EXPERIMENT 3

The previous experiment obtained evidence for an approximate linear fan pattern with children of Standard IV and parallelism pattern with children of Standard VIII in prediction of performance in singing competition. While this result is consistent with hypothesized interaction between nature of task and developmental level of subjects, it is inconsistent with the developmental trend reported in American studies of performance on puzzles (Kun et al, 1974) and weight-lifting contest (Surber, 1980). The finding of the linear fan pattern with children of Standard IV also casts some doubt on the plausibility of the cultural difference hypothesis (Singh, 1981; Singh et al, 1979). The first purpose of Experiment 3 was, therefore, to determine the precise age at which the fan and parallelism patterns emerge in prediction of performance in singing contest.

Results pertaining to order effects on prediction of performance do not allow any definite conclusion. Kun et al (1974) noted recency effect of both motivation and ability information on judgments by children of Standard I. Such order effects were not present in judgments by pre-
operational children of Experiments 1 and 2 of the present research. In addition, the puzzle task had evidence for recency effect on judgments by children of both Standards IV and VIII. It appears that order effects are also linked with the nature of task because the same groups of children had recency effect in puzzle task but no order effect in music task. The second purpose of Experiment 3 was, therefore, to study nature of order effect in music task with children from Kindergarten to Standard XI.

Method

Subjects

The subjects consisted of 144 children. The kindergarten children were from the Thumbelina Nursery and Kindergarten School, Narayanpura, Ahmedabad, Gujarat. Children of Standards II, IV, VI, VIII, and XI were from the Central School, Shahibaug, Ahmedabad, Gujarat. There were 12 boys and 12 girls in each age group. Mean ages for the six groups of children were 4 years 6 months, 6 years 6 months, 8 years 7 months, 10 years 8 months, 12 years 8 months, and 15 years 7 months with respective ranges of 4 years 2 months to 5 years 4 months, 6 years 7 months to 7 years 3 months, 8 years 2 months to 9 years 4 months, 10 years 6 months to 11 years 8 months, 12 years 3 months to 13 years 7 months, and 15 years 5 months to 17 years 9 months.
Stimuli, Design, and Procedure

The stimuli, design, and procedure were identical to those in the music competition task of Experiment 2. Each subject received detailed instructions, worked on practice examples, and rated profiles of three booklets. After the third trial of judgments, each subject received 5 toffees and thanks from the experimenter. In general, kindergarten children took much longer time in completing the task than other groups of children.

Results

Judgments of prediction of performance in singing competition were subjected to a $6 \times 2 \times 2 \times 2 \times 3 \times 3$ (Standard of subjects x Sex of subjects x Order of presentation of information x Trials x Motivation x Ability) analysis of variance. The first three factors were between-subjects ones; the remaining three were within-subjects factors (Winer, 1971). Summary of this analysis is given in Appendix-F. Only the results related to integration rule, order effects, and valuation of motivation and ability information will be presented in this chapter.
Patterns in Motivation x Ability Effect

Graphic analysis. Figure 12 presents mean judgment of singing performance as a function of motivation (curve parameter) and ability (listed on the horizontal axis) of the target child by the six groups of subjects. An inspection of this figure suggests that prediction of performance in singing contest may be represented by the multiplying- and adding-type rules. The first three graphs in the upper part of Figure 12 and the first graph from left on the bottom part of Figure 12 have a clear divergence toward right. These children seem to have predicted performance in singing contest as a multiplicative function of motivation and ability.

The second and third graphs on the bottom part of Figure 12 exhibit a clear pattern of parallelism. It appears that children of Standards VIII and XI predicted performance in singing contest as an additive function of motivation and ability.

Results from children of Standards IV and VIII provide an independent replication of the findings of Experiment 2. It can, thus, be said that prediction of performance in singing contest is indeed a task where developmental trends in cognitive algebra are just the opposite of those obtained with other tasks in the United States (Kun et al, 1974; Surber, 1980).
Figure 12. Mean judgment of performance in singing competition as a function of standard of subjects and motivation and ability of stimulus children.
Statistical analysis. The developmental trend evident in Figure 12 was also supported by the analysis of variance. If the six graphs in Figure 12 differ in their pattern, then there should be a significant interaction of Standard x Motivation x Ability effect. This interaction effect was highly significant, $F(20,480) = 9.51, p < .01$. This shows that the six graphs do not have the same pattern in Motivation x Ability effect.

Further analyses indicated that judgments by children of Kindergarten, Standards II, IV, and VI did not differ at all, for Standard x Motivation x Ability effect was nonsignificant, $F(12,320) = 1.27$. Similarly, judgments by children of Standards VIII and XI did not differ at all, $F(4,160) = 1.08$. This indicates that the developmental change from the fan pattern to the parallelism pattern occurs around Standard VII, that is, end of the middle school.

According to the multiplying rule, the entire Motivation x Ability effect should concentrate in the Linear x Linear trend, and the Linear x Quadratic, Quadratic x Linear, and Quadratic x Quadratic trends should all be statistically nonsignificant. If the parallelism pattern predicted by adding rule is perfect, then none of the four trend components should be statistically significant. Results from trend analyses of the Motivation x Ability effect for each of the six groups of subjects are shown in Table 4.
TABLE 4

Trend Components in Motivation x Ability effect
in Each of the Six Groups of Subjects

<table>
<thead>
<tr>
<th>Groups</th>
<th>df</th>
<th>L x L</th>
<th>L x Q</th>
<th>Q x L</th>
<th>Q x Q</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kindergarten</td>
<td>1,23</td>
<td>76.73**</td>
<td>2.19</td>
<td>8.21**</td>
<td>.01</td>
</tr>
<tr>
<td>Standard II</td>
<td>1,23</td>
<td>192.99**</td>
<td>1.02</td>
<td>1.08</td>
<td>.57</td>
</tr>
<tr>
<td>Standard IV</td>
<td>1,23</td>
<td>136.37**</td>
<td>.04</td>
<td>2.55</td>
<td>1.02</td>
</tr>
<tr>
<td>Standard VI</td>
<td>1,23</td>
<td>144.99**</td>
<td>.44</td>
<td>6.31**</td>
<td>.15</td>
</tr>
<tr>
<td>Standard VIII</td>
<td>1,23</td>
<td>.05</td>
<td>2.79</td>
<td>2.51</td>
<td>.13</td>
</tr>
<tr>
<td>Standard XI</td>
<td>1,23</td>
<td>.12</td>
<td>1.10</td>
<td>2.60</td>
<td>1.59</td>
</tr>
</tbody>
</table>

Note. L and Q refer to Linear and Quadratic components, respectively.

** p < .01
Results presented in Table 4 have three notable trends. First, judgments by children of Standards II and IV conform precisely to the statistical requirements of the linear fan pattern. The Linear x Linear trend is highly significant in each case, whereas the other three trends are nonsignificant. Second, judgments by children of Kindergarten and Standard VI have a strong Linear x Linear component along with a weak Quadratic x Linear trend which are expected to be nonsignificant. The two graphs on the left side of Figure 12 cannot, therefore, be regarded as consistent with the fan pattern and hence the underlying multiplying rule. Third, judgments by children of Standards VIII and XI satisfy the requirements of the parallelism pattern rather well, for none of the four trend components is significant in either group.

What stands out most clearly from these quantitative analyses is that the integration rule underlying prediction of performance in singing contest undergoes several developmental changes. Both younger children and high school children follow an adding rule, Kindergarten children show a transition from adding to multiplying, and children of Standards VI show a transition from multiplying to adding. Only children from Standard II to IV follow a really multiplying rule.
It should be emphasized that the Kindergarten children did not have a clear fan pattern in Motivation x Ability effect. On this basis, it is speculated that children younger than Kindergarten perhaps follow an adding-type rule in prediction of performance. This interpretation is consistent with the results from other developmental studies of cognitive algebra which found that the multiplying rule develops later than adding rule (Kun et al, 1974; Surber, 1980; Wilkening, 1979, 1980).

Integrational Capacity

Information utilization. Data of individual child were subjected to analysis of variance just as in the previous two experiments. Each main effect had degrees of freedom of 2 and 8. One hundred and 43 of the 144 children had used information about both motivation and ability. One child who used only ability information was from Standard VI. As in the previous experiments, these results indicate that centration is not the dominant response style of preoperational children.

Order effects. Figure 13 presents mean judgment of performance as a function of order of presentation. Effect of order of presentation of motivation information is shown in the upper part; effect of order of presenta-
Figure 13. Order effects of motivation information (upper part) and ability information (lower part) in the six groups of subjects.
tion of ability information is shown in the lower part. Clearly, there is no effect of order of presentation of motivation information, $F(2, 240) = 1.15$. The same trend is visible across all the six groups of subjects, for Standard x Order of presentation x Motivation effect was nonsignificant, $F(10, 240) = 1.38$. This result is similar to that of the previous experiment.

However, the situation with the order of presentation of ability information seems to be different. In statistical analysis, there was a significant Standard x Order of presentation x Ability effect, $F(10, 240) = 2.73, p < .01$. An examination of the six graphs of the bottom part of Figure 13 discloses that there is a primacy effect of ability information in judgment by children of Standard VIII, $F(2, 40) = 8.60, p < .01$. Other groups of children did not show any order effect at all (see Appendix-G). Although this result is statistically reliable, not much weight can be given to it, for Experiment 2 found no such evidence.

In the previous experiment, there was no evidence for order effect for ability information on judgments by children of Standard VIII but the present experiment found evidence for primacy effect. In addition, preoperational children did not yield evidence for any order
effect at all. This lends support to the position that order of presentation effects reflect more on properties of the tasks than on the cognitive capacity of children.

**Hypothesis of limited cognitive capacity.** The present results vis-a-vis information utilization and order effects in six groups of children provide no clue as to the limited cognitive capacity in children. Order effects in prediction of singing performance seem to be elusive. It was not present in the judgments by children of Standard VIII in the previous experiment. But primacy effect has been obtained in the present experiment. It may thus be said that recency effects and failure to utilize all the pieces of information do not reflect on the limited cognitive capacity of children.

**Valuation of Motivation and Ability**

**Standard effects.** In overall analysis of variance, there were statistically significant Standard x Motivation and Standard x Ability effects, $F(10, 240) = 3.82$ and $3.40, p < .01$. Profiles of these two interaction are shown on the left and right sides of Figure 14. No meaningful interpretation of either interaction effect seems to be possible. At best, it can be said that subjects of different age groups interpreted the stimulus cues at slightly different values. Similar position has been taken by Anderson and Butzin (1978) and by Bhargava (1983) also.
Figure 14. Profiles of Standard x Motivation effect (left side) and Standard x Ability effect (right side).
Effect of sex of subjects. Figure 15 presents mean judgment of performance as a function of standard and sex of subjects and ability of stimulus persons. In overall analysis of variance, Standard x Sex of subjects x Ability effect was statistically significant, $F(10, 240) = 2.03, p < .05$. An examination of the relative importance assigned to ability information by male and female children in six groups of subjects does not indicate any trend. In fact, the trends present in judgments by children of Standards IV and VIII are contrary to those noted in Experiment 2 (see Figure 11). This result thus cannot be given much weight either.

Discussion

The main result of Experiment 3 is that integration rules underlying prediction of performance in music competition undergo several developmental changes. The multiplying rule indeed develops out of an adding rule but it gets replaced by the adding rule again around the age of middle school. Only children of Standard II to IV follow a clear multiplying rule.

This evidence for multiplying rule with 6-9-year-olds and for adding rule with children of above 13 years of age in India is important in at least two ways. First,
it shows that even young children in India can follow the multiplying rule in prediction of performance. Bhargava's (1983) demonstration of developmental changes from parallelism to fan pattern around the age of 20 years is thus linked with the causal schema of the task of the life performance and not necessarily with the age of subjects alone. It appears that the integration rules underlying prediction of performance bear more upon causal conceptions or schemata of the task than cognitive capacity of the subjects as Gupta and Singh (1981) rightly proposed.

Second, the evidence for parallelism pattern beginning Standard VIII even with the singing task indicates that integration rule underlying prediction of performance also depends on the culture of the subjects. In research by Singh and his associates (Gupta & Singh, 1981; Singh et al, 1979), it was found that prediction of performance from information about motivation and ability usually follows the parallelism pattern. So they proposed a hypothesis of cultural difference: Americans follow multiplying-type rule whereas Indians follow an adding-type rule. Results from Experiment 3 show that cultural difference hypothesis is now restricted to high school and undergraduate college students. This is because the primary and middle school children of the
present experiment and postgraduate students of management studied by Singh and Bhargava (1982b) and by Bhargava (1983) followed a multiplying rule.

The second notable finding of Experiment 3 is that information utilization and order effects in children's judgment do not bear upon their cognitive capacity. The nature of order effects is highly variable. It does not show any definite relationship with either the age of the subjects or nature of the information. The occasional order effects which are found in children's judgments may thus be ascribed to the changing demands of the task. This refutes the hypothesis that order effects, particularly the recency effect, denote limited cognitive capacity in children.

In summary, it can be said that younger children in India employ multiplying rule when they predict performance in singing contest. Even in this task, the integration rule becomes similar to other tasks just as cultural difference hypothesis (Singh, 1981) states. Also, children are capable of doing complex information processing. The findings of this experiment thus provide no support for the hypothesis of limited cognitive capacity.