Experiment 1 had two goals. One was to determine the cognitive algebra underlying prediction of exam performance. Since previous research (Gupta & Singh, 1981; Singh & Bhargava, 1982 a; Singh et al, 1979) yielded evidence for an adding-type rule, the main point of interest in this experiment was to distinguish the adding rule from the averaging one.

Another goal was to study the manner in which missing information is dealt with by school teachers. Much of the research on information integration (Anderson, 1981) shows that judges render their judgments on the basis of only the given information. The three studies cited above and a recent study of prediction of gift size on the basis of generosity and income (Singh, in press), however, present evidence for imputations about missing informations. When needed information is absent, teachers may assume value of the missing information as a positive function of value of given information or they may assume a single, constant value for the missing information. As teachers deal with the problems of missing information very often in their day-to-day activities, study of how they deal with the missing information has a great practical interest.
Stimuli and Designs

Descriptions of stimulus persons were prepared on index cards. Motivation and ability were specified by verbal labels of extremely low, very much below average, below average, above average, very much above average, and extremely high. This allowed use of comparable scale for the two factors.

Stimulus descriptions were prepared according to four designs. Design 1 was a $2 \times 3 \times 3$ (Number of average motivation information x Motivation x Ability) factorial. The three levels of motivation and ability were extremely low, average, and extremely high. The number of average pieces of motivation information in a description was either none (0) or two (2). Descriptions with one piece of motivation and ability information will be referred to as two-cue and those with three pieces of motivation information, including two average pieces, and one ability information will be referred to as four-cue. Design 1 generated 9 two-cue and 9 four-cue descriptions.

Design 2 was a $2 \times 3 \times 3$ (Set size of motivation information x Motivation x Ability) factorial. The levels of motivation and ability were identical to those in Design 1. The size of the descriptive sets was manipulated by including 1 or 3 similar pieces of information about motivation. This design required 18 descriptions, 9 of which were already present in Design 1. Therefore, only 9 new descriptions were prepared.
Designs 3 and 4 had information about motivation alone and ability alone, respectively. The levels of two factors were identical to those in Designs 1 and 2.

There were four end anchor descriptions based on motivation. Information from four sources. The 12 practice examples included these four end anchors plus eight other descriptions from the set of 33 descriptions of the four designs. A total of 49 (37 main and 12 practice) descriptions were thus made.

Procedure

Each teacher completed the task individually in a small room of the school. All of the teachers were instructed by the same female experimenter. In general, the experimental task took 45 minutes.

The moment the teacher entered the experimental room, the experimenter gave her name and described the purpose for which she was doing the research. She also asked the subject to complete a background information sheet. All conversion was in English.

Subject received a typed-sheet of instructions that described the nature of task and the role of subject. The task was introduced as dealing with prediction of performance of same Class X students in their forthcoming Board examination. It was emphasized that prediction of exam performance could be based on both motivation and ability or just one of the two of the students.
Figure 1. Factorial plots of Number of Average Motivation Information x Motivation, Number of Average Motivation Information x Ability, Motivation x Ability, Set-size of Motivation Information x Motivation, Set-size of Motivation Information x Ability, and Motivation x Ability effects from Experiment 1. Three graphs on the left are from Design 1; three graphs on the right are from Design 2. The abbreviations EL, AV, and EH refer to Extremely low, Average, and Extremely high levels of a factor, respectively.
Vidyalaya, Indian Institute of Technology, New Delhi; Kendriya Vidyalaya, Cantt.I; Kendriya Vidyalaya, Cantt.II; Kendriya Vidyalaya, Jharauda Kalan; and Kendriya Vidyalaya, Andrewganj. The mean age for teachers of primary, middle, and high school sections were 34 years 10 days, 33 years 10 months 9 days, and 37 years with the respective ranges of 25 years 9 months to 43 years 4 months, 25 years 4 months to 42 years 7 months, and 24 years to 59 years 11 months.

Results

Effect of Addition of Average Motivation Information

The first three graphs on the left of Figure 1 present results pertaining to the effect of addition of average pieces of motivation information on prediction of exam performance. In the left most graph, the curve with open circle is based on the three levels of motivation information listed on horizontal axis; the curve with filled circle is based on very three levels of motivation information plus two additional pieces of average motivation information.

The evidence for the averaging process is quite clear. Addition of two pieces of average motivation information has raised the value of judgment based on just one piece of extremely low motivation. On the contrary, addition of two average pieces of motivation information to the extremely high value of motivation information had lowered the value
Figure 1. Factorial plots of Number of Average Motivation Information x Motivation, Number of Average Motivation Information x Ability, Motivation x Ability, Set-size of Motivation Information x Motivation, Set-size of Motivation Information x Ability, and Motivation x Ability effects from Experiment 1. Three graphs on the left are from Design 1; three graphs on the right are from Design 2. The abbreviations EL, AV, and EH refer to Extremely low, Average, and Extremely high levels of a factor, respectively.
of judgment. Naturally the curve based on one motivation information crosses over the curve based on very one piece of motivation information. This supports an averaging rule for integration of various pieces of motivation information.

The second graph from left provides a distinguishing test between the adding and averaging rules of integration of information about motivation and ability. The curve with open-circle is based on three levels of ability listed on the horizontal axis and is averaged over one piece of motivation. The curve with filled-circle is based on the very three levels of ability and is averaged over three average value of motivation. If the averaging hypothesis is correct, then the curve with open-circle should cross over the curve with filled-circle. This averaging prediction seems to have been borne out clearly.

The third graph plots mean prediction of exam performance as a function of motivation and ability of students. The three curves are essentially parallel. Since the distinguishing test between adding and averaging rules inirmed the former and confirmed the later, the parallelism pattern in the third graph is reflective of the constant-weight averaging rule.

In detailed statistical analysis (Appendix A), the three interpretations made above were precisely supported. The $F$ ratios for the three graphs from left to right were $F(2,108) = 199.32$, $F(2,108) = 10.68$, and $F(4,216) = 2.19$. The first two $F$ ratios are significant which provide statistical support
for crossover interaction in two respective graphs. The third \( F \) ratio is statistically nonsignificant which provides statistical support for parallelism pattern in the third graph. Considered together, results from Design 1 are in excellent agreement with the constant-weight averaging rule.

The left graph of Figure 2 presents another view of the averaging process in Design 1. The data from the two-cue and four-cue descriptions of Design 1 have been plotted together. The three curves with open-circles are nearly parallel, so are the three curves with filled-circles. In their combined plot, however, the two bottom curves have a tendency to converge, whereas the two top curves have a tendency to diverge. This is natural if judgments based on less information is to have steeper slope than judgments based on more pieces of information.

**Effect of Set-size of Information**

The three graphs on the right side of Figure 1 present data from Design 2 which varied set-size of motivation information. According to Anderson (1965, 1967), adding more information of equal value makes the judgment more polarized. Accordingly, curve based on Set-size 3 would be expected to cross over the curve based on Set-size 1.

Inspection of the fourth and fifth graphs of Figure 1 discloses no evidence for the predicted pattern. Both graphs are nearly parallel, \( F (2,108) = 2.62 \) and 2.57. Thus failure
Figure 2. Combined factorial plots of Motivation x Ability and Ability x Motivation effects from Designs 1 and 2 of Experiment 1. The dashed curve is based on information listed on the horizontal axis itself.
of the set-size effect reduces the discriminative power of Design 2 completely (Appendix B).

An alternative view of this situation is given in the second graph of Figure 2. Here also curves based on the two set-sizes are quite identical. It may be said, therefore, that teachers are perhaps not so sensitive to number of similar pieces of information.

This tendency has a major implication for cognitive analysis of adding and averaging rules. Look at the middle two curves in the first and second graphs of Figure 2. Both curves are based on three levels of ability listed on horizontal axis plus one piece of average motivation information (open-circle curve) or three pieces of average motivation information (filled-circle curve). According to the averaging hypothesis already supported above, the curve with open circle should convincingly cross over the curve with filled circle. There is no evidence for such a crossover at all $F(2,108) = 1.05$. Had only this test been used, the conclusion would have been in favor of adding rule and against the averaging rule. Fortunately, data from the entire design eliminate the adding rule and further suggest precaution in distinguishing test based on addition of so-called average pieces of information.
Evidence against Imputation

The dashed curves of the first and third graphs from left of Figure 2 are based on information about ability alone and motivation alone. Since this curve shows the expected crossover in both the first and third graphs, the simple interpretation is that the subjects made no imputations about the missing information.

The vertical spread and slope of the curves in Figure 1 indicated greater importance of ability than motivation in prediction of exam performance. Similar picture emerges from ability only and motivation only curves. The ability-only curve is markedly steeper than the motivation only curve, $F(2, 108) = 57.67$. This suggests that subjects used a uniform weighting system in rendering judgments from the given information.

Group Differences

In detailed statistical analyses of Design 1 and 2 (see appendices A and B), there was not any significant effect of age and sex of the subjects. These variables did not enter into any interaction term either. This indicates that the results presented above are generalizable to all school teachers irrespective of their sex and the classes they teach in.
Discussion

Experiment 1 yielded three main findings. First, school teachers predict exam performance of high school students according to a constant-weight averaging rule. This result confirms the previous finding of averaging rule for prediction of exam performance, and extends its generality to a new population of teachers.

Second, school teachers seem to utilize only the given information in the prediction of exam performance. They indicated no tendency to make any inference about missing information. While this result reflects on the manner in which teachers process information it questions the generality of the imputation about missing information (Singh, in press; Singh et al, 1979). Perhaps the imputation about missing information is a characteristic of student population alone.

Finally, teachers seem to be insensitive to the number of pieces of similar information in their judgments. Judgments based on Set-size 1 and Set-size 3 were virtually identical. This means two things. Similar opinions are redundant or teachers do not have initial opinion about motivation. It should be emphasized that the set-size effect emerges because of averaging of the initial opinion of the subjects. When this opinion receives lower weight, the set-size effect reduces to zero (Singh, 1977). The hypothesis that teachers give no importance to the initial impression deserves further study using other judgmental tasks.