Young Learner L2 Vocabulary Acquisition: Does the Revised Hierarchical Model Apply to Child Learners?

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Vocabulary learning is a process requiring the connection of mental concepts to new word-labels. The Revised Hierarchical Model claims that beginning learners recognize the meaning of L2 words via a process of translation, needing considerable time and effort to forge direct connections between L2 words and mental concepts. However, might young children, as they are still rapidly acquiring L1 vocabulary, be able to bypass the L2-to-L1 translation required by adult L2 learners, and instead link new L2 words directly to pre-existing mental concepts? This study tested over 1,000 4th-6th graders in Japanese elementary schools on their ability to match newly learned L2 words with corresponding pictures or L1 translations. The results demonstrate that students connect L2 vocabulary to pictures more quickly, and this effect becomes more robust when students are taught via pictures, which suggests that young learners are indeed capable of accessing concepts without translating from their L1.

語彙学習とは学習者の脳内に存在する概念を新しい語彙に連結するという過程である。改訂階層モデルによると、初級者は翻訳という過程を経ることで第二言語(L2)での意味を認識する。そのため、L2語彙と脳内概念への直接連結するにはかなりの時間と努力を要する。しかし、まだ急速に第一言語(L1)語彙習得過程にある子どもたちはどうだろうか。成人学習者が必要とするL2からL1への翻訳を介さずに、脳内概念とL2語彙へ直接連結することが可能なのではない

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だろうか。本研究では四年生から六年生の日本人小学生千人以上を対象に、新出L2語彙を対応する絵または日本語へ照合する能力について検証した。結果として、L2語彙に対応する日本語への照合よりもイメージへの照合がより早く行われ、またこの効果が絵を用いて教わった場合により強く見られた。このことから、年齢が低い学習者はL1への翻訳することなしに脳内に存在する概念にアクセス可能であることが示唆できる。

Keywords: conceptual access; Japanese learners of English; RHM; second language education; vocabulary learning

The importance of vocabulary acquisition in learning languages has been widely researched, across a variety of perspectives, and it is safe to claim that its significance is no longer a matter of debate. While vocabulary learning is one of the most basic aspects of language learning, and indeed, one of the basic units by which we can measure such learning, our understanding of the psychological processes, undergirding and driving the acquisition of words, is still only in its early stages. Especially when we cross-analyze first and second language acquisition dynamics, a number of interesting—and, as of yet unanswered—questions raise themselves immediately, such as the relative degree of difference and sameness in process. One issue that is often debated is the role of creation of direct links between vocabulary and mental concepts. While it is often taken for granted that word acquisition and conceptual access occur simultaneously in an L1 context, learning in an L2 context (wherein the conceptual links between L1 words and concepts already exist) opens up other possibilities. Might these fundamental psychological processes for learning vocabulary be different between L1 and L2 learners, could this be affected by learner variables such as age, and how would this affect learning?

Literature Review

Research on Conceptual Access

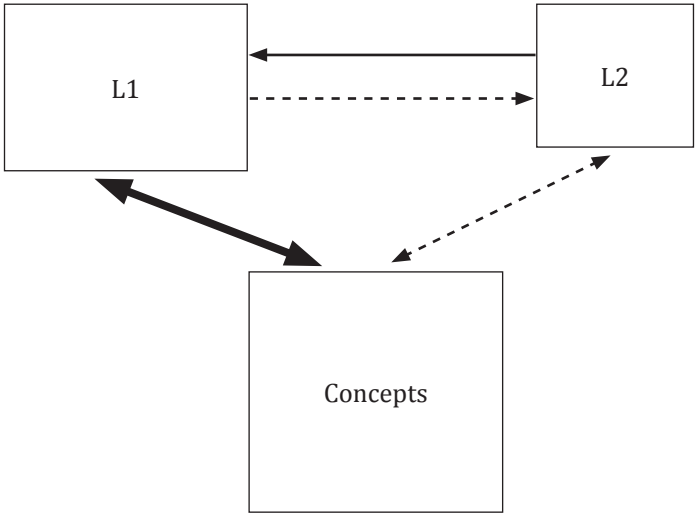
It is believed that most of the information in the brain is stored conceptually as images and/or ideas rather than aurally (or orally), and L1 users can make a link between those images without interference. However, applying this capability to L2 acquisition is still controversial. Potter et al. (1984)'s research was one of the first to investigate conceptual access. They proposed two hypotheses on how words in two languages are associated with each other. According to the *word association* hypothesis, mental concepts can only be accessed via words in the L1, and thus, L2 words have to be translated

to L1 before meaning can be unlocked. By contrast, the *concept mediation* hypothesis suggests that concepts are directly linked to both L1 and L2 vocabulary equally. These two conflicting theories were tested by a number of researchers. The *word association* hypothesis could be proven if translation from L1 to L2 were faster than naming the image in L2. This would verify that L2 word retrieval was conducted through L1 (i.e., the concept triggering the L1 label, which in turn triggers the L2 label), not via direct conceptual access. On the other hand, if the *concept mediation* hypothesis were proven true, recall of the names of objects in pictures (i.e., picture naming tasks) in L2 should take the same amount of time as word translation from L1 to L2. The findings by Potter et al. (1984) showed that it took the same amount of time for advanced L2 learners to translate from L1 to L2 as picture naming, while for lower level L2 learners, it took much less time to translate from L1 to L2 than picture naming. Therefore, it was suggested that both of the models required revisions in order to explain the subsequent results. Note that, while mental image and mental concepts are not synonymous, there is broad overlap, at least in terms of concrete, easily-visualizable vocabulary. Given the past methodology's reliance on picture naming as a means of testing conceptual access, this paper will use the terms *image* and *concept* fairly interchangeably. This is merely reflective of the concentration on concrete vocabulary (which both past research and the current study will concentrate upon), and is not meant to suggest a broad equivalence between mental image and concepts beyond the sorts of vocabulary items dealt with herein.

The Revised Hierarchical Model (hereafter the RHM) was devised by Kroll and Stewart (1994) to account for these differences in basic word processing by L2 students of different proficiency levels (refer to Figure 1). They claimed that L2 learners would develop the ability to directly link concepts to L2 target words over time. Their study found that there were differences in the speed of translation from L1 to L2 and picture naming, and the asymmetry could be found in the direction of translation: translation from L1 to L2 being slower than L2 to L1. They also found another asymmetry in terms of categorical interference. Tests devised to elicit semantic interference effects by grouping vocabulary found significant interference effects when translating from L1 to L2, but not the other way around. The other asymmetry found in the study by Sholl et al. (1995) was difference in priming facilitation occurring only when participants translated from L1 to L2 after a picture naming task, irrelevant to the language used in the task.

Figure 1

Revised Heretical Model (RHM)



Criticism on the Revised Hierarchical Model

In fact, the RHM has been criticized because the studies which followed Kroll and Stewart (1994) found contradictions in the proposed theory (Brysbaert & Duyck, 2010; de Groot et al., 1994; van Hell & de Groot, 1998). In particular, Brysbaert and Duyck suggested "leaving behind" (p. 359) the RHM based on their rather comprehensive review of research which was published after the theory was originally published. They concluded that since there have been previous models made for investigating bilingual language processing, more research should have been implemented to check how to adapt the existing models, including the Bilingual Interactive Activation model proposed by Dijkstra and van Heuven (2002). Another revision suggested for the RHM was on the interpretation of L1 and L2. When learners are in situations where they are immersed in the L2, making L2 the dominant language, reversed results were found (Heredia, 1997). Therefore, some researchers proposed that the RHM should be referred to from the perspectives of dominant vs. additional languages, rather than L1 vs. L2 (Heredia, 1997; Linck et al., 2009). Additionally, the study by Sunderman and Kroll (2006) found no appreciable differences in the degree of semantic sensitivity between low- and high-proficiency L2 learners. Williams (2017, 2018), in a series of studies on semantic priming sensitivity, found that orthographic properties of Japanese

and Chinese script may impair the development of certain types of semantic sensitivity in L2 learners of English from Japanese/Chinese L1 backgrounds.

Furthermore, Kroll et al. (2010) suggested acknowledging the possible weakness in the RHM that there is a bidirectional weak link between L2 and concept. The study found that the results of production tasks (i.e. naming) and receptive tasks (i.e. comprehension) showed significant gaps, indicating the link between L2 and concept is actually asymmetrical. To pursue possible reasons for an asymmetrical result in Kroll and Stewart (1994)'s study, the category facilitation effect in the L2-to-concept and L1-to-concept directions was further investigated by Wu and Juffs (2019). They tested whether they could find a category facilitation effect in both the L2-to-concept and L1-to-concept directions by providing the categorized list conditions and the randomized list conditions. Their results indicated a significant category facilitation effect in both L2-to-concept for young Chinese adults and L1-to-concept for young English adults when the number of trials was increased. They argue that the general L2-to-L1 null category effect discovered by Kroll and Stewart (1994) could not be used to disprove concept mediation in backward translation.

Responding to the general criticism on the RHM, Kroll et al. (2010) argued against the idea of "leaving behind the RHM" (Brysbaert & Duyck, 2010, p. 359), claiming that in principle "models provide a means to approach problem solving and to refine our thinking" (Kroll et al., 2010, p. 381) instead of being tested and rejected. While various issues have been evident in the model itself, the RHM has remained one of the most dominant in explaining concept mediation. It suggests that L2 access to concepts in the brain can only be achieved for lower-level L2 learners through use of the L1; however, learners would develop the ability to link concepts directly to L2 words as they develop proficiency. This, in turn, raises other questions, such as whether or not younger L2 learners are similarly restricted from connecting L2 vocabulary directly to mental concepts, and whether they could develop such conceptual links differently from adults.

Research of the RHM on Japanese Learners of English

As the study which will be presented in this paper is focused on Japanese learners of English, it would be useful to review prior research investigating the RHM as pertaining to Japanese learners of English. In one of the earliest studies, Kawakami (1994) tested how three groups of Japanese learners of English with different proficiencies (English-major university students, high school students, and junior high school students) would perform in learning new English vocabulary words. In her study, the group of higher proficiency

(English-major university students) performed similarly both in the Japanese and English priming tasks, which led her to conclude that both English and Japanese vocabulary were accessible to the higher proficiency group at the similar levels due to more direct links between meaning and concept than less-proficient learners. She found that the data generally corroborated RHM predictions because the group of higher proficiency evinced more direct links between meaning and concept, while the patterns that less-proficient learners produced matched more with the *word association* model as Potter et al. (1984) suggested.

Similarly, the study by Anezaki (2006) attempted to investigate if there would be any difference between first-year students who had learned English for three months and third-year students who had a longer experience in learning English for two years and three months in a formal school setting at junior high school. With a two-choice reaction time task, he discovered that it took longer for L2 learners at a very early stage to engage in backward translation than those learners with more experience in learning L2 at school. Another finding was that this asymmetry disappeared among the second group of learners. Therefore, Anezaki concluded, "the results of this study are congruent with the prediction of the Revised Hierarchical Model" (p. 128).

Some studies on Japanese learners of English focused on the concreteness of target vocabulary words to examine the RHM. Habuchi (2003) investigated how words would be processed in translating between English and Japanese. According to her study, advanced-level Japanese learners of English seemed to go through the process suggested by the RHM when they dealt with concrete words (e.g., fox and fish), whereas the results showed that the participants were processing words in accordance with the *word association* hypothesis (Potter et al., 1984) when dealing with abstract vocabulary words in L2. The study by Nakagawa (2009) explored interrelatedness among L1 and L2 lexicons and concepts through her experiment on Japanese first-year university students, finding that more concrete and higher frequency target words were found processed via concept mediation, while abstract words seemed to be processed via word association. In addition, Nakamura (2007) found that translation of concrete words from L2 to L1 would be processed as suggested in the *word association* hypothesis, while the L1 to L2 translation would be done through the process according to the *concept mediation* hypothesis (Potter et al., 1984). In addition, he explored differences between the direction of the translation, and the results supported the RHM, L1 to L2 translation of concrete words requiring concept mediation while L2 to L1 translation of concrete words done via word association.

Conceptual Access of Young Learners

The RHM has received tremendous attention and has been a target to be tested on bilingual adult learners, but less attention has been on young L2 learners. Young learners, in fact, exhibit distinctive traits from adult L2 learners. It is estimated that 6-year-old to 8-year-old children learn 6 to 7 new words per day, and this rate increases to 12 words per day at the age of 8 to 12 (Bloom & Markson, 1998). While young children are expanding their L1 vocabulary, creating links between new words and concepts, it can be assumed that it might not be as difficult to create direct links between L2 words and respective concepts. This was found to be the case in the study by Comesaña et al. (2009). After one vocabulary session, Spanish-L1 elementary school students showed semantic interference effects. It turned out that it was hard for them to reject incorrect translations that were semantically related when trying to acquire target L2 words (in this case Euskera, Basque language). Comesaña et al. (2012) replicated the study by Comesaña et al. (2009) with Portuguese L1 speaking children who are learning Euskera. The researchers found that the participants displayed similar results of semantic interference effects. In addition, it was found that the degrees of semantic interference increased when target words were instructed via pictures, and also the delayed posttest conducted one week later revealed that the semantic interference effect increased regardless of the different teaching methodologies being used.

Another study by Poarch et al. (2015) investigated how Dutch L2 fifth graders after receiving English instruction for eight months connected new vocabulary words to mental concepts. Their results generally corroborated what Comesaña et al. (2009) and Comesaña et al. (2012) found. Young Dutch learners of English at early stages of their L2 learning were found to be able to actively exploit conceptual links when they translated from English to Dutch. The study by Sheng et al. (2013) examined if Spanish-English bilingual children would prove to be influenced by their age and previous learning experience of L2 in semantic development. The study concluded that their results were "consistent with predictions of the Revised Hierarchical Model of bilingual lexical organization" (p. 1023).

The Present Study

The current study aimed to investigate whether young L2 learners can create conceptual links to L2 vocabulary which they learn as new words, and the researchers also tried to identify at what age the ability to build direct conceptual links to L2 words might cease. Additionally, the study looked at

whether pedagogical methods would influence the degree of the L2 conceptual connection strength or not.

Study Participants

During the data collection phase of the present study, 1,260 elementary-aged children, ranging from 4th to 6th graders, participated. The breakdown according to age/grade was: 4th graders = 437; 5th graders = 346; and 6th graders = 477. They were all monolingual native speakers of Japanese. Classroom teachers were consulted to identify any students who had multilingual backgrounds (e.g., students who had spent significant time abroad, who lived in households where languages other than Japanese were spoken, or who engaged in English study in private educational centers). Students with such backgrounds were still permitted to participate in the study, but their test results were not included in the analysis.

Participants were recruited from seven elementary schools in one city in northern Japan. The research team visited those seven elementary schools during the periods from July 2017 to November 2018 for data collection. The Ministry of Education, Culture, Sports, Science, and Technology (hereafter, MEXT) stipulates the school curriculum and releases new versions of course of study every 10 years. MEXT (2017) announced the new course of study in July 2017, suggesting to begin preparatory measures to ensure a smooth transition from April 2018 and to complete the transition before April 2020. When the current study was conducted, the new course of study had been released; however, the actual implementation of the new curriculum had not been in progress. Therefore, it was considered to be safe to assume that students below the 5th grade had no or minimal exposure to English in a formal classroom setting, and 5th and 6th graders had undergone one 45-minute English lesson per week since the beginning of the 5th grade when the study was executed in 2017-2018.

Materials

The vocabulary items used in the current study were decided in conjunction with the teachers at one of the elementary schools used for the pilot study (wherein all instruments and materials were calibrated). To maximize the probability of the participants never having heard the target words before the study, the researchers chose the target vocabulary through a careful discussion with a group of teachers beforehand. Additional efforts were made to avoid selecting English words which have been used as *katakana-eigo*,

borrowed foreign words which had been already integrated into the Japanese language, including many food names, e.g., *soup* and *broccoli*. Since public elementary schools in the same district use the same textbook and follow the same curriculum, it was presupposed that those 45 items to be used in the study would be English words that elementary-aged participants had not heard or acquired yet through the English lessons at school. A full list of the 45 items is available in Appendix A. Those 45 target vocabulary items were printed and made into laminated cards, one set of cards with an image to represent the target word, and the other set with the Japanese translation in *kana*. Card examples are available in Appendix B. The other research material included computers with the DMDX software (Forster & Forster, 2003) installed for the participants to take a computer-mediated test of vocabulary recognition with images and sound files of vocabulary items. The test itself was written with the DMDX software by one of the researchers.

Procedures

The study was conducted in two days for each participant group. Each class was randomly divided into two groups of equal size by their homeroom teacher beforehand. On the first day of the study, the two groups would go to separate classrooms where they would participate in an English lesson for 45 minutes taught by a graduate school student from the English Language Teaching Practices program at the university to which the researchers are affiliated. The graduate student instructors were from Japan, China, and Vietnam. They were scheduled to teach lessons according to their class schedules, avoiding any time conflicts with their academic activities on campus. All of them have experienced teaching demo lessons in classes but had not completed their teaching practicums yet. All the graduate instructors were required to participate in an explanatory session by one of the researchers beforehand. In addition, before each lesson, the graduate instructors reviewed the pronunciations of all the target words with one of the researchers to consistently present similar oral production to each other in terms of stress and pronunciation.

The graduate student instructors used the first 20 to 25 minutes to teach the 45 target vocabulary items. The words presented were the same in both groups, and all the vocabulary cards which instructors used for instruction were laminated. However, the teaching method and the information on the vocabulary cards differed.

In one group, the instructor utilized vocabulary cards with only images; this group will hereafter be referred to as the "Picture Group." On one side of

each vocabulary card for the Picture Group is a picture which can clearly represent the image of the target word, and the other side shows the target word itself for instructors to refer to when they teach the target vocabulary words. To illustrate, a vocabulary card would include an illustration of a dustpan on one side of the card, and the other side had an English word "dustpan" for reference. The Picture Group instructor was prohibited from using Japanese translations during the lesson, instead presenting the English vocabulary orally, and allowing the visual aid to convey meaning to the children. Therefore, when instructors were asked for the Japanese translation, they were told never to respond in Japanese; instead, they pointed to the target picture card.

The other group was taught using Japanese translation, hereafter referred to as the "L1 Group." The set of the vocabulary cards used for this group includes the Japanese translation in *hiragana* or *katakana* on one side with the target English word on the other side, without any image to represent target words. One example card contains the target English word "dustpan," and the other side shows the Japanese translation "ちりとり" in *kana*. The instructor used the Japanese translation of the vocabulary word along with the Japanese word cards during the lesson for the L1 Group.

The instructors were provided specific directions to follow for their lessons. Approximately the first 20 to 25 minutes of each lesson was devoted to vocabulary instruction of the target words. First, they had students repeat after the instructor while students were looking at each vocabulary card for three rounds. Then, they chose those target words that students seemed to have difficulty and repeated the "repeat-after-me" practice. Afterwards, the instructors randomly chose vocabulary cards to quiz students through asking them to say the English word aloud quickly as soon as they flipped the vocabulary cards. Each lesson was 45 minutes long, so instructors played some fun games for the rest of the lesson time, including playing musical chairs, drawing, crafting, and so on. One important point that the instructors were told to avoid including in the fun activities was not to have students exposed to those 45 target words in any part of the activities.

On the second day of the study (i.e., the day immediately following when the vocabulary was presented), the computer test was administered. Another English lesson was offered to the entire class (i.e., they were not separated into two groups this time), and during the lesson, students were invited in groups of six to go to a separate room to take a computer-mediated test of the vocabulary items they had learned on the first day. In the test, the students would hear (via a headset) vocabulary words from the list of 45 target words presented one at a time. Immediately following the presentation of

the word, a pair of pictures or a pair of words (written in Japanese *kana*) would be displayed on the screen. The pictures used in the test were of the same vocabulary items taught the previous day, but not the same pictures that were presented to the group taught with picture cards. Participants were asked to select which picture or word would best correspond to the vocabulary word they had heard by pressing either the RIGHT or LEFT SHIFT key (corresponding to the choices on the left and right sides of the screen, respectively). Research assistants encouraged participants to answer as quickly as possible, and feedback on accuracy and response time was displayed after each response (therefore encouraging test takers to try to make a game of it, and answer as quickly as possible). Each set of the choices included two *kana* words or two pictures, and the image and *kana* only presentations alternated for counterbalancing the total number of test items. The order of the test item presentations was randomized, and the reaction times were recorded for analysis.

Data Analysis

The reaction times were analyzed via multi-factor ANOVA. Each grade was analyzed to determine time latencies in matching the spoken target word to the picture vs. to the Japanese translation. Further analysis was conducted comparing groups within grade-levels to determine whether the teaching condition affected response times. An error cut-off rate of more than 20% resulted in participants' exclusion from analysis. Given the 20 minutes of actual vocabulary study and a one-day gap before testing, in addition to the participants being young learners, the error rate was high, which necessitated a rather large subject pool in order to gather enough reliable data.

Results

Comparison of reaction times revealed that every single group, whether taught via pictures or taught via L1 translation, was significantly faster at matching L2 words to pictures than they were at matching L2 words to L1 translation equivalents (F1, i.e., analysis of all groups: $p < 0.01$). The individual reaction times can be seen in Table 1.

Table 1
Reaction Times across Grades (Measured in Milliseconds)

Grade	n	Teaching condition (translation vs pictures)	Reaction time for matching L2 word with Picture	Reaction time for matching L2 word with L1 word
6th	199	L1 Translation	1330	1498
6th	190	Picture	1251	1482
5th	120	L1 Translation	1390	1576
5th	124	Picture	1326	1537
4th	130	L1 Translation	1540	1652
4th	121	Picture	1422	1629

Sub-analyses of interactions found a significant item effect (F2, i.e., analysis of the difference between reaction times in item types) whereby reaction times for matching the L2 words to pictures was significantly faster than that for matching them to L1 translations, but only in the Picture Groups: 4th Graders, $F2\ (1,8) = 5.37$, $p < 0.049$ ($\eta_p^2 = 0.40$, small effect); 5th Graders, $F2\ (1,8) = 6.10$, $p < 0.039$ ($\eta_p^2 = 0.43$, small effect); 6th Graders, $F2\ (1,8) = 6.88$, $p < 0.031$ ($\eta_p^2 = 0.46$, small effect). None of the L1 Groups demonstrated any significant item effects (i.e., all $p < 0.08$). While direct comparisons between the teaching conditions within grade levels revealed no significant differences, among 4th graders, the faster mean times for the Picture Group vs. the L1 Group nears significance: $F1\ (1,126) = 3.79$, $p < 0.0539$. Nonetheless, this near-effect fades in 5th grade: $F1\ (1,124) = 2.63$, $p < 0.107$, and it disappears entirely by 6th grade; however, in the 6th grade, there was also an item effect between the two teaching conditions, favoring the Picture Groups: $F2\ (1,8) = 6.98$, $p < 0.0297$ ($\eta_p^2 = 0.47$, small effect).

Discussion

The results do suggest the possibility that elementary-aged students can forge direct cognitive links between L2 labels and mental concepts. The faster speed of picture-matching across the board is highly suggestive of such. If the students were required to connect L2 words to the concept via L1 translation, we would see a slow-down in picture-matching, much as early testing on the *word association* model and the *concept mediation* model found

in picture naming among low-level students (Potter et al., 1984). The truly potentially surprising aspect of this study is that such robust acceleration in picture-matching vs. L1-matching was found only one day after the L2 label entering into the students' receptive vocabularies. It is possible, albeit entirely speculative at the moment, that if conditions allowed longitudinal instruction, such effects would likely have been even larger. It is important to note that some of the slow-down in L1 translation could possibly be due to latencies in reading speeds. Studies with young learners always face certain limitations due to their individual cognitive development levels; however, the fact that the latencies between picture-matching and L1-matching remained significant through 6th grade is suggestive that reading speed was not a critical factor (and early calibration efforts of the testing materials abandoned testing with students under 4th grade for precisely this reason – reading speeds were so slow with some learners as to make the comparison between categories invalid).

In addition to showing that elementary school-aged learners have the ability to bypass the RHM constraints by accessing mental concepts via L2 labels immediately after vocabulary acquisition, the study results also seem to support our earlier hypothesis that teaching methodology may have impacted the degree of latency between picture-matching and L1-matching. The significant item effects across all grades demonstrate that those taught with pictures are significantly faster at connecting pictures to L2 labels, compared with those taught via L1-translation. The reverse was not shown to be the case (i.e., those taught via translations were not significantly faster at matching L1-translations), so this is not simply a teaching effect, but instead, instruction using visual illustrations seems to better reinforce the conceptual links created during vocabulary acquisition, thus permitting faster recall, and may even be helping with translation between the L1 and L2 (as evidenced by the lack of significant advantage for L1-translation by the group taught via explicit use of L1).

From pedagogical points of view, the current study can suggest some important implications. One of such is benefits of utilizing images in teaching vocabulary to young learners. As the data in the present study suggested, the participants who were taught with images were significantly faster when they were matching images with L2 translation when compared with those who were taught the same set of vocabulary items by way of Japanese translations. It became evident that teaching with visuals appeared to have facilitated the conceptual access, which was demonstrated by the higher speed of recall in the dataset. Therefore, it could be suggested that using pictures to teach new

L2 terms, rather than L2 translation, could produce better results of learning in teaching L2 to young learners because using visuals seems to have facilitated establishment of direct conceptual access in learners.

Another pedagogical implication of the present study might be related to age and developmental factors. The younger the participants were, the more robust effects were found in the study. This could generally suggest that it might be useful for elementary school teachers in charge of third- and fourth-graders to make more use of pictures when teaching vocabulary words with concrete meaning (e.g., a dustpan), rather than those with abstract (less concrete) meaning (e.g., love). The results of the present study discovered the significant effects of use of images in teaching vocabulary; however, the target vocabulary words taught through the instructions were chosen carefully to avoid any misunderstanding of the target word meanings, specifically selecting rather concrete words which are found easy to be understood only with an image. Thus, future research could look into the effects of image usage in teaching more abstract vocabularies to confirm effectiveness of use of visuals over L1 translation in teaching L2 vocabulary in general.

While the study did not find a "cut-off" developmental period for conceptual access, the gradual decline in significance of teaching condition comparisons as students age very well may be indicative of an approaching point where conceptual access can no longer be achieved in the short-term. Finding an absolute point where conceptual access is no longer a factor and the RHM is in full effect will likely require extension of study in junior high school (or even high school) groups.

Conclusion

Japan made a significant change in the age when school children begin to learn English as a second language as part of the official school curriculum. At present, 3rd- and 4th-graders take a 45-minute lesson per week (in total 35 hours per grade year), and for 5th and 6th graders, English is one of the official school subjects in elementary schools (70 hours per grade year in total), as MEXT (2017) stipulates. This shift in the elementary school curriculum has resulted in the dramatic change in the junior and high school English curricula especially with the significant increase in the vocabulary size to be acquired before starting the 10th grade. With all these drastic changes being made, it is imperative that the English language educators develop effective pedagogical methods in terms of overall language instructions as well as vocabulary teaching strategies to young learners of English. Understanding how the young learner's brain functions in acquiring new words is an important step

forward to finding best methodologies of teaching L2. One of the possible ways for such investigation could be to test the RHM. Since not many studies have investigated the RHM with Japanese learners of English, more research could be conducted to determine most appropriate methods of teaching English vocabulary to Japanese learners with various proficiency.

This study aimed to provide evidence of elementary-aged students creating conceptual links to new L2 vocabulary, though the exact developmental period when the capability of utilizing direct links from L2 words to concept may cease (thus introducing the RHM dynamic whereby beginning adult learners are incapable of linking concepts to L2 vocabulary) was not clarified. Thus, more research is required to ascertain the present study findings. It was found that young learners of English seem to be capable of forming direct links between L2 vocabulary and concepts, but this ability disappears at a certain stage later in life and it is still not clear exactly at what age the ability ceases. Figuring out the exact age would be invaluable toward enabling both young learners and their teachers to determine maximally appropriate methods for teaching and learning new vocabulary words in elementary school contexts (and possibly even in junior high).

Another point of suggestion could be related to tools of testing concept mediation. Accuracy or error rate was not accounted into in the current study, and there might be some impact on the results, though elementary-aged children would have difficulty avoiding guessing answers or making mistakes in choosing answers since they are not used to using the computer keyboard in general. Therefore, it would be beneficial to create a testing tool which would make the testing of L1, L2, and concept linkage feasible for and more easily accessible to young participants.

In researching vocabulary acquisition, the "distance" between L1 and L2 can be considered one important factor to be accounted for since L2 being distant from L1 (e.g., Japanese L1 speakers learning English) has been found more challenging and thus present more difficulty in acquiring L2 than L2 being close to L1 (e.g., Spanish L1 speakers learning English). Crystal (1987) defined interlingual distance to be "[t]he structural closeness of languages to each other" (p. 371). Since then, it has been well established that L2 being distant from L1 (e.g., Japanese L1 speakers learning English) might be found more challenging and thus present more difficulty in acquiring L2 than L2 being close to L1. Burrows (2012) suggested that the language distance between English and Japanese might have been one of the crucial factors for Japanese learners of English having difficulties in learning English. Similarly, it might be interesting to investigate into how learners in English as a Foreign Language

(EFL) situations and those in English as a Second Language (ESL) situations might differ in terms of building vocabulary conceptual access. Consequently, similar studies to the present study can examine such contrasts among those with different L1 backgrounds and also in the situation where English is the learner's dominant language (e.g., in international school settings) so that most appropriate vocabulary teaching methodologies and strategies can be discovered, developed, and utilized in schools for maximized benefit.

In conclusion, the present study succeeded in garnering evidence that young learners of English could forge direct conceptual access to L2. However, the question of when the child ability to do so "switches off" remains unanswered, as the RHM model shows that adult learners are unable to directly connect mental concepts to L2 vocabulary at beginning stages of learning. This study can suggest future research directions in order to further knowledge of how young learners acquire L2 vocabulary.

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Appendices

All appendices are available from the online version of this article at https://jalt-publications.org/jj.

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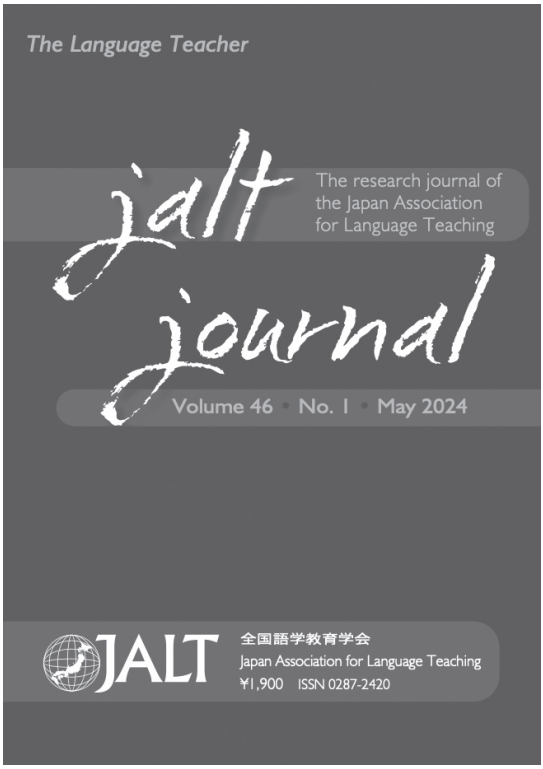

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Appendix A

List of the 45 Target Vocabulary Items

	English	日本語	よみがな
1	barber	床屋	とこや
2	envelop	封筒	ふうとう
3	motorcycle	バイク	ばいく
4	pear	梨	なし
5	broom	ほうき	ほうき
6	dustpan	ちりとり	ちりとり
7	ladder	はしご	はしご
8	chimney	煙突	えんとつ
9	hospital	病院	びょういん
10	persimmon	柿	かき
11	roof	屋根	やね
12	scale	体重計	たいじゅうけい
13	blanket	毛布	もうふ
14	fridge	冷蔵庫	れいぞうこ
15	garbage	ゴミ	ごみ
16	diaper	おむつ	おむつ
17	stroller	ベビーカー	ベビーカー
18	vase	花瓶	かびん
19	crab	蟹	かに
20	ladybug	てんとう虫	てんとうむし
21	cricket	コオロギ	こおろぎ
22	glue	のり	のり
23	swing	ブランコ	ぶらんこ
24	hippo	かば	かば
25	jellyfish	くらげ	くらげ
26	bread	パン	ぱん
27	fire engine	消防車	しょうぼうしゃ
28	flip-flops	ビーチサンダル	びーちさんだる
29	wallet	財布	さいふ
30	faucet	蛇口	じゃぐち

31	crocodile	ワニ	わに
32	cucumber	きゅうり	きゅうり
33	bookcase	本棚	ほんだな
34	shelf	棚	たな
35	pillow	枕	まくら
36	sleigh	そり	そり
37	swimsuit	水着	みずぎ
38	ambulance	救急車	きゅうきゅうしゃ
39	fox	きつね	きつね
40	leash	かわひも	かわひも
41	goat	やぎ	やぎ
42	tongue	舌	した
43	wall	壁	かべ
44	rain	雨	あめ
45	plane	飛行機	ひこうき

Appendix B

Images of Vocabulary Cards (Goat)

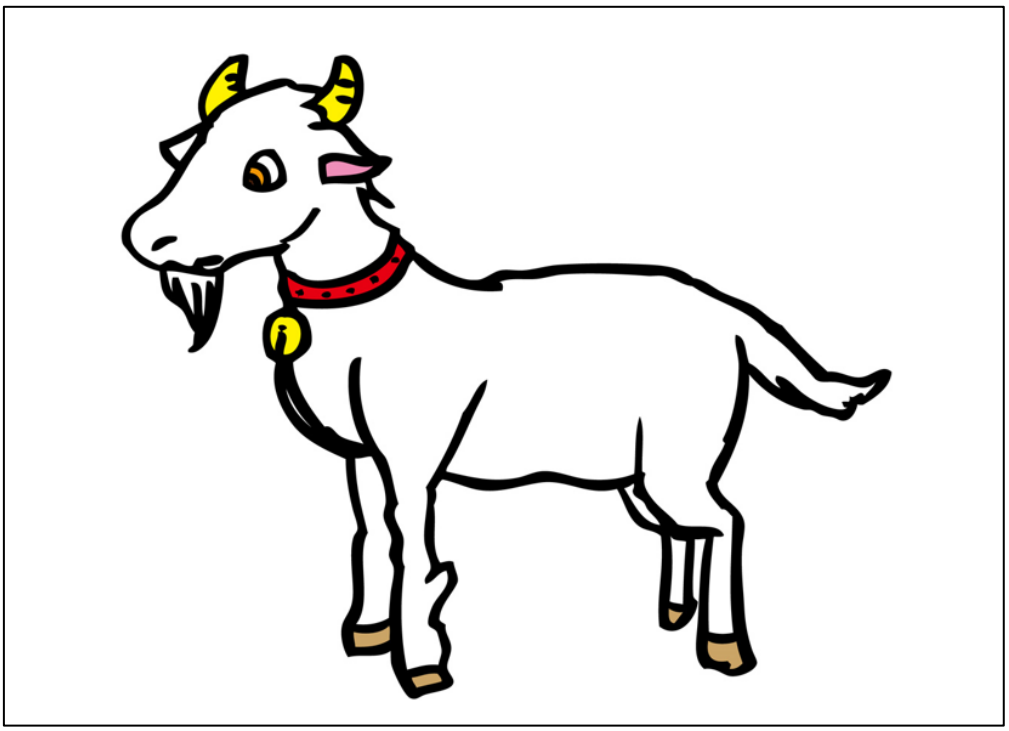

Image of card with Japanese (L1) Translation