THE IMPACT OF COGNITIVE STYLES IN MOBILE-ASSISTED LANGUAGE LEARNING: IS TECHNOLOGICALLY ENHANCED COURSEWARE EFFECTIVE FOR EVERY LEARNER?

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Abstract

This study examines the impact of learners' cognitive styles in learning English as a foreign language (L2) with multimodal environments. Simultaneous knowledge representation with verbal and visual annotations has been regarded as an effective way to retain knowledge and it has been verified by various studies in different settings. However, the manipulation of images for successful L2 learning, this study claims, depends on learners' preferences in the way they process knowledge with imagery: whether they are high imagers or low imagers. Thus, this study investigates the impact of learners' cognitive styles by developing two types of mobile-based applications to learn phrasal verbs. One application consists of sample sentences and images depicting the prototypical senses; the other consists of the sentences and their prototypical senses described verbally. As a result of fill-in-the-blank tests conducted one and two weeks after the treatment, it was found that the use of images could accelerate the processing to reach the correct answers whereas low-imagers process knowledge better with the verbally-oriented application than with the image-oriented application. These findings suggest that successful L2 learning requires multimodal knowledge representation and may be enhanced by materials that differ according to learners' cognitive styles.

1 Introduction

It has been assumed that the advantage of L2 learning materials lies primarily in the knowledge representation under a multimedia environment; the L2 materials available on personal computers or mobile devices could display not only verbal information but also visual information concurrently. This has been acknowledged as irrefutable not only because of theoretical support from Dual-coding theory (Paivio, 1971) and Generative theory of Multimedia Learning (Mayer, 2001), but also because of the findings of several studies, which demonstrate that multimodal knowledge representation facilitates longer knowledge retention (e.g. Chun & Plass, 1996; Lindstromberg & Boers, 2008; Sato & Suzuki, 2010; Sato, Lai & Burden, 2014). From the standpoint of our study, however, the advantage of multimodal L2 learning could not be gained by every L2 learner. Our previous study (Sato, Lai & Burden, 2014) demonstrates that the animated visual aids for learning L2 prepositions does not lead to better learning effects compared with materials using pictorial aids, whereas

the significant differences were found after dividing the participants in terms of their individual differences. Thus this study will conduct further examination of the impact on individual factors in L2 vocabulary learning.

1.1 Individual factors in multimodal L2 learning

It has been argued that L2 learners' individual difference affects their learning effects (e.g. Dörnyei, 2009; Ehrman et al., 2003; Skehan, 1991). However, CALL studies are less likely to consider these factors probably due to few critical remarks about multimodal representation as shown above. This study focuses on a certain individual factor based on the individual difference principle (Mayer & Moreno, 2003). The individual difference which this study seeks to investigate is learners' information processing styles. Learners who might be better at conceptualizing knowledge with the help of visual information have a holistic cognitive style, whereas others who might be good at analyzing knowledge through verbal information have an analytic cognitive style (Littlemore, 2001). They are called 'imagers' or 'verbalizers' (Riding & Rayner, 1998) respectively. According to Mayer & Moreno (2003), learners with high spatial ability got a higher learning effect than those with low spatial ability under a multimodal environment. Sato, Lai & Burden (2014) also show that the L2 imagers could make better use of multimodal L2 materials both in comprehension and production tasks. These findings trigger a further research question of what knowledge representation is preferable for L2 verbalizers. In this study, therefore, two new multimodal materials are developed to learn L2 phrasal verbs.

1.2 Phrasal Verbs

Phrasal verbs refer to multiword units which consist of a verb and a preposition or adverb. They are regarded as difficult to learn due to the fact that they are difficult to use in context although they appear frequently in any discourse. Lindstromberg (2001) argues that memorizing the verbs as idioms does not always help learners to use them in various contexts because of the nature of polysemy: as both verbs and prepositions entail several senses in each form, it is difficult for L2 learners to identify which sense is used in a certain context. This study choose this type of lexical item because traditional L2 vocabulary learning such as referring to a dictionary or a word list would not enhance learning, so other aids except for verbal information would be crucial.

2 Research questions

Considering the discussion above, three research questions are generated as shown below.

1. Do multimodal materials help Japanese L2 learners acquire phrasal verbs?
2. Do Japanese L2 imagers acquire the phrasal verbs more effectively than the verbalizers when they refer to the materials with visual aids?
3. Do Japanese L2 verbalizers acquire the phrasal verbs more effectively than the imagers when they refer to the materials with verbal aids?

2.1 Materials

The learning materials for this study were developed on Quizlet, a web-based tool to develop and learn L2 vocabulary, with which teachers can produce flashcards or fill-in-the-blank questions for the target words with pictorial aids such as pictures, photographs or graphs. L2 learners can learn the words whenever and wherever they are once they register with the site. This study focused on nine verbs (break, bring, come, give, go, keep, put, run, take) and three prepositions (above, on, over), amounting to eighteen phrasal verbs. As we prepared two sentences in each phrasal verb, there are thirty-six questions. In each question, the learners are expected to fill in the blank of the sentence (they are provided with a hint via a Japanese translation). In flash-card mode, for example, they can find the correct answer when they tap the screen.

This study attached two different types of aids. One is visual aids which depict the schematic image of each verb and preposition. These images were developed according to the image schema theory (Lakoff, 1987). Johnson (1987, p.2) defines image schemata as "abstract patterns in experience and understanding that are not propositional" and several studies which applied the schemata into L2 learning show the advantage for learning (Lindstromberg & Boers, 2008; Sato & Suzuki, 2010; Sato, 2016). The other type of learning aids are verbal explanations of the schematic images. Figures 1 and 2 are examples of the materials. The learners are expected to use the aids when they choose the appropriate verbs and prepositions. To reach correct answers, they will conduct conceptual mapping from the situation the sentence describes to the abstract patterns whether they are displayed visually or verbally. This study hypothesizes that the imagers utilize the images while the verbalizers utilize the verbal explanation.
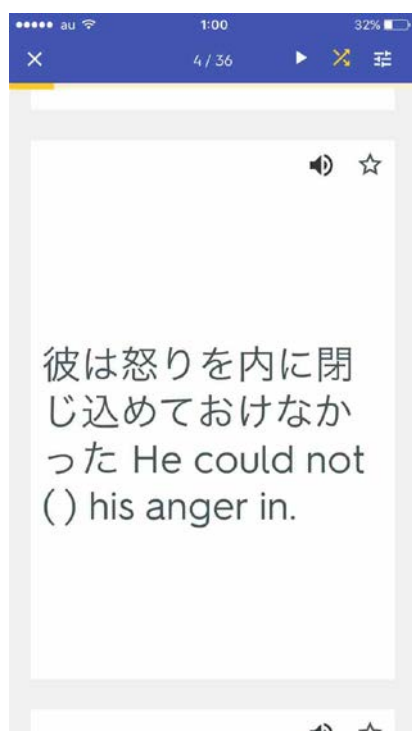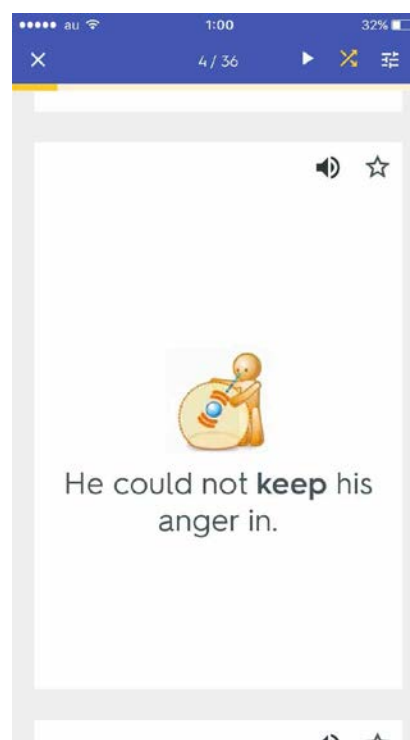

Fig, 1. Example sentence of the materials   **Fig. 2. Example image of the materials**

2.2 Participants

Fifty Japanese L2 learners participated in the research. They are all freshmen who belong to the faculty of economics of a private university in Tokyo. They were randomly divided into a control group (n=23) and an experimental group (n=27). The average scores on the reading section of the TOEIC test taken one month before the research (Control group: 212.39, Experimental group: 216.48) were not statistically different (t-test (p=0.25, >0.05)). Thus it can be said that the English language proficiency of each group was not different. This assures the effect of the L2 materials when any significant difference is found after the treatment.

2.3 Research procedures

The research was conducted in the computer room where their English classes were held, so they conducted all the assigned tasks on their computers. First of all, an experimenter asked them to complete the Information Processing Styles Questionnaire (Childers, Houston & Heckler, 1985) to divide them into a verbalizer or imager. Then they answered eighteen fill-in-the-blank questions about the target phrasal verbs as a pretest. After the test, the experimenter instructed them about how to register with Quizlet and use the materials to learn the phrasal verbs which was made for this research. After their trial to use the material for some time, they were told to study the words with Quizlet outside the class for a test to be conducted the following week. Their learning logs could be observed as a function of teacher modes on Quizlet, so it was found they had used Quizlet for some amount of time during the week.

One week after, a post-test was held, consisting twenty-eight questions. Half of the questions were from the sentences they learned on Quizlet, but the others were newly developed. Finally, a delayed test with fifteen questions was conducted one week after the post-test.

As all the tests were developed by an online test system, their scores on each test and time used to answer all the questions were automatically calculated. Their scores were analyzed by t-tests to compare the results between the control and experimental groups, and also by multiple comparison analysis (Fisher LSD) to compare the findings among the four groups (imagers and verbalizers of the control group, and imagers and verbalizers of the experimental group).

3 Findings

The findings of the analyses are shown here. Table 1 shows the average scores and answer time of each group in the pre, post-and delayed test respectively. As a result of t-test, there is no significant difference (Score: p=0.95, >0.05 / Time: p=0.48, >0.05) in the pre-test. However, in the post-test, a significant difference was found in terms of their answering time (Score: p=1.00, >0.05 / Time: p=2.58, <0.05). In the delayed test, a different finding was found. Although there was no significant difference in terms of the test score as the previous tests showed, the answer time showed a significant difference between the groups (Score: p=0.07, >0.05 / Time: p=3.71, <0.05), but the control group shortened their answer time more than the experimental group.

Table 1. Average score and answer time of each test

	pretest	post-test	delayed test	pretest	post-test	delayed test

With a spanning header "tal Group (n=27)" over the last three columns:

				tal Group (n=27)		
	pretest	post-test	delayed test	pretest	post-test	delayed test

Next, the findings of the multiple comparison are illustrated. The average scores and answer times of the four groups are illustrated in Table 2. Although no significant differences were obtained in the score and answer time among the groups, the answer time of the post-test showed a significant difference between imagers with visual aids and verbalizers with verbal aids (p=0.03, <0.05). As for the delayed test, there were no significant differences in their scores, three significant differences were found in their answer time: between the imagers with the visual aids and the imagers with verbal aids (p=0.00, <0.05); between the imagers with the visual aids and verbalizers with verbal aids (p=0.02, <0.05); and verbalizers with the visual aids and imagers with verbal aids (p=0.02, <0.05).

Table 2. Average score and answer time of each test (in terms of the individual factor)

	pretest	post-test	delayed test	pretest	post-test	delayed test
alizer s (n=12)	7.07	11.75	8.00	4.35	6.09	4.11

Furthermore, another multiple comparison analysis was conducted among the four groups in terms of the improvement of their accuracy rate between the pre and post-test and between delayed and post-test (see Table 3). The results show a sharp increase of the verbalizers with the verbal aids between pre and post-test. As a result of the multiple comparison analysis, a significant difference was obtained between the verbalizers with the verbal aids and verbalizers with visual aids (*p*=0.04, <0.05).

Table 3. Accuracy rate of the average scores between the two tests

	Control		Experimental	
	verbalizers (n=8)	imagers (n=15)	verbalizers (n=12)	imagers (n=14)
post-pre	19.99	6.93	2.15	5.58
post-delay	6.82	7.59	11.37	10.9

4 Discussion

According to the results of the three tests conducted, there was no significant difference between the groups whether the participants use visual or verbal aids, or they are imagers or verbalizers. Considering their scores improved after using Quizlet, the learning effect of multimodal L2 materials is supported. However, some significant differences were found in terms of their average answer time. In the post-test, the participants with the visual aids saved more answer time than those with the verbal aids, but the results of the delayed test were reversed.

As for the results after dividing them into verbalizers and imagers, some differences were found in their answer time. Although the post-test answer time of the imagers with the visual aids was significantly shorter than the verbalizers with verbal aids, in the delayed test, the answer time of those with verbal aids became significantly shorter than those with visual aids.

Furthermore, the accuracy rate of those with the verbal aids has considerably improved compared with those with the visual aids, although no significant difference was obtained in the rate between the post and delayed test.

5 Conclusion

This study challenged the advantage of multimodal L2 materials. An advantage which has received few critical remarks. It hypothesized that multimodal knowledge representation will bring about better effects for imagers than verbalizers, so verbalizers may prefer the traditional knowledge presentation which verbally depicts the conceptual mapping from schema to sentences. Thus three research questions are answered according to the findings.

First of all, the answer to question 1 is no in terms of scores but yes in terms of answer time. Regardless of the types of aids to explain the core meaning of the verbs and prepositions, their answer time was improved in either the post or delayed test. As for question 2, the answer is yes only in terms of the answer time of the post-test. In the delayed test, however, the results were reversed. Finally, the answer to question 3 is yes for the answer time of the delayed test and accuracy rate between the pre and post-tests.

Overall, the impact of the visual aids is rather short-lived, while that of verbal aids continues longer, not only for verbalizers but also imagers. Our study could not answer our research questions clearly and our findings are not what we expected, so they include some pedagogical implications for L2 material development with multimodal functions. Considering the gains of the visual aids in the post-test and of the verbal aids in the delayed test, representing both aids may facilitate L2 learners' information processing although too much information on one small screen must be avoided. In order to verify more generalized conclusions about the impact of individual factors in multimedia learning, further studies must be conducted with larger samples and different research designs.

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