

## The Effects of Theory of Mind and Metacognition on Performance.

Haruo KIKUNO & Yuichiro KIKUNO

(平成28年10月4日受理)

### Abstract

In this study it was examined whether metacognition and Theory of Mind facilitate performance in achievement tests of History, Japanese and Society. It was expected that students with high metacognition would be better performers in achievement tests than students with low metacognition. It was also expected that students with high Theory of Mind would be better performers in achievement tests than students with low Theory of Mind. The results showed that the correlation coefficient between metacognition and History was significant but the correlation coefficient between Theory of Mind and achievement was not significant. The results suggest that metacognition influences achievement but Theory of Mind does not influence it.

### Introduction

How do students acquire knowledge in class at school? What factors make them acquire knowledge in class and show good performance in achievement tests? In this study it is examined whether metacognition and Theory of Mind of students is a determining factor for their acquiring knowledge in class.

Many studies indicate that metacognition influences the achievement tests at school (e.g., Sannomiya, 2008). Why does metacognition facilitate a student's performance in the achievement test? Flavell(1976) assumed that metacognition consisted of both monitoring and regulation aspects. It is also assumed that metacognition includes metacognitive knowledge, metacognitive regulation and metacognitive experiences (Flavell,1979). These metacognition factors would facilitate students to activation of good strategies to understand class in school.

Many studies suggest that Theory of Mind is an important ability for children and adults to understand others' minds (Doherty, 2009; Mitchell, 1997; Premack. & Woodruff, 1978; Wimmer & Perner 1983). Theory of Mind is also important for students to understand the teacher's minds as students acquire much knowledge by communication between teachers and students. So, it is assumed that Theory of Mind also facilitates students to understand knowledge in class. When we solve problems in tests in school, we have to understand the intention of the

questions. It is assumed that excellent children would understand what a question-master or a teacher thinks when he/she makes the questions. Previous studies showed that if students had high metacognition, the performance in mathematics of students with high Theory of Mind was superior to that of students with low Theory of Mind (Kikuno, 2012, 2013a, 2013b). It was also shown that if students had low metacognition, the score in mathematics of students with high Theory of Mind was not superior to those of students with low Theory of Mind. These results suggest that metacognition would activate Theory of Mind in answering questions. If students have high metacognition, then they would activate Theory of Mind to understand the intention of a question-master or a teacher so that they answer the question correctly. However, if students have low metacognition, then they would not activate Theory of Mind so that they do not answer correctly.

In this study it was examined whether metacognition and Theory of Mind facilitate performance in the achievement tests of History, Japanese and Society. It was expected that students with high metacognition would show better performance in achievement test than students with low metacognition. It was also expected that students with high Theory of Mind would show better performance in achievement test than students with low Theory of Mind.

## Method

### ***Participants:***

The participants were fifty students including 39 male and 11 female students at university. Their mean age was 19 to 20 years old.

### ***Design and Procedure:***

Participants took three tests including the Personal question, the Metacognition test, the Theory of Mind test and the achievement test of History, Japanese and Society. The research was done all at once in a group. They filled in answers in each test.

In the Personal question, they were asked to give their sex, number of siblings, dominant hand, and dominance of faculty of liberal arts or physical science. In the metacognition questionnaire, they were asked to grade according to four ranks (from 1 to 4). The metacognition questionnaire is a questionnaire test consisting of fifteen questions. Table 1 shows items on the metacognition questionnaire. In the Theory of Mind questionnaire, they were asked to grade according to four ranks (from 1 to 4) how they understand another's mind (Kikuno, 2013). The Theory of Mind questionnaire consists of ten questions as given in Table 2. In the achievement test, they were asked to answer the questions. The achievement test consisted of four question including the History, the Geography,

and National language. Table 3 shows questions of the achievement test.

**Table 1**  
**Metacognition Questionnaire**

Questions
I know the limit of one's memory.
When I answer a problem, I can understand "what do you not understand?" by oneself
When I solve a problem, I intend to solve a problem in which way.
When I solve a problem, I check it whether one's way is right
When I solve a problem, I stop it as soon as I think that a way is strange and think about a different way.

**Table 2**  
**Theory of Mind Questionnaire**

Questions
It is difficult to suppose the feeling of the person from an action.
Even if a joke is said, it is incomprehensible.
I am not good at saying a joke.
Even if it is necessary to deceive it, I cannot deceive it well.
During a conversation, a story does not often engage with a partner.
It is said that I am good at ordering a person.
I can suppose the feeling of the partner just to look at the expression of the partner.
It is hard to read the other side of the feeling of the partner.
A feeling is reflected on an expression.
I may mishear the contents of the story.

Table 3  
Achievement test

Questions
<b>History</b>
Who founded Muromachi Shogunate government?
When was Kamakura Shogunate government founded?
<b>Geography</b>
Is New York a capital of USA?
Was Vietnam a colony of France?
Is the most populous country is China in the world?
Is Monaco a smallest country of the area in the world
Is the area of Italy smaller than Japan?
<b>Japanese</b>
Who is an author the following novel? Choose the author among choice group.
Novels: (1)Maihime, (2)Izu no Odoriko, (3)Bocchann, (4)Ukigumo, (5)Kappa
Choice Group of Authors: Akutagawa Ryunosuke, Mori Ougai, Futabatei Shimei, Kawabata Yasunari, Natsume Souseki

## Results and Discussion

### 1. Correlation coefficient

#### 1 – 1 Correlation coefficient Between Subjects:

Table 4 shows the correlation coefficient among the questions. The correlation coefficient between Geography and Japanese was significant ( $p < .05$ ). However, the correlation coefficients between History and Geography and between History and Japanese were not significant.

Table 4  
Correlation coefficient Between Subjects

	Geography	Japanese
History	-0.031 ns	0.148 ns
Geography		0.322 *

Note: "ns" indicates nonsignificant, \* means significant 5%.

#### 1 – 2 Correlation coefficient between the Metacognition and the Theory of Mind

The correlation coefficient between metacognition and Theory of Mind was - 0.053. This correlation coefficient was not significant.

### 1 – 3 Correlation coefficient between the Metacognition and the Achievement

Table 5 shows the correlation coefficients between the metacognition and the achievement. The correlation coefficient between metacognition and History was significant ( $p < .01$ ). However, the correlation coefficient between metacognition and Geography, and the one between metacognition and Japanese were not significant.

Table 5

Correlation coefficient between the Metacognition and the Achievement			
	History	Geography	Japanese
Metacognition	0.390 **	-0.174 ns	-0.045 ns
Geography		0.322 *	

Note: “ns” indicates nonsignificant, \*\* means significant 1%.

### 1 – 4 Correlation coefficient between the Theory of Mind and the Achievement

Table 6 shows the correlation coefficients between Theory of Mind and Achievement. None of the correlation coefficients were significant.

Table 6

Correlation coefficient between the Theory of Mind and the Achievement			
	History	Geography	Japanese
Theory of Mind	0.123 ns	-0.127 ns	-0.053ns
Geography		0.322 *	

Note: “ns” indicates nonsignificant.

## 2. Mean correct score of achievement test as functions of Metacognition and Theory of Mind

Figures 1 to 3 depict the mean correct score as functions of metacognition and Theory of Mind on each achievement test. A two-way mixed ANOVA for metacognition and Theory of Mind was performed in each subject.

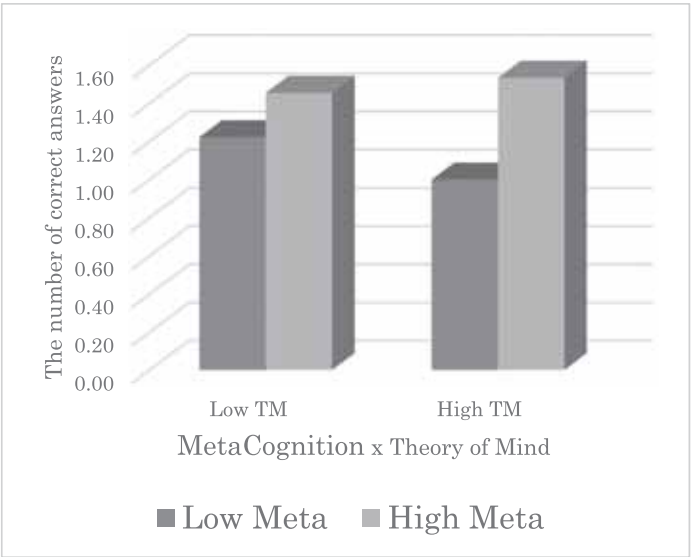


Figure 1  
The number of correct answers on History achievement test  
as functions of Metacognition and Theory of Mind

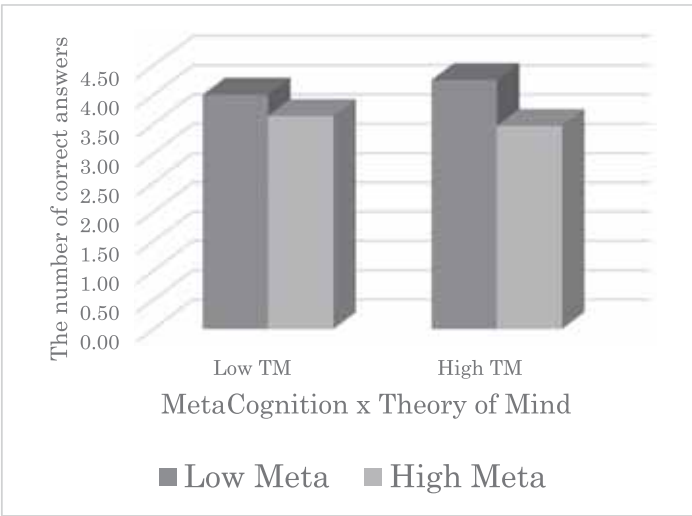


Figure 2

Figure 2  
The number of correct answers on Geography achievement  
testas functions of Metacognition and Theory of Mind

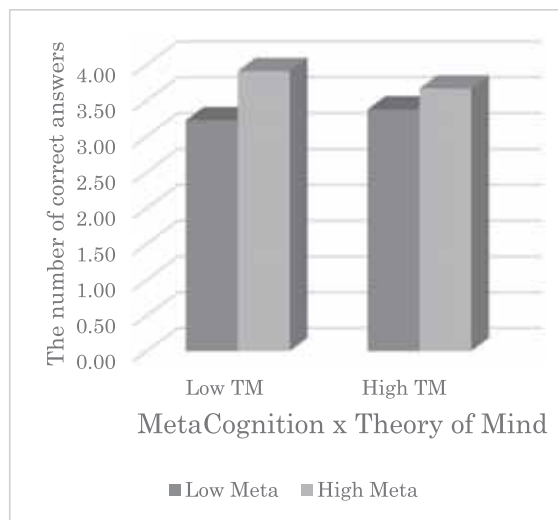


Figure 3

The number of correct answers on Japanese achievement test as functions of Metacognition and Theory of Mind

The ANOVA on the History achievement test revealed a significant main effect of metacognition ( $F(1, 39) = 4.83, p < .05$ ). However, the main effect of Theory of Mind and the interaction were not significant ( $F < 1.00$ ).

The ANOVA on the Geography achievement test revealed a significant main effect of metacognition ( $F(1, 39) = 4.83, p < .05$ ). However, the main effect of Theory of Mind and the interaction were not significant ( $F < 1.00$ ).

The ANOVA of the Japanese achievement test indicated no significance for the main effects of metacognition and Theory of Mind and the interaction ( $F_s < 1.00$ ).

Is the effect of metacognition on school achievement different from that of Theory of Mind? The result showed that the correlation coefficient between the metacognition and the Theory of Mind was not significant. This result suggests that the function of metacognition is different from the function of the Theory of Mind. It is assumed that both metacognition and Theory of Mind is meta-ability. If it is so, why was the correlation coefficient between the metacognition and the Theory of Mind not significant? One reason is that metacognition is cognition processing about oneself mainly but Theory of Mind is cognition processing mainly things about other. The other reason is that the processing of the metacognition is more complicated than the processing of Theory of Mind. These factors would make nonsignificant correlation coefficient between metacognition and Theory of Mind.

How do metacognition and Theory of Mind facilitate on the performance of the achievement test? The results showed that the correlation coefficient between the metacognition and the History was significant although the correlation coefficient between Theory of Mind and any achievement was not significant. Main effects of metacognition on History and Geography achievement tests were significant although the main effects of metacognition on the Japanese was not significant.

These results suggest that metacognition facilitates performance on achievement tests but Theory of Mind does not facilitate performance on achievement tests. Especially, it suggests that metacognition influences in achievement in History and Geography. Why does the metacognition influence on achievement in History and Geography but not Japanese? The reason is unclear for the moment. This will be examined in the future.

## References

- Doherty, M.J. (2009) *Theory of Mind: How Children Understand Others' Thoughts and Feelings*. Routledge.
- Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence*. Hillsdale, NJ: Erlbaum.
- Flavell, J.H. (1979). "Metacognition and cognitive monitoring: A new area of cognitive-development inquiry". *American Psychologist*. 34, 906-911.
- Kikuno, H. (2012) The effect of Metacognition and Theory of Mind on learning ability. *Bulletin of Institution of Child Sciences*, 2, 1-5.
- Kikuno, H. (2013a) Is the scholastic academic ability of mathematics related with the ability of theory of mind? *The British Psychology Society Developmental Section Annual Conference*.
- Kikuno, H. (2013b) Theory of Mind and Metacognition: Does Theory of Mind facilitate to solve problems in mathematics? *9th International Conference on Cognitive Science*.
- Mitchell, P. (1997) *Introduction to Theory of Mind: Children, Autism and Apes*. Arnold.
- Premack, D. & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? *Behavioral & Brain Sciences*, 4, 515-526.
- Perner, J., & Wimmer, H. (1985). "John thinks that Mary thinks that...": Attribution of second-order beliefs by 5- to 10-year old children. *Journal of Experimental Child Psychology*, 39, 437-471.
- Sannomiya, M. (2008) *Metacognition*, Kitaoji-Shobou, Kyoto.
- Wimmer, H., & Perner, J. (1983). Beliefs about beliefs: Representation and constraining function of wrong beliefs in young children's understanding of deception. *Cognition*, 13, 103-128.