

# 또래의 상대적 능력에 대한 객관적, 주관적 평가가 아동의 과제 해결 능력에 미치는 영향

## The Influence of Objective and Subjective Evaluations about Peers' Relative Competency on Children's Problem Solving Performances

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### < Abstract >

본 연구의 목적은 아동이 또래와 함께 과제를 풀어 나가는 과정에서, 상호작용하는 아동들의 객관적인 상대적 능력과 주관적인 상대적 능력을 고려하여 이들이 아동의 과제해결능력에 어떠한 영향을 주는지를 알아보고자 하는 것이었다. 구체적으로 본 연구에서는 대상 아동이 자신보다 우수하거나 열등한 아동과 상호작용을 경험하게 하며, 이들 상대방에 대해서 아동자신은 어떻게 평가하고 있는지, 또한 이러한 상대방의 능력에 대한 주관적 평가가 아동의 과제해결 능력에 어떠한 영향을 미치는지를 살펴보고, 마지막으로 이러한 관계가 상대방에 대한 친밀도와는 어떻게 관련지어 나타나는지를 살펴보았다. 6, 8, 10세의 아동을 대상으로 하여 서로에 대한 친밀도를 조사하였으며 상대방의 능력에 대해 어떻게 생각하고 있는지에 대한 주관적인 평가를 하게 했다. 또한 하노이탑 과제를 사용하여 사전 검사, 처치, 사후 검사 단계를 통해 아동의 과제 해결 능력을 측정하였다. 그 결과, 자신보다 더 우수한 짝과 함께 공동 과제 해결을 한 아동이 그렇지 않은 아동보다 사후검사에서 더 많은 향상력을 보여줄 것이라고 기대하였으나 이 가설은 기각되었고, 아동이 자신의 짝에 대하여 긍정적으로 생각할 때, 다시 말하면 자신보다 과제를 더 잘 풀어 나갈 것이라고 판단할 경우에만 과제 수행 능력이 향상되었다. 이러한 결과는 객관적으로 평가된 아동의 능력보다 아동 자신이 주관적으로 상대방의 능력에 대해 판단한 것이 더 의미 있게 과제수행 능력에 영향을 미친다는 것을 보여준다.

**주제어(Key Words):** 객관적 상대적 능력(objective relative competency), 주관적 상대적 능력(subjective relative competency), 과제해결능력(problem solving performance)

## I. Introduction

Now lots of research on peers' joint problem solving performance focused on their relative competency between interacting peers. Basically these are based on Piaget and Vygotsky's theories. Vygotsky believed that interaction with a more capable partner was most likely to be conducive to development (Tudge & Rogoff, 1989). Vygotsky emphasized the effect of interaction with a more skilled partner; his notion of the zone of proximal development focuses on problem solving under adult guidance or in collaboration with more capable peers (Vygotsky, 1978).

In contrast to Vygotsky, Piaget suggested that interaction with equal peers, rather than adult-child interaction, was more likely to lead to cognitive development. Piaget proposed that influential social interaction occurs between partners of similar status. In Piaget's view, peers foster the progress of one another's cognitive development through attempts to resolve cognitive conflict or discrepancy deriving from differences in their perspectives (Rogoff, 1990). Adults may be useful for providing answers to questions, but agreeing with an adult because that adult has more power will not lead to cognitive restructuring (Piaget, 1970/1983).

Researchers have compared peer interactions in problem solving tasks in terms of relative competency based on both Piagetian and Vygotskian theories. Some research has shown that children's cognitive development is improved as a result of collaborative problem solving, especially when a child works with a more competent partner (Azmitia, 1988; Bearison, Magzamen, & Filardo, 1986; Tudge, 1990, 1992). However, in

some studies children have not improved as a result of collaborative problem solving (Doise & Mugny, 1984; Herber, 1981), and in some cases they even have regressed (Tudge, 1985, 1992).

These perplexing results can be explained that partners' relative degrees of competence in peer interaction may be less apparent to the children. Independent of partners' objective relative competency measured by the researcher, each child might make his or her own evaluation about a partner's competency. This is referred to as subjectively evaluated competency compared to objective competency. It was believed that relative competency itself does not fully explain peer interaction.

Another reason for inconsistent results can be explained that they did not consider the relationships of interacting peers. Recently there has been increasingly interested in affective factors when examining children's interaction on problem solving performance and found out that the children who worked with more friendly partners showed better performance than the children who worked with less friendly partners (Hwang, 1996).

The present study examined children's problem solving performance depending on their partners' relative competency and the effect of relative competency on children's problem solving performance considering their subjective evaluations of partners' competence and friendliness.

The present study examined following hypotheses.

Hypothesis 1: Children's problem solving performance as a result of joint work will be different according to their partners' relative competency.

Hypothesis 2: The effect of relative competency on children's problem solving performance will differ according to their subjective evaluation about each other.

Hypothesis 2: The effect of relative competency on children's problem solving performance will differ according to their friendliness.

## II. Methods

### 1. Participants

122 children attending one preschool and one elementary school in Incheon, Korea participated in this study. The number of children was distributed as follows: 40 children (20 boys, 20 girls) of six-year-olds in preschool classes, 42 children (23 boys, 19 girls) of eight-year-olds in second-grade classes, and 40 children (19 boys, 21 girls) of ten-year-olds in fourth-grade classes.

They were randomly matched into pairs by the researcher. They worked individually in pretest and posttest sessions and in pairs during joint problem solving (intervention) session.

### 2. Measures

#### 1) Friendliness Assessment Inventory

To measure children's degree of friendliness, the Friendship Assessment Inventory (Clark and Ayers, 1993) was used. The inventory consists of 28 behaviors or qualities that could exist in friendships; seven statements are included from each of the following four categories: mutual activities, conventional morality, empathic understanding, and loyalty and commitment. The focus of the

questions for the mutual activity is to determine the likeliness of proximity and common activities in friendships (e.g., "I enjoy spending a lot of time with ---"). The questions for the conventional morality assess whether friends are expected to possess positive character traits (e.g., "--- does not lie or cheat") and are honest and straightforward about the relationship (e.g., "--- does not pretend to like me"). The questions composing the empathic understanding dimension measure the importance of having friends with common interests and with whom one can share intimate information (e.g., "--- helps me when I am in trouble"). Finally, the questions for the loyalty and commitment dimension measure the belief that friendships should be lasting and resistant to dissolution (e.g., "--- stands by me through anything").

Participants decided how likely each behavior or quality happen to them and respond using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). The higher the score is, the more the friendliness pairs have for each other. The reliability coefficients for this measure were as follow: conventional morality, .62; mutual activities, .72; empathic understanding, .88; and loyalty and commitment, .89.

#### 2) Subjective Evaluation Inventory

Four statements regarding evaluating the pairs' subjective competency were provided (e.g., "When do you work together, who do you think perform well in the task?") at the end of the Friendship Assessment Inventory. These questions measure children's subjective evaluation of their partners' performance on problem solving task. Children responded by using a 5-point Likert scale (1 = strongly disagree, 5 = strongly agree). High scores

indicate that children highly evaluate their partners' competences.

The inventory for subjective evaluation was an unstandardized measure, so item analyses were performed with the entire sample. The results of the item analyses indicated that the internal consistency reliabilities of each item were relative high (Alphas = .67).

### 3) Problem Solving Task

To measure children's performance in problem solving task, the Tower of Hanoi (Glachan & Light, 1982) was used. The tiles vary regularly in size and were placed on one of the pegs in a seriated order, the largest at the bottom. The problem is to move all the tiles to another (specified) peg under the constraints that only one tile may be moved at a time, and that a larger tile may never be placed on top of a smaller one.

## 3. Procedures

### 1) Friendliness

On the first day of visiting school, children in the second- and fourth-grade classes was provided Friendship Assessment Inventory to measure their friendliness with their pairs and Subjective Evaluation Inventory to measure their evaluations about their partner's competency. In the case of preschool children, the experimenter interviewed the children individually to fill out the questionnaire because they were unable to read and understand it.

### 2) Tower of Hanoi

After completing the Friendship Assessment Inventory, children participated in three problem

solving sessions (pretest, intervention, and posttest) with two weeks between each. Children were tested by the same female experimenter in a room provided by their school.

### (1) Pretest

All children were pre-tested individually. When the rules have been explained they were given two trials with three tiles. Children were told to try to find the best solution to the problem, and that it could be completed in seven moves. The first trial began with the tiles on one outer peg and the second began with the tiles on the other outer peg.

### (2) Intervention (pairs' joint work)

Children working in pairs were told to work together and help each other. Children were given two trials, both with four tiles with four pegs (This apparatus was more complex and difficult than that of pretest.). Children were also told to try to find the best solution to the problem, and that it could be completed in nine moves.

### (3) Posttest

The posttest session occurred approximately two weeks after the intervention session. The pairs of children were retested individually, to determine whether or not there was any change in their problem solving two weeks after the intervention. The same instruction that was used during the pretest session was used. However, this time the children were given two trials, both beginning from the center peg, one 'goal' peg being left and the other being right.

### (4) Scoring

The criterion measure for performance on this task was the number of moves taken to solve the

problem. In the pretest and posttest the optimal score took seven moves in one trial and twelve moves and more was regarded as a failure. Failures got 13 points. Pretest and posttest scores were derived from the adding moves for the two trials. The higher the number of moves, the worse the performance is, and, adversely, the lower the number of moves, the better the performance is.

Also pretest scores were used to measure children's relative competency. Comparing pairs' pretest scores to each other, their relative competency were determined (more, similar, and less competent partners).

### III. Results

#### 1. Relative Competency and Subjective Evaluation

A univariate 3 (partners' relative competency:

more competent than oneself, similar to oneself, vs. less competent than oneself) x 3 (subjective evaluation to their partners: worse than oneself, similar to oneself, vs. better than oneself) x 3 (degree of friendliness: high, medium, vs. low) analysis of covariance (ANCOVA) was performed on the posttest scores, with pretest scores as the covariate. The results are shown in Table 1.

There existed a significant main effect for degree of friendliness,  $F(2, 94) = 16.4, p < .001$ . However, between subjects effects revealed no significant effect of relative competency on children's posttest scores. That is, different relative competency did not differ in terms of their subsequent individual performances.

The analysis in Table 1 also revealed that although relative competency as a main effect did not account significantly for children's posttest scores, the interaction of relative competency and subjective evaluation,  $F(4, 94) = 3.3, p < .05$ , was significant. To clarify the nature of the two-way

<Table 1> Analysis of Covariance: Posttest Scores by Relative Competency, Friendliness, and Subjective Evaluation with Pretest

Source of Variation	Sum of Squares	DF	Mean Squares	F	Sig. of F
Covariates	44.5	1	44.5	4.1	.047
Pretest	44.5	1	44.5	4.1	.047
Main Effects	449.2	6	74.9	6.8	.000
Relative Competency	64.3	2	32.2	2.9	.058
Subjective Evaluation	15.5	2	7.8	.7	.495
Friendliness	68.4	2	179.2	16.4	.000
2-way interactions	175.8	12	14.7	1.3	.211
Relative competency x Subjective Evaluation	145.4	4	36.4	3.3	.014
Relative Competency x Friendliness	11.1	4	2.8	.3	.907
Subjective Evaluation x Friendliness	2.0	4	.5	.0	.996
3-way Interactions	65.5	8	8.2	.7	.650
Relative Competency x Subjective Evaluation x Friendliness	65.5	8	8.2	.7	.650
Explained	735.0	27	27.2	2.5	.001
Residual	1030.0	94	11.0		
Total	1030.0	121	14.6		

interaction, two-tailed paired t-test were conducted on posttest scores comparing pretest scores for each group to examine whether each group significantly improved or declined as a result of working together with their partners. The result of this analysis is provided in Table 2.

Children's relative competency was significantly related to their subsequent individual performances only for the better subjective evaluation group and similar subjective evaluation group. As Table 2 shows, children who worked with more competent partners significantly improved from the pretest only in better and similar subjective

evaluation groups. In worse subjective evaluation group, children who worked with more competent partners did not improve from the pretest. There did not exist a significant relative competency x friendliness interaction effect for posttest.

#### IV. Discussion

It was expected that children who worked with more capable partners during the joint problem solving session would show better performance on the posttest than those who worked with same or

<Table 2> Mean and Standard Deviations for Individual Performance by Relative Competency and Subjective Evaluation

Group	n	Performance		t-test (pre-post)	
		Pretest	Posttest		
<b>(Better Subjective Evaluation)</b>					
MC	17	<u>M</u>	23.6	20.4	2.78*
		<u>SD</u>	3.0	3.8	
SC	10	<u>M</u>	19.2	17.2	1.84
		<u>SD</u>	3.9	5.0	
LC	17	<u>M</u>	17.8	19.0	-1.32
		<u>SD</u>	2.6	2.5	
<b>(Similar subjective Evaluation)</b>					
MC	12	<u>M</u>	23.1	17.9	3.50**
		<u>SD</u>	2.6	3.8	
SC	11	<u>M</u>	20.1	20.2	-.04
		<u>SD</u>	4.4	4.3	
LC	17	<u>M</u>	18.4	18.4	.00
		<u>SD</u>	3.7	3.3	
<b>(Worse Subjective Competency)</b>					
MC	16	<u>M</u>	22.4	22.5	-.13
		<u>SD</u>	2.7	3.0	
SC	11	<u>M</u>	18.8	17.6	1.00
		<u>SD</u>	3.3	3.7	
LC	11	<u>M</u>	17.3	18.8	-1.15
		<u>SD</u>	2.4	3.3	

\*  $p < .05$  \*\*  $p < .01$

MC= children who worked with More Competent peers during intervention

SC= children who worked with Similar Competent peers during intervention

LC= children who worked with Less Competent peers during intervention

less capable partners. Unexpectedly, however, there was no significant association between children's relative competency and their subsequent posttest scores. This result provides a puzzling discrepancy with Vygotsky's idea that interaction with a more capable partner is most likely to be conducive to development. Also this result is incongruent with Piaget's idea that interaction with peers enhance cognitive development.

From the result that children's problem solving performance was not associated with their relative competency, it can be said that just working with more capable partners or less capable partners itself does not improve or decrease children's performance. Some other important variables should be taken into account in association with relative competency. The present study considered children's subjective evaluations of their partners' competency in association with relative competency on problem solving performances. It was expected that, independent of their objective competency measured by the researcher based on the pretest, each child's subjective evaluation about his partner's competency might affect the result of problem solving. In fact, regardless of their objective competency measured by the pretest, children had their own thoughts and evaluation about their partner's competency. A correlational analysis was performed to examine the relation between relative competency and subjective evaluation and the result showed that these two variables were not correlated each other.

Interestingly, an interaction between subjective evaluation and relative competency on problem solving performances was found. That is, the effect of relative competency on problem solving

performance was different depending on children's subjective evaluation about each other. In a specific way, the effect of relative competency on the posttest was significant only in the case of children who subjectively recognized their partners as more competent (better subjective evaluation group) or similar competent (similar subjective evaluation group). That is, the children who worked with more competent partners during the joint problem solving session significantly improved on the posttest from the pretest only when they thought that their partners were more competent than themselves or similar competent to themselves.

So, unlike previous research (Tudge, 1990, 1992; Tudge & Rogoff, 1989) which optimistically showed the effect of relative competency on problem solving performance, this study provided the evidence that problem solving performance influenced by relative competency should be considered in the consideration of subjective evaluation.

Also the present study considered children's friendliness in association with relative competency on problem solving performances. Even though previous study (Hwang, 1996) found out the effect of friendliness on children's problem solving performance, this study failed to find out the interaction between friendliness and relative competency on children's problem solving performances.

This study provides evidence that just working together with capable partners does not, itself, improve children's problem solving performance. However, children benefitted from working with capable partners only when they thought that their partners were more competent than themselves or,

at least, similar to themselves. This indicates the importance of children's subjective evaluation of their partners when considering the effect of children's relative competency on problem solving performance.

The present have following limitations. First, this study investigated children's interaction in a closed-field situation. Considering the fact that most of children's interaction occur in everyday mundane activities not in controlled situation, children should be examined in natural situations for future research. Second, future studies will be more meaningful and have more strength if characteristics of the task are taken into account. Children had interest in the Tower of Hanoi at the pretest but lost some interest following the intervention. The apparent decrease in interest in the posttest might have influenced their performances. Tasks more likely to keep children's interest, such as computer games, might be used in future research. Third, the Friendliness Assessment Inventory and Subjective Evaluation Inventory have internal consistency reliabilities from .62 to .89, which might reduce the reliability and validity of the present study. For further study, the inventories should be revised to improve the reliability and validity.

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