The Influence of the Mind's Eye on Reading Skills

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ABSTRACT

After inspecting the effect of image production on students' metacognition in our previous study "Utilizing Social Media and Student-Generated Images and Video as a Facilitator of Metacognition" we found that we wanted to analyze students' Vividness of Visual Imagery (VVI) and Trial-by-Trial imagery levels and see if there is any correlation to language learning skills. Understanding and testing the VVI, or the mind's eye, has been an area interest for many researchers since the early 1970s. Visual Imagery or the mind's eye, is the part of the brain that generates imagined images. Many cues generate these images. One such cue is text based literature. For example when you read the word "tomato" you picture what that tomato looks like without actually seeing a physical tomato with your eyes. Multiple tests have been carried out showing the correlation of an individual memory recall skills as well as athletes' achievements and their VVI levels. It is the aim of this study to investigate whether the level of VVI correlates with a learner's reading comprehension or recall skills.

INTRODUCTION

This paper will examine the correlation between an individual's Vividness of Visual Imagery (VVI; Marks, 1973) as well as their Trial-by-Trial vividness (D'Angiulli, 2013) imagery level and reading comprehension and reading recall abilities. Visual Imagery or the mind's eye, is the part of the brain that generates imagined images (Pearson, & Kosslyn, 2013; Thomas, 2016). Many cues generate these images. One such cue is text based literature (Tulving, McNulty, & Ozier, 1965). For example when you read the word "tomato" you picture what that tomato looks like without actually seeing a physical tomato with your eyes.

In semiotics Saussure describes signs as something that has meaning and each sign has a signifier, the article that is omitting the signal, and signified the receiver and interpreter. In the example above the written word “tomato” would be the signifier and you would be the signified. Saussure concluded that neither signifier or signified could exist without the other. (Saussure, 1959). As you receive this signal you generate a mental image in your mind that is unique that only you have the ability to perceive.

In our prior research we explored the process our participants went through in trying to produce their perceived visual imagery into video that others could see. We were interested to see if normalizing the procedure of pre-visualization, production and post-production would facilitate metacognition (Pearson, Rademaker, & Tong, 2011). The process our participants underwent was very informative but difficult to measure. We used a TAPP based approach and coded our participants’ data Metacognitive Thinking Skills (MTS; Tuncer & Kaysi 2013), this left us questioning what was happening in the participant's mind that we were not measuring. We were curious about the uniqueness of participants internal images and wondered how well they could communicate the images from what we called the internal camera (Von Joo & Hall, 2015). In the course of this research we began to question how people differed in the abilities to produce mental imagery they were trying to communicate.

The idea of mental images is not new to science. The first time mental images were recorded being connected to how people perceive the nonphysical was by John Tydall (1870) in his "Scientific Use of the Imagination." We found that in psychology measuring what mental imagery does and how it differs from person to person has been coming up for decades. In the early 1970s Marks started to question if the recall of someone who said stated that their imagery was clear and vivid was better than someone who felt they had a vague or dim image (1973). At this time many researchers such as Paivio (1969) and Sheenan (1969) were interested in how mental imagery related to memory. They questioned whether vivid

mental imagery would allow an individual to remember incidental information that they had not anticipated needing to remember.

Past research has shown that a high level mental imagery can produce higher achieving athletes (Hall, 1998; Watt, Spittle, Jaakkola, Morris, 2008; MacIntyre et al., 2013), longer recall of incidental memory (Hertzog & Dunlosky, 2006), and clearer communication (Kosslyn, Thompson, Ganis, 2006). An individual who could form High Imagery (HI) of a text better than another their recall tended to be stronger in recall. Also when Low imagery (LI) individuals were instructed to form images of text their recall was enhanced. This raised many questions for us in that we wanted to see if this applied to second language learners as well. Our questions are:

- Does a general VVIQ score correlate with a reading comprehension and or recall score in testing circumstances?
- Does a specific trial-by-trial vividness score generated from a passage correlate with comprehension and or recall score testing circumstances?

As we mentioned above, a high level of visual imagery has benefits for both achievement and memory. We felt that language learners would want these benefits when taking high stakes tests. This is why we picked a passage from the TOEFL practice test and an additional passage from a standardized reading test by Pearson Longman. We would like to see if a general high level of imagery helps in testing. The VVIQ is seen as giving a general understanding of an individual's overall capacity for mental imagery, whereas the trial-by-trial allows the individual to rate their level of vividness according to any subject, not only those included in the VVI questionnaire (Begg, 1988; Hertzog and Dunlosky, 2006; D'Angiulli, 2009; Pearson et al., 2011, D'Angiulli et al., 2013). This is why in our second question we look at what a high level of visual imagery specific to one cue in a trial-by-trial might produce as opposed to a general VVI level.

MATERIALS AND METHODS

In this study we first tested our participants VVI using an adapted version of Marks Vividness of Visual Imagery Questionnaire (VVIQ; 1973). We then gave the participants two different passages to read. After each passage participants first rated their level of Trial-by-Trial imagery using the same scale seen in Figure 2 and then answered comprehension questions. One week later the participants did a delayed free recall test of both the passages (Figure 1).

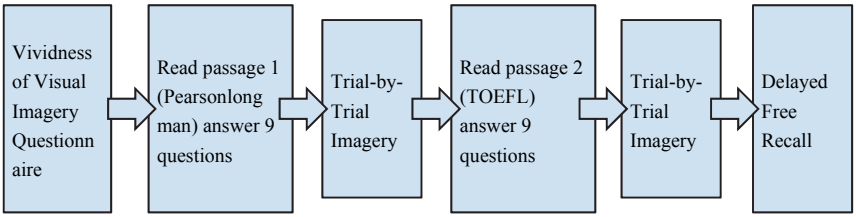

Figure 1. Overview of the steps that participants underwent.

Participants

Participants were 54 sophomore level students enrolled in the International Communication department at Kanda University of International Studies. The Participants were separated into two groups that underwent the same order of operations however the procedure of how the VVIQ was presented differed between the two groups. When taking the VVIQ Group 1 were given the original statement and questions on one page whereas group 2 were given the statement and questions on separate pages (Table 1). We also removed the numbers from the 5 level scale for Group 2 as we suspected the numbers might influence participants' rating (Figure 2). We did the latter for group 1 because that is how the original VVIQ was administered, however we used the former method for Group 2 to enhance the

opportunity for visual imagery to occur. All steps for both groups in the experiment were done on computers that had identical operating systems.

VVIQ

We chose Marks VVIQ because the questionnaire was used in many of the studies we referenced when designing our research method. We adapted the VVIQ in two crucial ways for our participants. The first being the grammar and vocabulary used in the questionnaire. We adapted this because our participants were L2 English speakers who varied in fluency. We did not want language comprehension of the survey to interfere with our participants' mental imagery process. We first gave Mark's original VVIQ to an external trial group and had them circle sections of the questionnaire that were unclear. In order to adapt the sections of the VVIQ we ran the questionnaire through readability and vocabulary level rating tests and then adapted accordingly The second adaptation to the VVIQ was that we eliminated a question that focused on an ocean scene because we felt that the question would be to heavily affected by the participants exposure. In redesigning the questions our main priority was our participants understanding as well as upholding the original meaning. Due to these priorities the word order in the adapted question may seem awkward, but we felt it necessary to keep the questionnaire as close as possible to the original VVIQ that has been cited in over 700 studies regarding mental imagery (Table 1).

Table 1

Sample of original VVI Questionnaire alongside adapted version.

Test	VVIQ	Adapted
Original statement	Think of some relative or friend whom you frequently see (but who is not with you at present), and consider carefully the picture that comes before your mind's eye. Then rate the following items:	Think of a relative or friend you see often (but who is not in the room now), and think carefully of the picture that you see in your mind. Then rate the following questions:
Question 1	The exact contour of face, head, shoulders, and body.	The exact shape of their face, head, shoulders, and body.
Question 2	Characteristic poses of head, attitudes of body, etc.	How they move their head, attitudes (mood) of body, etc.
Question 3	The precise carriage, length of step, etc., in walking.	What their walk is like, size of step, ect.
Question 4	The different colors worn in some familiar clothes.	Colors or designs in clothes they wear often.

We did not amend the original wording used in Marks' scale, instead participants were normed on the meaning of the levels. The final adapted VVIQ that we administered had a total of 25 amended questions that the students rated from the scale in Figure 2. Please note that we did not use the numbers for Group 2 seen above on the scale.

1	2	3	4	5
Perfectly Clear and as vivid as normal vision	Clear and reasonably vivid	Moderately clear and vivid	Vague and dim	No image at all (only "knowing" that you are thinking of the object)

Figure 2. Vividness of Visual Imagery Questionnaire scale for participants to self-rate perceived imagery level.

Passage Selection

Two passages were selected. One from the practice TOEFL test and the other from the pearson longman reading test used to assess English reading levels of students in the United States. Both passages were run through readability tests. Our goal was to find preexisting passages that reflect a test that is given to test English. TOEFL passages on average test at a twelfth grade reading level. We wanted a lower level passage in an effort to alleviate the level of language attainment affecting the participant's score more than their level of imagery. In Table 1 you can see that the readability levels and reading time required for both passages. After testing the overall readability level, scores and time we also wanted to test the individual vocabulary using the common words list in lext tutor (Table 2).

Table 2

Average reading grade levels, score, and times for passages tested

Passage	**1 (Pearsonlongman)**	**2 (TOEFL)**
Readability Formula	**Grade**	**Grade**
Flesch-Kincaid Grade Level	5.5	10
Gunning-Fog Score	7.2	12.7
Coleman-Liau Index	10.8	12
SMOG Index	8.2	12.2
Automated Readability Index	5.8	10.2
Average Grade Level	7.5	11.4
Readability Formula	**Score**	**Score**
Flesch-Kincaid Reading Ease	76.8	56.4
Spache Score	3.5	4.7
New Dale-Chall Score	3.5	5.3
Reading time		
Reading Time	2:15	3:04
Speaking Time	4:03	5:32

Table 3

Word count and word frequency levels of text for passages tested

Passage	**1 (Pearsonlongman)**	**2 (TOEFL)**
Word Count	508	698
Words per Sentence	11.8	18.4
Word Levels		
K1	83%	76%
K2	6%	14%
K3	4%	6%
K4	4%	4%
K4≤	3%	0.70%

Trial-by-Trial

The Trial-by-Trial vividness core used the same scale as seen in Figure 2. The participants gave separate ratings for their level of visual imagery for each passage. This would test the participant's specific level of imagery for the passage they read opposed to their general score acquired from the VVIQ. The participants also scored the two passages separately in order to isolate whether one passage was easier to form visual imagery for. Trial-by-trial vividness scores have been found to be correlate more reliable for delayed incidental memory opposed hat of the VVIQ (Runge, M., Bakhilau, 2015).

Comprehension and Recall Tests

Both passages were followed with nine comprehension questions. The questions were multiple choice and short answer questions that were the original questions used in the two practice tests. These questions were not amended because we wanted the participants scores to reflect these actual tests as close as possible. All the questions were equally weighted and total average score was computed to later be correlated with the VVIQ, trial-by-trial and

recall test scores.

One week after reading the TOEFL and Pearson Longman passages participants were given a delayed free recall test. This test was administered to measure the student's long term retention of the incidental information from the reading. The participants were instructed to write down as many words and ideas that they remembered from the passages. There was no time limit given for this exercise. Participants were asked about each passage separately in English and were then asked in Japanese if there was anything else they remembered about the passage that they would like to add. The TOEFL passage had a total 18 different points and the Pearson Longman had 17. Participants were scored by how many concepts they mentioned out of the total. If information from the original passage was misunderstood but it was clearly recalled the participant was given credit for that answer.

RESULTS

There was no significant correlation between the VVI and both the comprehension and recall test scores when the passages were combined. It does however show a positive correlation between the comprehension and recall test scores. Three Pearson product-moment correlation coefficient were computed for both groups. The three correlations were the VVI and comprehension scores, VVI and recall scores, and lastly the comprehension and recall scores were computed. The former two correlations were computed to test whether there is a connection between the VVI and reading skills and the former was to test if the scores for comprehension and recall tests would correlate. For Group 1 There was a no correlation between the participants comprehension score and VVI variables $r = .036$, $n = 35$ $p = .837$. There was also no correlation between the recall score and VVI variables $r = -.022$, $n = 35$, $p.901$. However, there was a positive correlation between the participants comprehension and recall scores $r = .405$, $n = 35$, $p = .016$. The second was to assess the

relationship between. There were no significant correlations between any of the variables for group 2 when both the Longmen Pearson and TOEFL passage scores were combined. After the totals were calculated for both groups the groups were then further separated to address the if the trial-by-trial scores correlated with the comprehension or recall scores.

Group 2's VVIQ and Trial-by-Trial scores computed with their comprehension and recall scores. Imagery there was a significant correlation found to the comprehension and recall. For Group 2 There was a negative correlation between the participants comprehension score and Trial-by-Trial variables r = .620, n =17 p =.008. There was also a negative correlation between the recall score and Trial-by-Trial variables r=-.579, n=17,p=.015. There was no significant correlation for the trial-by-trial and test scores for Group 1, or the Longmen Pearson passage for Group 2.

Figure 3 shows the negative correlation Stating that when the trial by-trial score low imagery the participant's recall and comprehension scores were also low and conversely if the students had high imagery they scored highly on both their comprehension and recall scores.

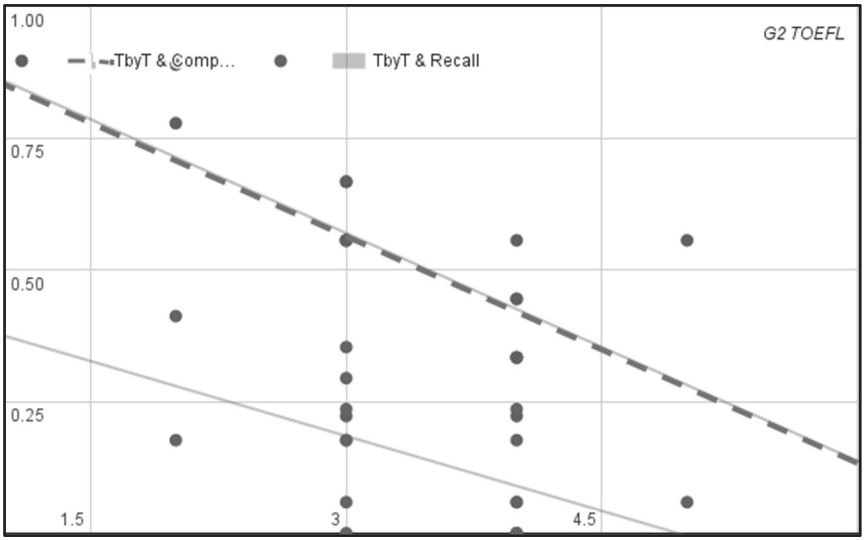

Figure 3. Correlation for TOEFL Trial-by-Trial comprehension and Trial-by-Trial delayed free recall.

DISCUSSION

Though there were instances when we found that participants Trial-by-trial imagery levels correlated with recall and comprehension scores there was no significant correlation between the VVI and comprehension or recall scores. According to the lack of correlation found in our study a general VVI level may not affect the reading comprehension or recall level. Many researchers of visual imagery have recently come to favor trial-by-trial tests over the VVIQ because visual imagery may be more task specific than it is general (D'Angiulli, et al., 2013; Runge, Bakhilau, Omer, & D'Angiulli, 2015;). These same studies that are evaluating the two imagery level tests have also found that they often yield very different data and therefore are not interchangeable. Group 2 had significant correlation between the trial-

by-trial between the TOEFL passage in both comprehension and recall whereas they only had a strong correlation for the recall in the Longmen Pearson passage. This suggests that the level of imagery created for the TOEFL passage reflected more of what the participants could comprehend and recall.

In sports psychology the VVIQ score can often correlate with what an athlete can achieve. Sports trainers often argue for the value of what an athlete can accomplish by clearly visualizing what they are attempting (MacIntyre, 2012). In our research our participants were focused on comprehending and recalling which did not correlate with the VVIQ. However perhaps if the students were given the task to picture how the test would look or how it would feel to finish and focus on the test this may have more in common with athletes that train to enhance their general VVI.

The other possibility is that our participants self-assessment of their VVI could not have been as accurate as that attain in other studies using the VVIQ. When we administered the VVIQ we were very surprised at the expedited nature in which the participants rated the level imagery. When we gave the VVIQ to participants we stated that it was not a test but instead a survey. However due to the nature of the scale design being very test like we feel participants could have felt that finishing quickly was a matter of pride. Also in order to keep the participants familiar with the rating system we gave the VVIQ and reading test at the same time which could have influenced the participants' self-awareness of their level of imagery.

An additional significant finding in our results was the differences found between the experimental groups correlations. We believe that the significant differences between the two experimental groups were due to the procedure of how the digital test was administered. When taking the VVIQ group one had the questions on the same page as the original cue this replicated the original questionnaire used by Marks, however with Group 2 the cue was given and then the questions were each on separate digital pages. We feel that this difference may

have encouraged the participants in group 2 to make more of an effort to form visual imagery. This coincides with what was found in Pavilo experiments when low imagery level participants scored higher after being encouraged to focus on forming creating mental imagery (Yuille, 1983). Further research with a larger sample size would be necessary and we recommend continue use of the VVIQ as a norming tool for participants. In accordance to our results we feel that measuring and enhancing a learner's mental imagery level has the potential to contribute to gains in both comprehension and recall.

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