EXPERIMENT 4

The purpose of Experiment 4 was two-fold. The first was to replicate and extend the result of differential-weight averaging rule for prediction of life performance. The second was to obtain further evidence against imputation hypothesis in achievement judgments by teachers.

Method

Stimuli and Designs

There were nine stimulus designs. The first was the four-way factorial, with three motivation factors and one ability factor. Each motivation factor was defined by the opinion of a different teacher: Teacher 1 (Bottom most, average, top most); Teacher 2 (Very much below average and very much above average); and Teacher 3 (Quite below average and quite above average). The ability information came from a teacher and the three levels were very much below average, average, and very much above average. These levels of the two factors of motivation and ability were taken from a 11-point scale: Top most, very much above average, quite above average, fairly above average, little bit above average, average, little bit below average, fairly below average, quite below average, very much below average, and bottom most.
The second design was a three-way factorial, using the three motivational factors already mentioned. Designs 3, 4, and 5 were two-way factorials that paired one of three motivational factors with the ability factor. Designs 6, 7, and 8 had information about motivation alone. Their levels were identical to those of three motivation factors. Design 9 had information about ability alone with the same levels as in the four-way design.

These nine designs yielded the descriptions of 79 stimulus students. In addition, 11 end anchors and filler descriptions were prepared. They were based on extreme levels and on levels different than those used in the construction of 79 stimulus students. Of these 11 descriptions, four had four cues, one had three cues, two had two cues, and the remaining four had only one cue. There were fifteen practice examples taken from the set of 90 descriptions already mentioned.

Procedure

The general procedure was same as in Experiment 3. Subjects were told that information about motivation and ability came from the teachers who had known them for at least two years. Furthermore, motivation information came one to three teachers. Whenever more than one piece of motivation information was available, they were to be treated as equally important and valid. When information about either
motivation or ability was not known, subjects were urged to rely their judgments on only the given information. After practice session, the main set of 90 cards were rated over two trials of judgment in different shuffled order. Data from both trials were analyzed.

Subjects

Sixteen male and 16 female teachers drawn from four Central Schools of Delhi served as subjects. The schools were Kendriya Vidyalaya, Gole Market; Kendriya Vidyalaya, Masjid Moth; Kendriya Vidyalaya, Jankpuri; and Kendriya Vidyalaya, R.K.Puram, Sector VIII. The mean age of the subjects was 35 years 2 months 19 days with a range of 23 years 9 months to 49 years 1 month. Each subject spent around one hour and thirty minutes on the experimental task.

Results

Two-operation Model

Experiment 3 demonstrated operation of averaging rule in the prediction of life performance. Experiment 4, therefore, further studied averaging operation using two-operation logic. If motivation and ability are indeed multiplied, then prediction of life performance should be

\[
\text{Life Performance} = (\text{Motivation-1} + \text{Motivation-2} + \text{Motivation-3}) \times \text{Ability.}
\] (10)
That is, the three motivation cues should be averaged together and then should be multiplied by ability.

If this model is correct, then Motivation-1 x Ability, Motivation-2 x Ability, and Motivation-3 x Ability effects should all yield the linear fan pattern in the main four-cue design and the supplementary two-cue designs. In addition, their combined factorial plot would also conform to the very linear fan pattern. But if the averaging rule is operative, then the two-cue curves should have steeper slope than the four-cue ones.

Figure 8 presents combined factorial plot for Motivation-1 x Ability, Motivation-2 x Ability, Motivation-3 x Ability effects for the four- and two-cue designs. The curves with filled-circle are based on data from four-cue design; the curves with open-circle are based on data from corresponding two-cue design.

Consider the left graph of Figure 8. The three curves with filled-circle have a tendency to diverge toward the right, as have the three curves with open-circle. This divergence pattern replicates the results of Experiment 3 and suggests that life performance was made either by multiplying or the differential-weight averaging rule.
Figure 8. Combined factorial plots from Motivation-1 x Ability, Motivation-2 x Ability, Motivation-3 x Ability effects from the four- and two-cue designs. Data from Experiment 4.
The slope of the curves from the two-cue and four-cue designs provide a distinguishing test between multiplying and differential weight averaging rule. In each panel, the bottom curve has slope steeper than the second curve from below. This trend agrees with averaging rule and disagrees with the multiplying rule. On this basis, it can be said that all the four pieces of information were integrated simultaneously by averaging rule, and that the two-operation model proposed above is incorrect.

In detailed quantitative analyses, the nonparallelism pattern present in the four-cue and two-cue curves did not conform to the precise requirements of the linear fan pattern. Table 1 presents results from trend analysis for the four-cue and two-cue designs. Although the Linear x Linear trend is substantial in most cases, the higher order trends are also statistically significant. These deviations from linear fan pattern also question any multiplying interpretation of the data shown in Figure 8.

Further Evidence for Averaging Rule

Figure 9 presents two-way factorial plot of Motivation-1 x Motivation-2, Motivation-1 x Motivation-3, Motivation-2 x Motivation-3 effects from the four-cue and the two-cue designs. Data from the three-cue design are shown by curves with square and data from the four-cue design are shown by curves with
Figure 9. Two-way factorial plots of Motivation-1 x Motivation-2, Motivation-1 x Motivation-3, Motivation-2 x Motivation-3 effects from the four-cue and the two-cue designs.
TABLE 1

Trend Components in Motivation x Ability Effects in Four-cue and Two-cue Designs

<table>
<thead>
<tr>
<th>Designs</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><strong>Four-cue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation-1 x Ability</td>
<td>1,31</td>
<td>296.01</td>
<td>1.18</td>
<td>7.77**</td>
<td>6.16**</td>
</tr>
<tr>
<td>Motivation-2 x Ability</td>
<td>1,31</td>
<td>133.65</td>
<td>21.05**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation-3 x Ability</td>
<td>1,31</td>
<td>85.91**</td>
<td>35.31**</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Two-cue</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation-1 x Ability</td>
<td>1,31</td>
<td>250.01**</td>
<td>30.44**</td>
<td>20.84**</td>
<td>2.84</td>
</tr>
<tr>
<td>Motivation-2 x Ability</td>
<td>1,31</td>
<td>110.40**</td>
<td>5.18*</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Motivation-3 x Ability</td>
<td>1,31</td>
<td>3.73</td>
<td>71.05**</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note. Letters L and Q refer to Linear and Quadratic trends, respectively. These analyses were performed, using Shanteau's (1977) POLYLIN program.

* $P < .05$

** $P < .01$
filled-circle. Data from three-cue design are averaged over one motivation cue. But the data from the four-cue design are averaged over one motivation cue and ability. According to averaging hypothesis, the three-cue curve should have a steeper slope than the four-cue ones. In each of the three panels of Figure 9, there is a convincing evidence of the crossover of the four-cue curve by the three-cue curves. This establishes averaging rule for integration of information about motivation and ability but infirms the multiplying rule.

Figure 10 presents the four-way design data in a two-way Ability x Motivation format. The motivation levels are spaced on the horizontal axis according to their functional measurement values. The curves connected with open circles are from the four-cue design; the dashed curve with open squares is from the three-cue, Motivation-1 x Motivation-2 x Motivation-3 design. Again the three-cue curve has slope steeper than the lower and the middle ability curves. This also confirms the averaging interpretation made above.

The motivation only curve of Figure 10 is not a straight line function of motivation. A drop in value at the fifth level was because of a three-way interaction, F (2,62) = 4.69. This three-way interaction is shown in Figure 11. The profile of Motivation-2 x Motivation-3 effect has been shown under
Figure 10. Two-way Ability x Motivation factorial plot of data from the four-cue and the three-cue designs. The dashed curve is based on data from Motivation-1 x Motivation-2 x Motivation-3 designs.
Figure 11. Factorial plot of Motivation-1 x Motivation-2 x Motivation-3 effect from the three-cue design.
the three conditions of Motivation-1. Across all the three panels, there is only one trend: Opinion of the third teacher (Motivation-3) was always discounted when opinion of the second teacher was negative (very much below average). The flatness of bottom curve illustrates this discounting process. It deserves emphasis that subjects discounted one of the three pieces of information even when they were instructed to treat all the 3 pieces of information equally important and valid. One such result cannot be given much weight in favor of the discounting hypothesis. Nevertheless, it illustrates the analytic power of integration-theoretical approach.

**Imputation Hypothesis**

The dashed curves of Figure 8, 9, and 10 have slope steeper than the solid curves. This agrees with the averaging hypothesis. It may be claimed, therefore, that subjects made no imputation about the missing information.

Further evidence against the imputation hypothesis is shown in Table 2. Difference between the high and low levels of each factor in various designs directly reflects on the slope of the curves. According to the averaging hypothesis, steepness of curve for the main effects should gradually increase from four-cue to one-cue design data. For all the four factors, this requirement was satisfied in most of the cases.
TABLE 2

Differences Between High and Low Levels of Various Designs

<table>
<thead>
<tr>
<th></th>
<th>Ability</th>
<th>Motivation-1</th>
<th>Motivation-2</th>
<th>Motivation-3</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-cue Design</td>
<td>8.87</td>
<td>3.25</td>
<td>1.82</td>
<td>1.52</td>
</tr>
<tr>
<td>3-cue Design</td>
<td>-</td>
<td>4.53</td>
<td>4.00</td>
<td>1.76</td>
</tr>
<tr>
<td>2-cue Design</td>
<td>10.32</td>
<td>6.89</td>
<td>4.97</td>
<td>2.92</td>
</tr>
<tr>
<td>1-Teacher alone</td>
<td>10.05</td>
<td>9.57</td>
<td>5.22</td>
<td>2.36</td>
</tr>
</tbody>
</table>

Note. Values reported some from main effects of each factor in the group analysis.
The single-cue curve has steepest slope; the two-cue curve has steeper slope than four-cue curve. This argues against the imputation hypothesis.

Discussion

Experiment 4 has clearly shown that prediction of life performance obeys the differential-weight averaging rule. This confirms the result of Experiment 3. In addition, it illustrates that nature of task affects weighting of information, not the integration rule.

Evidence against the imputation hypothesis is also clear. Experiments 1 and 2 found no evidence for imputation in exam and competition performance. Experiment 4 found no evidence for imputation in life performance. It may be said, therefore, that teachers have a tendency to rely on the given pieces of information for their judgment, and that they make no imputation about the missing information. Consistent evidence against the imputation hypothesis also shows that imputation process is not linked with nature of task at least with teachers.