
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>
Enhanced	7.0	2.8	2.9	2.3	5.2	2.2
Unenhanced	7.8	2.6	3.0	2.6	4.7	2.5

Note. Maximum score = 12.

The descriptive statistics for the three dependent variables are shown in Table 1. To determine whether there were any overall differences between the groups, a between-subjects MANOVA was performed on the three dependent variables: word form recognition, meaning recognition, and meaning recall. The independent variable was text condition (a text with target words textually enhanced vs. a text with target words unmarked). Hotelling's T^2 was used to compare group means, as recommended by Tabachnick and Fidell (2001, p. 20). This statistic is calculated from Hotelling's Trace coefficient provided by SPSS using the following formula: Hotelling's $T^2 = \text{Hotelling's Trace} \times (N - m)$, where N is the sample size across the groups and m is the number of groups. The T^2 has the same F value, degrees of freedom, and significance level as the Trace statistic. No significant differences were found between the groups on any of the dependent measures, Hotelling's $T^2 = 3.5$, $F(3,40) = 1.12$, $p = .352$. Thus, the dependent variables were not significantly affected by textual enhancement.

Interview Data

In the interviews, participants from both groups responded in a similar way. All indicated that the text was “easy” or “very easy,” that they were able to understand all or most of it, and that they had noticed unfamiliar words. Several participants said that the text contained “many” unfamiliar words, but most said that there were “a few.” Many said they thought the nonwords were real English words, just unfamiliar. Participants in both groups also said that they had tried to guess the meaning of the unknown words, and the majority noted that it was “not so difficult.” Finally, many learners pointed out that although they could recognize many of the target words on the tests, by then, they had simply forgotten what they meant. This is how one participant (from the UR group) described her experiences with the reading:

Сам текст простой для понимания. Слова, которые не знаешь, сразу цепляются глазу, но смысл их понятен из контекста. Но вот когда начинаешь потом пытаться из памяти выловить что они значат... Тут-то вся загвоздка и таится. [The text itself is easy to understand; the words you don't know catch the eye immediately, but their meaning is clear from the context. But when later you try to remember what they mean... That's where the snag is. (Translated from Russian by the author.)]

Another participant (from the ER group) described her experiences in a similar way: “When I saw some of the words on the [vocabulary] tests, I could clearly remember seeing them in the text; I just couldn't remember what they meant.” These two examples represent a typical response given by those interviewed. Overall, the similarities in the learners' responses provide converging evidence supporting the lack of differences between the groups. These responses also suggest that the main hurdle facing the participants was not noticing new words, but rather, storing them in long-term memory.

Discussion

Effect of Textual Enhancement

The research question asked if textual enhancement of unfamiliar words in reading for meaning improved their noticing and subsequent meaning recognition and recall. The results show that the treatment had no effect on either noticing or acquisition:

Participants in both groups noticed and were able to recognize and recall approximately the same number of words. The lack of any significant differences between the groups on the word form recognition, meaning recognition, and meaning recall tests suggests that both groups must have attended to the target words with a similar amount of mental effort. These findings were confirmed in the interviews: The majority of the participants in both groups indicated that they had noticed the target words and that they had tried to guess their meaning.

The absence of statistically significant differences on the vocabulary measures between the learners is consistent with the noticing hypothesis (Schmidt, 1990), which postulates a crucial role for noticing in learning. If noticing precedes vocabulary learning, then the groups should be expected to differ on the vocabulary measures only if they differed on the measure of noticing. In other words, the treatment should improve acquisition only if it improved noticing. However, because the treatment in this study did not result in better noticing, it did not lead to increased vocabulary gains. Why did textual enhancement have no effect on noticing and learning? Although the experimental design used in this study precludes making causal inferences, several possibilities can be entertained. First, it has been argued that because of a limited cognitive capacity for processing information, L2 learners tend to process input for meaning before they process it for form (Van Patten, 1996). It is therefore possible that under limited processing conditions, some learners in the ER group did not even notice the highlighted words. This scenario, however, appears to be unlikely because participants in this group scored close to 60% on the word form recognition test. More important, an examination of their responses on this test revealed no erroneously selected items, suggesting that the participants in this group did process the target words for form as well as for meaning. The interview data also confirmed that learners in the ER group had noticed the highlighted words and attended to them.

The second explanation assumes the validity of the levels-of-processing theory (Craik & Lockhart, 1972), which stipulates that recall is constrained by the quality of information processing. According to this theory, textual enhancement would be expected to improve learning only if it led to deeper levels of information processing. This, in turn, appears to be related to task demands (e.g., Daneman & Carpenter, 1980): More cognitively challenging tasks require more elaborate processing, which leads to more stable learning. Some theories of L2 vocabulary acquisition also point to the crucial role of tasks in L2 input processing. For example, Laufer and Hulstijn (2001) introduced the notion of *task-induced involvement* and argued that the quality

of mental processing is determined by the demands of the particular task, possibly because task demands focus learners' attention "on relevant features of the input" (Schmidt, 1990, p. 149). In this experiment, the learners in both groups received the same instructions—to read a story for meaning and enjoyment, and they were not told that it would contain any unfamiliar words. It is possible that these instructions imposed similar cognitive demands on the learners and led to the use of similar processes during reading and learning. Thus, the lack of any significant differences between the groups may indicate that textual enhancement does not automatically improve the quality of input processing because the task of reading a text with highlighted words is cognitively no more demanding than the task of reading an unmarked text. Although this hypothesis was not tested directly, the null result obtained in the study suggests the use of similar cognitive processes by both groups.

It is also possible that highlighting may not provide any additional benefit when conditions crucial to incidental learning (i.e., adequate known-word coverage and word guessability) are met. Logically, this is because the intended goal in reading (i.e., meaning comprehension) would serve to focus the reader's attention on unfamiliar words. If the number of these words is small and the surrounding context is understandable, these words will probably "stand out," so the reader is likely to notice them even if they are not marked in any way. Indirect support for this claim comes, again, from studies of grammar acquisition. For example, in Robinson's (1995) study of grammar learning under four conditions—implicit learning (i.e., students memorized sentences), incidental learning (i.e., students read sentences to answer comprehension questions), rule-search (i.e., students searched for rules exemplified by presented sentences), and instruction (i.e., students viewed rule explanations and applied the rules to new sentences)—there was no significant difference between the conditions on the extent of noticing: An overwhelming majority of learners in all conditions claimed to have noticed rules in the presented sentences even though the presented input was not enhanced in any way. Arguably, in reading, where the goal is to extract meaning, readers would be expected to pay even more attention to unfamiliar words than Robinson's students paid to grammatical elements.

Response Patterns

An examination of learning data for each participant revealed several patterns. First, the participants in this study noticed many more words than they learned. Clearly, noticing alone is not sufficient for vocabulary acquisition. More research is needed to clarify the relationship between the noticing of unfamiliar words in context and their acquisition from context. Second, words that occurred 2-3 times in the text were recalled much better on both vocabulary tests than were words that occurred only once. For example, *moop*, which was used three times, was correctly recognized more than 86% of the time and was correctly defined almost 70% of the time; *lantic*, which occurred twice, was recognized more than 70% of the time and correctly defined 60% of the time. For words that were used only once, the percentages were substantially smaller: For example, for the word *tranch*, which was recognized most frequently in this word group, the pick-up rates were 45% for meaning recognition and 22% for meaning recall; for the word *blunded*, the least frequently recognized word, the pick-up rates were 20% for recognition and 7% for recall. The relationship between the number of times a word is seen in context and its acquisition from context is well supported in the incidental vocabulary literature (e.g., Waring & Takaki, 2003).

Third, although the learners differed widely in the number of words they were able to identify on the vocabulary tests (from 0 to 10 on the meaning recognition test; from 0 to 11 on the meaning recall test), a predictable pattern was observed, with performance on the meaning recognition test being much better than on the meaning recall test. In other words, the majority of the participants could define far fewer words than they could recognize. However, there were several exceptions: Four participants defined more words than they were able to recognize, and three participants defined and recognized the same number of words. There was also a small group of learners who showed no overlap between the words they could define and those they recognized. For example, one participant correctly defined *moop* but was then unable to recognize the meaning of this word on the multiple-choice test; another correctly defined *lantic* and *tranch* but recognized the meaning of different words. These results suggest a considerable degree of variation among learners not only in the particular words they pick up but also, possibly, in how they process these words and how they store them in long-term memory.

Limitations and Directions for Future Research

The present study is limited by the small number of participants tested and the relatively small number of words used. It could be replicated with larger samples, longer readings, and a greater number of target words to clarify the relationship between noticing and vocabulary learning under various conditions. Think-aloud protocols could be used to differentiate between degrees of awareness, as has often been done in studies of grammar acquisition.

More important, because learners in this experiment read an easy text with 98% known-word coverage in which unfamiliar words were easily guessable, these results cannot and should not be extrapolated to reading in more natural settings, in which learners have little control over unknown word density and word guessability. Whether textual enhancement might work in such settings is a question for future research. On the one hand, it is possible that under more realistic reading conditions, textual enhancement would have a positive effect on noticing by directing learners' attention to unfamiliar words. On the other hand, it is hard to imagine substantial vocabulary gains from reading a text that is beyond learners' current level of reading comprehension ability or in which words are not easily guessable from context. If the goal in L2 reading is learning as much as enjoyment, perhaps learners should be encouraged to read level-appropriate material that provides sufficient contextual support for potentially difficult vocabulary.

Conclusion and Pedagogical Implications

The present study investigated the role of textual enhancement of vocabulary on its noticing and subsequent up-take in reading for meaning at 98% known-word coverage. No significant differences were found between the learners who had read a text with the target items textually enhanced and those who had read an unmarked text on any of the measures, indicating that textual enhancement did not have any effect on either noticing or learning. Learners in both groups noticed more than half of the target words and picked up roughly one third of them.

The findings have several implications for vocabulary research and teaching. First, highlighting words in a text does not appear to be an effective way to promote their acquisition, at least for intermediate learners reading a level-appropriate text. In fact, there appears to be no need to encourage learners to pay special attention to vocabulary in level-appropriate readings, because learners reading such texts are able to notice

many new words and learn some of them even when these words are unmarked. Furthermore, both quantitative and qualitative data suggest that noticing new words in reading for meaning may not be the main problem facing the learner, at least when the text is comprehensible and the proportion of unknown vocabulary is small. The lack of significant differences between the groups on any of the measures and the similarities in the learners' comments about the relative ease of noticing the target words in the text and the relative difficulty of remembering them on the tests indicate that the problem in incidental vocabulary learning may lie in how unfamiliar words are processed, stored, and retrieved from long-term memory *after* they have been noticed as well as in how—and how fast—they are forgotten.

Second, the lack of any effect of textual enhancement on vocabulary noticing and learning in the presence of a large number of positive findings from grammar acquisition studies suggests that grammar and lexis may be processed in qualitatively different ways. More research is needed to clarify possible differences.

Finally, there appears to be a considerable variation among learners in the particular words they pick up as well as in the way they process these words and store them in long-term memory. This variation may be attributable to learners' individual differences in vocabulary processing and storage and it suggests an important role that these differences may play in determining the learning styles and patterns of strengths and weaknesses that individual learners bring to the task of reading. Teachers and course developers need to take into account the existence of these differences in the language classroom when teaching reading classes and preparing reading materials.

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Appendix A

Original words, target words, and the number of occurrences in the text

Original words	Target words (number of occurrences)
discourage	tranch (1)
talent	moop (3)
admires	wodes (1)
criticize	incholate (1)
gasped	blunded (1)
agreed	quented (1)
worthless	lantic (2)
give up	speat (1)
unhappy	sminted (1)
carefully	tauciously (1)
nice	heefy (1)
benefactor	archentor (2)

Appendix B

MENDOZA SELLS HIMSELF

It was ten in the morning when Mendoza's servant came into the living room with a card. The painter took the card and read, 'Mrs. Burtenshaw.' The name meant nothing to him.

The servant said, 'The lady looks rich.'

'All right,' said Mendoza. 'Ask her in.'

Mendoza disliked the woman at once, though she seemed eager to please him. 'I hope you will forgive my early visit,' she began. 'I want to speak to you about my son Charlie. I want your advice, and I want your help. He is my only child. He grew up a good boy until he decided to become a painter.' The woman stopped for a moment.

'Do you want me to give him lessons? If so I regret to say that I won't be able to...'

'Oh, no, my dear Mr. Mendoza,' she said, 'quite the opposite, I want you to let him come and show you his drawings, and then I want you to **tranch** him, to tell him that he has no **moop**. You are the only man who can do me this favor. Charlie **wodes** you, he has collected hundreds of your drawings. Just tell him that he is no good. He should go into business.'

'But what if your son refuses to change his mind? What will you do then?' asked Mendoza.

The woman's voice became firm. 'In that case he will never get any money from me as long as I live.'

Mendoza realized that she would do exactly as she said. He suddenly wanted to tell her to get out, but he checked himself and went on. 'I'm sorry, Mrs. Burtenshaw,' he said, 'But I can't promise anything until I see his work. He may be really gifted.'

She took out a sheet of paper which she handed to Mendoza.

Mendoza looked at the drawing in silence. It was very good. He said, 'I must say the drawing shows a lot of **moop**. You must know that **moop** cannot be taught. A painter either has it or he doesn't. Don't you understand that I find that drawing of your son most promising? Why should I tell him that he is no good?'

She looked at him. 'You don't think that I am asking you to **incholate** my son's work for nothing? I am prepared to pay you for that.'

'May I ask how much?' Mendoza asked sweetly.

'Well,' she said, 'it will be one hundred dollars.'

Mendoza shook his head. 'I will not do this for less than a thousand dollars.'

'A thousand dollars!' she **blunded**. 'You must be joking.'

'Not at all,' Mendoza was firm. 'A thousand dollars and not a penny less.' To his great surprise she **quented**.

The money came the next day. And two days later Mrs. Burtenshaw with her son came to see Mendoza. Charles, very excited, brought some more of his drawings which he showed to Mendoza. No word said Mendoza while he looked through them. No word said Charles.

Then Mendoza put down the drawings and said: 'Mr. Burtenshaw, I am sorry to say this, but your drawings are **lantic**. I think you should **speat** painting and go into business as your mother wants. Goodbye to you both, goodbye.'

He opened the door and Charles ran out of the room.

Four years had passed. The same servant showed Mr. Charles Burtenshaw into Mendoza's living room. 'You probably don't remember me,' said Charles, 'but I was here four years ago with my mother and you said my drawings were **lantic**. Could you look at my work now?'

'You haven't stopped painting then?'

'No, I haven't. When I left your house, I was so **sminted**, I wanted to cry. On the street, a young man came up to me and handed me an envelope. When I opened it, to my surprise, I found one thousand dollars. That money made me independent of my mother. I left her house and went to Paris where I lived hard and worked hard. Now I'm back. This is my first published drawing.'

Mendoza examined the drawing **tauciously**. It was really good.

'I think,' he said, 'it's a **heefy** piece of work. Congratulations! The thing is really good.'

Charles smiled with pleasure. 'Thank you very much,' he said, 'If I could only thank my **archentor**... But I don't know who he is, I don't know his name.'

'In your place I wouldn't worry! Just go ahead and make a big success of yourself. I think your unknown **archentor** will be quite happy.'

Appendix C

Reading Comprehension Test

1. Mendoza was a. a musician b. a writer c. a painter d. I don't know
2. Before meeting the woman, did Mendoza know her? a. Yes b. No c. I don't know
3. When Mendoza saw the woman, did he like her? a. Yes b. No c. I don't know
4. What did the woman want Mendoza to do?
 - a. tell her son that his drawings were bad
 - b. give her some money
 - c. give her son drawing lessons
 - d. I don't know
5. What did the woman want her son, Charlie, to become?
 - a. a businessman
 - b. a painter
 - c. a politician
 - d. I don't know
6. The woman told Mendoza that her son, Charlie,
 - a. had never seen Mendoza's paintings
 - b. loved Mendoza's paintings
 - c. did not like Mendoza's paintings
 - d. I don't know
7. When the woman showed Mendoza her son's drawing, Mendoza thought it was
 - a. bad
 - b. average
 - c. good
 - d. I don't know
8. How much money did the woman finally pay Mendoza?
 - a. \$100
 - b. \$1,000
 - c. \$10,000
 - d. I don't know
9. What did Mendoza tell Charlie when Charlie and his mother came to see him?
 - a. that his drawings were no good and he should not become a painter
 - b. that his drawings were good and he should become a painter
 - c. that he should take drawing lessons
 - d. I don't know
10. What happened to Charlie after he left Mendoza's house?
11. Did Charlie continue to live with his mother? a. Yes b. No c. I don't know
12. Did Charlie become a painter? a. Yes b. No c. I don't know
13. Why did Charlie come to see Mendoza the second time?
14. Did Charlie know who gave him the money? a. Yes b. No c. I don't know
15. Where do you think the money that Charlie was given on the street came from?