

# **EXAMINING THE IMPACT OF INDIVIDUAL DIFFERENCES OF INFORMATION PROCESSING STYLES IN TECHNOLOGY-ENHANCED SECOND VOCABULARY LEARNING**

Takeshi Sato

([tsato@cc.tuac.jp](mailto:tsato@cc.tuac.jp))

Tokyo University of Agriculture of Technology, Japan

Yuda Lai

([yudalai@gmail.com](mailto:yudalai@gmail.com))

Providence University, Taiwan

Tyler Burden

([tylerburden1@gmail.com](mailto:tylerburden1@gmail.com))

Meisei University, Japan

## **Abstract**

Many studies have been conducted to verify the effectiveness of technology-enhanced visual aids in second language learning, and conclude the positive effects of the aids both in incidental and intentional vocabulary learning. On the other hand, previous research by Sato & Suzuki (2010, 2011, 2012) to compare the effectiveness of still pictures with animations depicting the schematic images of English prepositions found no significant difference between the pictorial and animated images. This indicates that successful second vocabulary learning with technological aids results not only from the technology itself, but the individual factors of the learners who use the technology. This study, therefore, explores the individual factors that affect the learning of prepositions through the use of animations, focusing on information processing styles and the first language of the learners. The results of our research conducted both in Taiwan and Japan show that the Taiwanese received a positive effect in the post-test administered immediately after using the visual aids whereas the Japanese received a positive effect in the delayed-test two weeks later. Besides, the imagers, who prefer using images in processing information, tend to get better results than the verbalizers, who prefer using languages in their information processing, whether they are Taiwanese or Japanese. From these findings, we conclude the importance of individual factors in examining second vocabulary learning with technology.

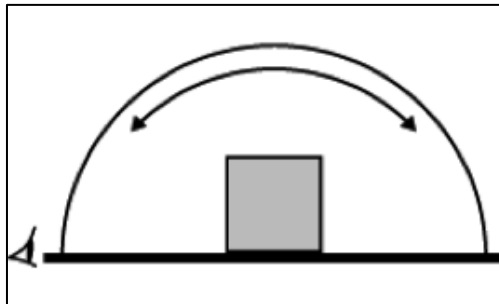
## **1 Introduction**

One of the primary goals in second or foreign language (L2) learning and teaching is to improve the comprehension of L2 texts and discourse. To achieve this comprehension, increasing attention has been paid to vocabulary in L2 learning and teaching, because insufficient vocabulary has been consistently reported to be a major problem for achieving L2 proficiency (e.g. Ellis, 1995; Hatch & Brown, 1995). As a result, many studies have focused on how L2 vocabulary is most effectively learned (e.g. Laufer & Hulstijn, 2001).

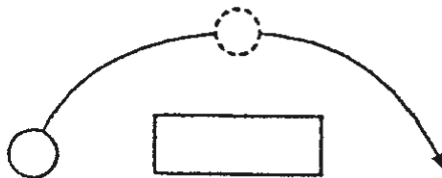
One of the effective tools we address here is a pictorial aid as a gloss (Lomicka, 1998) in explaining the meanings of L2 words in dictionaries and learning materials. This is because much research postulates the positive effect of pictorial aids as glosses, leading to longer retention of the target L2 words (e.g. Chun & Plass 1996; Al-Seghayer 2001; Yoshii & Flaitz 2002; Yeh & Wang, 2003) and appropriate use of L2 words according to the contexts (Sato & Suzuki 2010, 2011, 2012). These findings might indicate that technological aids will always bring better results in L2 vocabulary learning than the aids shown on paper.

### **1.1 Challenges of technology-enhanced L2 vocabulary learning**

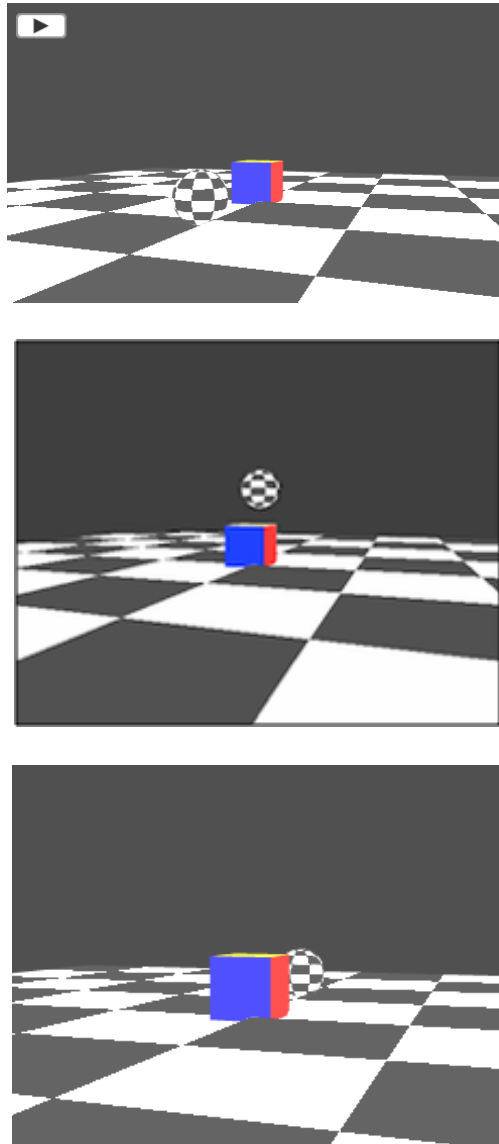
Despite the fact that much research concludes the effectiveness of pictorial aids displayed on a PC screen, there is a challenge to be examined. This is the impact of individual differences of the learners who utilize the aids. Al-Seghayer (2001) shows that the animation is a more effective technique than the use of still images. Littlemore (2009) also claims that three-dimensional diagrams might be useful when they could be displayed dynamically. Therefore, it might be thought that the more technology-enhanced visual annotations learners are exposed to, the better learning outcomes they could get. According to my previous research, however, it was found that using technology-enhanced aids does not always bring better text comprehension with L2 target words. Sato & Suzuki (2010) examine the relative effects of two types of visual aids, still images and animated images, in learning English prepositions. Each image is developed based on the concept of the image schema (Lakoff 1987) and central image schema (Dewell, 1994) which conceptually depict the prototypical sense of each word. Figure 1 shows the visual aid of the preposition ‘over’ (Tanaka et al., 2003), which is a still picture conceptually depicting the prototypical sense based on Dewell (1994)’s central image schema (see in Figure 2).



**Fig. 1. Static image of over as a visual aid (Tanaka et al., 2003)**



**Fig. 2. The central image schema of over (Dewell, 1994)**



**Fig. 3. Animated images of “over” (Sato & Suzuki, 2010)**

Figure 3 depicts a series of the animation depicting the above-across schema like Figure 1, but they are developed in an animation format. After showing these glosses, a vocabulary test was conducted to examine which type of visual aid best develops the understanding of the senses of “over”.

The findings conclude that no significant difference between the two visual aids is found, although significantly different learning results are found between visual annotations and verbal annotations (which verbally explains the prototypical sense above). The other studies Sato & Suzuki (2010, 2011, 2012) conducted with different research designs, also illustrate the same results: no significant difference between pictorial and animated aids in learning prepositions. This suggests that the successful use of technology-enhanced visual aids for L2 vocabulary learning might result not only from the advancement of the technology utilized, but also from individual factors of the users.

## **1.2 Individual factors with successful use of technology**

Our study questions whether every learner can get a positive effect with technology-enhanced aids and therefore hypothesizes two individual factors that might affect the successful use of technology-enhanced visual aids. These are cognitive styles and the first language of each learner.

Foreign language teachers frequently report that with the help of visual aids, some learners appear to easily and quickly learn the target vocabulary such as finding an appropriate word or sense according to contexts, while others appear not to. For example, some learners might quickly visualize the situations the following sentences show: “The airplane is flying over the mountain”, “My house is over the river”, or “You will get over a problem” with the help of the visual aids shown above, whereas others may still find it difficult to connect the target word in the sentences with the images. Therefore, the ease of the visualization in information processing leads us to focus on the difference in learners’ cognitive styles. Some learners, for example, might be better at conceptualizing knowledge with the help of visual glosses, whereas others might be good at analyzing knowledge through verbal information. These inclinations can be captured by grouping the cognitive learning styles as holistic cognitive style or analytic cognitive style (Littlemore, 2001), or the learners as imagers or verbalizers (Riding & Rayner, 1998). Littlemore (2001) shows that those who have a holistic cognitive style or better metaphoric competence, could derive metaphorical senses faster than those who have an analytic cognitive style. Grounded on the above, we further investigate the correlation between learners’ cognitive style and the effectiveness of visual glosses in learning L2 vocabulary. As Boers and Lindstromberg (2008) point out that L2 learning with the approach of Cognitive Linguistics would be preferable for visualizers than for verbalizers, our study supposes that this claim could be applied to L2 vocabulary learning with technology-enhanced visual aids developed by Lakoff and Dewell’s image schema.

In addition to the cognitive style, the difference in learners’ first language (L1) is another individual factor to be examined. English prepositions are regarded as difficult to learn because L2 learners, despite being advanced learners, do not always understand their meanings (Brala, 2002; Lindstromberg, 2001). This might be especially true for Japanese learners because translations added to each sense of the target word may hinder learners from understanding the semantic networks of the senses. For example, a prototypical sense of “over” like “an airplane is flying over the mountain” is translated into “hikouki ga yama *no ue wo tondeiru*” in Japanese, but the Japanese translation of over “*no ue wo*” is also used in the prototypical sense of “above” and “on”. This overlapping might lead to inappropriate use of the senses according to the context. However, we are wondering whether this difficulty would be applicable to learners whose L1 is not Japanese. For example, Chinese learners of English, whose L1 linguistic features are very different from that of Japanese but are rather similar to English, might not experience the same difficulty.

## **2 Research questions**

### **2.1. Participants**

Considering these discussions, our study speculates the impact of the individual factors that have greater influence on successful L2 vocabulary learning with technology-enhanced animations as visual aids. With special attention to English prepositions, several variants are discussed: still images or animated images, verbalizers or imagers, and Japanese learners or Chinese learners. Our research questions are as follows:

1. If L2 learners use animations to help comprehend the semantic network of the target prepositions, could the animations enhance their appropriate use of the word senses?
2. If the learners are imagers, could the use of the animations enhance their appropriate use of the senses?
3. If the learners' L1 is Chinese, could the use of the animations facilitate their appropriate use of the senses more than if their L1 is Japanese?

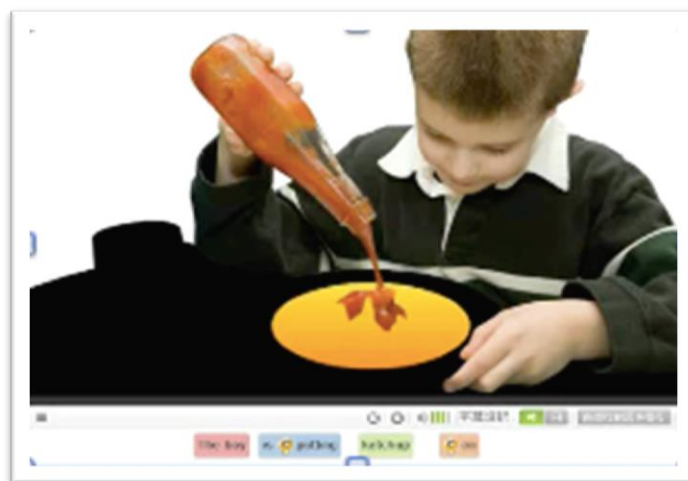
### **2.2. Procedure**

The research was conducted in a Taiwanese university and three Japanese universities and the total participants amount to 160. They are all freshmen in the universities to which they belong. The Taiwanese participants are from the department of English literature while the Japanese participants are from departments not specialized in English or related subjects; economics, commerce and education respectively. They are divided into two groups: a control group and an experimental group. Those who belong to the control group are asked to use still images and those belonging to the experimental group are asked to use animations as interventions in learning three English prepositions, "above", "on" and "over". As the research was conducted in their language classrooms, the groups are divided according to the class they belong to. We estimated the English language competence of both groups would be standardized without any test because in all universities the students are allocated to each language class according to their student id numbers, not their English levels.

All of them are firstly asked to complete Processing Style Questionnaire (Childers, Houston & Heckler, 1985), which is widely used as a measure of individual information processing styles. Boers and Lindstromberg (2008) also used the questionnaire to divide their participants into verbalizers and imagers. According to the division of the participants Boers and Lindstromberg (2008) conducted, the participants in our research are also divided into imagers and verbalizers within each group. As a result, four groups are formed (verbalizers in the control group; imagers in the control group; verbalizers in the experimental group; and imagers in the control group).

After a pre-test, the still visual aids and animated aids for three English prepositions are shown. The prepositions are "above", "on" and "over", each of which has the same translation in both Japanese 'no ue ni (located at the upper surface)' and Chinese 'zai ... shangmian'. Figure 4 shows the example of the animated image of "on", which was

developed by the chief editor of the English-Japanese dictionary (Tanaka et al., 2003) whose still images are used as the visual aids for the control group. After learning the three words by referring to the visual aids and then reading the lists of the example sentences of each word, a post-test was conducted to examine which group got the better results with the use of the aids. Two weeks after the post-test, a delayed test was conducted without prior notice. All the vocabulary tests are essentially the same test consisting of 40 questions where the students are required to fill in a blank space to complete a sentence using one of the three prepositions under investigation. The only difference between the three tests was that the order was randomized. No feedback was given after the pre and post tests.



**Fig. 4. Animated images of “on”**

All the data collected from each vocabulary test and writing test was analyzed by *t*-test according to the groups they belonged to and the information styles they were categorized by.

### **2.3. Findings**

The findings we found after analyzing the data from the reading and writing tests are as follows.

- No significant difference was found between the control group and experimental group in each country, so this supports the prior assumption that knowledge of the three prepositions was standardized before the intervention.
- No significant difference was found between the control and experimental group of both countries in post and delayed tests.
- The imagers in the experimental group who used the animations showed a significant difference in the post-test and marginal significance in the delayed test, compared with the verbalizers in the control group.
- The imagers in the experimental group showed a significant difference in the post-test compared with the verbalizers in the control group.
- As for the Japanese L2 learners, the experimental group showed a significant difference in the delayed vocabulary test.

- As for the Taiwanese L2 learners, the experimental group showed a significant difference in the post vocabulary test.
- As for the Japanese L2 learners, imagers in the experimental group showed no significant difference compared with any other groups except for a marginal significance between the difference of the scores in the post and delayed tests.
- As for the Taiwanese L2 learners, the imagers in the experimental group showed a significant difference in the post-test and a marginal difference in the delayed test, compared with the verbalizers in the control group and also showed a marginal significance in the delayed test compared with the imagers in the control group.

### 3 Conclusion

This study explored the impact of individual factors in learning English prepositions with the aid of technology-enhanced visual aids. The effectiveness of the animated annotations in learning three English prepositions was examined focusing on the information processing styles and the first languages of the learners. Three vocabulary tests were conducted just before, just after and two weeks after the intervention of visual aids shown to each group. The collected data was analyzed to examine the significant difference between the control and experimental group, the visualizers and imagers, and Japanese and Chinese as L1.

The findings show that some significant differences were found after dividing the participants into imagers and verbalizers and Japanese and Taiwanese, despite the fact that overall no significant difference was found not only in the post test but also in the delayed test. The use of animation could have a positive effect on learning the English prepositions, and the imagers got better scores than the verbalizers. Furthermore, the difference between the imagers in the control and experimental groups was clearer for the Taiwanese than for the Japanese subjects. From these findings, we can conclude that the individual factors affect the successful use of technology-enhanced visual aids in L2 vocabulary learning, and further research should be conducted to find out what other individual factors affect successful use of technology in second vocabulary learning.

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