PERSPECTIVES IN "DISTRIBUTED COLLABORATION"

Yugo Hayashi[1], *Kazuhisa Miwa*[1], *Junya Morita*[2]

Nagoya University[1], JAIST[2]

ABSTRACT

In this study, we investigated effects of having different perspectives in solving collaborative tasks. A simple reasoning task was given to several pairs of subjects, each of whom discussed their views with their partner. Protocol analysis was performed to reveal how people exchange information with a partner who has a different perspective to achieve successful collaboration.

1. INTRODUCTION

Studies in Cognitive Science have indicated that obtaining different perspectives generally promotes effective interactions in human collaborative problem solving. However, there have been no studies that focus on the information-sharing process and analyze the conversation pattern in controlled experimental settings. In this work, we therefore set up a situation in which two subjects having different perspectives interact with each other, and analyze their conversation patterns through performing a protocol analysis.

2. RESEARCH FRAMEWORK

Figure 1 shows the situation of collaboration that we discuss in this study. The two problem solvers observe the Data based on their own context and background knowledge, which provide different perspectives. The filters construct individuals' perceived reality to be different, and we call this perceived reality Fact.

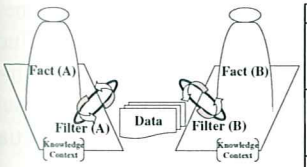

Fig. 1. Data and Fact

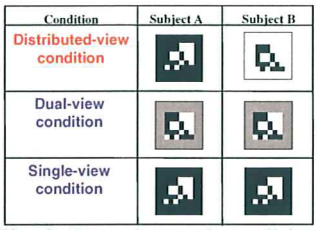

Fig. 2. Experimental conditions

3. AIM OF THIS STUDY

We conduct a laboratory study to investigate the following two points based on the research framework presented above.

1. Understanding differences in interaction of collaborating pairs who have different perspectives and pairs who have the same perspectives.
2. Identifying factors for successful problem solving in interaction of collaborating pairs who have different perspectives.

4. METHOD

4.1. Conditions and Subjects

We set up three experimental conditions to compare the characteristics of interaction of pairs having different perspectives (focusing on each of two different-colored surfaces called "objects") and those having the same one. These three conditions are; (1) Distributed-view condition, (2) Dual-view condition, (3) Single-view condition (see Fig. 2).

In the distributed-view condition, to one subject the stimuli are presented on a black background whereas to the other one, the same stimuli are presented on a white background. Therefore, in this condition, two perspectives, focusing on the black and white objects, are distributed to the two subjects.

In the dual-view condition, the stimuli are presented on a gray background. Therefore, the subjects simultaneously have two perspectives, focusing on both of the colored objects.

In the single-view condition, to both subjects the stimuli are presented on the black (or white) background. Therefore, both subjects have only one perspective, focusing on only one of the two colored objects.

Fifty undergraduate students, arranged into twenty-five pairs, participated in the experiment. Two pairs were excluded from the analysis because they knew the details of the experiment beforehand. Eleven pairs were assigned to the distributed-view condition, six pairs to the dual-view condition, and six pairs to the single-view condition.

4.2. Target rule

Here, we explain how to manipulate a sequence of numbers of objects in the distributed-view condition. The manipulation is identical in the other two conditions. In the introductory phase, the subjects are led to have one of the following distributed perspective separately: either a perspective focusing on black objects or one focusing on white ones. After this phase, a conflict phase follows in which the subjects are required to integrate the two distributed perspectives to discover the target rule (See Table 1).

Table 1. Example of Sequences of the numbers of objects

	Introductory phase					Conflict phase				
White	⋯	3	4	5	6	2	2	6	5	⋯
Black	⋯	3	4	5	6	4	6	4	7	⋯
Total	⋯	6	8	10	12	6	8	10	12	⋯

5. PROTOCOL ANALYSIS

As mentioned in the explanation of our research framework described in Fig. 1, conversation between two subjects occurs through interaction of their Facts constructed from the Data. In the protocol analysis, we have to detect which object, black or white, as Data each verbalization as Facts refers to. In the following we represent verbal data mapped with the black and white objects as BLACK and WHITE.

5.1. Indicies for evaluation

The frequencies of BLACK and WHITE labels were analyzed to detect which perspective, focusing on black or white objects, the subjects had. We adopt the following two indicies, $Bias$ and for the analysis. The symbols used in the two equations are based on the following tables.

- Individual activities:

$$Bias = \frac{|n_1 - n_2|}{n_1 + n_2}$$

Table 2. Table for $Bias$

	BLACK	WHITE
Subject A	n_1	n_2

- Group activities:

$$= 0 (n_{1.} = 0, n_{2.} = 0, n_{.1} = 0, n_{.2} = 0)$$

$$= \frac{|n_{11}n_{22} - n_{12}n_{21}|}{\sqrt{n_{1.}n_{2.}n_{.1}n_{.2}}}$$

(other than those listed above)

Table 3. Table for

	BLACK	WHITE	Sum
Subject A	n_{11}	n_{12}	$n_{1.}$
Subject B	n_{21}	n_{22}	$n_{2.}$
Sum	$n_{.1}$	$n_{.2}$	N

5.2. Results

The subjects were divided into successful pairs who found the target rule, and unsuccessful pairs who did not. The two indicies defined above were estimated for each of the two groups.

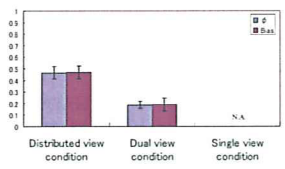

Fig. 3. and $Bias$ for the subjects who discovered the rule.

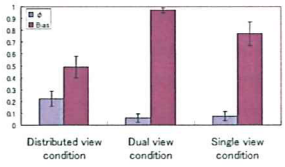

Fig. 4. and $Bias$ for the subjects who didn't discover the rule.

5.2.1. Successful pairs

The result for the successful pairs is shown in Fig. 3. There were no successful pairs in the single-view condition. A 2 (indexes: and $Bias$) $\times$ 2 (conditions: distributed and dual) ANOVA was conducted, revealing that the main effect of the conditions was significant ($F(1, 16) = 11.192, p < .01$), but neither the main effect of the evaluated indexes ($F(1, 16) = 0.007, n.s.$) nor the interaction between the two factors was significant ($F(1, 16) = 6.389, n.s.$). This result shows that the scores of both indexes, and $Bias$, in the distributed-view condition were greater than those in the dual-view condition. This means that problem solving in the distributed- and dual-view conditions showed almost the same performance; however, the quality of the interaction between pair subjects was different. That is, in the distributed view-condition, each of pair subjects had one partial perspective with respects to individual problem-solving activities. From the viewpoint of group activities, however role sharing where each of pair subjects compensates for the other emerged. On the other hand, in the dual-view condition, each of pair subjects had two perspectives, focusing on both kinds of objects; role sharing did not appear.

5.2.2. Unsuccessful pairs

The result for the unsuccessful pairs is shown in Fig. 4. A 2 (indexes: and $Bias$) $\times$ 3 (conditions: distributed, dual, and single) ANOVA was conducted, revealing that the interaction between the two factors was significant ($F(1, 25) = 7.086, p < .01$). The main effect of the indexes reached significance ($F(1, 25) = 79.192, p < .01$) but the main effect of the conditions was not significant ($F(1, 25) = 2.127, n.s.$). Analysis of the simple main effect showed that the score of $Bias$ was higher than that of in every condition. [In the Distributed-view condition ($F(1, 9) = 7.596, p < .05$); in the dual-view condition ($F(1, 5) = 366.084, p < .01$); In Single view condition ($F(1, 11) = 28.362, p < .01$)] These results show that, in every experimental condition, the individuals were fixated to have one partial perspective. Moreover, in group activities both members tended to be drawn into one partial perspective, either black or white, and role sharing did not emerge. In the single-view condition, both members were forced to focus on one figure, and found it difficult to notice another ground perspective. In the dual-view condition, even though each subject seemed able to perceive both black and white objects, why did a similar interaction to the one in the single-view condition emerge? In these cases, during the early stage of problem solving, one subject proposed counting the numbers of black objects while ignoring white ones, and the other accepted it. Once this agreement was concluded, it was very difficult for them to change this assumption throughout the task. In the distributed-view condition, both subjects communicated with each other while sharing one partial perspective, focusing on one of two kinds of objects.

6. CONCLUSION

In this study, we analyzed the characteristics of paired problem solvers, who have different perspectives, compared with those who have the same perspectives. The protocol analysis showed that the successful pairs holding different perspectives constructed a mutually complementary interactive pattern such as role sharing, even though each of them locally took his/her partial perspective. On the other hand, in the unsuccessful pairs, one of the subjects shifted his/her perspective to the partner's perspective, meaning that this subject interacted with the partner while holding the ground perspective.