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The Effect of Lexical Coverage and Dictionary Use on L2 Reading Comprehension

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ABSTRACT

This study aims to further understand the role of lexical coverage on L2 reading comprehension. It examines test scores of learners at or near the 90-95% coverage level to determine if this coverage range allows for comprehension of authentic texts. The findings suggest that 92-93% may be a threshold mark at which understanding of a text significantly increases. However, the data confirms results from previous studies: that many participants in the 90-95% coverage range have difficulty comprehending texts. The second part of the study examines the influence of dictionary use on lexical coverage and comprehension. The data indicates that, for learners at this proficiency level, dictionary use increases comprehension at a similar rate as increased coverage. However, most participants using dictionaries still did not achieve comprehension, though learners who utilized the dictionary links to increase their coverage to over 96% showed some significant gains in comprehension.

INTRODUCTION

Research has shown that vocabulary knowledge is strongly correlated with second language (L2) reading comprehension (Brunfaut, 2008; Golkar & Yamini, 2007; Hu & Nation, 2000; Laufer, 1989, 1992; Shiotsu & Weir, 2007; Schoonen, Hulstijn, & Bossers, 1998; Yamashita, 1999). Its importance is considered to be the strongest predictor of comprehension, even more so than other factors including topic familiarity, strategy use, and grammar knowledge. Crucial to this issue is lexical coverage and the *lexical threshold theory*, which hypothesizes that readers need receptive knowledge of at least a certain percentage of words in the text, often suggested as 95% or 98%, to enable comprehension. The transfer of L1 reading strategies is often not possible if one lacks adequate proficiency (Clarke, 1979; Schoonen, et al., 1998), and context clues needed to infer word meaning from context are not accessible without adequate lexical coverage (Laufer & Sim, 1985; Liu & Nation, 1985).

The lexical threshold theory has been influential in second language acquisition. West (1926) was the first researcher to propose that 98% lexical coverage of a text was necessary for L2 comprehension. He used this mark as a guideline for creating graded readers, which he

indicated would lead to the incidental acquisition of vocabulary. Researchers have also used the threshold theory to establish a benchmark for vocabulary learning by identifying the number of high-frequency words needed to be acquired in order to most efficiently reach the threshold (Committee for Vocabulary Selection, 1936, as cited in Chujo & Utiyama, 2005; Laufer, 1992; Nation, 2001; West, 1953).

Laufer's oft-cited 1989 study claimed to confirm the hypothesis that learners need to reach 95% coverage to adequately comprehend texts. However, while the strong influence of vocabulary knowledge on reading comprehension is clear, the threshold mark of 95% often quoted by researchers and educators in the field may be taken too literally. One reason may be that the term *threshold* is used by Laufer as a "probabilistic boundary" rather than the traditional view of a threshold as being an "all-or-nothing phenomena" (Nation, 2001, p. 144). A review of studies (below) on lexical coverage reveals that there may not be a specific threshold percentage which enables comprehension. Nevertheless, educators often mention the 95% mark as an absolute threshold. For example, citing Liu and Nation (1985) and Laufer (1989), Hirsh and Nation (1992, p. 690) claim "learners *need* 95% lexical coverage" for comprehension (emphasis added). The online learning tool, Word Engine, which measures learners' vocabulary to predict their coverage on texts and proficiency tests, informs users that it is not possible to comprehend texts unassisted with less than 95% coverage (Word Engine, 2008).

Moreover, the influence of dictionary use on coverage has largely been ignored. Researchers often recommend that less proficient learners read graded materials or build their receptive vocabulary before transitioning to authentic texts (e.g., Laufer & Hadar, 1997; Nation & Wang, 1999). When focusing on authentic texts, current communicative language-teaching practices often stress guessing the meaning of unknown words from the context (Grabe & Stoller, 2001; Knight, 1994; Liu & Nation, 1985), and many teachers discourage the use of dictionaries altogether in the reading classroom (Bensoussan, Sim, & Weiss, 1984; Summers, 1988). However, many of the studies examining the comprehension scores of learners with and without dictionary use have demonstrated that dictionary use can enable comprehension, though significant results may depend on learners' proficiency level and other factors (e.g., Knight, 1994; Goyette, 1995). Therefore, how dictionary use affects lexical coverage to influence reading comprehension needs to be explored.

This study aims to more deeply understand the role of lexical coverage and dictionary use on reading comprehension. First, the study will examine the effect of lexical coverage on the comprehension scores of a group of low-intermediate and intermediate level learners who did not have access to dictionaries (Control Group). Second, the comprehension scores of a group of learners who had access to online dictionary links will be examined (Dictionary Group), considering their vocabulary coverage and the number of words looked up. The study hopes to help educators determine whether learners with 89-96% coverage of authentic texts can handle unsimplified texts, and the degree to which they might benefit from dictionary use.

FACTORS AFFECTING READING COMPREHENSION

Reading comprehension is complex and involves several processes interacting with each other (Bernhardt, 1991; Grabe & Stoller, 2001). Factors other than vocabulary that have been shown to influence reading include: prior knowledge, syntax, text structure, strategy use, and metacognition. Most of these factors are influenced by learners' overall proficiency, especially vocabulary knowledge.

Background knowledge (including topic awareness and cultural familiarity) has been shown to be one of the more important factors of comprehension (Erten & Razi, 2009; Lee, 2009; Ridgway, 1997; Schmidt-Rinehart, 1994; Yin, 1985). Yin's research of 60 university students in Singapore found that less proficient learners closed the gap between their comprehension scores and the scores of more proficient students when reading topics that they were familiar with. However, though Ridgeway found that the effect of background knowledge was significant for most learners, there was little influence on the comprehension of low-proficiency learners, demonstrating that there may be a limit on the effect of prior knowledge. At the other end of the spectrum, there is evidence that high-proficiency students have enough linguistic competence to read texts on unfamiliar topics, making topic familiarity less essential for them (Lee, 2009; Peretz & Shoham, 1991; Ridgeway, 1997).

Cognitive and metacognitive strategy use has also been shown to be a predictor of reading proficiency (Zhang & Wu, 2009), and training on strategy use can increase learners' comprehension (Carrell, 1985; Carrell, Pharis, & Liberto, 1989). L1 reading ability has been shown to correlate with L2 reading ability (Carrell, 1991; Yamashita, 2002), especially among more proficient readers (Bossers, 1991). However, without adequate language support, reading skills and strategies use may be unhelpful if the text is too difficult for the learner (Bossers, 1991; Laufer & Hadar, 1997; Schoonen et al., 1998). The idea that L1 reading strategies cannot be transferred to L2 reading unless the learner has reached a certain proficiency was referred to as the *linguistic threshold* or *language ceiling* (Clarke, 1979). Nevertheless, less proficient participants improved more after receiving strategy training in one study, suggesting that lower-intermediate learners may benefit more from reading strategy use in order to tackle authentic texts (Song, 1998).

Syntactical competence is also influential on reading comprehension, as readers need to parse sentences into meaningful syntactical structures (Alderson, 2000). Though grammar knowledge was a somewhat better predictor than vocabulary knowledge of the reading ability of 599 Japanese university students (Shiotsu & Weir, 2007), grammar knowledge has been shown to be much less influential than vocabulary in most studies (e.g., Brunfaut, 2008; Yamashita, 1999).

Many other factors may also influence reading comprehension, including motivation, learning styles, the complexity of the ideas in the text, and the task (Alderson, 1984; Carver, 1994; Lee, 2009; Oxford, 2001). These factors are interdependent and their influence often varies according to language proficiency, especially one's vocabulary, which is likely the greatest factor on reading comprehension.

Lexical Coverage

As mentioned above, theories concerning a lexical coverage threshold have been around since West (1926) first recommended that 98% lexical coverage was necessary for L2 comprehension. West later created the *General Service List* (1953) to continue to identify the most essential words for language learning and adequate lexical coverage. In the 1970s and early 80s, several researchers estimated that the lexical threshold was 95% (Chujo & Utiyama, 2005), but a review of studies in 1984 by Alderson found no empirical evidence that reading incompetence was a "language problem," not just a "reading problem."

It was not until Laufer (1989) that a L2 study specifically examined the claim of the lexical threshold. Laufer had 100 learners underline unknown words in an academic text, and this number was adjusted based on a vocabulary translation task to estimate learners' coverage. On a reading comprehension test, it was found that there was a significant number of "readers" above the 95% level than below that level. The mean scores of the two groups

were also significantly different. Significant results were not found above and below the 90% level, but other coverage points were not examined.

In a study of 92 learners' vocabulary level and reading comprehension scores, Laufer (1992) found that learners with knowledge of 3,000 word families, or about 5,000 individual words, were significantly better readers than those with a 2,000-word vocabulary. Again, Laufer used a low mark (56%) to measure adequate comprehension. She noted that 70% comprehension would require knowing 5,000 word families. However, Laufer (1989, 1992) does not say that 95% coverage or 3,000 word families are actually *required* for comprehension. Some learners below the mark had adequate comprehension of the texts, and many above this mark may have had only limited understanding of the passages. Moreover, some concerns with the Laufer (1989) study involve the fact that coverage was estimated based on learners underlining unknown words in the text, and the study participants were instructed not to underline previously unknown vocabulary that they were able to guess from context while reading. Thus, their pre-reading lexical coverage of the text was not actually measured.

Hu and Nation (2000) sought to examine the lexical threshold more deeply. They tested the comprehension of a narrative text by 66 advanced learners, adapting the text to include frequent words estimated to be known by all the subjects. They replaced uncommon words with nonsense words in order to set coverage levels to 80%, 90%, 95%, and 100%. Comprehension of the various versions of the passages was measured by a multiple-choice comprehension test and a recall measure. Subjects at the 95% level had a mean score of 10.2 points out of 14 on the multiple-choice text, while the readers with 90% coverage averaged only slightly lower at 9.5 points. There were a wide range of scores at these two coverage levels with 7 of 16 subjects at the 90% level getting a higher score than the mean score of the 95% coverage group. The results were similar on the recall measure. Overall, while there was a clear and strong correlation between coverage and comprehension, the existence of the 95% lexical threshold was not supported by Hu and Nation. They estimate that if there was a comprehension threshold at all, it may have been between 80 and 90% since all the readers with 80% coverage had difficulty comprehending the text. Hu and Nation state that learners at the 90% were able to reach comprehension through reading skills and background knowledge. They also hypothesize that 98% may be the coverage required at which most learners can comprehend the text adequately. The mark they set to determine this was about 85% comprehension, which was much higher than that used by Laufer (1989, 1992).

Considering that comprehension scores vary among learners with similar vocabularies, the variance is likely due to other factors mentioned above, such as background knowledge, grammar knowledge, motivation, and the task. While there is a clear and undeniable correlation between vocabulary and reading proficiency, it is an oversimplification to consider 95% or 98% coverage as an "all-or-nothing" threshold. Researchers have expressed doubts about using a specific threshold in research, but these numbers have continued to be used as a benchmark in research studies (e.g., Hazenberg & Hujlistin, 1996; Prichard, 2008; Ward, 1999). As mentioned above, the meaning of *threshold* is ambiguous. It could refer to many coverage points:

> *Lower threshold:* A percentage at which comprehension becomes possible; a percentage at which few learners below have any significant comprehension of the text (referred to by Hu & Nation, 2000, as potentially being between 80 and 90%).

Significant increase threshold: A coverage point above which learners' mean comprehension increases significantly (95%, based on Laufer, 1989).

Adequate comprehension threshold: A percentage at which most learners achieve "adequate comprehension" (suggested as 95% in Laufer, based on 55% comprehension; hypothesized as 98% coverage in Hu & Nation based on 85% comprehension).

Upper threshold: A point above which an increase in coverage does not lead to improved comprehension (Laufer, 1992). If it exists, it is likely 98-99%.

Clearly, lexical coverage is complex and needs to be examined in more depth. One potential direct influence on lexical coverage that was not examined in the studies above is dictionary use. While not allowed on most proficiency tests and not preferable for extensive reading for pleasure, dictionaries are commonly used by L2 readers in academic, professional, and personal settings. Not considering the influence of dictionary use ignores a potentially significant variable. Choosing to look up a word is a cognitive strategy which could increase one's coverage of the text, possibly increasing comprehension.

Dictionary Use

Several studies have examined the efficacy of dictionary use; many have shown that learners' comprehension increases by looking up words, while others have resulted in no significant gains. Examining the proficiency of the learners in these studies may reveal how the use of a dictionary interacts with one's lexical coverage to affect understanding. Dictionary use may not enable learners with very low lexical coverage of a text to comprehend the text because dictionary use requires significant cognitive resources (Goyette, 1995; Scholfield, 1982) and using a dictionary may overwhelm learners. When looking up a word, readers must identify the correct definition as it applies to the context in the text (Bensoussan et al., 1984), but thoroughly understanding the context requires knowledge of most of the other words in the passage. A study of limited proficiency among middle school learners of English confirmed that less proficient learners do not benefit from dictionary use (Albus, Bielinski, Thurlow, & Liu, 2001). Learners showed no increase in comprehension scores when using a dictionary.

However, intermediate learners with higher text coverage may benefit from dictionary usage. While learners at this level may struggle to accurately infer meaning from context (Liu & Nation, 1985), they may be able to grasp enough context clues to identify the correct dictionary definition and construct meaning from the text. Summers (1988) and Bogaards (1998) found that learners were significantly more likely to identify the correct definition in the dictionary than they were to accurately infer meaning from context. In the Albus et al. (2001) study mentioned above, self-reported intermediate learners showed "moderately significant" increases in their comprehension scores on the dictionary part of the test (10.8 versus 9.6). This was true only for learners who took more time on the section which allowed for dictionary use. In a small-scale study of 24 learners of French (Goyette, 1995), high-intermediate learners used the dictionary (both hard copy and online versions) more often than advanced learners, resulting in similar comprehension scores among the two groups.

If there is an upper threshold for reading comprehension, looking up more words than necessary would likely not lead to a significant increase in the comprehension of learners

with an already high coverage of the text. Indeed, in a series of three studies (Bensoussan et al., 1984) there was no significant difference in the comprehension scores of high-proficiency learners when they used a dictionary. It is possible that these learners already knew enough words in the passages to enable adequate comprehension. Nesi and Meara (1991) confirmed these results in studies of 63 and 85 EFL learners. The proficiency of the participants was not mentioned, but their level was likely advanced considering that they were post-graduate students planning to study in Britain.

Strategy-use surveys suggest that more proficient learners use a variety of vocabulary strategies while reading (Gu & Johnson, 1996; Moir, 1996, as cited in Nation, 2001; Zhang, 2001). Guessing word meaning from context correlates highly with proficiency scores and vocabulary size (Gu & Johnson), and advanced learners are somewhat less likely to consult a dictionary if the meaning of the unknown word was easily inferred (Hulstijn, 1993). High proficiency and increased coverage may allow readers to use other strategies like guessing meaning from context more often. Moreover, selective attention, including knowing when a word is essential to a reading passage, correlates significantly with proficiency (Gu & Johnson). Prichard (2008) confirmed that participants, whose lexical coverage ranged from 93-98%, looked up words more often when they were judged to be relevant to the main points of the texts. While advanced learners may be able to identify relevant words to look up, the ability to do so is likely much more difficult for learners with significantly less coverage.

Several other variables, including learner motivation, task, the time learners have to read, and learning style, may influence the frequency and efficacy of dictionary use (Bogaards, 1998; Goyette, 1995; Hulstijn, 1993; Oxford, 2001). Dictionary type is one key variable, including whether the dictionary is monolingual or bilingual (Bensoussan et al., 1984; Laufer & Hadar, 1997), and whether it is a traditional, electronic, or online dictionary (De Ridder, 2002; Koyama & Takeuchi, 2004). One disadvantage of looking up words in a traditional dictionary is that the time it takes to look up words interferes with readers' short-term memory and may prevent learners from focusing on the text as a whole (Bensoussan et al., 1984; Knight, 1994). L2 participants using dictionaries have been shown to take much longer to read compared to control groups without the use of dictionaries (Luppescu & Day, 1993; Nesi & Meara, 1991).

However, utilizing new technologies such as online dictionary links or electronic glosses takes much less time and distracts the reader to a lesser degree (De Ridder, 2002; Koyama & Takeuchi, 2004). Though many studies concerning the use of glosses did not show significant comprehension gains, a meta-analysis of 18 studies revealed that glosses can lead to increased comprehension (Taylor, 2006). Not all studies mentioned the proficiency of the participants, but in Ko (2005), which showed significant results, the learners were deemed to be intermediate and high-intermediate learners in a Korean university. Less than 2% of the running words were glossed, indicating that a moderate increase in coverage can make a significant difference for such learners.

The research studies described above suggest that there are some advantages, disadvantages, and a number of variables concerning the use of dictionaries for L2 readers. Considering the importance of lexical coverage, it could be concluded that dictionaries might effectively be used if learners' look-up behavior increases their coverage to the 95-98% range. However, the studies on dictionary use do not always explicitly describe the proficiency of the participants, and even when they do, such labels are often subjective. None of the studies (other than Prichard, 2008) measured the lexical coverage of the learners.

THE STUDY

Method

This study aimed to increase understanding on the role of lexical coverage and dictionary use on reading comprehension. The study was divided into two parts and involved over 100 learners. The first part examined the effect of vocabulary coverage on the ability of one group of learners to read and comprehend a short text. The second part of the study examined how dictionary use increased lexical coverage and affected the comprehension of the other group of participants.

Participants

The 103 participants involved in the study were lower-intermediate to intermediate first-year university students at a women's university in Japan. This level was chosen because it was estimated that they would be at or just below the 95% coverage mark often recommended as the lexical threshold. The Control Group consisted of 49 students in three classes, while the Dictionary Group consisted of 54 students in three classes. The Control Group's mean score on the University of Michigan's English Placement Test (EPT) was higher (178, *SD* = 12.6) than the Dictionary Group's (171, *SD* = 5.53), but the only significant difference was between the two groups' listening scores. Their mean EPT vocabulary scores were very similar (Control Group, 53.1; Dictionary Group, 52.1), and the pre-reading vocabulary test results suggested that the two groups had very similar coverage of the text involved in the study. The Dictionary Group had a mean coverage of 92.7% (*SD* = 1.5) while the Control Group's coverage was 92.5% (*SD* = 1.9).

Materials

The study involved one authentic reading passage of two pages (650 words). The passage length was similar to that used in Hu and Nation (2000). The article, revised from a Wikipedia article (en.wikipedia.org/wiki/Rock_scissors_paper), concerned the hand game, *rock, scissors, paper*, including worldwide variations of the game and modern tournaments. The passage was selected because it was written in an academic way but still featured a topic that was deemed to be of interest to the participants. Though *rock, scissors, paper* is an extremely common game in Japan, a posttest survey indicated that the participants had previously known very little of the article's content.

The article was edited for length and clarity, which is allowed under Wikipedia's Creative Commons License. The revised passage consisted of a title, an introduction, two sections each, with a section heading, and a conclusion. There were three small photos depicting the hand signs representing *rock*, *scissors*, and *paper*. Therefore, more strategic readers could pre-read the text to understand the topic, and it was organized in a way so participants could use basic reading strategies to grasp some of the main themes of the text. Of the words in the text, 86.6% were pronouns or words in the top 2,000-frequency word list based on corpus data (Cobb, 1999; Heatley & Nation, 1994). Words from the Academic Word List (Coxhead, 2000) consisted of 5.6% of the text, and relatively infrequent off-list words represented 7.8 %.

The study also included a comprehension test, which consisted of eight multiple-choice questions (see Appendix). Two of the questions concerned the main points of the article and were assigned a value of two points each. The rest of the questions were worth one point each.

Procedure

In order to estimate their receptive knowledge of the words in the target reading, three weeks before the pretest, the participants were given a list of 71 words taken from the passage and asked to write each word's definition in Japanese. Considering that words often have various senses and meanings, simple context clues were occasionally given to elicit the correct definition (e.g., one item was written *index finger*, rather than just *index*). The task took about ten minutes to complete. A native Japanese speaker scored the pretests. Wrong definitions and blank responses were subtracted from the total number of words in the passage (650), and then divided by 650 to determine each participant's lexical coverage of the text. Half-points were occasionally given for answers indicating partial or somewhat inaccurate knowledge of a word. The vocabulary pretest totals correlated with the learners' standardized EPT vocabulary score results ($r = .31$, $p < .001$).

The Dictionary Group met in a computer lab during the time of their reading class, and was asked to open a Microsoft Word document containing the passage saved on the internet. They were told that they could check the definition of words while reading. The words were previously linked by the researchers to an internet-based bilingual English-Japanese dictionary (www.alc.co.jp). When the participants clicked on a word in the document, an internet browser window opened containing the word's translation. When they finished reading, they printed out the document that indicated which words were consulted in the online dictionary, since these words were automatically underscored by the Word program as visited links. When participants in either group finished reading, they turned in the text and received the comprehension test.

Analysis

The influence of vocabulary coverage on the comprehension scores of the Control Group was first examined to further understand the influence of 90-95% coverage on learners' comprehension. The coverage and comprehension were analyzed to see if there was any support for the following comprehension thresholds:

> *Significant-increase threshold*: a coverage point above which participants' comprehension is significantly higher (based on a *t*-test) than the learners below this point.
>
> *Majority threshold:* a point at which most learners achieve "adequate comprehension," based on the regression line in case of a statistically significant correlation between comprehension and coverage.

This study used 70% to measure "adequate comprehension," which is halfway between marks previously used, 55% (Laufer, 1989) and 85% (Hu & Nation, 2000). This score would represent understanding both of the main points and at least half of the details (or just one of the main points, but five of six details). As most participants were in the 90-95% range, the lower and upper thresholds were not examined. It was hypothesized that the results would lack sufficient evidence of the majority threshold, but that there would be evidence of a significant-increase threshold.

For the Dictionary Group, to figure the participants' coverage of the passage after dictionary use, the number of words looked up while reading was subtracted from the number of unknown words on the vocabulary test. The scores of the two groups were compared using *t*-tests at various coverage levels to determine if dictionary usage improved learners'

comprehension. The number of words looked up was also analyzed to determine if dictionary usage improved less proficient learners' comprehension at an increasingly higher rate. Lastly, to understand if dictionary use is parallel to increased coverage, the linear regressions of the two groups were analyzed.

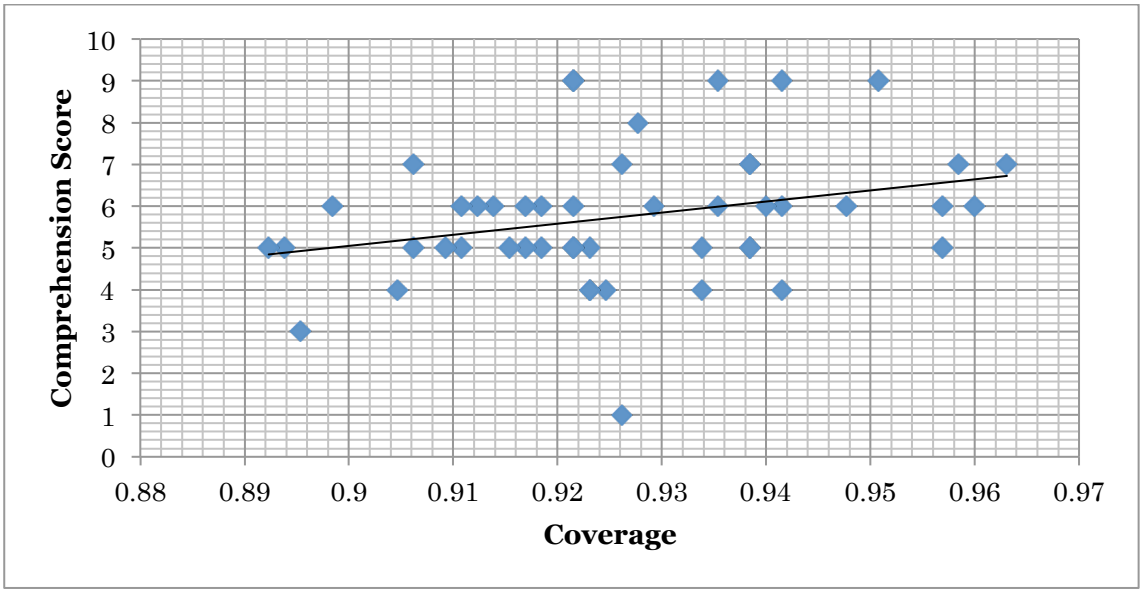
It was hypothesized that dictionary use would increase comprehension for this group, but to a lesser degree than increased coverage. It was also suspected that learners who used the dictionary links to increase their coverage to over 95% would have significantly higher comprehension scores than those who did not reach 95% coverage.

RESULTS

Control Group: Coverage and Comprehension

In the Control Group, the comprehension scores and coverage correlated significantly, but moderately (r = .29, p < .05). As with Hu and Nation (2000), the data shows some variation in the comprehension scores among learners' with roughly 90-95% coverage (see Figure 1).

Figure 1. Non-Dictionary Users' Coverage & Comprehension Score



Ninety-two to ninety-three percent coverage could be considered a significant threshold mark above which comprehension increases. Just one in seventeen learners below 92% reached an "adequate" comprehension score, while 11 of 32 learners above this mark did so. The mark of 92.75% is the only point at which the comprehension of learners below and above the mark are significantly different, based on t-tests (5.3/10 versus 6.3/10, p < .05).

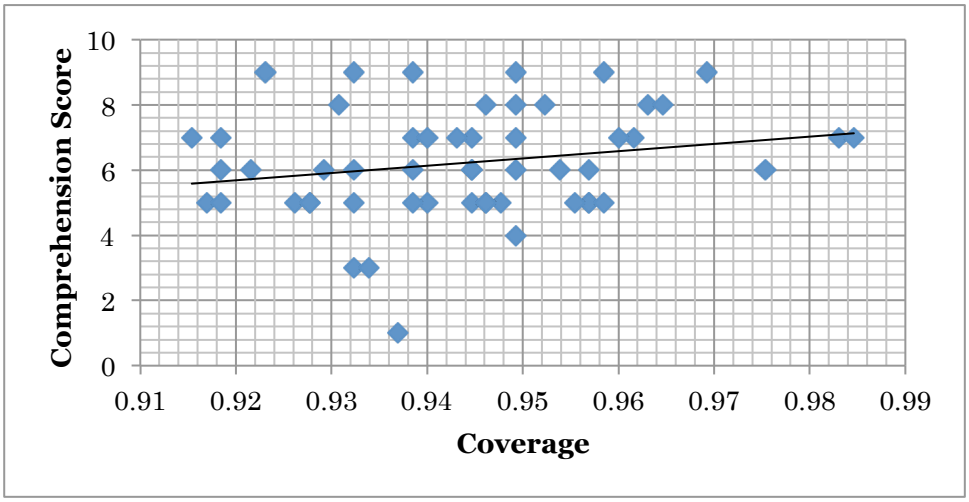
Nevertheless, the data reveals that 90-96% coverage was not enough for most learners, considering adequate comprehension for this text was considered 70% and the mean score of the group was 5.76/10 (SD = 1.61). Less than a quarter of the participants (12 of 51) had a score of at least 7/10. Though few students had coverage of over 95%, it could be speculated, based on the regression line, that 97% coverage may have been necessary for most learners to comprehend the text.

Effect of Dictionary Use on Coverage and Comprehension

In the Dictionary Group, who had access to online dictionary links, the mean number of words looked up was 10.78 (median = 8.5, *SD* = 8.15), which was 1.7% of the running words. This increased the group's coverage from a mean of 92.7% to 94.4%. As in Prichard (2008), the participants varied greatly in terms of the number of times they used the dictionary links. While three students looked up no words and five looked up just one, eight students looked up over 20 words. One participant used the dictionary link 37 times, increasing her coverage of the text by 5.7 percentage points. There was a negative correlation between the pretest vocabulary scores and the number of words looked up (r = -.33, p < .05), suggesting that less proficient learners showed a moderate tendency to use the dictionary link more often than more proficient learners to increase their coverage.

The mean score of the Dictionary Group was 6.22 (*SD* = 1.68), which is not considered adequate comprehension. Twenty-three of 54 participants (43%) had an adequate score of 7/10 or better. Four learners had a score of below 4, while six scored 9 (there were no perfect scores). There was no significant correlation between pretest vocabulary scores (not including dictionary use) and the comprehension scores in this group (r = .16, p = .24). Also, comprehension scores did not significantly correlate with the number of words looked up (r = .11, p = .52). However, there was a significant correlation (though weak to moderate) between the comprehension scores and coverage when including the number of looked-up words to the participants' coverage (r = .29, p < .05; see Figure 2). This shows that dictionary use interacted with the learners' coverage to affect the group's understanding of the text.

Figure 2. Dictionary Users' Coverage (after Dictionary Use) & Comprehension Score



Linear regression of the relationship between the Dictionary Group's scores and their coverage suggests that the learners may have needed to reach 98% to adequately understand the text. However, there was some evidence that 96% coverage may lead to adequate comprehension. There were only eight participants who reached 96% coverage, yet this was the only mark at which comprehension significantly increased in this group. Those learners reaching at least 96% coverage after dictionary use had a mean score of 7.4, versus 6.0 below it (p < .05). Seven of the eight (88%) learners above the 96% coverage mark reached a passing score, significantly higher than the 35% of learners below the mark who did so. At

the 95% coverage range, the mean score of those below this mark was 6.0, versus 6.75 for those above it (p = .135).

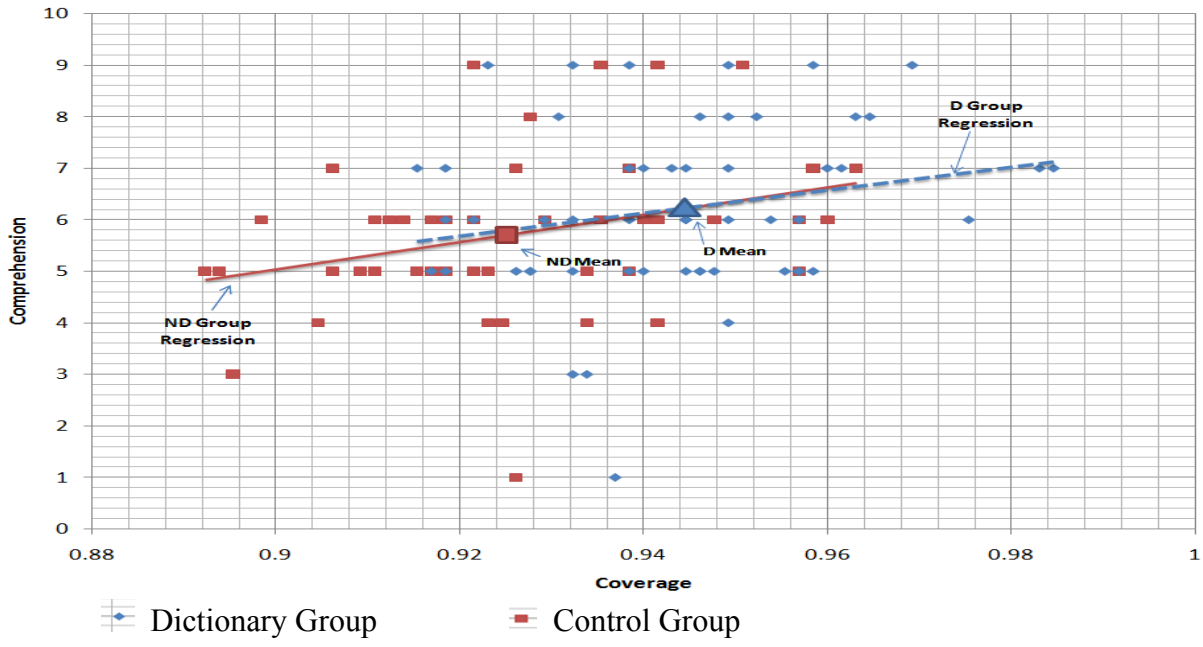
There was evidence that less-proficient learners could significantly improve their comprehension through dictionary use. Among the 29 participants whose coverage was below 93.0% before dictionary use, the 12 learners who increased their coverage to over 94.0% through dictionary use had significantly higher scores than those who did not increase their coverage to this mark (6.8 versus 5.4; $p < .05$).

Dictionary Group versus Non-Dictionary Group

The mean score of the Dictionary Group was higher (6.22) than the Control Group (5.86). However, the results were not significant (p = .27). Twenty-three of 54 (43%) of the learners in the Dictionary Group had a score of 7 or better, compared to 12 of 49 (25%) for the other group. This difference was not quite significant (p = .11).

The fact that the Dictionary Group had slightly higher scores, but not significantly more, than the Control Group might be explained by the fact that the coverage of the Dictionary Group was increased from 92.5% to just 94.3% by using the dictionary links. The linear regression lines of the two groups are in nearly identical positions and nearly parallel (see Figure 3). This demonstrates that dictionary use increased comprehension for the Dictionary Group at nearly the same rate as increased coverage did for the Control Group. Had the Dictionary Group looked up more words, their scores would likely have been higher, perhaps significantly more so the Control Group.

Figure 3. Coverage & Comprehension of the Two Groups



DISCUSSION

The findings here support research from Hu and Nation (2000) that the comprehension scores of learners at the 90-95% coverage level vary. While increased coverage did correlate with higher comprehension scores, the correlation was weak to

moderate. The variance in test scores is likely partially due to the nature of the test (see *Limitations*). The reading skills of the students also seemed to play a role, according to a post hoc analysis, which included a ten-item reading-strategy use survey taken by a sub-group of 26 participants from the Control Group. There was a moderate correlation ($r = .41$, $p < .05$) between the comprehension scores and the use of reading strategies, such as pre-reading the text and focusing on the main points of the text (versus reading *each* sentence carefully and looking up *all* unknown words). Other factors seemed to be of less importance. There was no correlation between the EPT grammar scores of the participants and their comprehension on this test.

Overall, the data suggests that 90-95% coverage is not enough to adequately comprehend the text, though 92-93% coverage did mark a significant increase in comprehension. In the Control Group, there were few learners above 95% coverage, so the data was inadequate for examining the *adequate comprehension threshold*. Yet, it could be speculated, based on the regression line, that 97% coverage would have led most learners toward adequate comprehension. This is on par with both Laufer (1989) and Hu and Nation (2000) if you consider the differing scores used for measuring adequate comprehension in these studies.

Dictionary use interacted with lexical coverage to affect the comprehension of the Dictionary Group. While there was no significant correlation between coverage (when not including dictionary use) and the reading comprehension scores, there was a significant correlation when the looked-up words were considered. The location and slope of the regression lines between the two groups was remarkably similar, indicating that dictionary use increased comprehension at nearly the same degree as increased coverage did. This may be partly due to the effectiveness of the dictionary links, which gave L1 translations and corpus-based example sentences. Moreover, using the dictionary links was fairly effortless and fast. However, as with other studies, the Dictionary Group took significantly longer to read the text (a mean of 16.1 minutes versus 10.6, $p < .0001$).

Implications

This study proposes that comprehension is possible for some learners with 90-95% coverage, though most learners at this coverage will have difficulty comprehending a text. Comprehension is possible at this level depending on other factors, such as reading-strategy use. Considering that strategy training has been shown to be effective, teachers of students at this proficiency level should not shy away from utilizing authentic texts in class for practice. Learners do not need to wait until they reach a higher vocabulary level (e.g., 5,000 words) to begin reading unsimplified authentic texts, and many learners need to read such texts before they can build their vocabulary to an optimal level. However, considering the importance of lexical coverage as shown in this and other studies, learners at the 90-95% coverage level would also benefit from extensive reading of graded materials and explicit vocabulary-building activities.

Second, this study confirms that the use of dictionaries can increase comprehension for learners at this proficiency level. However, the frequency at which students should look up words depends on their coverage. Though conclusive results were not found in this study, the data implies that increasing one's coverage to at least 96% would likely lead to adequate comprehension in many cases. This mark may be difficult to measure for learners and instructors. However, students could be advised to use their dictionary in order to understand most words in the text, but that a small percentage of words can be left unknown. A review of the literature on dictionary use and reading comprehension (Prichard, 2008) suggests that

selective dictionary use may be the most effective way for readers to comprehend texts as well as build vocabulary. Selective dictionary use was defined as looking up words that are frequent or relevant to the main points of the text (or the task at hand), but whose meaning cannot be readily inferred from the context.

Limitations

A couple limitations in the study procedures warrant caution and might explain why a stronger correlation was not shown in the results. The biggest limitation was that learner comprehension was measured with a short multiple-choice test of eight questions. The correct answers to multiple-choice questions can be guessed at least 25% of the time, and the small number of questions suggested that there would be variance that was not attributed to comprehension. Moreover, though the comprehension questions were piloted and revised, and standards were followed to establish face validity of the instrument, time restrictions did not allow for a test-item analysis of the revised test. After the test was administered, a more in-depth item analysis was done which revealed that two items should have been further revised to increase their validity. The first question may have been too easy and the last may have been overly confusing.

Recommendations for Further Research

More studies are needed to confirm the research findings in this study concerning how dictionary use interacts with vocabulary knowledge to affect comprehension. This phenomenon also needs to be examined with learners at higher and lower coverage levels. In future studies, a comprehension recall measure and/or more carefully designed comprehension questions would greatly increase the strength of the statistical analysis. However, making more questions or including a longer text would make it difficult to reliably measure the learners' lexical coverage with a pretest.

The vocabulary pretest methods used in this study may offer a more precise and in-depth analysis of the role of coverage compared to the methods used in previous studies. The instrument used by Hu and Nation (2000) to measure lexical coverage by using nonsense words can only be utilized with advanced learners who have near total comprehension of the other words in the text. Also, this may reduce the authenticity of the task, as using nonsense words does not measure partial knowledge of a word and does not allow for guessing word meaning from its roots. The methods used by Laufer (1992), which rely on vocabulary knowledge tests to predict one's coverage, are valid, but coverage estimates are not as precise as those used in this study.

CONCLUSION

This study aimed to further understand the role of lexical coverage on L2 comprehension. We believe that the oft-mentioned 95% lexical coverage threshold is often taken too literally, though the influence of vocabulary on comprehension is clear. There are different ways to view thresholds and each needs to be examined. This study also examined the reading comprehension of learners at or just below 95% coverage level (89-96%). The findings here confirmed previous studies, which indicated that the participants in the 90-95% coverage range have difficulty comprehending the text. The data showed that 92-93% may be

a threshold at which understanding of a text significantly increases, but that learners may need at least 97% coverage to reach adequate comprehension (a score of 70%).

Further, the study examined the influence of dictionary use on coverage and comprehension. While previous studies advise that intermediate-level learners may benefit from dictionary use, coverage was not analyzed. This study found that dictionary use increased comprehension at a similar rate as increased coverage. However, the Dictionary Group still did not have adequate comprehension. This may be because most learners did not utilize the dictionary links to increase their coverage to over 96%, which was a mark which showed some significant gains in comprehension.

It is recommended here that intermediate learners with 90-95% coverage are proficient enough to start using authentic texts to build reading skills (along with extensive reading and vocabulary-building activities), and that dictionary use might increase learners' coverage and comprehension, as long as words are looked up selectively. However, the efficacy of dictionary use depends on a number of factors, especially one's vocabulary level. More research is needed among intermediate learners to support the results in this study, and the relationship between dictionary use and comprehension among learners at lower and higher coverage levels also needs to be examined.

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Appendix

English translation of the reading comprehension test.

1. What is one main point of the article?
   a. *Rock, scissors, paper* has not changed much over the years.
   b. *Rock, scissors, paper* was introduced to Japan many years ago.
   c. Hand games, like *rock, scissors, paper* can be very entertaining.
   d. *Rock, scissors, paper* has many variations around the world.

2. What is another main point of the article?
   a. Hand games reveal our culture.
   b. *Rock, scissors, paper* has turned into major competitions and events.
   c. *Rock, scissors, paper* is also played in the US.
   d. *Rock, scissors, paper* is a simple game.

3. How is the game played differently in parts of the US?
   a. It is played with four players.
   b. They use different weapons depending on their rank.
   c. The players yell out a fourth count before showing their weapon.
   d. The players make dynamite noises when they tie.

4. How is the game played in Indonesia?
   a. People traditionally played the game riding on elephants.
   b. *Rock, scissors, paper* is played to win rides on elephants.
   c. They use a bug, a human, and an elephant as weapons.
   d. They play the game the same way as elsewhere these days.

5. How does the author feel about using four weapons?
   a. All weapons have an equal chance of winning.
   b. Using weapons (like dynamite) makes the game more exciting.
   c. The game loses some of its simple appeal.
   d. It will be the most popular way to play in the future.

6. How is *rock, scissors, paper* different from a coin flip?
   a. *Rock, scissors, paper* is not always random.
   b. There is no skill involved in the game, *rock, scissors, paper*.
   c. *Rock, scissors, paper* is used as a selection method.
   d. A coin flip is no longer common in America.

7. What is noted about *rock, scissors, paper* tournaments?
   a. These tournaments are very sophisticated.
   b. Many people gamble on *rock, scissors, paper* in Las Vegas.
   c. These tournaments are a colorful spectacle.
   d. They are now an Olympic sports tournament.

8. According to one champion, how do men and women play differently?
   a. Men like to play more randomly.
   b. Men are better at predicting the moves of their opponents.
   c. Women are not allowed to enter the tournaments.
   d. Men tend use some weapons slightly more often than women do.