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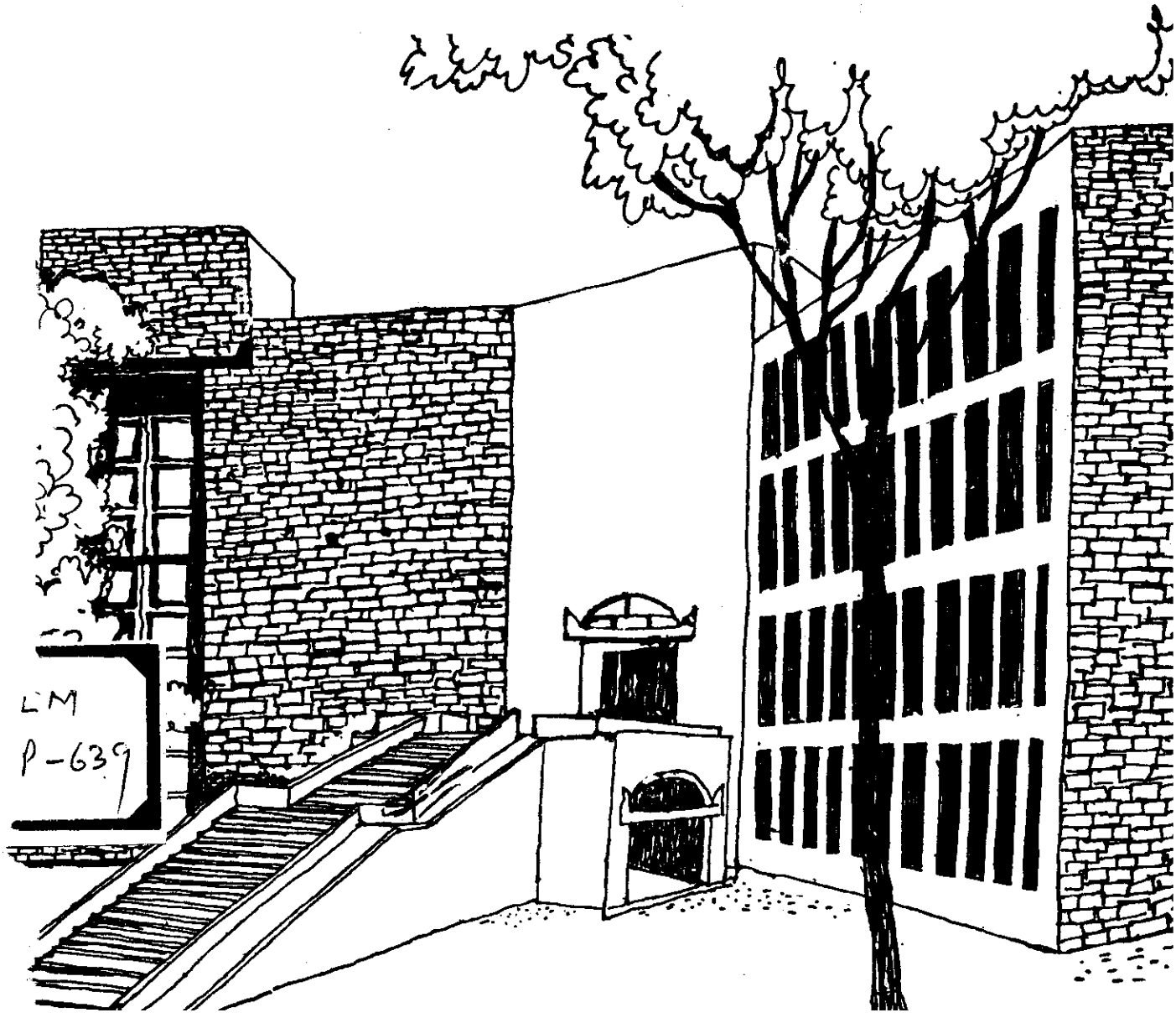

PREDICTION OF JOB PERFORMANCE BY INDIAN MANAGERS: FOUR TESTS OF THE TWO-STAGE AVERAGING-MULTIPLYING MODEL

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Prediction of Job Performance by Indian Managers: Four Tests of the Two-Stage Averaging - Multiplying Model

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Running Head: TWO-STAGE MODEL

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Abstract

Prediction of job performance from information about motivation and ability of subordinates was studied. Experiment 1 made the first test by manipulating reliability of information with managers (n= 22) and professors (n=22). At the first stage of integration, subjects averaged motivation and ability information with their corresponding initial opinions. At the second stage, however, they integrated motivation and ability information differently. Managers followed the multiplying rule; professors followed the constant-weight averaging rule. Experiment 2 (n=22) paired three or one motivation cue with one ability cue. Predictions from information about either motivation or ability were also obtained. The three motivation cues were first averaged and then multiplied by ability as Test 2 predicted. The combined factorial plots of the Motivation x Ability effects from the two-cue and four-cue descriptions also had the linear fan pattern prescribed by Test 3. However, Test 4, which predicted that the initial opinion of the unavailable information would multiply the given information, needed an additional parameter of imputed value for the unavailable information. Theoretical, methodological, and practical implications of the results were discussed.

Many situations require managers to consider motivation and ability of subordinates in prediction of their performance. Some examples of these situations are recruitment, promotion, transfer, job rotation, feedback, and training. Vroom (1964) suggests "that managerial efforts to obtain and develop persons with skill and ability and to motivate these persons must proceed concurrently" (pp. 203-204). His suggestion comes directly from his multiplying model, Performance = Motivation x Ability, which implies that motivation is more effective with persons of high than of low ability.

Both motivation and ability are usually inferred from many different cues about the person. The will to work, interest in any assigned task, sincerity, attendance record, and even opinions of co-workers and immediate supervisors are often used to infer motivation of a worker. Similarly, education, work experience, scores on psychological tests of aptitude, and opinions of teachers and immediate supervisors serve as cues for his ability. Thus, managerial expectation of performance involves integration of information about not only motivation and ability but also about various indicators of motivation and of ability.

Even after 22 years of Vroom's (1964) proposal for multiplying process, there is not any study showing that managers in fact expect performance of their subordinates according to the multiplying rule. How the various cues of motivation and of ability are combined in the overall estimation of motivation and

of ability of a subordinate has not been studied either. The present research tested the hypothesis that Indian managers follow a two-stage averaging - multiplying model in prediction of job performance. Given multiple cues about motivation and single cue about ability, they average the qualitatively similar motivation cues first and then multiply the qulitatively different ability cue by the estimated value of motivation.

Three lines of evidence in the literature on judgment and decision suggest the above hypothesis. The first is the verbal report of the judges on their own integration strategy. For example, Phelps and Shanteau (1978) obtained judgments of hypothetical gilts described along 11 dimensions from livestock judges. Discussions with the judges revealed that they first divided the dimensions into groups and then made overall judgment based on a combination of group judgments. Phelps and Shanteau suggested, therefore, " While certainly more research is needed in such two-stage strategies, it is a viable alternative to the usual ideas of adding or averaging all dimensions simultaneously " (p. 217).

The second is the evidence for the two-stagte averaging-multiplying model in prediction of gift size from information about generosity and income of the donors (Singh, in press). The number of heterogeneous and homogeneous pieces of generosity information affected effectiveness of generosity information but not of income information even when generosity multiplied income.

Similarly, reliability of generosity information enhanced effectiveness of generosity information but not of income information. Although the original interpretation of the reliability effects was in terms of one-stage simultaneous myltiplying process, Singh, Bhargava, and Norman (1986) have recently reinterpreted it as suggestive of the two-stage averaging-multiplying model.

The final and more direct evidence for the two-stage model comes from studies of prediction of exam performance (Singh & Bhargava, 1986) and life performance (Singh et al., 1986) by prospective managers in India. In the Singh and Bhargava study, post-graduate students of management predicted exam performance of hypothetical students from motivation and ability information ostensibly varying in reliability. Since effectiveness of one kind of information was independent of the reliability of another kind of information and the factorial plot of the Motivation x Ability effect had a perfect pattern of parallelism, support for the two-stage averaging-averaging model was claimed. As Singh and Bhargava note, "... that manipulation of information reliability engenders averaging of the external information with the corresponding initial opinion at the first stage of integration and estimated values of motivation and ability are combined by the constant-weight averaging rule at the subsequent stage " (p. 27).

A clear demonstration of the two-stage averaging-multiplying

model was made by Singh et al. (1986) in prediction of life performance. The effectiveness of one kind of information was independent of the reliability of another kind of information even when motivation multiplied ability. In addition, the number of heterogeneous and homogeneous pieces of motivation information had impact on effectiveness of motivation cue but not on ability cue. When information about either motivation or ability was unavailable, predictions were made by multiplying the available information with the value of initial opinion of unavailable information.

Since prediction of performance from information about motivation and ability in India always yielded evidence for a pattern of parallelism predicted by the constant-weight averaging rule (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Singh, Gupta & Dalal, 1979; Srivastava & Singh, 1986a), the linear fan pattern predicted by the multiplying rule (Anderson, 1983; Anderson & Butzin, 1974; Kun, Parsons & Ruble, 1974) in prediction of life performance (Singh, 1986; Singh et al., 1986) could be interpreted as evidence for the hypothesis of nature of task (Singh & Bhargava, 1985; Surber, 1984a;Srivastava & Singh, 1986b). But such a hypothesis would be inconsistent with Bhargava's (1983) finding that the two-stage averaging-multiplying model is employed in prediction of life performance by only the prospective managers and not by other younger groups of students in India.

One explanation for the emergence of the linear fan pattern could be the realistic and practical outlook of the prospective

managers. Since managers are concerned with getting things done and such realistic concerns for even performance of son in Indian mothers, the domestic managers (Jain, 1986), yield predictions nearer to the multiplying rule (Singh & Mehta, 1986), a new social variable of roles that people play in their everyday life (Sarbin & Allen, 1968/1975), in addition to their cultural background (Gupta & Singh, 1981; Singh & Bhargava, 1985; Singh et al., 1979; Srivastava & Singh 1986b), is necessary to account for the differences in cognitive algebra of task performance. The present research tested this hypothesis of role of judges in combining information about motivation and ability by including a group of nonmanagers, namely, college professors who are believed to be not only idealistic in their life philosophy but also more concerned with the general development of people than just getting things done.

The Two-Stage Averaging-Multiplying Model

Four Tests

Test 1. If the two-stage averaging-multiplying model (Singh & Bhargava, 1986; Singh et al., 1986) is correct, then managers should predict job performance, JP, according to the following model,

$$JP = \underline{w}'_M \left[\frac{\underline{w}_{Im}\, Im + \underline{w}_M\, M}{\underline{w}_{Im} + \underline{w}_M} \right] X\, \underline{w}'_A \left[\frac{\underline{w}_{Ia}\, Ia + \underline{w}_A\, A}{\underline{w}_{Ia} + \underline{w}_A} \right], \quad (1)$$

where Im and M are scale value of initial opinion and external

motivation information, respectively, and $\underline{w}_{Im}$ and $\underline{w}_{M}$ are their respective relative weights; Ia and A are scale value of initial opinion and external ability information, respectively, and $\underline{w}_{Ia}$ and $\underline{w}_{A}$ are their respective relative weights; and $\underline{w}'_{M}$ and $\underline{w}'_{A}$ are weights of estimated values of motivation and ability from the first-stage integration. The $\underline{w}'_{M}$ and $\underline{w}'_{A}$ are independent of and unaffected by information reliability.

Model 1 makes four testable predictions when values of motivation and ability and their reliability are varied in a four-way design. First, the factorial plot of the Motivation x Ability effect should show a linear fan pattern, that is, a systematic divergence toward right. Second, the greater the reliability of an information, the greater its effectiveness. Third, effectiveness of one kind of information should be independent of the reliability of another kind of information. Finally, all the higher-order interaction effects should be statistically nonsignificant. Clear support for all the predictions of Model 1 has been obtained by Singh et al. (1986).

There are two alternatives to Model 1. One is the one-stage multiplying model. When reliability of information affects just the weight parameters (Surber, 1981a), then prediction should be

$$JP = \underline{w}_{M} M \times \underline{w}_{A} A . \qquad (2)$$

This model agrees with the first two predictions of Model 1 but disagrees with the other two predictions. It is distinguishable

from Model 1 by its prediction that the greater the reliability of one kind of information, the greater the effectiveness of another kind of information. Because Model 2 is a four-factor multiplying model, it predicts similar enhancement effects of information reliability on all two-way, three-way, and four-way interaction effects.

Another one-stage alternative to Model 1 is the configural-weight averaging model (Birnbaum & Stegner, 1979, p. 61). When the relative weights of motivation and ability information would depend upon their reliability as well as upon their respective values in a stimulus description, the configural-weight averaging model would also produce an approximate linear fan pattern in the Motivation x Ability effect. According to this model,

$$JP = \left[\frac{w_I I + w_M M + w_A A}{w_I + w_M + w_A}\right] + w_c\left|M - A\right|, \qquad (3)$$

where the new terms w_I and I are weight and scale value of a generalized initial opinion, and w_c is the configural-weight for values of motivation and ability information in a particular description. The configural-weight can take on negative or positive value. When it is negative, weight from higher valued information will be taken and added to the lower valued one. So the Motivation x Ability effect would show an approximate linear fan pattern.

Model 3 is distinguishable from Models 1 and 2 by its prediction that the greater the reliability of one kind of information, the less the effect of another kind of information.

Surber (1981a) obtained support for this model in prediction of exam performance, though the configural-weight had taken on positive value. In other words, the configural-weight averaging model was supported even when the Motivation x Ability effect had a pattern of convergence. Experiment 1 tested the plausibility of Model 1 through 3 by varying reliability of information just as in the studies by Surber (1981a) and by Singh et al. 1986).

Test 2. If managers are provided with three independent pieces of motivation information (M1, M2, and M3) and one piece of ability information for prediction of job performance, they may follow the two-stage averaging-multiplying model,

$$JP = \underline{w}'_M \left[\frac{\underline{w}_{Im} I_m + \underline{w}_{M1} M1 + \underline{w}_{M2} M2 + \underline{w}_{M3} M3}{\underline{w}_{Im} + \underline{w}_{M1} + \underline{w}_{M2} + \underline{w}_{M3}} \right] X \, \underline{w}'_A \left[\frac{\underline{w}_{Ia} I_a + \underline{w}_A A}{\underline{w}_{Ia} + \underline{w}_A} \right]. \quad (4)$$

The two-stage integration is obvious in Model 4. The three pieces of motivation information are averaged with the initial opinion of motivation in the left bracket and the given ability information is averaged with the initial opinion of ability in the right bracket at the first stage of integration. At the second stage of integration, the estimated values of motivation and ability are multiplied. The $\underline{w}'_M$ and $\underline{w}'_A$ are independent of and not affected by the number of cues about either motivation or ability.

When stimulus descriptions constructed from a four-factor, Motivation 1 x Motivation 2 x Motivation 3 x Ability design are indeed judged as prescribed by Model 4, then the three two-way

plots of the three motivation factors are expected to exhibit a similar pattern of parallelism but those of Motivation 1 x Ability, Motivation 2 x Ability, and Motivation 3 x Ability effects are expected to exhibit a pattern of linear fan (Anderson, 1976). Parallelism is expected only under the condition of constant-weight averaging of the three motivation cues (Anderson, 1981 p. 64). It is methodologically important, therefore, to select stimuli which invoke a constant weighting of information (Singh, in press). Evidence for such a two-stage model has been obtained in prediction of performance in graduate school (Anderson, 1983) and in prediction of gift size from information about generosity and income of donors (Singh, in press, Experiments 2, 3, and 4).

However, if the configural-weight averaging model is employed to predict job performance, then

$$JP = \left[\frac{w_I I + w_{M1} M1 + w_{M2} M2 + w_{M3} M3 + w_A A}{w_I + w_{M1} + w_{M2} + w_{M3} + w_A} \right] + w_c \left| D_{ij} \right| , \qquad (5)$$

where the new term D_{ij} is the difference in the values of any pair of the four pieces of given information. This model is distinguishable from Model 4 by its prescription that all the six two-factor plots should yield the same divergent interaction.

Test 3. Models 1 and 4 predict that the effect of number of pieces of motivation information would be confined to the

motivation information alone. Thus, the combined two-way factorial plot of the data from the four-cue, Motivation 1 x Motivation 2 x Motivation 3 x Ability design and from the corresponding three two-cue, Motivation 1 x Ability, Motivation 2 x Ability, and Motivation 3 x Ability designs should all evince the very linear fan pattern. Anderson (1983), Singh (in press), and Singh et al. (1986) obtained evidence for this prediction of the two-stage averaging-multiplying model.

In contrast, when all the given pieces of information are averaged simultaneously, as conceptualized in Models 3 and 5, then slope of the four-cue curves should be shallower than those of the two-cue ones. This would happen because the relative weight would be divided among five terms of Model 5 but among three terms of Model 3. The two-cue curves will, therefore, have steeper slope than the four-cue ones in the common factorial plot of the Motivation x Ability effects (Singh & Bhargava, 1986, Experiment 3; Surber, 1985).

Test 4. The two-stage averaging-multiplying model (i.e., Model 1) also differs from the one-stage averaging model (i.e., Model 3) in its prediction about the effect of motivation or ability information presented alone. The former predicts that the initial opinion of the unavailable information would multiply the value of available information. So the single-cue curve should fit in the linear fan pattern in the Motivation x Ability effect (Singh et al., 1986, Experiment 2; Surber, 1980, adults' data).

However, the latter predicts that the weight of the unavailable information would be zero. The effect of motivation or ability information presented alone should, therefore, be greater than that of both motivation and ability presented together (Gupta & Singh, 1981; Singh & Bhargava, 1986; Singh et al., 1979; Sunber, 1980, 1981a, 1981b, 1985). Experiment 2 made Test 2 through 4 of the two-stage averaging-multiplying model and the alternative configural-weight averaging model.

Experiment 1 : Test 1 of the Two-Stage Model

Experiment 1 had two main purposes. The first was to test plausibility of Model 1 through 3 by manipulating information reliability. The second was to show that managers differ from nonmanagers, that is, college professors, in their second-stage integration of information about motivation and ability. As professors are believed to be idealistic, they were expected to follow the constant-weight averaging rule which implies that motivation is equally effective with persons of low through high ability (Singh & Bhargava, 1985). Thus, the Motivation x Ability effect for managers and for professors were expected to show the pattern of linear fan and parallelism, respectively.

Method

Stimuli and design. Descriptions of technical supervisors were prepared from information about motivation and ability and their reliability. Motivation was defined as "willingness to do

well" as supervisor; and ability information came from a preselection test of supervisory aptitude. Both motivation and ability were described along a comparable 7-point scale : Extremely low, very much below average, below average, average, above average, very much above average, and extremely high. The three levels of both the motivation and ability information were very much below average(VBA), average (AV), amd very much above average (VAA).

Reliability of motivation information was manipulated by varying the length of contact between the stimulus supervisor and his immediate boss. The length of contact scale had five levels: 1 hour, 1 day, 3 months, 3 years, and 4 years, and the three middle ones were used as levels of motivation reliability. Reliability of ability information was manipulated by varying the duration of the preselection test of supervisory aptitude. The tests were of 15 minutes, 1 hour, 1 day (5 hours), 2 days (10 hours), or 3 days (15 hours) duration. The middle three levels were used as levels of ability reliability.

The design was a 3 x 3 x 3 x 3 (Motivation x Motivation reliability x Ability x Ability reliability) factorial which generated 81 descriptions. In addition, there were nine filler and 15 practice descriptions. They were based on levels more extreme or other than those used in the regular descriptions. All the 105 descriptions were typed on separate index cards.

Procedure. Data from each subject were collected individually. During the experimental session, no external interference was allowed.

A written sheet of instructions introduced the task to the subject as one dealing with the prediction of job performance of some newly hired technical supervisors. The instructions defined motivation and ability as well as information reliability. The subject was asked to consider not only the value of motivation and ability information but also the authenticity and reliability of the sources from where the information came. In fact, it was specifically emphasized that motivation information coming from boss having one hour to four years of contact should be treated as varying in accuracy from extremely low to extremely high. Similarly, ability information coming from aptitude test of 15 minutes to 15 hours of duration should be treated as varying in validity from extremely low to extremely high.

After reading the instruction sheet twice, each subject worked with the practice examples. He read the information about each supervisor and then indicated how well the stimulus supervisor would perform in his job. Prediction was made along a 21-step ladder which had digits 1-21 written on the corresponding steps.

After the practice session, the main points of the instructions were summarized to the subjects by the experimenter.

All queries about the task were answered. When the experimenter was convinced that the subject understood the task, he asked the subject to judge the set of 90 cards (81 main and nine filler) two times in different shuffled orders. In each case, the subject wrote the code number of the stimulus card and his prediction of performance on the response sheet supplied for this purpose. Data from both trials of judgments were coded and analyzed.

At the end, the general purpose of the research was described to the subject by the experimenter. The experimenter also thanked the subject for his cooperation in the research.

Subjects. The subjects were 22 senior personnel managers and 22 senior college professors. The managers were attending an advanced management development program on personnel management and industrial relations at the Indian Institute of Management, Ahmedabad, India. The professors were from the Lalbhai Dhanpatbhai College of Engineering, Ahmedabad, India. The two groups of subjects were comparable with respects to their age (M = 41 years 11 months *vs.* 41 years, t (42) = 0.48) and work experience (M = 15 years 10 months *vs.* 16 years 9 months, t (42) = 0.50).

Managers participated in the study in response to an appeal by the program coordinator and college professors in response to an appeal by the college principal. The stimulus supervisors were presented as technical supervisors to the managers and as technical supervisors in college laboratories to professors

in order to make the task meaningful to the subjects.

Results and Discussion

Effects of information reliability. The manipulations of information reliability produced effects as prescribed by the two-stage model. The effect of an information was greater when it was of high than of low reliability. More importantly, the effectiveness of one kind of information was completely independent of the reliability of another kind of information.

These results can be seen in Figures 1 and 2 which present an overview of the results for managers and for professors, respectively. There are nine graphs for each of the nine combinations of the reliability of motivation and ability information. Each graph has motivation as curve parameter and ability on the horizontal axis.

Figures 1 and 2 about here

The principal point of interest in the data at the moment centers around the vertical seperation between curves (effect of motivation) and slope of the curves (effect of ability) as a function of information reliability. Look at the three graphs at any level of abilty reliability. The three curves have greater spread when motivation reliability is high (right panel) than when it is low (left panel). But the slope of the ability curves is

nearly the same across the three levels of motivation reliability. This means that the effect of motivation reliability is restricted to motivation information itself.

Comparisons of the bottom, middle, and top graphs in the left, center, or right panel of Figures 1 and 2 also reveal the same trend in the effect of ability reliability. The curves of the top graphs have steeper slope than those of the bottom graphs. However, the vertical spread of the three curves in the bottom, middle, and top graphs is essentially the same. This means that effectiveness of ability reliability is confined to just the ability cue.

The foregoing results stand out more vividly from the four two-way plots of the data in Figure 3. Results for managers are at the bottom and those for professors are at the top. The two leftside graphs display relationship between reliability and value of an information, whereas the two rightside graphs display relationship between reliability of one kind of information and value of another kind of information. The crossover pattern in the four left-side graphs show that the greater the reliability of an information, the greater its effectiveness. The parallelism patterns in the four rightside graphs show that the reliability of one kind of information does not alter the effectiveness of another kind of information. These results agree precisely with

the requirements of the first-stage integration in the two-stage model.

Figure 3 about here

The above interpretations were confirmed by two kinds of statistical analyses. First, the eight sets of data shown in Figure 3 were subjected to Shanteau's (1977) POLYLIN analysis. Table 1 presents F ratios for the overall interaction effects as well as for the four possible trend components in each of the two-way interactions. It is clear that the four left-side graphs of Figure 3 which show corssovers have not only statistically significant overall interaction effects but also statistically significant Linear x Linear trend. The four rightside graphs which evince parallelism, on the contrary, have all the four overall interaction tests statistically nonsignificant. Except one case, all the trend components of an interaction effect are also statistically nonsignificant which support the interpretation that these graphs are indeed parallel.

Table 1 about here

Second, statistical tests of the higher-order interaction effects were made by analysis of variance. According to the two-stage model, all the four three-way interactions and the four-way interaction should be statistically nonsignificant. Of the 10

such interactions, only two reached statistical significance. They were the Motivation x Ability x Ability reliability effect for managers, F (8, 168) = 2.60 $p < .05$, and the Motivation x Motivation reliability x Ability reliability effect for professors, F (8, 168) = 2.24, $p < .05$. Neither of the two three-way effects concentrated in the Linear x Linear x Linear trend, F (1, 21) = 0.46 and 1.38, however. So overall support for the two-stage model from the patterns in the higher-order interactions can be adjuged as good.

Two separate initial opinions. Model 1 recognizes presence of two separate initial opinions, one about motivation and another about ability, and regards them to be the foundations of the two-stage strategy. The four crossover interactions between reliability and value of an information, shown on the leftside of Figure 3, bear directly upon the validity of such an assumption.

The locations of the crossover of the curve for information of low reliability by the curve for information of high reliability reflect on the value of the initial opinion (Singh et al., 1986). Accordingly, the initial opinions of motivation and ability are 7.15 and 5.90 for managers and are 8.10 and 7.70 for professors along the 21-point scale. These values have been estimated from the location of crossovers, as indicated by the dashed lines of the four graphs. Similar differences were present in prediction of exam performance (Singh & Bhargava, 1986) as well

as of life performance (Singh et al., 1986). However, the experiments which obtained evidence for the configural-weight averaging rule (e.g., Surber, 1981a, 1984b) did not have such a difference at all. Thus, it may be said that there are in fact two separate initial opinions in the subjects.

The four crossovers of Figure 3 arose due to the averaging of the external information with the corresponding initial opinion as conceptualized within Anderson's (1981, p. 276) model for source-message integration.. Had subjects simply multiplied the reliability and value of an information, the three curves of all the four graphs would have shown the linear fan pattern, not the crossover. To account for the crossover interactions, the multiplying model would have to require negative values of motivation and of ability information which hardly seem to be the case. In fact, the prevailing pattern of linear fan in the nine graphs of Figure 1 argue against negative values for motivation and ability information.

Second-stage integration rule for managers. On the basis of previous research, managers were expected to follow the multiplying rule at the second stage of integration. This expectation was clearly fulfilled, for the Motivation x Ability effect had the linear fan pattern. This is evident in the nine graphs of Figure 1 which presents the Motivation x Ability effect as a function of reliability of motivation and ability information

and in Figure 4 which presents the overall Motivation x Ability effect.

Figure 4 about here

In the left graph of Figure 4, the vertical spread between the top and bottom curves increases about 16% from the first to the second level and about 48% from the first to the third level of ability, as shown by the left- and right-side equal-length vertical bars. This divergence is real, for the Motivation x Ability effect was highly significant, F (4, 84) = 9.13 p<.01, and 85% of its variance resided in just the Linear x Linear trend, F (1, 21) = 13.43, p < .01. The other three trends, namely, Linear x Quadratic, Quadratic x Linear, and Quadratic x Quadratic were generally small and statistically nonsignificant, F (1, 21) = 0.20, 1.99, and 4.04, as they are in fact required to be by the multiplying rule.

The present findings of the linear fan pattern in the Motivation x Ability effect and of independence of the effectiveness of one kind of information from the reliability of another kind of information show that Model 1 was indeed employed by managers in prediction of job performance. This confirms finding of Singh et al. (1986) in prediction of life performance, and extends the generality of the two-stage averaging-multiplying model from prediction of life performance to job performance.

Second-stage integration rule for professors. Results also disclosed that the multiplying rule employed by managers was not generalizable to nonmanagers such as college professors. Instead of a multiplying rule, an adding or averaging rule could account for the predictions by professors, for there is a pattern of parallelism in the nine graphs of Figure 2 as well as in the overall Motivation x Ability effect, F (4, 84) = 1.29, shown in the right graph of Figure 4.

Since the Motivation x Ability effect exhibits a pattern of parallelism and effectiveness of information of one kind is independent of the reliability of information of another kind, predictions by professors can be represented by the two-stage averaging-averaging model (Singh & Bhargava, 1986):

$$JP = \frac{w'_M \left[\frac{w_{Im}\, Im + w_M\, M}{w_{Im} + w_M} \right] + w'_A \left[\frac{w_{Ia}\, Ia + w_A\, A}{w_{Ia} + w_A} \right]}{w'_M + w'_A} \quad . \quad (6)$$

In this model, averaging takes place twice. The external information is first averaged with its corresponding initial opinion, and the estimated values of motivation and ability are then integrated by the constant-weight averaging rule.

Difference between managers and professors. In overall analysis of variance, only one significant difference emerged between the two groups of subjects. Since the Motivation x Ability effect had a fan pattern with managers but a parallelism

pattern with professors, the Group x Motivation x Ability effect was statistically significant, F (8, 168) = 5.28, p <.01. This indicates that managers and professors differed in integrating information about motivation and ability at the second stage, as was hypothesized on the basis of differences in their professional roles.

Evidence against one-stage models. Both Models 2 and 3 can be rejected on the basis of the foregoing results. Model 2 predicted similar crossover patterns in all the four graphs of managers shown in the lower part of Figure 3; Model 3 predicted that the three curves of the third and fourth graphs from left of Figure 3 should have the crossover with opposite ordering of curves in the first and second graphs from left of Figure 3. There is no hint for either requirement at all. Accordingly, it may be said that prospective (Singh & Bhargava, 1986; Singh et al., 1986) and actual managers and senior engineering professors in India do not use one-stage multiplying or configural-weight averaging rule.

Experiment 2: Test 2 through 4 of the Two-Stage Model

The main purpose of Experiment 2 was to make Test 2 through 4 of the two-stage averaging-multiplying model with a new group of Indian managers. If the two-stage model is indeed generalizable, then evidence for it should be obtained with manipulations of

number of cues about motivation as well as with manipulations of unavailablity of one of the two kinds of needed information.

Method

Stimuli and designs. Descriptions of computer programers were prepared based on information about both motivation and ability as well as about either motivation or ability. Motivation was defined as "willingness to do well in computer programing", and was supposedly obtained from three reference letters received at the time of recruitment. Each referee had expressed his opinion in the form of percentiles varying from lower 1 per cent to upper 1 per cent : Referee 1 (lower 5 per cent, around 50 per cent, and upper 5 per cent), Referee 2 (lower 10 per cent and upper 8 per cent), Referee 3 (lower 8 per cent and upper 10 per cent). None of the descriptions had exactly the same information from all the three referees in order to avoid differential weighting of motivation cues (Singh, in press). Motivation information coming from Referees 1, 2 and 3 will be referred to as Motivation 1, Motivation 2, and Motivation 3, respectively.

The ability information came from a preselection test of aptitude carried on stimulus persons, and the three levels were very much below average (VBA), average (AV), and very much above average (VAA). These three levels were taken from the same 7-point scale of ability used in Experiment1.

There were eight stimulus designs. The first and main design was a 3 x 2 x 2 x 3 (Motivation 1 x Motivation 2 x Motivation 3 x Ability) factorial having levels mentioned above. Designs 2, 3, and 4 were two-way factorials that paired one of the three motivation factors of the main design with the ability factor. The remaining four designs, Designs 5, 6, 7, and 8, had just one factor from the main design. These eight designs created 36 four-cue profiles, 21 two-cue profiles, and 10 single-cue profiles. There were thus a total of 67 test descriptions.

Thirteen fillers and end anchor descriptions were also constructed. Of these 13 descriptions, four had motivation information from four referees and ability information, three had three motivation cues and ability information, two had one motivation and ability information, and four had information about just one cue. In general, the levels of these descriptions were more extreme or other than those used in the construction of the main descriptions. These 13 descriptions were also presented to the subjects along with the main descriptions.

There were 15 practice examples as well. They included 13 filler and end anchor descriptions and two descriptions from the main set of descriptions. Each description was typed on separate index card.

Procedure. The general procedure was the same as in

Experiment 1. Each subject predicted job performance of computer programers from information about their motivation and ability or about just one of the two. It was emphasized that motivation information came from one to four teachers who wrote confidential reference letters for the hiring of the programer. Whenever more than one piece of motivation information were available, they were to be treated as "equally important and valid". Whenever one of the two kinds of information was unavailable, the subject was asked to make prediction on the basis of only the given information. Each subject judged the main set of 67 and 13 filler and end anchor descriptions one by one over two trials of judgment in different shuffled orders. Data from both trials were analyzed.

Subject. Twenty-two electronic data processing managers, who were attending a management development program on computer based information system, analysis, and design at the Indian Institute of Management, Ahmedabad, India, served as subjects. They were all males with mean age of 35 years 6 months and mean work experience of 12 years 3 months. Only because of these subjects, the stimulus persons were described as computer programers.

Results and Discussion

Test 2. Results from Test 2 supported Model 4 but rejected Model 5. All the three two-way factorial plots of each of the three motivation cues with the ability cue evinced the pattern of

linear fan, whereas all the three two-way factorial plots of the three motivation cues exhibited a pattern of parallelism.

These results can be seen in Figures 5 and 6. In the left panel of Figure 5, the three solid curves with filled-circle are for the Motivation 1 x Ability effect from the main four-cue design. The corresponding two curves in the center and right panels are for the Motivation 2 x Ability and Motivation 3 x Ability effects. All the three sets of curves show a systematic divergence toward right, and the Linear x Linear trend accounted for 72%, 97%, and 99% of the two-way interactions.

Figure 5 about here

On the contrary, the three graphs for Motivation 1 x Motivation 2, Motivation 1 x Motivation 3, and Motivation 2 x Motivation 3 effects shown in the left, center, and right panels of Figure 6 are essentially parallel. In analysis of variance also, all the three two-way interactions, F (2, 42) = 1.60, 0.49, and F (1, 21) = 0.01, and the three-way interaction, F (2, 42) = 1.37, were statistically nonsignificant. This indicates that the three motivation cues were in fact integrated by the constant-weight averaging rule at the first stage of integration.

Figure 6 about here

Further evidence for averaging of the three motivation cues can be seen in the three graphs of Figure 7 which shows data from the four-cue and the two-cue designs in the Ability x Motivation format. At each level of ability, the solid curve with open-circle has markedly steeper slope than the solid curve with filled-circle. In fact, the main effects of Motivation 1, Motivation 2, and Motivation 3 factors calculated at the level of individual manager for the four-cue and two-cue designs yielded statistically significant Design x Motivation effect, F (2, 42) = 86.89 and F (1, 21) = 38.12 and 42.67, $P < .01$, which shows that the slope of the motivation curve is indeed steeper in the two-cue than in the four-cue design. Theoretically, the slope represents the relative weight of the motiation cues listed on the horizontal axis. This cue has higher relative weight when it is alone, such as in the two-cue designs, than when it is one of the three motivation cues, such as in the four-cue design.

Figure 7 about here

Had managers followed Model 5, all the six two-way factorial plots from the main design, shown in Figures 5 and 6, would have shown the same pattern, either fan or convergence. But all the three graphs of Figure 6 show parallelism. Thus, Model 5 can be rejected.

Test 3. According to Test 3, each curve of the factorial

plot of the Motivation x Ability effect should be a straight line function of ability information with slope equal to the value of motivation information. Hence, the solid curves with filled-circle and with open-circle in each of the three graphs of Figure 5 should form a common linear fan, as indeed they do.

Further support for the two-stage averaging-multiplying came from the comparisons of slopes of the solid curves with filled-circle and with open-circle. The slopes of the filled-circle curves, since they are averaged over the other two motivation cues, should lie between the slopes of the low and high motivation curves from the two-cue designs. This requirement is also fulfilled in each of the three graphs of Figure 5. Accordingly, Model 4 can be regarded as a good representation of the process underlying prediction of job performance by managers.

Had managers followed Model 5 with configural weighting of motivation and ability information, the solid curves with open-circle would have crossed over the sold curves with filled-circle. There is no sign of such a crossover at all. The slight crossover between the two middle solid curves in the left panel was not statistically significant. Thus, the configural-weight averaging model cannot account for the linear fan in the common factorial plots of the Motivation x Ability effects from the two- and four-cue designs.

These interpretations of the linear fan pattern in the Motivation x Ability effects of Figure 5 were also confirmed by

statistical analyses. Table 2 lists F ratios for various trend components in the Motivation x Ability effects from the POLYLIN analyses. If the linear fan pattern is exact, then all the nine F ratios mentioned in the L x L column of Table 2 should be statistically significant but the remaining 19 F ratios for other trends should all be nonsignificant.

Table 2 about here

As required, all the 19 F ratios for higher-order trends are statistically nonsignificant in Table 2. However, all the nine F ratios for the Linear x Linear trend are not as expected. Six are highly significant; one is marginally significant; and two are nonsignificant. Each of the three F ratios which failed to reach .05 level of significance had unusually bigger error term and not absence of the linear fan pattern as already noted. Accordingly, evidence for the hypothesized linear fan pattern may be considered as unambiguous.

It should be noted that the slight crossover between the two middle solid curves in the left panel of Figure 5 did not cause any deviation from the Linear x Linear trend in the 6 x 3 POLYLIN analysis. This means that all the six solid curves formed a common linear fan pattern as required by Test 3 of the two-stage averaging-multiplying model.

Test 4. If the initial opinion of the unavailable information multiplies the value of given information, then Test 4

of the two-stage averaging-multiplying model requires that the ability-only curve should form part of the linear fan pattern in the Motivation x Ability effect and the Motivation-only curve should form part of the linear fan pattern in the two-cue Ability x Motivation effect. But the slope of the ability-only and motivation -only curves did not meet this requirement. The former formed part of the linear fan pattern (see Figure 5); the latter violated it (see Figure 7).

Table 3 presents F ratios for various trend components in the Motivation x Ability and Ability x Motivation effects when the corresponding single-cue data entered as an additional row in the POLYLIN analyses. It is notable that the ability-only data conformed to the linear fan pattern, for the Linear x Linear component is highly significant but the remaining components are all nonsignificant. On the contrary, the motivation-only curves due to their steeper slope have either wiped out the Linear x Linear component or produced higher-order trends in the three Ability x Motivation effects.

Table 3 about here

It should also be added that the motivation-only data caused deviations from parallelism in the three two-way plots of the three motivation cues shown in Figure 6. The same data which originally exhibited parallelism, as already shown, evinced nonparallelism after the inclusion of the corresponding

motivation-only data in the analyses of variance, F (3, 63) = 4.18, 9.77, and F (2, 42) = 5.20, $P < .01$.

The simplest interpretation for the asymmetry in the slope of ability-only and motivation-only curves can be made by the types of imputations about missing information (Singh, in press). Perhaps the imputed value for the missing motivation information was a fixed constant but the imputed value for the missing ability information varied directly with the value of given motivation information. This result along with other recent results (e.g., Levin, Johnson, Deldin, Cartens, Cressey, & Davis, 1986; Levin, Johnson, Russo, & Deldin, 1985) indicate that subjects indeed impute value to the needed missing information. Accordingly, it may be said that the slope of the single-cue curve may be more useful for studying imputation rather than integration rules (Singh, in press, Singh & Bhargava, 1986).

If it is assumed that managers did not make imputations about unavailable information, then prediction of job performance from information about motivation alone should have been made by

$$JP = \underline{w}'_M \left[\frac{\underline{w}_{Im}\, Im + \underline{w}_{Ia}\, M}{\underline{w}_{Im} + \underline{w}_{M}} \right] \times \underline{w}_{Ia}\, Ia , \qquad (7a)$$

and from information about ability alone should have been made by

$$JP = \underline{w}_{Im}\, Im \times \underline{w}'_A \left[\frac{\underline{w}_{Ia}\, Ia + \underline{w}_{A}\, A}{\underline{w}_{Ia} + \underline{w}_{A}} \right] . \qquad (7b)$$

Since motivation-only curves did not fit within the respective linear fan pattern in Figure 7, Models 7a and 7b have to include

imputed value of the unavailable information to account for the asymmetry in the slope of motivation-only and ability-only curves.

If the imputed value is included, Models 7a and 7b become

$$JP = \underline{w}'_M \left[\frac{\underline{w}_{Im}\, Im + \underline{w}_M\, M}{\underline{w}_{Im} + \underline{w}_M} \right] x\, \underline{w}'_A \left[\frac{\underline{w}_{Ia}\, Ia + \underline{w}_{A^*}\, A^*}{\underline{w}_{Ia} + \underline{w}_{A^*}} \right], \qquad (8a)$$

and

$$JP = \underline{w}'_M \left[\frac{\underline{w}_{Im}\, Im + \underline{w}_{M^*} M^*}{\underline{w}_{Im} + \underline{w}_{M^*}} \right] x\, \underline{w}'_A \left[\frac{\underline{w}_{Ia}\, Ia + \underline{w}_A\, A}{\underline{w}_{Ia} + \underline{w}_A} \right], \qquad (8b)$$

respectively, where the new terms M* and A* are imputed value to the unavailable motivation and ability information. This revision would account for the asymmetry in the slope of motivation-only and ability-only curves by making a further assumption that imputations about unavailable motivation and ability information are made in different ways (Singh, in press). Such an assumption is reasonable, for Test 2 and 3 which had both of the needed information yielded unambiguous evidence for the two-stage averaging-multiplying model.

The foregoing interpretation would suggest that imputations were also made in prediction of contest performance (Surber, 1980, adult's data) and life performance (Singh et al., 1986). However, a constant, fixed value was imputed to both the unavailable information about motivation and ability. So the motivation-only and ability-only curves formed part of the linear fan pattern. Similarly, the motivation-only and ability-only curves which did not fit within the common linear fan pattern predicted by the

present Test 3 in Anderson's (1983) study are indicative of imputations about unavailable information as a direct function of the value of available information.

Considered together, results from the studies cited above allow two speculations. First, imputations about unavailable information for prediction of performance are more pervasive with multiplying rule (Anderson, 1983, Singh et al., 1986; Surber, 1980) than with averaging rule (Singh & Bhargava, 1986; Surber, 1985). Second, different imputation rules for different kinds of unavailable information are strategy of managers. Students follow the same strategy in imputations about unavailable motivation or ability information (Anderson, 1983; Singh et al., 1986; Surber, 1980, 1981b). While the present research extends the generality of the two-stage averaging-multiplying model obtained with students (Anderson, 1983; Singh et al., 1986), it casts doubt on the generality of the imputation rules followed by students.

Evidence against averaging rule. The only evidence in favor of the configural-weight averaging model (i.e., Models 3 and 5) is that the three motivation-only curves of Figure 7 have steeper slope than the two- and four-cue curves. But the same averaging process also requires a steeper slope for ability-only curve of Figure 5 which is not present. To account for the slope of the ability-only curve, the configural-weight averaging model has to assume imputations about unavailable motivation information just

as the two-stage averaging-multiplying model did (see Models 8a and 8b). Nevertheless, the configural-weight averaging model would not be able to account for the results from Tests 2 and 3. It may be concluded, therefore, that the configural-weight averaging model is not applicable to the prediction of job performance by Indian managers.

General Discussion

Overall, the results of the present research lead to two main conclusions. First, prediction of job performance obeys the two-stage model. Despite the differences between two experiments with respect to nature of inputs to the task, job requirements of the stimulus persons, and background and age of managers, the two-stage model remained robust. The success of the model with professors further testifies to its pervasiveness.

Second, both the managers and professors calculate subjective values of motivation and ability in a uniform manner at the first stage of integration. But they differ in combining information about motivation and ability at the second stage of integration. The former follow a multiplying rule; the latter follow a constant-weight averaging rule. The multiplying rule with managers agrees with Vroom's (1964) proposal as well as with prescriptions of several theories of motivation such as those of Lewin, Tolman, and Hull (see Anderson, 1974, P.29). It is also in line with Heider's (1958) suggestion that capability and trying of a person should be multiplied to predict his performance. In contrast, the constant-weight averaging rule with professors implies that motivation is equally effective with persons of low through high ability and hence agrees with the idealistic, egalitarian outlook (e.g., Singh & Bhargava, 1985; Singh et al., 1979) of college professors and with the hypothesis of role differences in cognitive algebra (Singh et al., 1986).

The two results just mentioned have some theoretical, methodological, and applied implications. They are briefly discussed below.

Theoretical Implications

Successive versus simultaneous processing. In their review of the literature on managerial information processing, Ungson, Braunstein, and Hall (1981) discuss the current controversy on serial (Newell & Simon, 1972) versus simultaneous multiple (Broadbent, 1977; Neisser, 1963) processing of information, and remark that "...we have not adequately investigated the use of multiple processing" (p.125). Results of the present study throw some light on this issue.

There are indications for the use of both the multiple and serial processing of information in the same judgmental task. For example, subjects of the present experiments did averaging of information about motivation with their initial opinion of motivation and about ability with their initial opinion of ability simultaneously at the first stage of integration. But they combined estimated values of the two kinds of information at the second stage. So the two averaging operations at the first stage illustrate simultaneous multiple processing and the shift from averaging to a different rule at the second stage illustrates serial processing.

Whether people use multiple processing or serial processing seems to be a non-issue. What is really needed is a specification of the conditions which invoke serial and simultaneous processing. Findings of the present as well as past work show that qualitatively similar pieces of information such as motivation (Anderson, 1983; Singh et al., 1986) and generosity (Singh, in press) are taken up first and qualitatively dissimilar pieces of information, such as motivation and ability (Anderson, 1983; Singh et al. 1986) and generosity and income (Singh, in press) are taken up next by the judges. Thus, serial procesing is linked with the quality of the inputs to the task. However, if more than one cue of more than one qualitatively different information are available, they are processed separately but simultaneously by multiple processing, as was the case with two separate averaging operations with motivation cues and with ability cues at the first stage of integration. Such a multiple processing fits in nicely with Miller's (1956) evidence on chunking of multiple informational inputs as well as with the descriptions of integration strategies by the livestock judges (Phelps & Shanteau, 1978).

It should be emphasized that the successive and simultaneous processing are consequences of judges' memory storage systems (Ungson et al., 1981) or initial opinions in the present case. The two-stage averaging-multiplying processes of Model 1 and 4

hold only when subjects have separate initial opinion of motivation and of ability, and they assign some importance to them. If the initial opinions are altogether ignored, Model 1 automatically reduces to Model 2 which implies a simultaneous handling of all the given pieces of information (Singh et al., 1986). This calls attention to the importance of individual differences in analyses of information processing (Srivastava & Singh, 1986b).

Multiplying versus configural-weight averaging. On the basis of the results from managers, it has been concluded that prediction of job performance from information about motivation and ability follows the averaging-multiplying model. As professors followed the two-stage averaging-averaging model (i.e., Model 6), it can also be speculated that managers followed the same strategy but differed in configural weighting of estimated values of motivation and ability at the second stage. In other words, the two-stage averaging-configural-weight averaging model could also cause the linear fan pattern in the Motivation x Ability effect. Thus, Model 6 could be extended as

$$JP = \left[\frac{\underline{w}'_M \left[\frac{\underline{w}_{Im}\, Im + \underline{w}_M\, M}{\underline{w}_{Im} + \underline{w}_M} \right] + \underline{w}'_A \left[\frac{\underline{w}_{Ia}\, Ia + \underline{w}_A\, A}{\underline{w}_{Ia} + \underline{w}_A} \right]}{\underline{w}'_M + \underline{w}'_A} \right] + \underline{w}'_c \left| M' - A' \right|, \quad (9)$$

where the new terms M′ and A′ are estimated values of motivation and ability from the first-stage integration and $\underline{w}'_c$ is the configural weight at the second stage of integration.

Model 9 makes exactly the same predictions as does Model 1. They are thus not easily distinguishable. The only way to distinguish the two models is the presence of the linear fan pattern in the Motivation x Ability effect. While Model 1 predicts a perfect fan pattern, Model 9 predicts only an approximate linear fan pattern. Since all the experiments supporting the two-stage averaging-multiplying model (Singh et al., 1986; present two experiments) obtained a perfect linear fan pattern in the Motivation x Ability effect, the present interpretation of the multiplying model may be accepted. However, there is an obvious need for more research on the plausibility of Models 1 and 9.

Separate initial opinions versus one initial opinion. There is still another interpretation for the two-stage averaging-multiplying model. Even if the multiplying interpretation of the linear fan pattern is accepted, doubt may be expressed about the need for having two separate initial opinions, one about motivation and another about ability. If it is assumed that the same generalized initial opinion of the managers is averaged with motivation information and with ability information separately at the first stage of integration, then Model 1 becomes

$$JP = \frac{w'_M}{}\left[\frac{w_I I + w_M M}{w_I + w_M}\right] \times \frac{w'_A}{}\left[\frac{w_I I + w_A A}{w_I + w_A}\right], \qquad (10)$$

Model 10 makes exactly the same predictions about the patterns in the factorial plots of data as does Model 1. The two cannot be distinguished, therefore, when the two initial opinions take on exactly the same value. Fortunately, however, the two initial opinions had different values in all the experiments showing the two-stage model (Singh & Bhargava, 1986; Singh et al., 1986; present Experiment 1). So there can be no doubt about the need for having separate initial opinions for qualitatively different kinds of information.

Comments. While there is a clear need to devise new distinguishing tests among Models 1, 9, and 10 in future research, all the three models agree with the two-stage integration. This is enough to claim that Indian managers follow the two-stage integration in prediction of job performance. The main contribution of the present research lies, therefore, in showing that the two-stage strategy is a viable alternative to the usual ideas of adding or averaging all the available pieces of information simultaneously.

Methodological Implications

The field of organizational behavior has been witnessing a growing use of more and more complex models of psychological processes since early 1960s. Some of these models hypothesize multiplicative relationships among variables (e.g., Wanous, Keon, & Latack, 1983) as well as compound averaging-multiplicative

relationships (e.g., Hackman & Oldham, 1976). But the tests of goodness of fit between model and data have invariably been correlation, a measure which would be highly misleading in many situations (see Anderson, 1982, pp. 159-166). Moreover, "...the measures and statistical methods available", note Arnold and Evans (1979), "do not permit distinctions to be drawn empirically between alternative formulations of such models (e.g., a 'pure' multiplying model vs a 'compound' adding-multiplying model)" (p. 58). They suggest, therefore, that an appropriate research strategy for tests of multiplying and compound adding-multiplying models be developed. They recommend that the hierarchical multiple regression techniques may be an alternative to the existing techniques.

Results from the present research suggest still another methodology. Functional measurement which has been successful in so many areas of psychology (Anderson 1976, 1981) can provide the most sensitive tests of the multiplying and compound averaging-multiplying models. The present work on averaging-multiplying model and the earlier work on subtracting-ratio model (Singh, 1983) clearly illustrate the usefulness of functional measurement.

It should also be noted that the diagnosis of the multiplying and configural-weight averaging rules from judgments of two-cue and single-cue descriptions cannot be unambiguous (e.g., Surber, 1980, 1981b) if imputations are made about missing information as

Experiment 2 showed. Perhaps a better approach to model diagnosis would be to avoid the problems of missing information by using two-cue and four-cue descriptions just as Tests 2 and 3 of Experiment 2 did. Since these descriptions contained both of the essential information, they are less vulnerable to imputation interpretation (Singh & Bhargava, 1986). One advantage of such a method is that it can provide a base for diagnosis of imputations people make about unavailable information (Singh, in press).

Applied Implications

One of the areas of research in organizational behavior has been measurement of managerial attitudes and values across nations (England & Lee, 1979; Hofstede, 1976; Ronen & Kraut, 1977). The present research shows that managers differ from nonmanagers, particularly professors, even within the same nation just as the role theory (Sarbin & Allen, 1968/1975) prescribes. Similar differences have been found in reward allocation also (Singh, 1982, 1985). Since judgments and decisions by managers are closer to the prescriptions of expectancy theory (Vroom, 1964) and equity theory (Adams & Freedman, 1976; Anderson, 1981, pp. 77-80) than those by nonmanagers, two inferences are possible. First, there are a distinct set of attitudes and values which may be called "managerial". Second, integration tasks have high construct validity for measurement of those managerial attitudes and values.

Based on these inferences, two practical implications of the present results can be drawn. One is for the identification and measurement of managerial values. Instead of paper-and-pencil tests which have been customary in applied psychology, decision tasks such as those employed here and previously (Singh, 1982, 1985) could be used to measure managerial attitudes and values. Such an approach will allow comparisons with respect to response patterns and hence the underlying value systems (Gupta & Singh, 1981; Singh, 1985; Singh et al., 1979). The conventional method of comparing differences between group means is not appropriate, for such comparisons are always confounded with prior scale differences between groups. This approach of pattern differences deserves more extensive use in applied psychology.

Another implication is for training of young graduates as managers. The idealistic egalitarian values fostered in them by their fathers (Singh & Mehta, 1986) and college professors (Singh & Bhargava, 1985; professors of present Experiment 1) may not be very useful in their managerial career. They need to be exposed to managerial attitudes and values before they are actually placed on the job. To this it may be added that a battery of integration tasks designed to measure managerial attitudes and values may be quite useful in identifying potential managers, training them in decision-making, and assessing effectiveness of their training programs.

The implications mentioned above rest on an important assumption that the values expressed by managers in the integration tasks are generalizable to the real organizational settings. This assumption is reasonable, for the present tasks were made as realistic and involving as possible, a necessary condition for the external validity of results (Levin, Louviere, Schepanski, & Norman, 1983).

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Table 1

F Ratios for Overall Interaction Effects and for Four Trend Components in Each Interaction Effect of Managers and Professors

	Overall Interaction Effects and Trend Components									
	Managers					Professors				
Interaction Effects	Overall	L × L	L × Q	Q × L	Q × Q	Overall	L × L	L × Q	Q × L	Q × Q
Motivation reliability × Motivation	18.55**	20.02**	0.52	0.73	0.04	23.00**	23.34**	0.00	2.04	0.00
Ability reliability × Ability	13.18**	12.41**	2.66	0.27	3.96	12.53**	15.48**	0.16	5.32*	4.29
Motivation reliability × Ability	0.50	0.31	0.38	0.00	2.42	2.06	1.03	10.03**	0.36	2.19
Ability reliability × Motivation	0.63	0.09	0.18	0.00	0.14	1.49	0.85	0.09	1.61	1.38

Note. The L and Q refer to linear and quadratic components, respectively. The dfs for the overall interaction F ratios were 4 and 84 and for those of the trend components were 1 and 21.

* P < .05

** P < .01

Table 2

F Ratios for Four Trend Components in the Motivation x Ability Effects from the Two-cue, Four-cue and Combined Design Analyses

	Trend Components			
Designs and Interaction Effects	L x L	L x Q	Q x L	Q x Q
Two-cue Designs				
3 x 3 (Motivation 1 x Ability)	6.27*	0.01	2.22	1.16
2 x 3 (Motivation 2 x Ability)	8.81**	1.52		
2 x 3 (Motivation 3 x Ability)	9.27**	0.68		
Four-cue Designs				
3 x 3 (Motivation 1 x Ability)	5.02*	0.00	1.63	3.79
2 x 3 (Motivation 2 x Ability)	3.34	0.19		
2 x 3 (Motivation 3 x Ability)	4.27	0.06		
Combined Designs				
6 x 3 (Motivation 1 x Ability)	6.36*	0.18	1.62	2.17
4 x 3 (Motivation 2 x Ability)	6.28*	2.69	0.79	2.65
4 x 3 (Motivation 3 x Ability)	2.15	0.57	2.58	1.51

Note. The L and Q refer to linear and quadratic components, respectively. The *dfs* for each *F* ratio were 1 and 21.

* $p < .05$

** $p < .01$

Table 3

F Ratios for Trend Components in Two-cue Designs after Including Ability-only and Motivation-only Data

Designs	Trend Components			
	L x L	L x Q	Q x L	Q x Q
Ability-only as a Additional Row				
4 x 3 (Motivation 1 x Ability)	6.05*	2.04	0.27	1.73
3 x 3 (Motivation 2 x Ability)	7.27*	0.62	0.74	0.00
3 x 3 (Motivation 3 x Ability)	7.04*	0.10	0.39	0.39
Motivation-only as an Additional Row				
4 x 3 (Ability x Motivation 1)	3.30	1.03	2.97	0.06
4 x 2 (Ability x Motivation 2)	5.14*		5.03*	
4 x 2 (Ability x Motivation 3)	3.78		1.92	

Note. The L and Q refer to linear and quadratic components, respectively. Each *F* ratio had *dfs* of 1 and 21.

* $p < .05$.

Figure Captions

Figure 1. Mean job performance as a function of motivation (curve paramater) and ability (listed on the horizontal axis) under nine conditions of reliability of two types of information. Data from managers of Experiment 1.

Figure 2. Mean job performance as a function of motivation (curve parameter) and ability (listed on the horizontal axis) under nine kinds of reliability of the two types of information. Data from professors of Experiment 1.

Figure 3. Factorial plots of Reliability of motivation information x Motivation, Reliability of ability information x Ability, Reliability of motivation information x Ability, and Reliability of ability information x Motivation effects of the managers (lower panel)and professors (upper panel) of Experiment 1.

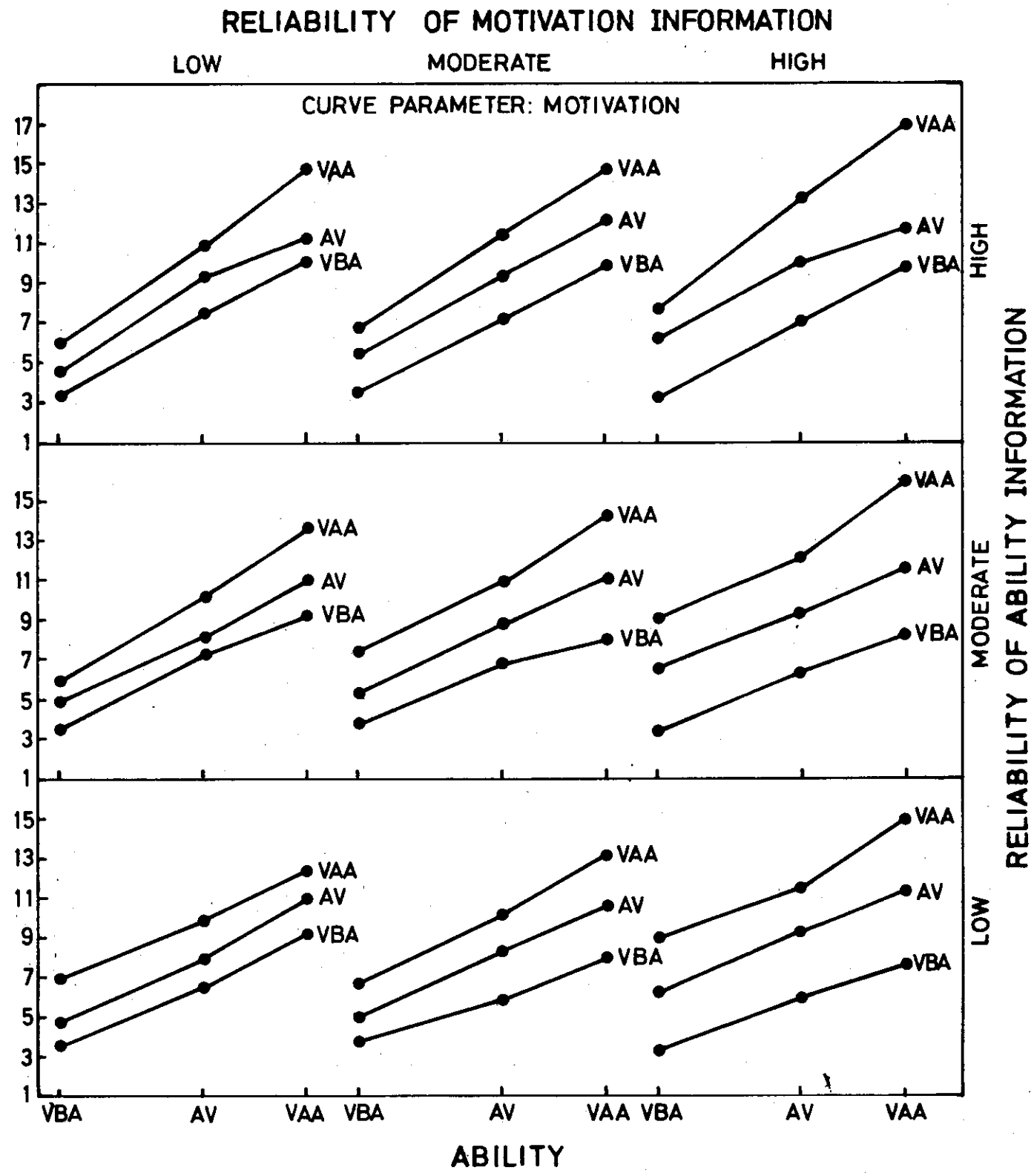
Figure 4. Mean job performance as a function of motivation (curve parameter) and ability (listed on horizontal axis). Data from the managers and professors of Experiment 1.

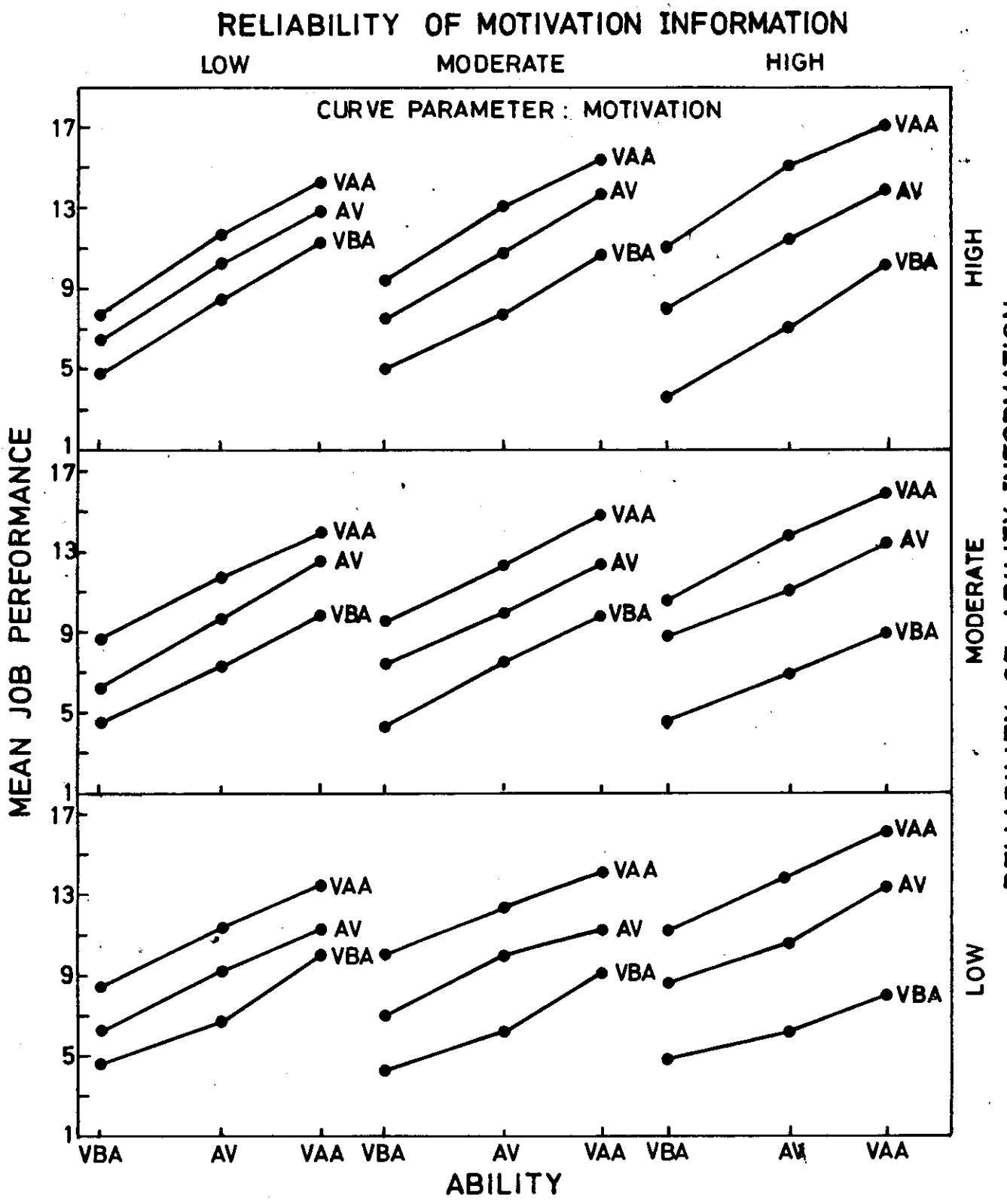
Figure 5. Combined factorial plots of Motivation 1 x Ability, Motivation 2 x Ability, and Motivation 3 x Ability effects from the two-cue and four-cue designs. The dashed curve is based on information about ability-only listed on the horizontal axis. The

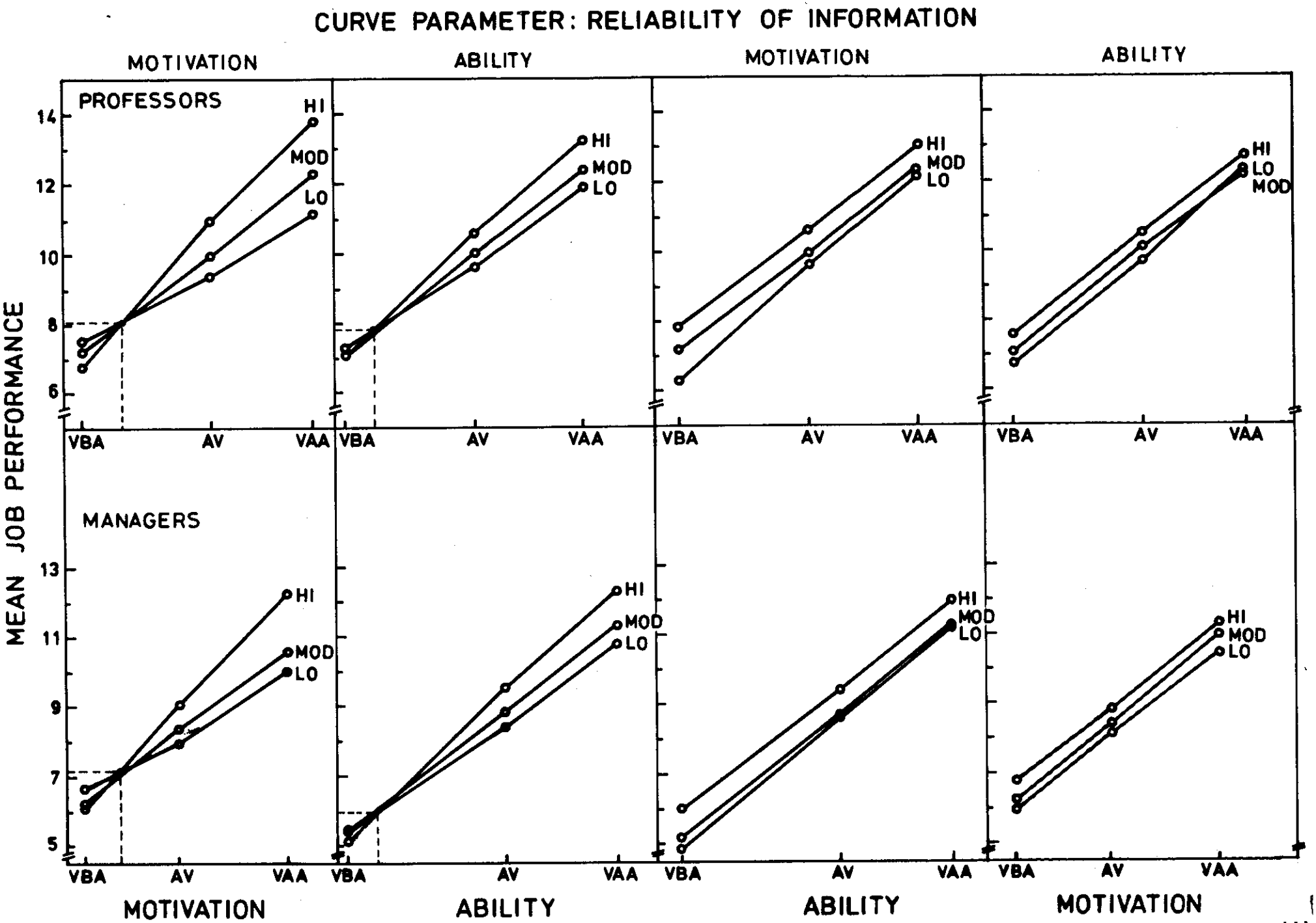
LO, MOD, and HI refer to lower 5-10 per cent, around 50 per cent, and upper 5-10 per cent motivation, respectively.

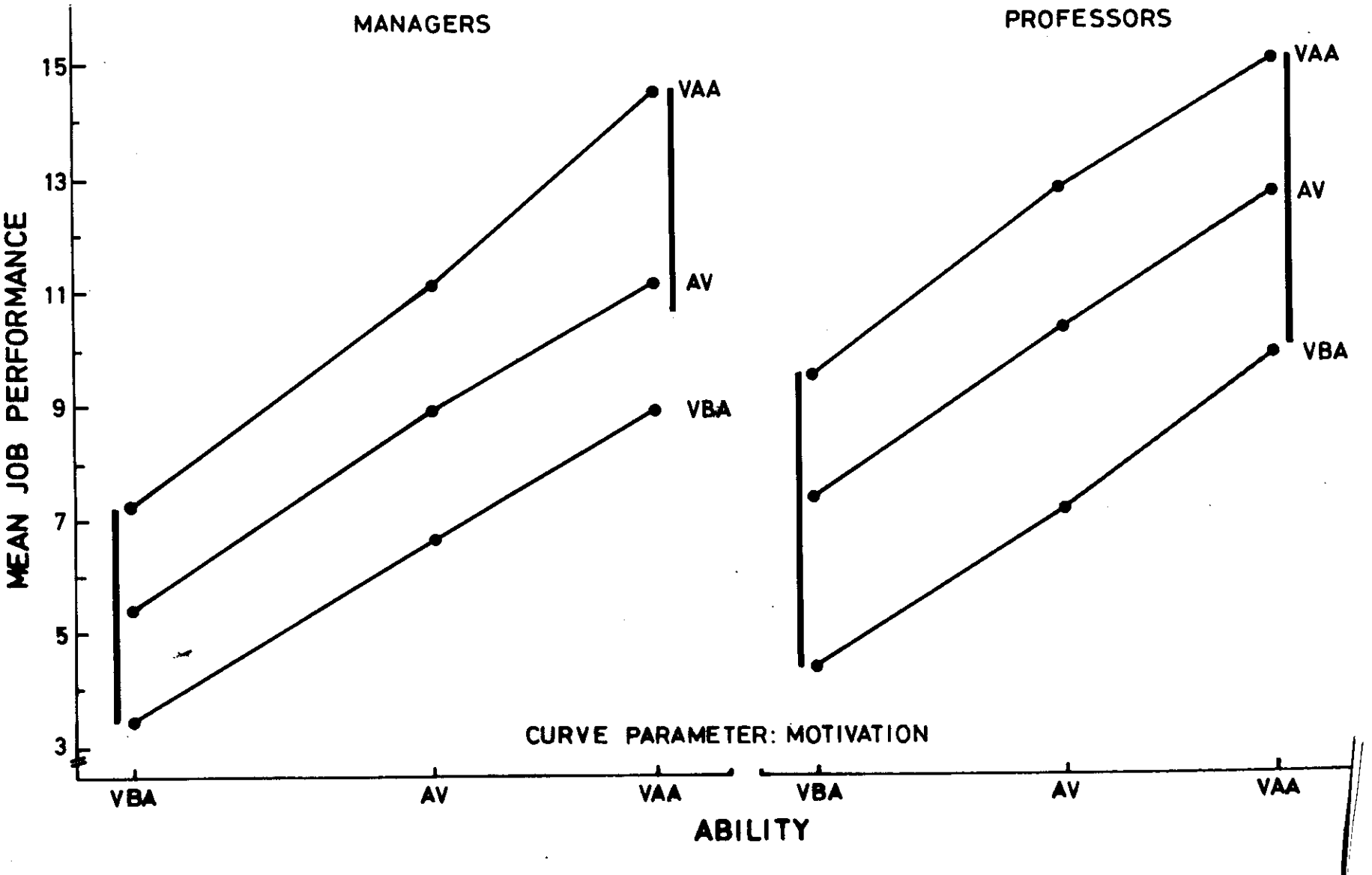
Figure 6. Factorial plot of Motivation 1 x Motivation 2, Motivation 1 x Motivation 3, and Motivation 2 x Motivation 3 effects from the main four-cue design of Experiment 2.

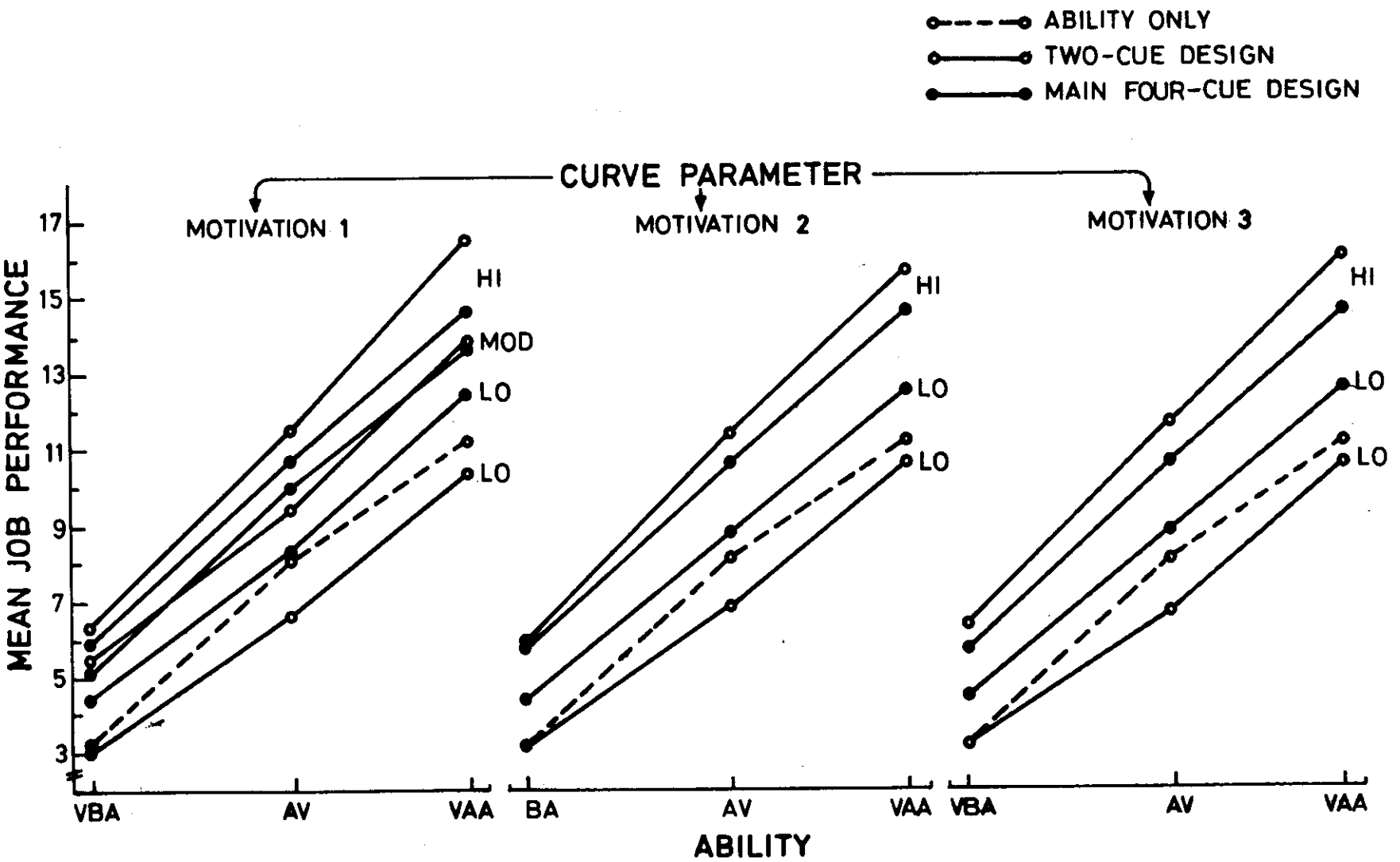
Figure 7. Combined factorial plots of Ability x Motivation 1, Ability x Motivation 2, and Ability x Motivation 3 effects from the two-cue and four-cue designs. The dashed curve is based on information about motivation-only listed on the horizontal axis.

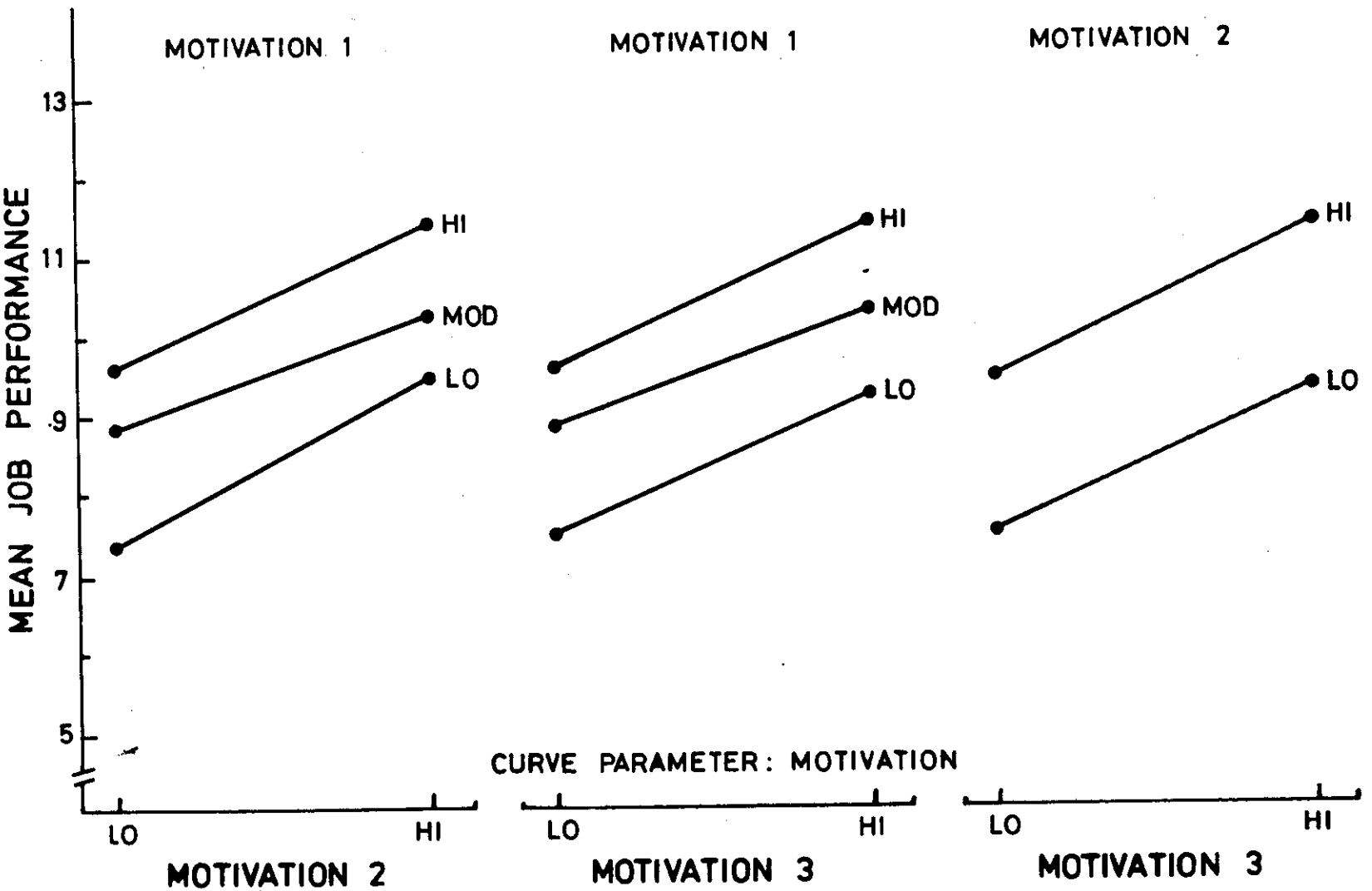

RELIABILITY OF MOTIVATION INFORMATION
LOW
MODERATE
HIGH
CURVE PARAMETER: MOTIVATION
VAA
AV
VBA
17
15
13
11
9
7
5
3
1
HIGH
MODERATE
LOW
RELIABILITY OF ABILITY INFORMATION
VBA
AV
VAA
ABILITY

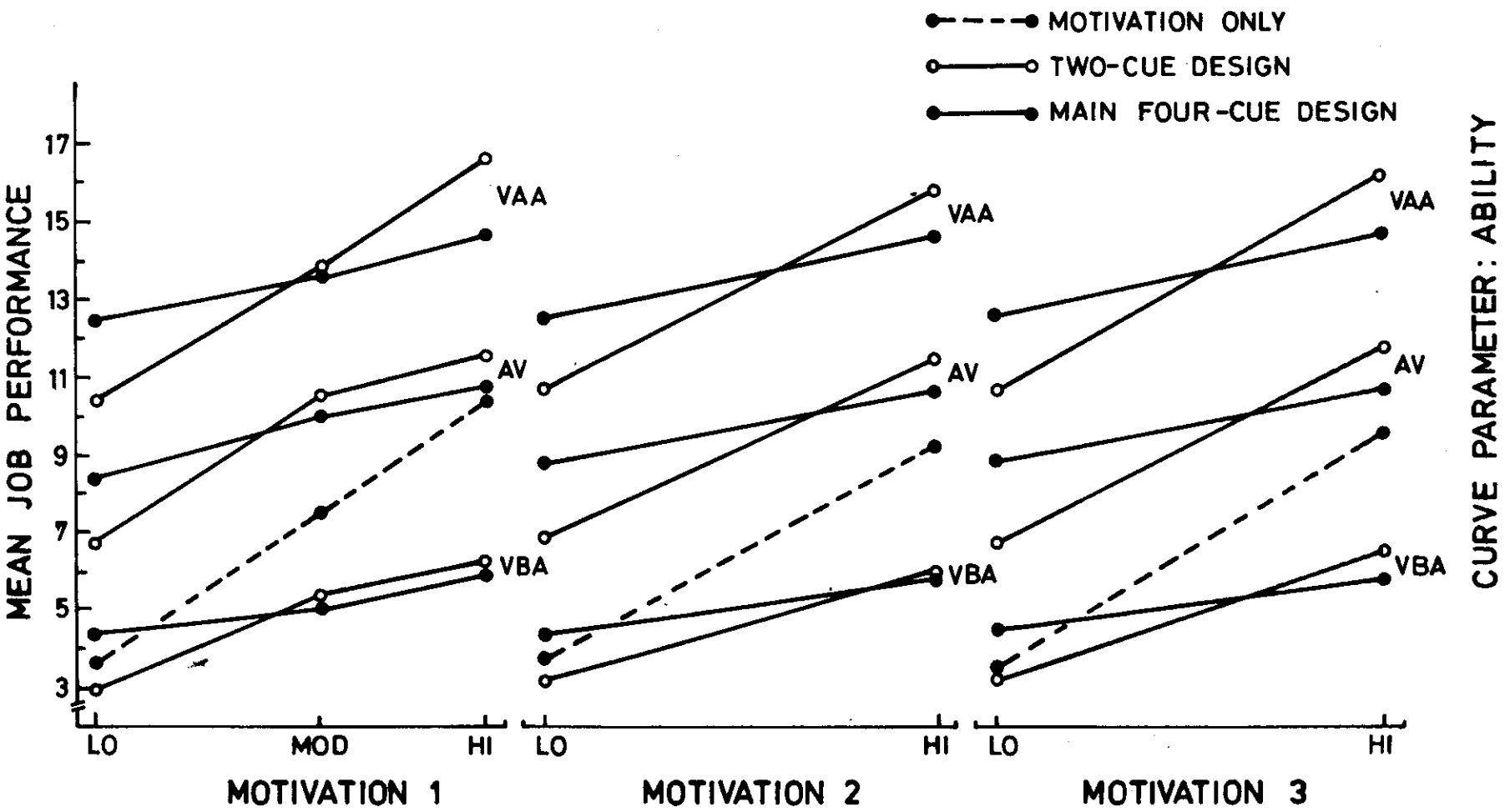

RELIABILITY OF MOTIVATION INFORMATION
LOW
MODERATE
HIGH
CURVE PARAMETER : MOTIVATION
MEAN JOB PERFORMANCE
RELIABILITY OF ABILITY INFORMATION
HIGH
MODERATE
LOW
VAA
AV
VBA
17
13
9
5
1
ABILITY


CURVE PARAMETER: RELIABILITY OF INFORMATION
MOTIVATION
ABILITY
MOTIVATION
ABILITY
PROFESSORS
MANAGERS
MEAN JOB PERFORMANCE
HI
MOD
LO
VBA
AV
VAA
MOTIVATION
ABILITY
ABILITY
MOTIVATION


MANAGERS
PROFESSORS
MEAN JOB PERFORMANCE
15
13
11
9
7
5
3
VAA
AV
VBA
VAA
AV
VBA
CURVE PARAMETER: MOTIVATION
VBA
AV
VAA
VBA
AV
VAA
ABILITY


ABILITY ONLY
TWO-CUE DESIGN
MAIN FOUR-CUE DESIGN
CURVE PARAMETER
MOTIVATION 1
MOTIVATION 2
MOTIVATION 3
MEAN JOB PERFORMANCE
17
15
13
11
9
7
5
3
HI
MOD
LO
LO
HI
LO
LO
HI
LO
LO
VBA
AV
VAA
BA
AV
VAA
VBA
AV
VAA
ABILITY


MOTIVATION 1
MOTIVATION 1
MOTIVATION 2
MEAN JOB PERFORMANCE
13
11
9
7
5
HI
MOD
LO
HI
MOD
LO
HI
LO
CURVE PARAMETER: MOTIVATION
LO
HI
LO
HI
LO
HI
MOTIVATION 2
MOTIVATION 3
MOTIVATION 3


MOTIVATION ONLY
TWO-CUE DESIGN
MAIN FOUR-CUE DESIGN
MEAN JOB PERFORMANCE
17
15
13
11
9
7
5
3
VAA
AV
VBA
LO
MOD
HI
MOTIVATION 1
MOTIVATION 2
MOTIVATION 3
CURVE PARAMETER: ABILITY