This initial experiment was designed primarily to study developmental changes in integration rules underlying prediction of exam performance from information about motivation and ability of the stimulus children. Gupta and Singh (1981) noted no developmental trend in integration rule underlying prediction of exam performance, but the youngest group of subjects in their study were 6-7-year-olds. Bhargava's (1983) study of prediction of life performance had 10-year-olds as the youngest group of subjects. The really preoperational children in Piaget's (1970) sense were thus not included in either study. The present experiment extended the age level of subjects down to four years and studied five groups of children (i.e., Kindergarten to Standard IV) rather thoroughly.

There were two other goals. One was to study integrational capacity of younger children. While other studies (Anderson & Cuneo, 1978; Gupta & Singh, 1981; Kun et al, 1974) used two or three pieces of information for judgment, the present experiment used four pieces of infor-
mation. Also, notable is the methodological rigor: Each child was studied for three consecutive days. This allowed more sensitive test of the hypothesis of limited cognitive capacity in younger children than the previous tests referred above.

Another was to determine order effects in prediction of performance. Do children assign equal importance to information about motivation and ability irrespective of the order in which they appear? Or do they show recency effect as other studies (Kun et al, 1974; Singh, 1982; Surber, 1982) have shown? Since both questions of integrational capacity and order effects pertain to the hypothesis of limited cognitive capacity in younger children, Experiment 1 tested this hypothesis as well.

Method

Subjects

Subjects were 120 children from Kindergarten, Standard I, Standard II, Standard III, and Standard IV of the Campus School, Indian Institute of Technology, Kanpur, Uttar Pradesh. There were 12 boys and 12 girls in each age group. Mean ages for the five groups of children were 4 years 6 months, 5 years 10 months, 7 years, 8 years, and 9 years 2 months with the respective ranges of 4 years 3
months to 5 years 3 months, 5 years 5 months to 6 years 4 months, 6 years 5 months to 7 years 6 months, 7 years 7 months to 8 years 5 months, and 8 years 5 months to 10 years 2 months.

**Stimuli and Designs**

There were three designs. The first and main design was a $2 \times 2 \times 2 \times 2$ factorial which produced descriptions of 16 stimulus children. The two factors were motivation and ability of the stimulus children. Each factor was described by information from two sources. The two sources of motivation information were mother and neighbor of the stimulus child. They had indicated how much time did the child spend over study at home. The two levels of mother's opinion were does not study at all (NS) and always studies (AS); the two levels of neighbor's opinion were studies little bit (SL) and studies very much (SVM). Information about ability came from two teachers of the stimulus child. The two levels of the opinion of Teacher 1 were not at all good in studies (NAG) and very good in studies (VG); the two levels of opinion of Teacher 2 were slightly good in studies (SG) and good in studies (G).
Designs 2 and 3 were 2 x 2 factorials. Design 2 had information about motivation alone from mother and neighbor of the stimulus child, whereas Design 3 had information about ability alone from the two teachers. The levels of the factors of these designs were identical to those in the main design described above. Each design generated four two-cue stimulus children. These designs were intended to serve as checks on the results pertaining to information utilization in main design and also as distinguishing tests between the adding and averaging rules of information integration (Anderson, 1981).

Fourteen practice examples were also constructed. Six practice examples had six pieces of information, 3 about motivation and 3 about ability. Information about motivation came from two neighbors and mother; information about ability came from three teachers. These cases were more extreme than the regular four-cue stimuli. They were prepared with a view to orient the children toward the use of entire response scale (Anderson, 1980, 1982). Also, they served as end anchors. The remaining 8 practice examples were taken from the four-cue and two-cue designs.
All the 38 stimuli (24 test stimuli and 14 practice stimuli) were typed on separate index card. Two sets of cards were prepared. One had information about motivation and then about ability; other had information in just the reversed order. This manipulation of order of presentation of information was done to study the nature of order effects in prediction of exam performance.

**Procedure**

Each child completed the experimental task individually in the small room of the school over three consecutive days. The same female experimenter collected data from all the 120 children.

*Day 1*. The moment the child entered the experimental room, the experimenter gave her name, asked child's name, and appreciated its attractiveness. All conversations were in Hindi.

The experimental task was introduced to the child as one dealing with prediction of future exam performance of some unknown students of the same sex, age, and class as the subject. It was emphasized that some students would be described by the opinion of 6 persons, some by opinion of 4 persons, and some by opinion of 2 persons. Therefore, prediction of future performance of students must be made on
the basis of all the informations given about him or her.

The measure of exam performance was a 21-step ladder scale which is shown in Figure 1. The experimenter placed this response scale in front of the child and trained him or her to use the entire scale. She described the bottom step as poorest performance, the top step as excellent performance, and other steps as performance denoting intermediate levels. She demonstrated the use of response scale by asking ten different questions. Subjects were able to use entire scale without much difficulty.

To make the task clear and meaningful, the experimenter gave 14 practice examples described earlier. The information about each stimulus child was read aloud to the subject and he or she was asked to indicate his or her judgment by pointing at one of the 21 steps of the ladder.

After the practice session, the main points of the instructions were summarized by the experimenter. She also answered all the queries of the subject. Finally, the main 24 experimental stimuli were presented one by one in random order. Description of each stimulus person was read aloud to the subject and he or she was asked to reproduce it. This was done in order to enable the subject to pay attention to all pieces of the available information. When the subject
Figure 1. Response scale used in Experiment 1-3.
was able to reproduce the information, he or she indicated his or her expectation of exam performance of the stimulus child. Ratings of all the 24 stimulus children were made in this way. The orders of presentation of the two types of informations were balanced over equal number of subjects over each age group.

Once subject rated all the 24 stimulus persons, experimenter gave 5 toffees and 5 balloons to the child for the cooperation in the experiment. She thanked the child and asked him or her to show up on the next day for further experimentation.

Days 2-3. The procedure of Day 2 and 3 were identical to those of Day 1. Subjects received detailed instructions, worked with 14 practice examples, and finally rated the 24 stimulus persons twice in different shuffled orders. As on Day 1, the subject received 5 toffees, 5 balloons, and thanks for his or her cooperation.

For data analysis, 21 steps of the ladder were treated as a rating scale corresponding to digits 1-21. Judgments made on the first day were considered to be additional practice for the subject. Only the data from the second and third days were coded and analyzed. There were thus 4 trials of judgments.
Results

Integrational Capacity

Information utilization. Ratings of predicted exam performance by five groups of children were subjected to separate 2 x 4 x 2 x 2 x 2 x 2 (Sex of subjects x Trials x Mother x Neighbor x Teacher 1 x Teacher 2) analyses of variance. In these analyses, the first factor was a between-subjects factor; the remaining five were within-subjects factors (Winer, 1971). Summary analyses of variance for the five groups of subjects are shown in Appendix-A. From these analyses, the F ratios for the four main effects of the opinion of mother, neighbor, and two teachers on the prediction of performance by the five groups of children are reproduced in Table 1.

According to the centration hypothesis, children of Kindergarten to Standard II should not be able to utilize more than one piece of information in prediction of performance. An examination of Table 1 indicates that all the four main effects were highly significant with each of the five groups of subjects. It can, therefore, be said that younger children utilized all the four pieces of information in prediction of performance without much difficulty.
TABLE 1

F Ratios for Four Main Effects from 2 x 4 x 2 x 2 x 2 x 2
(Sex of subjects x Trials x Mother x Neighbor x Teacher 1
x Teacher 2) Analysis of Variance for each of the Five
Groups of Children

<table>
<thead>
<tr>
<th>Groups</th>
<th>F for Main Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mother</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>508.75</td>
</tr>
<tr>
<td>Standard I</td>
<td>1996.97</td>
</tr>
<tr>
<td>Standard II</td>
<td>2827.04</td>
</tr>
<tr>
<td>Standard III</td>
<td>966.62</td>
</tr>
<tr>
<td>Standard IV</td>
<td>542.31</td>
</tr>
</tbody>
</table>

Note. Each F ratio has dfs of 1,22. The critical F ratios at .05 and .01 levels of significance are 4.30 and 7.94, respectively.
Even though all the children of each group might not have used all the pieces of information available in their individual judgment, the group analysis may yield significant F ratios for each piece of information (Anderson, 1980; Anderson & Cuneo, 1978). To rule out this possibility, data of the individual child were subjected to separate analyses of variance (Gupta & Singh, 1981). Table 2 lists number of children having 1, 2, 3, and 4 significant main effects from each of the five groups of subjects.

It is clear that 119 children were able to use all the four pieces of information in their judgments. One child used only three pieces of information but he is from Standard IV. It can thus be said that centration is not the dominant attention strategy of even preoperational children.

Evidence against centration was also present in the individual child analysis of the data of two-way, Mother x Neighbor and Teacher 1 x Teacher 2 designs. All the 120 children had significant main effects of both factors on their judgments. It is notable that the statistical tests of main effects in these two designs had degrees of freedom of 1 and 9 only. Nevertheless, the main effects were substantial. This suggests that utilization of four pieces of
TABLE 2

Number of Children Having One, Two, Three, and Four Significant Main Effects at Each Standard Level

<table>
<thead>
<tr>
<th>Standard</th>
<th>Number of Significant Main Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>One</td>
</tr>
<tr>
<td>Kindergarten</td>
<td>0</td>
</tr>
<tr>
<td>Standard I</td>
<td>0</td>
</tr>
<tr>
<td>Standard II</td>
<td>0</td>
</tr>
<tr>
<td>Standard III</td>
<td>0</td>
</tr>
<tr>
<td>Standard IV</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Note. For each main effect, df = 1,45.
information in the main four-way design mentioned earlier is not an artifact of the statistical power.

The foregoing analyses clearly show that all the five groups of children utilized all the given pieces of information in similar manner. There is thus no evidence for any developmental trend in cognitive capacity. It may also be said that the number of significant main effects in analysis of variance for the individual child perhaps does not reflect upon the integrational capacity of children. It is likely that these main effects bear more upon the relevance of particular piece of information in judgment than on integrational capacity of children. This interpretation is in line with that favored by Gupta and Singh (1981) and by Singh (1982).

Order effects. Judgments of prediction of performance were subjected to a $5 \times 2 \times 2 \times 4 \times 4 \times 4$ (Standard 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 factors; the last three factors were within-subjects factors. The four levels of motivation and ability factors were products of the opinions of mother and neighbor about motivation and of two teachers about ability. The complete analysis is given in Appendix-B. In this analysis, the effect of Order of presentation x Motivation and Order of presentation x Ability were highly
significant, $F (3,300) = 51.21$ and $28.46$. Profiles of the two interactions are shown in Figure 2.

Both Order 1 for motivation information and Order 2 for ability information refer to the same motivation-ability sequence. The simplest interpretation for the two graphs of Figure 2 is that expectations of exam performance of the stimulus children were slightly more positive when information appeared in motivation-ability order than in ability-motivation order. The loci of the two interaction effects seem to be slight variations in the magnitude of order effect across the values of the two types of information. The order effect of motivation information has a tendency to decrease over the increasing levels of motivation information. On the contrary, the order effect of ability information has a tendency to increase over the increasing levels of ability information. This result is completely new. Therefore, it does not fit into the conventional order effect reported in developmental literature.

The two order effects shown in Figure 2 did not characterize children from all the five groups, for Standard x Order x Motivation effect and Standard x Order x Ability effects were also highly significant, $F (12,300) = 8.53$ and $6.12$. Figure 3 presents nature of order effect
Figure 2. Mean judgments of performance as a function of order of presentation of information. The abbreviations NS, SL, SVM, and AS stand for does not study at all, studies little bit, studies very much, and always studies, respectively. The abbreviations NAG, SG, C, and VG stand for not at all good in studies, slightly good in studies, good in studies, and very good in studies, in order. Order 1 for motivation Order 2 for ability information refer to the same motivation-ability order.
Figure 3. Order effects of motivation information (upper part) and ability information (lower part) for the five groups of children. See Figure 2 captions for meanings and abbreviations.
for the two types of information in the five groups of children.

An examination of Figure 3 discloses three trends in order effects. First, the nature of order effect of motivation and ability information with children of Standards I to III are identical to those shown in Figure 2. Second, the expectations of performance from the stimulus children by the Kindergarten children were slightly more positive when information appeared in ability-motivation order than in motivation-ability order. Though this result is different from that obtained with children of Standards I to III, the nature of order effect is precisely the same. In all these cases, order of presentation has affected origin of the response scale more than its unit. Finally, children of Standard IV indicate conventional recency effect of motivation information. The finding of recency effect in prediction of performance with older children is, however, surprising, for Kun et al (1974) found this effect with children of Standard I only.

If recency effect really bears upon the cognitive capacity of the children, then it should be more prevalent in judgments by younger than older children. Experiment 1 yielded no evidence for such a trend. In fact, the finding
of recency effect of motivation information with children of Standard IV illustrates that this effect has nothing to do with cognitive capacity.

**Hypothesis of limited cognitive capacity.** Results pertaining to information utilization and order effects presented above do not provide any indication that children are of limited cognitive capacity. The hypothesis that number of significant main effects in individual child analysis and order effect in children's judgments reflect upon the requirements by the task. This appears to be supported by the findings of Experiment 1.

**Integration Rules**

Near-parallelism pattern. Figure 4 presents mean ratings of exam performance as a function of motivation (curve parameter) and ability (listed on the horizontal axis) of stimulus children. The four levels of motivation information represent the combinations of opinions of mother and neighbor; the four levels of ability information represent the combinations of opinions of the two teachers.

Of direct interest in the five graphs of Figure 4 is the pattern in judgments. The three sets of curves on the right side of the Figure 4 are from children of Standards II to IV. All these three groups have the prevailing
Figure 4. Mean judgments of performance as a function of motivation and ability of the stimulus children. The dashed curve is based on ability information alone (i.e., Design 3).
pattern of near-parallelism. This confirms the result reported by Gupta and Singh (1981).

Data of the two younger groups of children, namely, Kindergarten and Standard I, also show the very pattern of near-parallelism. On the basis of these graphs, it can be said that Kindergarten to Standard IV children all followed the same adding-type rule.

A strict adding-type rule requires parallelism in the factorial graph and hence a nonsignificant interaction term in analysis of variance (Anderson, 1981, 1982). In analysis of variance of the data of these five groups of subjects, however, interaction terms were significant (see Appendix-C). Decomposition of the Motivation x Ability effect by Shanteau's (1977) POLYLIN program\(^1\) into Linear x Linear, Linear x Quadratic, Quadratic x Linear, and Quadratic x Quadratic trends indicated evidence for the presence of one of the higher order trends.

A closer examination of the five graphs in Figure 4 suggests that deviations from parallelism are due to end

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\(^1\) Shanteau (1977) has developed a computer program for the test of multiplying model. This program partitions two-factor interaction into four components, namely, Linear x Linear, Linear x Quadratic, Quadratic x Linear, and Quadratic x Quadratic at the level of individual subject. If the multiplicative rule is correct, then Linear x Linear trend yields a significant F ratio, whereas other three trends yield nonsignificant F ratios. This computer program has been adapted for PDP 11/70 computer at the Computer Center, Indian Institute of Management, Ahmedabad. This program is available from Dr. Ramadhar Singh upon request.
effects in the response scale. There is a tendency for the highest point to be too high and the lowest point to be too low as though the children had preference for the end portions of the response scale. In any case, the deviations from parallelism are relatively minor. Therefore, they do not require any serious qualification on the adding-type rule. Accordingly, it may be said that there is no developmental trend in prediction of exam performance: Kindergarten to Standard IV children all adopted and adding-type rule in integration of information about motivation and ability of stimulus children.

Adding-versus-averaging. Both the adding and averaging rules can account for the pattern of near-parallelism in the five graphs of Figure 4. The dashed curves of Figures 4 and 5 are based on information about ability alone and motivation alone, respectively. The adding rule requires this dashed curve to plot parallel to the other four solid curves. This is because the added information would have the same directional effect across the four levels of the factor listed on the horizontal axis. Figures 4 and 5 show no sign of parallelism. Instead all the ten graphs exhibit very strong crossovers. These crossovers are convincing evidence against the adding rule.
The averaging rule predicts the crossover interaction that is visible in all the ten graphs displayed in Figures 4 and 5. The dashed curve for ability-only of Figure 4 crosses over the middle two solid curves convincingly. The dashed curve for motivation-only of Figure 5 crosses over nearly all the four solid curves. These crossovers are too strong to require any formal statistical test of crossover interaction. It seems reasonable to conclude, therefore, that children averaged information about motivation and ability in prediction of exam performance.

Further evidence for averaging rule and against adding rule comes from the graphs of Figure 6. The five sets of curves on the lower part of Figure 6 represent opinions of mother and neighbor about motivation. The five sets of curves on the upper part of Figure 6 represent opinions of the two teachers about ability. The solid curves are from the four-way, Mother x Neighbor x Teacher 1 x Teacher 2 design; the dashed curves come from the two-way, Mother x Neighbor and Teacher 1 x Teacher 2 designs. The crossover of the solid curves by the dashed ones indicates that the two factors, namely, opinion of Teacher 1 and Teacher 2 about ability in the lower set of graphs and opinion of Mother and Neighbor about motivation in the upper set of
Figure 5. Mean judgments of performance as a function of ability and motivation of the stimulus children. The dashed curve is based on motivation information alone (i.e., Design 2).
Figure 6. Factorial plots of Mother x Neighbor (lower part) and Teacher 1 x Teacher 2 effects from the main four-factor design (solid curves) and the corresponding two-factor designs (dashed curves).
graphs were also averaged. Had an adding rule been followed, the four curves could have conformed to just one common pattern.

Considered together, these results indicate that children followed an averaging rule in prediction of exam performance:

\[ \text{Exam Performance} = \sum w_i \cdot (M, N, T1, T2) \]  

where sume of the four weights, \( w_i \), is unity, and the symbols, M, N, T1, and T2 refer to the opinion of Mother, Neighbor, Teacher 1, and Teacher 2, respectively. Success of this model can be seen from the prevailing pattern of near-parallelism in the solid curves of Figure 6. Factorial plots of Mother x Teacher 1, Neighbor x Teacher 1, Mother x Teacher 2, and Neighbor x Teacher 2 effects had even nicer pattern of parallelism.

Valuation of Motivation and Ability Information

In the overall analysis of variance (see Appendix-B), Standard x Motivation and Standard x Ability effects were highly significant, \( F (12,300) = 7.76 \) and \( 5.36, \ p < .01 \). Profiles of these two interactions are shown on the left and right sides of Figure 7. The only interpretable trend in both graphs is that Kindergarten children used slightly lower portion of the response scale in relation to the
Figure 7. Profiles of Standard x Motivation and Standard x Ability effects from the main four-factor design.
other children. Similar tendency appears to be with children of Standard III. Judgments by other groups of children show no definite age trend. It can thus be said that children of the five groups interpreted the levels of motivation and ability at slightly different values.

Discussion

There are three important findings of Experiment 1. First, younger children are capable of utilizing four pieces of information in prediction of exam performance. This result is at odd with the results reported in literature (Gupta & Singh, 1981; Kun et al, 1974). But it should be emphasized that the present experiment collected much more data with each child than any previous published experiment. With properly sensitive design and relevant cues for judgment, it appears possible to make children utilize upto four pieces of information efficiently. This finding refutes the claim made by the Piagetians that preoperational children use centration as their attention style.

Second, the finding of effect of order of presentation on origin of the response scale and increase and decrease in the magnitude of order effect as a function of value of information is novel. In previous developmental literature,
order effect has been either primacy or recency. Furthermore, recency effect has been noted with younger children. However, the recency effect was present with children of Standard IV in the present experiment. This effect was restricted to motivation information only. This implies that order effects may possibly be accounted for by the nature of task and not necessarily by the cognitive capacity of children.

Finally, prediction of exam performance indeed follows an averaging rule. In research by Gupta and Singh (1981), the response measure consisted of nine squares. In the present research, a continuous ladder scale was used. Nevertheless, results obtained from children of Standards II to IV are basically the same. Present research, therefore, confirms the findings of Gupta and Singh. In addition, it extends their finding of averaging rule for prediction of exam performance to really preoperational children (i.e., 4-6-year olds).

Considered together, results of Experiment 1 provide general support to the hypothesis that information utilization, order effects, and integration rule are perhaps linked with the nature of task. Prediction of exam performance obeys the averaging rule, and this rule is used by children in much the same way as by adults.