Peer Interaction and Problem Solving: When Are Two Heads Better Than One?

Margarita Azmitia
Florida International University

AZMITIA, MARGARITA. Peer Interaction and Problem Solving: When Are Two Heads Better Than One? CHILD DEVELOPMENT, 1988, 59, 87–96. 80 5-year-olds participated in 4 sessions in which they built a replica of a Lego model. During the first session, children’s building competence was assessed. Based on their performance, children were classified as either expert or novice builders. Children then participated in 2 sessions in which they built alone or with a partner. There were 3 types of dyads: novice, expert, and mixed ability (expert-novice). Their performance was compared with that of novice and expert singletons. In the final session, children’s ability to copy 2 new models was assessed to determine whether they generalized the skills acquired during interaction. Collaboration was more conducive to learning than independent work, and children were able to generalize their skills. However, these conclusions were qualified by the fact that children’s expertise and that of their partners, the acquisition of task strategies, the quality of verbal discussion, children’s tendency to observe and imitate their partners, and experts’ tendency to provide guidance mediated learning.

There is much controversy over whether collaborative or individual problem solving is more conducive to learning during the preschool years. Whereas Piaget (1968) argued that solitary work would be more productive due to young children’s egocentrism, both Vygotsky (1978) and Mead (1934) argued that collaboration would be more beneficial. Within their approach, children acquire cognitive skills while solving problems interactively with adults or more capable peers. There presently are no data that could be used to resolve conclusively the controversy between Piaget’s and Vygotsky’s and Mead’s theories.

In the present study, children’s solitary and collaborative performances on a construction task that involved reproducing a Lego model were compared to address three questions about the contribution of peer interaction to problem solving in preschool children. First, does interactive problem solving lead to greater learning than solitary problem solving? Second, do the benefits accrued from interaction generalize to children’s subsequent individual performance? Third, what are the features of interaction that promote learning?

Peer interaction can foster cognitive development by allowing children to acquire new skills and restructure their ideas through discussion. Although the cognitive benefits of collaborative problem solving during the elementary school years have been documented extensively (e.g., Allen, 1973; Doise & Mugny, 1984; Perret-Clermont, 1980; Skon, Johnson, & Johnson, 1981), little is known about its role in intellectual development during the preschool years. One reason for the paucity of research on this problem is the acceptance of Piaget’s claim (1968) that preschool children’s egocentrism limits their ability to sustain cooperation and simultaneously evaluate different perspectives, two abilities that are necessary for collaboration.

In fact, preschoolers are less egocentric than Piaget proposed (e.g., Donaldson, 1978; Gelman, 1978), but there still is some ques-
tion about the sophistication of their interactive skill. Cooperation is fairly rare (Strayer & Trudel, 1984). Also, although preschoolers can consider other’s perspectives in some situations (e.g., Brownell, 1982; Pratt, Scribner, & Cole, 1977), they usually are unable to sustain the discussions or resolve the conflicts assumed to mediate learning during collaborative problem solving (Damon, 1983). Despite these limitations, preschoolers can solve simple problems interactively (e.g., Brownell, 1982; Cooper, 1980; Koester & Bueche, 1980). However, because comparisons of solitary and collaborative problem solving were not included in these studies, we still do not know whether collaboration leads to greater learning than solitary work.

Another limitation of previous research is that the generalization of skills acquired during collaboration has not been tested. Testing for generalization can provide information about what children learn from collaboration. Children could acquire interactive skills that will facilitate subsequent collaboration. Alternatively, children may acquire information about the task that will benefit subsequent independent problem solving. Because the second alternative, the influence of collaboration on individuals’ cognitive performance, is central to Vygotsky’s and Mead’s theories, generalization was tested in the present study by including an individual posttest in which children worked on two building tasks that, although superficially different from the learning task, required the same strategies.

A central goal of the study was to identify features of collaboration that mediate cognitive growth. To this end, several potential mediators were examined. These included expertise, task engagement, strategies, conflict of ideas, guidance by an expert, and observational learning.

Consider expertise first. Research on the relation between expertise and interactive effects has been inconclusive. Some researchers (e.g., Bandura, 1977; Doise & Mugny, 1984; Perret-Clermont, 1980) have found that children are more likely to progress when they work with a more expert partner, but others (e.g., Ames & Murray, 1981; Forman & Cazden, 1985; Glachan & Light, 1982; Skon et al., 1981) have found that the partner’s expertise does not constrain learning. Another unresolved issue is whether children’s expertise influences their capacity to profit from collaboration. Whereas some researchers (e.g., Doise & Mugny, 1984; Piaget, 1977) have found that collaboration is most beneficial when children are first acquiring a skill, others (e.g., Glachan & Light, 1982; Skon et al., 1981) have found that both experts and novices profit from collaboration. To examine further the relation between expertise and learning, in the present study novice and expert singletons were compared to dyads formed by two novices, two experts, or an expert and a novice.

Having a partner can increase the amount of time children work on a task. For example, the presence of a partner can prevent children from giving up in a difficult situation and make a task more enjoyable.1 Although the relation between collaboration and task engagement has not received much attention, Leuba (1933) and Perlmutter, Behrend, and Muller (1986) presented suggestive evidence that the presence of a peer increased 4- and 5-year-olds’ task engagement relative to a solitary condition. Based on these data, it was predicted that dyads would spend more time on-task than singletons. Also, if having a partner decreases the probability that children will give up before solving a difficult problem, the difference between dyads’ and singletons’ times on-task should be greater for novices than experts.

Collaborative contexts can facilitate children’s acquisition of strategies because partners often bring different skills to the task. In the present study, children’s acquisition of the strategy of looking at the model was explored. This strategy was selected because it had reliably differentiated experts from novices in the pilot study. Dyads’ use of task-related comments, explanations, demonstrations, and conversation was also studied because children’s acquisition of strategies depends on whether they realize that the strategies aid problem solving (see Paris & Lindauer, 1982) and because many researchers (e.g., Doise & Mugny, 1984; Hartup, 1985) have suggested that discussions during in-

1 Johnson, Johnson, and Skon (1979) have collected self-reports from elementary school children that indicate that dyads perceive a task as less difficult than singletons. However, due to the questionable validity of self-report measures collected from preschool children (see Cantor, 1983), these measures were not collected in this study. Also, although the data showed that dyads exhibited twice as much positive effect than did singletons, these data were not analyzed because it is possible that this pattern was due to dyads, but not singletons, having a recipient for their affect (their partner).
teraction help children understand the significance of strategies.

Finally, the contribution of three mechanisms that are assumed to mediate social influences on children’s cognition also was explored. Because Piaget (1968, 1977) proposed that conflict between children’s ideas mediates cognitive growth, the relation between children’s disagreements and learning was assessed. The contribution of observational learning (see Bandura, 1977) was measured by recording the amount of time that novices observed their partners build and whether they imitated the behaviors that they observed. The contribution of experts’ guidance (see Vygotsky, 1978; Wood, 1980) was assessed by examining experts’ use of explanations and demonstrations and their tendency to monitor their novice partners’ behavior and adjust the interaction to meet their needs.

Method

Subjects

One hundred thirty-two 5-year-olds \( M = 5-1 \); range: 4-6 to 5-6) from middle-class preschools were tested to obtain the 40 experts and 40 novices who participated in the study. Children were performing at average levels in the classroom, as determined by teacher ratings and school records. Also, children were of average social competence, as determined by teacher ratings and observations of their interactions in the classroom and the playground. There was an equal number of boys and girls in the final group.

The 80 children were assigned randomly to the alone, same-ability (expert and novice dyads), or mixed-ability conditions. The alone condition included 10 experts and 10 novices (20 children), the same-ability condition included 10 expert dyads and 10 novice dyads (20 children), and the mixed-ability condition included 10 novice-expert dyads (20 children). Dyads were formed by randomly pairing same-sex children.

Design

The overall design was a 2 (sex) × 3 (condition: alone, same-ability dyads, mixed-ability dyads) × 2 (ability: expert, novice) × 4 (session: pretest, interactive sessions, posttest) mixed factorial, with all factors except session manipulated between subjects. Children first participated in an individual pretest and then in either two interactive or two solitary sessions. After these sessions, they participated in an individual posttest. Two interactive sessions were used because some dyads need more than one session to develop a stable working style, and, once stability is attained, interactive benefits increase (Forman & Cazden, 1985; Goldberg & Maccoby, 1965).

Materials

The task, copying a complex Lego model, was selected for four reasons. First, it required children to represent spatial relations mentally, an important component of intelligence (Liben, Patterson, & Newcombe, 1981). Second, it required children to break down a complex problem, an important problem-solving skill. Third, construction tasks seem particularly conducive to interactive benefits (see Morrison & Kuhn, 1983). Fourth, the task was familiar and enjoyable to preschoolers.

Two Lego houses served as models. One was used in the pretests and posttests; the other, during the two interactive sessions. The models shared structural similarities (3.5 walls, a garage, the same height, and the manner in which the door and roof were built) but were not identical (e.g., differing with regard to color scheme; location of the door; the number, structure, and location of the windows; and the presence of an inner wall). Different models were used to test the generalization of skills from the interactive sessions to the posttest and to avoid potential boredom induced by having to build the same structure four times. The second generalization task was the block design subtest of the Wechsler Preschool and Primary Mental Intelligence Scale (WPPSI) (1967). Like the Lego task, this test measures children’s ability to copy models; unlike the Lego task, some of the WPPSI blocks have two colors, and, thus, children had to attend to a new type of relationship.

Procedure

Children were tested by the same female experimenter in a room provided by their school. Prior to the experimental sessions, the experimenter spent 1 or 2 days in the classroom establishing rapport with children and observing their interactions with others. Then, children participated in four 15-min sessions with 2 or 3 days between them. Children’s performance was videotaped during all sessions.

Pretest.—The experimenter first verified that the child understood that he or she had to build an exact copy of the model by asking the child to copy three simple Lego structures. All children were able to do this. Next, the experimenter produced the pretest model and two twin Lego dolls. She told the child that a friend had built one of the twins that house and that the other twin would like a
house just like his brother's. The experimenter then rotated the model and reiterated that the child should build an exact copy. She also told the child that it was okay to move the model while copying it. After this, the experimenter set a timer to 15 min and told the child that she had a lot of work to do and, thus, would like the child to work alone. Only one child completed the model during the pretest. Most children indicated that they would like to finish but were allowed to do so only in the posttest. Based on their performance in the pretest, children were classified as either novices ( < 20% correct) or experts ( ≥ 80% correct). Children who achieved between 20% and 79% accuracy in the pretest did not participate in subsequent sessions.

Sessions 2 and 3.—Singletons were told that the twins would like them to build a new house. Dyads were given the same instructions but were also told that the twins thought they would make a great team and wanted them to work together on the same house. They also were told that there were enough Legos for both, so they should not fight over them. To make building equally convenient for both children, the model was placed between them, and the Legos were presented in two piles, one in front of each child. Before starting the timer, children were reminded that they could rotate the model (no child failed to rotate the model at least once during each session).

Posttest.—The same instructions that had been used for singletons during the interactive sessions were used. Unlike the pretest, many children (N = 35) finished. After the child had finished or the time had elapsed, the experimenter said that she would like to see whether the child could build with another type of block and administered the block design test of the WPSSI.

Coding.—The operational definitions for each dependent measure are shown in Tables 1, 2, and 3. Reliability was assessed for 20% of the data selected randomly. During reliability coding, two coders simultaneously coded behaviors from videotape. Their reliability was computed by dividing the number of agreements into the number of agreements plus disagreements. Disagreements included differences in the assignment of behaviors to categories and omissions. Total reliability averaged 87%, with 80%–100% reliability in each category.

Results

The results are organized into two major sections. First, results for task performance, expertise, and generalization will be presented. Second, results concerning mediators of interaction effects (task engagement, strategies, conflict, observational learning, and guidance by an expert) will be discussed. Although expertise also is conceptualized as a

---

2 Low- and medium-ability children were aware that their building did not replicate the model because they often told the experimenter that they had worked very hard but had not been able to copy it. The experimenter responded to these remarks by praising them for their hard work and suggesting that perhaps next time they would be able to build an exact copy.
### TABLE 2
DEFINITIONS AND MEANS FOR VERBAL STRATEGIES AS A FUNCTION OF TYPE OF DYAD, ABILITY, AND SESSION

<table>
<thead>
<tr>
<th>DEPENDENT MEASURE</th>
<th>DEFINITION</th>
<th>TYPE OF DYAD</th>
<th>ABILITY</th>
<th>MEAN</th>
<th>Session 2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Session 3&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task-related statements</td>
<td>Statements about the task that provide no information to guide partner (e.g., &quot;This is a red Lego&quot;).</td>
<td>Same ability</td>
<td>Expert</td>
<td>32</td>
<td>25</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>24</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed ability</td>
<td>Expert</td>
<td>28</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>22</td>
<td>18</td>
<td></td>
</tr>
<tr>
<td>Explanations</td>
<td>Statements about the task that provide information about what the partner’s next move should be and why (e.g., &quot;Get a long red one to hold the door&quot;).</td>
<td>Same ability</td>
<td>Expert</td>
<td>6.8</td>
<td>3.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>2.3</td>
<td>2.2</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed ability</td>
<td>Expert</td>
<td>7.5</td>
<td>3.0</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>4.4</td>
<td>3.4</td>
<td></td>
</tr>
<tr>
<td>Demonstrations</td>
<td>Statements about the task that describe and justify the child’s placement or removal (e.g., &quot;I’m going to put this long piece here to hold the door&quot;).</td>
<td>Same ability</td>
<td>Expert</td>
<td>3.6</td>
<td>2.8</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>2.5</td>
<td>0.75</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed ability</td>
<td>Expert</td>
<td>4.0</td>
<td>2.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>2.5</td>
<td>1.4</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> First interactive session.  
<sup>b</sup> Second interactive session.

### TABLE 3
DEFINITIONS AND MEANS FOR MECHANISMS OF FACILITATION

<table>
<thead>
<tr>
<th>DEPENDENT MEASURE</th>
<th>DEFINITION</th>
<th>CONDITION</th>
<th>ABILITY</th>
<th>MEAN</th>
<th>Session 2&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Session 3&lt;sup&gt;b&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conflict</td>
<td>Sequence of at least 3 statements that reflect disagreements about a step in the task.</td>
<td>Same ability</td>
<td>Expert</td>
<td>3.1</td>
<td>1.5</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td>1.2</td>
<td>1.6</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Mixed ability</td>
<td>Expert</td>
<td>2.3</td>
<td>1.3</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Novice</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Observational learning</td>
<td>Total no. of seconds novices spent observing their partners. An observation period = a period of at least 2 sec in which child observes partner's building without making concurrent placements and removals.</td>
<td>Same ability</td>
<td>Novice</td>
<td>64</td>
<td>61</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Mixed ability</td>
<td>Novice</td>
<td>89</td>
<td>86</td>
</tr>
<tr>
<td>Guidance by expert</td>
<td>Total no. of seconds experts spent observing their novice partners. An observation period defined above.</td>
<td>Mixed ability</td>
<td>Expert</td>
<td>19</td>
<td>11</td>
<td></td>
</tr>
</tbody>
</table>

<sup>a</sup> First interactive session.  
<sup>b</sup> Second interactive session.
mediator of interaction effects, it will be discussed in the first section because the major finding of the study was the significant interaction between condition, expertise, and session that emerged in the analysis of building accuracy and generalization. Thus, the discussion of the remaining mediators is more informative when framed in terms of this interaction.

For analyses comparing singletons and dyads, the design was a 2 (sex) × 3 (condition: alone, same-ability dyad, mixed-ability dyad) × 2 (ability) × 4 (session) mixed factorial. For analyses comparing dyads, there were only two levels of the condition factor (same-ability dyads, different-ability dyads) and two levels of the session factor. Unless indicated otherwise, all reported F’s were significant at p < .05. Multivariate analyses of variance (MANOVA) were performed for variables that were expected to vary together (e.g., strategies). The other measures were analyzed using analysis of variance (ANOVA). All post-hoc comparisons among means were carried out with the Newman-Keuls procedure (p < .05).

During Sessions 2 and 3, individual and pair scores were available for each dyad. Unless indicated to the contrary, the analyses were performed on individual scores. Also, because there were twice as many children in the same-ability dyad condition as in the alone or mixed-ability dyad condition, for analyses involving comparisons between the three conditions, half of the same-ability dyads (five low ability and five high ability) were selected randomly and used in the analyses. However, to guard against possible bias, the analyses were repeated using the other half of the sample. The results were the same for both analyses, and, thus, the results of the second analysis will not be reported.

Measures of Task Performance

To prevent building speed from influencing the results, the building accuracy score for each child was computed by assigning a score between 0 (placement/removal incorrect in all three dimensions, color, size, and location) and 3 (placement is correct in all three dimensions/removal of misplaced piece) to each placement and removal and dividing the total points by the total number of placements and removals. This yielded a mean accuracy score between 0 and 3. The mean accuracy score for experts was at least 2.40 (range: 2.40–2.96); for novices it was less than 1.40 (range: .98–1.39).

An ANOVA performed on children’s building scores showed that children in the mixed-ability dyads built more accurately than children in the other two conditions, whose accuracy did not differ, F(2,43) = 8.22. However, as seen in Figure 1, the change in building accuracy exhibited by mixed-ability dyads was due to the improvement of novices. This conclusion was supported by the emergence of several significant interactions: a condition × session interaction, F(6,129) = 5.26, an ability × session interaction, F(3,129) = 7.39, and a condition × ability × session interaction, F(6,129) = 2.69.

According to Newman-Keuls tests, novices in the alone, same-ability, and mixed-ability conditions did not differ in the pretest, nor did experts in the three conditions. Experts’ performance did not change over sessions, a result that is attributable to ceiling effects. However, the results for novices were different. Neither novice singletons nor novices in dyads improved over sessions. In contrast, novices who worked with an expert improved significantly during and following the interaction and also built more accurately than singletons and dyads during Sessions 2 and 3. Importantly, these differences were maintained in Session 4, when children worked alone on a different model than had been used in Sessions 2 and 3.

Analysis of the WPPSI scores indicated that children generalized their skills fairly broadly. In particular, the 2 (sex) × 3 (condition) × 2 (ability) ANOVA performed on the standardized scores revealed the same pattern that had emerged in the analysis of building scores. The ability × condition interaction, F(2,68) = 3.74, was significant and reflected the fact that novices from mixed-ability dyads scored higher than novices in the other conditions (M = 12.6 vs. 10.8 and 10.6), but experts attained similar scores in all three conditions (M = 14.6 vs. 15.7 and 15.4).

Mediators of Interactive Benefits

Additional analyses were conducted to determine whether the significant improve-
ment in performance for novices from mixed-ability dyads was mediated by changes in task engagement, discussion, observational learning, and guidance from their expert partner.

Task engagement.—Task engagement was calculated as a percentage score because some children finished before the time had elapsed (see Table 1). High-ability children spent more time on the task than low-ability children, $F(1,24) = 27.93$. Also, children’s task engagement did not increase over sessions; rather, they spent more time on-task in the pretest than in any of the remainder sessions, $F(3,72) = 5.34$. The condition $\times$ ability $\times$ session interaction was not significant.

Looking at the model.—The patterns for children’s tendency to look at the model are shown in Table 1. Experts looked more frequently than novices, $F(1,48) = 124.01$. Newman-Keuls tests of the significant condition $\times$ ability $\times$ session interaction, $F(6,92) = 2.74$, showed that the pattern for looks converged with the function obtained for novices’ and experts’ building accuracy. Compared with novices in other conditions, novices in mixed-ability dyads looked more often at the model during Sessions 2, 3, and 4.

Verbal strategies.—The mean frequency of task-related statements, explanations, and demonstrations is shown in Table 2. A MANOVA performed on task-related comments, accurate explanations, and accurate demonstrations revealed significant main effects for condition, $F(3,48) = 2.72$; ability, $F(2,48) = 3.09$; and session, $F(3,48) = 3.48$. The interaction between these variables was not significant. Analysis of the significant univariate patterns revealed that same-ability dyads engaged in more task-related conversation than mixed-ability dyads, $F(1,52) = 5.16$. Also, experts gave more correct explanations and demonstrations than novices, $F$’s(1,52) = 7.03 and 10.95, respectively, and more explanations and demonstrations were given in the first than the second interactive session, $F(1,52) = 26.44$ for explanations and $F(1,52) = 4.32$ for demonstrations. Although the condition $\times$ ability $\times$ session interaction was not significant, note that, at least in the first session, experts from mixed-ability dyads gave the most explanations and demonstrations.

Mechanisms of facilitation.—The data for conflicts, observational learning, and guidance by an expert partner are shown in Table 3. The ANOVA indicated that conflicts did not mediate changes in children’s building accuracy, as neither the main effect for condition nor any of the interactions involving this factor were significant.

To assess the contribution of observational learning, the amount of time that children spent observing their partners was measured. In comparisons involving novices, one child in each same-ability dyad was designated randomly as the focal child, and his or her scores were compared with those of novices from mixed-ability dyads.
Children spent more time observing their partners in the first than in the second interactive session, $F(1,36) = 4.98$. More important, the condition × ability interaction was significant, $F(1,36) = 9.54$. Newman Keuls tests revealed that in same-ability dyads, experts spent more time observing their partners than novices did ($M = 170$ sec vs. 76 sec). In contrast, in mixed-ability dyads, novices spent more time observing their partners than experts ($M = 186$ sec vs. 29 sec). Experts’ tendency to monitor their novice partners is one index of the contribution of expert guidance to novices’ improvement. As is evident in Table 3, experts spent very little time monitoring their novice partners.

**Discussion**

Three questions concerning the relation between peer interaction and problem solving in preschool children were addressed in the present study. First, does collaboration lead to greater learning than solitary work? Second, do the benefits accrued from collaboration generalize to children’s subsequent individual performance? Third, what are the features of interaction that mediate learning?

The results converged with other work (e.g., Brownell, 1982; Cooper, 1980; Koester & Bueche, 1980) in which preschool children were shown to solve problems interactively and extended this finding to a more complex problem. The inclusion of solitary and collaborative conditions and pretest and outcome measures made it possible to distinguish two competing hypotheses: that collaboration promotes greater learning than solitary work (see Mead, 1934; Vygotsky, 1978; Wood, 1980) and that during the preschool years solitary work is more conducive to learning than collaboration (see Piaget, 1968). The results are consistent with the hypothesis that, as early as the preschool years, collaboration can lead to greater learning than independent work. Experts’ building approximated ceiling accuracy and, consequently, cannot be interpreted easily. However, for novices, collaboration produced superior learning, and learning was maximized when children worked with an expert partner. This pattern supports Vygotsky’s and Wood’s position that children are more likely to acquire cognitive skills when they work with a more expert partner.

Concerning the second question—whether children generalize the skills acquired during interaction to their individual problem-solving attempts—the data are consistent with the suggestion that generalization may be mediated either by the amount of progress accrued during interaction or by the relation between children’s expertise and that of their partners. Only novices who worked with an expert generalized their skills to the individual posttest.

The third goal of the study was to identify mediators of the learning accrued from interaction. As mentioned, expertise clearly contributed to interactive effects. In the remainder of the discussion, I will focus on the contributions of task-engagement, discussion, conflict, observational learning, and guidance by an expert.

Although the trends were in the expected direction, with collaboration having greater influence on novices’ task engagement than on experts’ task engagement, these differences were not statistically significant. This result is contrary to other work (e.g., Leuba, 1933; Perlmutter et al., 1986) in which dyads spend more time on-task than singletons. However, past work has not evaluated the interaction between collaboration, expertise, and task engagement. Perhaps future work will show that the relation between collaboration and task engagement is influenced by individual differences such as children’s expertise and interaction styles. Anecdotally, for example, independent of their ability structure, some dyads worked well together, whereas others were unable to do so. Thus, a closer look at the dynamics of interaction is indicated.

Clearly, novices’ increased competence was mediated by their acquisition of task strategies (e.g., looking at the model). Novices from mixed-ability dyads exhibited the greatest increase in the use of these strategies following the pretest. Increases in competence also were mediated by the quality of verbal interaction. Children’s conversations generally were task related. Although children often discussed alternative approaches, these discussions rarely were negative. Rather, through explanations and demonstrations, children argued their point and, in the case of experts from mixed-ability dyads, mediated their novice partner’s improvement.

Of the three mechanisms of facilitation that were examined—conflict, observational learning, and guidance by an expert—only observational learning and guidance by an expert mediated learning. Although conflict has been associated with learning in studies involving older children (e.g., Perret-Clermont, 1980), it is possible that preschoolers lack the skill to sustain discussions of alternatives.
(e.g., Damon, 1983). Thus, other mechanisms, such as observation and some forms of guidance, may be more instrumental for learning at this age (see Azmitia & Perlmutter, in press).

Novices spent more time observing expert than novice partners. This pattern converges with other work (e.g., Bandura, 1977; Morrison & Kuhn, 1983) in which even young children are aware of the relation between their competence and that of others, and this awareness influences their preference for observing competent models. This conclusion is supported further by the fact that experts spent more time observing experts than novices.

Although the contribution of experts' guidance to novices' improvement is less clear, it is noteworthy that experts gave slightly more explanations and demonstrations to novices than to experts and that, although they seldom monitored novices' performance, their observations usually led them to correct novices' building and to justify the corrections. However, experts provided guidance more frequently during the first than the second interactive session. There are two possible explanations for this pattern. First, after the first session, the goal of completing the task may have taken precedence over the goal of working together. Alternatively, during the course of the first session, experts may have become aware that novices' competence had increased and, thus, decreased their guidance. Future research should examine the moment-to-moment dynamics of interaction to allow us to choose between these two alternatives. Regardless of which interpretation is correct, taken together, the data on observational learning and guidance by an expert suggest that learning is mediated not only by experts' guidance (see Vygotsky, 1978) but also by novices' own initiative in observing, imitating, and making suggestions. By making suggestions, for example, novices may have developed a rationale for the importance of using task strategies. This result converges with that of studies involving older children (e.g., Ellis & Rogoff, 1986) that have highlighted the contribution of the tutee to the tutoring process.

Finally, as hypothesized, interactive benefits increased over time: novices from mixed-ability dyads built more accurately during the second than during the first interactive session. However, this improvement does not appear to have been mediated only by increased use of task strategies, discussion, observational learning, or guidance. Although the decrease in the frequencies for the measures of verbal interaction suggests that improvement was not mediated by an increase in interaction per se, it is possible that, once a certain level of proficiency is attained (see Doise & Mugny, 1984; Piaget, 1977), interaction becomes less instrumental for learning, and children can effect their own progress.

References


96 Child Development


Wechsler Preschool and Primary Scale of Intelligence. (1967). New York: Psychological Corp.