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PREDICTION OF PERFORMANCE FROM MOTIVATION AND ABILITY: AN APPRAISAL OF THE CULTURAL DIFFERENCE HYPOTHESIS

By

Ramadhar Singh

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PREDICTION OF PERFORMANCE FROM MOTIVATION AND ABILITY: AN APPRAISAL OF THE CULTURAL DIFFERENCE HYPOTHESIS

RAMADHAR SINGH
Organizational Behavior Area
Indian Institute of Management, Ahmedabad

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This chapter is a major revision and extension of an early paper, Averaging as a general principle of information integration, presented at the first workshop on "Experimental Social Psychology in India" held at the University of Allahabad, Allahabad during December 7-9, 1979. I am grateful to Norman H. Anderson, Ajit K. Dalal, Suresh B. Kanekar, and Sasi B. Misra for comments on the original draft. Preparation of this chapter was supported by a research project, Prediction and postdiction in social judgments, from the Indian Institute of Management, Ahmedabad.

How do people integrate information about motivation and ability of a person when they predict his performance? Heider (1958) made the following suggestion:

The personal constituents, namely, power (ability) and trying (effort) are related as multiplicative combination, since the effective personal force (performance) is zero if either of them is zero. For instance, if a person has the ability but does not try at all he will make no progress toward the goal. (p. 83)

If Heider's proposal is correct, then prediction of performance from motivation and ability information would follow the multiplying rule:

$$\text{Performance} = \text{Motivation} \times \text{Ability}. \qquad (1)$$

Heider's rationale for the multiplying rule is much the same as in Hull's (1943) formulation, Reaction Potential = Drive x Habit. In both formulations, an energizing factor and a capability factor are required to produce an action. Furthermore, the dynamic energizing factor (Motivation, Drive) is assumed to act as an amplifier of the static capacity factor (Ability, Habit). The algebraic model that entails such an operation is the multiplying rule. Accordingly, motivation and ability are expected to multiply each other.

Anderson's (1974a, 1974b, 1976a, in press) theory of information integration and functional measurement which has guided much of the research by the author shows that such a multiplying rule implies a <u>linear fan pattern</u> in the factorial plot of the Motivation x Ability data. This linear fan prediction of the multiplying model has been supported in the United States but not in India.

The central task of the present chapter is to provide an explanation for the discrepancy in results obtained with American and Indian subjects. The position taken here is that the integration rule underlying prediction of performance are culture - specific, and that American and Indian students differ in their cultural outlook on how motivation and ability determine performance. This chapter will attempt, therefore, to put several studies by the author and his associates together in such a fashion that an objective appraisal of the cultural - difference hypothesis would be possible.

AMERICAN STUDIES

Anderson and Butzin, 1974

In a study of college students, Anderson and Butzin presented information about motivation and ability of target persons, applicants to graduate school or athletes trying out for college track, and asked subjects to predict how the target persons would perform. Target persons were products of a 4 x 4 (Motivation x Ability) factorial design, and the two factors had low, moderately low, moderately high, and high as levels.

Mean judgments of performance as a function of motivation and ability information are plotted in Figure 1, for applicants to graduate school in the left side and for athletes in the right side. The general shape of the curves for the two types of stimulus persons is essentially the same. The curves have a clear tendency to diverge toward right. This divergence is real, for test of the interaction term was statistically significant and most of the variance, 75% for applicants to graduate school and 81% for athletes, concentrated in the Linear x Linear trend. The data shown in Figure 1 thus conform to the linear fan pattern rather well. Therefore, Anderson and Butzin concluded that subjects multiplied motivation and ability information in prediction of performance.

Figure 1 about here

Graesser and Anderson, 1974

The possibility of a multiplying operation of an energizing factor and a capability factor was further checked by Graesser and Anderson. In two experiments, they presented information about generosity and annual income of sixteen stimulus persons constructed from a 4 x 4 design, and asked subjects to predict size of gift each stimulus person would give to a family whose house had burned down. As in the study by Anderson and Butzin (1974), Graesser and Anderson obtained linear fan pattern in the graphic plot of Generosity x Income data.

Identical findings across the two conceptually similar judgmental tasks enabled the authors to provide a unifying, theoretical rationale for the multiplying rule:

> Both Gift size = Generosity x Income, and Performance = Motivation x Ability have the same psychological structure. In each case, an energizing factor or action tendency operates on a capability potential. These equations thus represent a judgmental analog of the behavioral equation used by Hull and others that Drive multiplies Habit strength. (pp. 696-697)

Kun, Parsons, and Ruble, 1974

In a developmental study, Kun and her associates studied attribution of performance on puzzles from effort and ability information about the stimulus children. They also obtained evidence for a linear fan pattern in the plot of Effort x Ability data. Judgments by the youngest children had a parallelism pattern, as if an adding-type rule was operative, whereas judgments by second graders and others had clear linear fan shape. Therefore, the authors suggested that a multiplying rule develops out of an adding rule around 8-9 years of age.

Comments

Results of the three studies just reviewed suggest that there is a considerable generality to the multiplying rule. The energizing and capability factors do operate in a multiplicative fashion to produce reaction as Heider (1958) and Hull (1943) suggested. Furthermore, there is a developmental progression in the integration rule: A multiplying-type rule evolves out of an adding-type rule.

If prediction of performance from motivation and ability follows a multiplying rule, then judgments of motivation from information about performance and ability, and judgments of ability from information about performance and motivation should follow a dividing rule:

$$\text{Motivation} = \text{Performance} \div \text{Ability}; \qquad (2a)$$

$$\text{Ability} = \text{Performance} \div \text{Motivation}. \qquad (2b)$$

This would happen if the subjects are mathematically consistent as Heider (1958) assumed. However, Anderson and Butzin (1974) obtained data supportive of a subtracting rule:

$$\text{Motivation} = \text{Performance} - \text{Ability}; \quad (3a)$$

$$\text{Ability} = \text{Performance} - \text{Motivation}. \quad (3b)$$

Anderson and Butzin concluded, therefore, that these judgments obeyed a simple cognitive algebra but that this cognitive algebra was not consistent mathematically.

At the Indian Institute of Technology, Kanpur, the author and his students thought that perhaps there is an alternative interpretation, one in which the subjects are mathematically consistent. The linear fan pattern is not restricted to the multiplying rule alone. This pattern can also be engendered by a conjunctive averaging rule with differential weighting (Anderson, 1974b). If lower value of motivation and/or ability had greater weight, then the averaging model would produce an approximate linear fan (Ostrom & Davis, 1979). This possibility was noted by Anderson and Butzin (1974) also, who said, "Since averaging process is pervasive in judgment, a conjunctive integration rule deserves consideration" (p. 602). So the author and his students undertook experimental analyses of prediction of performance from motivation and ability information.

INDIAN STUDIES

Singh, Gupta, and Dalal, 1979

Singh and his associates tested the plausibility of the alternative interpretation as a conjunctive averaging rule in three experiments. The three experiments are described below in detail.

Experiment 1. Thirty-two subjects were provided with information about interest in studies and intelligence of stimulus students, and were asked to predict how the stimulus students would perform at the Indian Institute of Technology, Kanpur. Sixteen stimulus students were prepared according to a 4 x 4 (Interest in Studies x IQ) factorial design; four stimulus students were described with respect to their I.Q. alone.

On the basis of the results reported in American studies, it was predicted that the judgments of sixteen persons described with respect to their interest in studies and IQ would yield a linear fan pattern, just as in the two sets of curves shown in Figure 1. Furthermore, the curve for judgments based on only ability information would also form part of the linear fan. This would happen because the subjects would impute some value for the missing motivation information and multiply that with the given value of IQ. But if the conjunctive averaging rule would operate, then ability - only curve would cross over at least one of the four two-cue curves (Anderson, 1974b; Dalal & Singh, Note 1; Lampel & Anderson, 1968; Singh, Bohra, & Dalal, 1979).

Figure 2 plots mean judgment of performance as a function of interests in studies (curve parameter) and IQ. The IQ levels are spaced on the horizontal axis according to the marginal means of the 4 x 4 factorial design. This spacing allows the linear fan pattern to appear. If the two pieces of information were integrated by multiplying rule, then the four solid curves would form a diverging fan of straight lines.

Figure 2 about here

The pattern of the data in Figure 2 is quite contrary to the multiplying rule. There is not any evidence for divergence at all. Instead, the four solid curves exhibit neat parallelism. Perhaps subjects integrated the two given information by an adding or averaging rule.

A distinguishing test between the adding and averaging rule is provided by the dashed curve of Figure 2. This curve represents judgments based on IQ information alone, with interest in studies not specified. According to the adding rule, the dashed curve should be parallel to the solid curves. The averaging rule requires the dashed curve to have sleeper slope than the solid curves. This requirement of the averaging rule seems to have been satisfied in Figure 2.

To obtain statistical support for the averaging rule, the dashed curve data were considered as a fifth level of the interest-in-studies factor. The interaction term in this 5 x 4 (Interest in studies x IQ) analysis of variance tests for nonparallelism in the set of all five curves in Figure 2. This interaction was highly significant, $F\ (12, 372) = 8.36$, $p < .01$. Since the four solid curves are essentially parallel, $F\ (9, 279) = 1.44$, it appears that the dashed curve is reliably steeper than the solid curves. This test thus supports the averaging rule and rejects the alternative adding rule.

The principal finding of Experiment 1 is that the information about motivation and ability is integrated by a simple, equal-weight averaging rule. This result is contrary to the prediction; it disagrees with results from American subjects. One hypothesis is that this discrepancy in integration rules is a consequence of cultural differences in outlook on social motivation.

Before this hypothesis can be taken seriously, however, it is necessary to examine methodological differences between the present and previous experiments. Methodologically, this experiment was different from those of Anderson and Butzin (1974) in two notable ways. First, they asked their subjects to describe in writing how they integrated information about motivation and ability during the practice session. This was not done in the present experiment. This difference, however, does not seem to be serious at all. Kun et al (1974) obtained the linear fan pattern with children of second grade even without following the Anderson and Butzin procedure. Second, and perhaps more important, the motivation factor was defined here as interest in studies, and the subjects may not have interpreted that in terms of motivation and trying. This possibility was checked in the next experiment by using more explicitly motivational information.

<u>Experiment 2</u>. This experiment was conducted chiefly as a reliabi- check on Experiment 1. However, there were three notable changes from Experiment 1. First, information about laboriousness was used as motivation factor to allow direct comparison of findings with those obtained in the United States. Second, the levels of the two factors,

laboriousness and IQ, were drawn from a wider scale range to increase the opportunity for a linear fan pattern to appear. Finally, sufficient data were collected from each of the 12 subjects to explore various integration rules at the individual level.

The upper left panel of Figure 3 plots mean judgment of performance as a function of laboriousness (curve parameter) and IQ (horizontal axis) of stimulus students. If the parallelism pattern of Figure 2 is indeed reliable, then the four solid curves of Figure 3 should also be parallel. This seems to be true; the four curves are essentially parallel. Although the Laboriousness x IQ interaction was statistically significant, $\underline{F}$ (9, 99) = 2.13, $\underline{p} < .05$, there is no sign of the linear fan pattern reported in the American studies. On the contrary, there is a slight tendency for the curves to converge to the right. Despite the change in the nature of the motivation cue, these results confirm those in Figure 2.

Figure 3 about here

The dashed curve in the upper left panel of Figure 3 represents judgments based on IQ alone, with no information about laboriousness. This curve is nearly parallel to the solid curves, as though subjects added information about laboriousness and IQ. At face value, this result seems to argue for the adding rule and against the averaging rule. But the averaging rule can also account for it. If subjects inferred an implicit value of laboriousness when no information was given and they averaged that in with information given about IQ, then the corresponding dashed curve would be expected to be parallel to the solid curves.

In separate analyses for each subject, the subjects broke down into three subgroups. Mean judgments of performance for these three subgroups are shown in Figure 3. The upper right panel displays results for eight subjects, all of whom had nonsignificant interactions. Here parallelism is quite evident. Perhaps these subjects followed an adding or an averaging rule. The lower left panel has data from two subjects who apparently averaged, as shown by the crossover of the dashed and solid curves. The lower left panel shows data from two subjects who had a strong convergence tendency. However, the general shape of the curves is too irregular to be interpreted.

The most important information from these individual subject analyses is that not a single subject showed the linear fan pattern obtained in the American experiments. That supports the suggestion of Experiment 1 that Indian college students make prediction of performance in a rather different way from their American counterparts.

The findings of Experiments 1 and 2 converge to make a single point: Information about motivation and ability is added or averaged in making prediction of scholastic performance. The evidence leans toward the averaging rule, but the results of Experiment 2 require the supplementary assumption that subjects impute an implicit value for motivation when no information is given. This assumption is reasonable, since no performance is logically possible without some level of motivation. Nevertheless, more direct evidence is required.

Direct cvidcmo c-n be obtained by using threc stimulus cues, for example, past performance, motivation, and ability. If the averaging model is correct, then the single-cue curves should be clearly steeper than the curves in the two-way factorial plots from the three-cue design. The reason is simple. When the single cue is given, any implicit inference about the absent motivation information will yield an effective two-cue response. But the averaging model implies that the slope of a curve based on two cues will be greater than that based on three cues. Accordingly, the crossover test remains valid even if subjects do impute an implicit value to the missing dimension of information. The adding hypothesis, of course, still predicts parallelism in such a three-cue design.

<u>Experiment 3</u>. This experiment had 27 stimulus students prepared from a 3 x 3 x 3 (Past Performance x Laboriousness x IQ) design and 9 stimulus students from a 3 x 3 (Laboriousness x IQ) design. In addition, there were nine single-cue stimulus persons, based on one of the three levels of each factor of the three-cue design. Twelve subjects predicted performance of all the stimulus students in their next examination.

If subjects use multiplying rule for information about motivation and ability, then performance judgments should conform to the compound averaging - multiplying rule:

$$\text{Performance} = \text{Past Performance} + \text{Motivation} \times \text{Ability} . \quad (4)$$

In the three-factor design, therefore, two of the two-way plots. P--
Performance x Motivation and Past Performan--

the parallelism pattern, and the third, Motivation x Ability, should exhibit linear fan pattern (Anderson & Butzin, 1974). However, results from the previous two experiments suggested the three-term averaging model:

$$\text{Performance} = \text{Past Performance} + \text{Motivation} + \text{Ability}. \quad (5)$$

The results shown in Figure 4 clearly support the three-term averaging model. Each panel shows one of the two-cue factorial graphs from the three-cue design. In each panel, the solid curves are nearly parallel. The right panel, which corresponds to the Laboriousness x Ability interaction, is marginally significant, $F(4, 44) = 2.46$. However, the three solid curves indicate a slight convergence, as in Experiment 2, not the divergence required by the multiplying rule.

Figure 4 about here

A test between the adding and averaging rules is obtained by comparing the dashed curve with the solid curves in each panel of Figure 4. The dashed curve represents judgments based on just the single cue listed on the horizontal axis. In each panel, the dashed curve has much steeper slope and crosses over the lowest solid curve convincingly. This crossover interaction is evidence against the adding rule and for the averaging rule.

Results from two-cue design are shown in Figure 5. The solid curves are nearly parallel, but with a visible and barely significant tendency to converge to the right, $F(4, 44) = 2.85$, $p < .05$. The dashed curve is again nearly parallel to but slightly steeper than the solid curves. These results are essentially the same as those in Experiment 2.

Figure 5 about here

The two-cue data support the assumption of implicit inference about motivation information suggested by data of Experiment 2. The dashed curve in the center and right panels of Figure 4 is the same as the dashed curve of Figure 5. The clear crossover of the dashed curve in Figure 4 supports the averaging rule. Hence, the failure to yield a clear crossover in Figure 5 would appear to reflect the presence of an inferred, implicit value for the missing motivation information.

Data of individual subject were also analyzed. Table 1 presents the F ratios for the four interactions for each of the twelve subjects in the main three-cue, 3 x 3 x 3 (Past Performance x Laboriousness x IQ) design.

Table 1 about here

As required by the three-term averaging rule, the two-way and three-way interactions are in general nonsignificant. Only five scattered interactions are statistically significant. Closer examination of the data disclosed that they reflected individual idiosyncrasies such as may be seen in the lower right panel of Figure 3. Almost all subjects showed the crossover interaction for the single-cue curves. Thus, the results showed the generality of the averaging rule at the level of the individual.

In single subject analyses of the two-cue Laboriousness x IQ data, 11 of the 12 subjects showed parallelism. Only 1 subject had a converging type of nonparallelism. It can thus be said that present two-cue results are indeed similar to those of Experiments 1 and 2.

Conclusion. The results of the present set of three experiments do not agree with the multiplying model suggested by Heider (1958) and supported by Anderson and Butzin (1974) with American adults and by Kun et al (1974) with older American children. In the present experiments, prediction of performance from motivation and ability cues appears to have been governed by a process quite different from the multiplying. Strong evidence for parallelism pattern indicates that an equal-weight averaging could very well account for the data. It seems reasonable to conclude, therefore, that prediction of scholastic performance from motivation and ability information obeys an averaging rule in India, and that integration rules underlying prediction of performance are culture-specific.

Gupta and Singh, Note 2

A more thorough test of the cultural-difference hypothesis was made by Gupta and Singh. They patterned their experiment after Experiment 3 of Singh et al (1979), and used twenty-four subjects from five age groups ($\underline{n}$ = 120), beginning 6 years. This yielded not only greater generality of the averaging results but also direct comparison with Kun et al (1974) on development of cognitive algebra. Results of this developmental study are presented in Figures 6 - 8.

<u>Parallelism pattern</u>. The upper part of Figure 6 shows the two-way graph for Past Performance x Motivation for each of the five age groups. The upward slop of the curves represents the effect of information about past performance, while the vertical separation of the curves represents the effect of information about motivation. The three curves are essentially parallel at all five age levels. Although the parallelism is not perfect, as shown by the interaction tests noted below, the overall picture is one of strong support for an adding-type rule for integration of information about past performance and motivation.

<u>Figure 6 about here</u>

A quite similar picture emerges in the lower part of Figure 6, which plots the two-way graphs for Past Performance x Ability. Again the three curves for each age group are nearly parallel. This means that integration of information about past performance and ability also followed an adding-type rule.

Most important for cross-cultural comparison are the two-way graphs for Motivation x Ability. These are shown in Figure 7, for the three-cue design in the upper panel and for the two-cue design in the lower panel. The general shape of the curves from the two designs is exactly the same, and all ten graphs exhibit a prevailing pattern of near-parallelism. This pattern of near-parallelism supports an adding-type rule suggested by Singh et al (1979) but rejects the multiplying rule (Anderson & Butzin, 1974; Kun et al, 1974). Evidently, Indian students at all ages coordinate information pertaining to motivation and ability in a way quite different from that of their American counterparts.

Figure 7 about here

A strict adding-type rule requires parallelism in the factorial graph, and hence a nonsignificant interaction term in the analysis of variance. In analyses of variance of the three-cue and two-cue design data, however, the interaction terms were generally significant for the graphs of Figures 6 and 7. Closer examination of the graphs for children of all the four age groups suggests that the deviations from parallelism reflect end effects in the response scale. There is a tendency for the lowest point to be too low and the highest point to be too high, as though children had a preference for the two categories of the response scale. In any case, the fluctuations from parallelism are relatively small. Therefore, they do not seem to require any serious qualification on the adding-type rule.

Averaging versus adding. Both the adding and averaging rules can account for the parallelism in Figures 6 and 7. Figure 8 presents distinguishing tests between adding and averaging rules for motivation and ability across the five ages. In each graph, the curve connected by circles is based on the single cue listed on the horizontal axis, namely, motivation in upper panel and ability in the lower panel. The other two curves are based on main effect of the very same cue from the two and three-cue designs.

Figure 8 about here

The adding hypothesis requires the three curves in each graph to exhibit parallelism. The reason is simple: The added information would have the same directional effect across the three levels of the factor listed on the horizontal axis. Figure 8 shows no sign of parallelism at all. Instead, all ten graphs exhibit crossovers. These crossovers are strong evidence against the adding rule.

The averaging rule predicts the crossover interaction that is present in all ten graphs of Figure 8. The two-cue curve crosses over the three-cue one clearly in eight cases. Similarly, the single-cue curve crosses over the two - and three-cue curves in nine and ten cases, respectively. All statistical tests of crossover interaction were statistically significant. Thus, it can be said that subjects averaged the three prices of information in prediction of performance.

Information utilization. Developmental trends in capacity to utilize all three pieces of information were also examined. Only main effects from the individual subject analyses were considered (Anderson & Butzin, 1978). Most subjects of all ages except the youngest utilized all three pieces of information. In 6-7-year-old group, however, 5 subjects used just one cue, 5 used two cues, and the remaining 14 used all three cues.

Examination of the nature of cues used by the 6-7-year-old group disclosed an interesting result. The five children who used just one cue all used motivation, even though information about motivation appeared in the stimulus descriptions at different serial positions. Perhaps those children believed that motivation is all that is important for performance. Of the five subjects who used two cues, three utilized information about motivation and ability, and two utilized information about past performance and motivation. All these five children also used motivation information. In this way, all twenty four preoperational children considered motivation as a crucial determinant of performance. This indicates that belief in the power of trying to improve upon one's lot develops in Indian children at quite early age.

Conclusion. The chief finding of the research by Gupta and Singh is that prediction of performance from information about motivation and ability obeys an averaging rule. Not only adults but also preoperational children average relevant information when they predict performance. This result confirms the previous finding with adults (Singh et al, 1979), and extends the averaging process to children as young as six years of age. In India, therefore, prediction of performance can not be described as a multiplicative function of motivation and ability.

CULTURAL DIFFERENCE HYPOTHESIS

From the studies presented above, it is quite evident that prediction of performance from information about motivation and ability cannot be described by just one algebraic rule. In all studies of American students, judgments of future performance conformed rather well to the linear fan pattern which implies that

Americans used a multiplying rule. On the contrary, all studies of Indian students obtained evidence for parallelism pattern which means that Indian subjects added or averaged information about motivation and ability. Distinguishing tests between adding and averaging rules further disclosed that the parallelism pattern was attributable to the equal-weight averaging. Clearly, then, integration rules underlying prediction of performance are culture-specific: Americans follow a multiplying rule; Indians follow an equal-weight averaging rule.

Does the difference between the multiplying rule and the equal-weight averaging rule point to any important difference in cultural outlook between America and India? For prediction of performance from information about motivation and ability, the following argument suggests at least one important social difference. According to the multiplying rule, effort or trying will be more effective with persons of high than low ability. Within a cultural system of attribution that obeys the multiplying rule, therefore, it will appear that persons of lower ability have less to gain by trying. In other words, persons with high ability can exercise more control over their performance than those with low ability. Given the achievement orientation of American culture, it is no surprise to see a multiplying rule emerge in the prediction of performance by American subjects, especially older school children and college students. From a social-cultural view, however, the multiplying rule portrays an elitist orientation.

The equal-weight averaging rule, in contrast, implies that effort or trying will be equally effective with persons of low and high ability. Within the cultural system of attribution that obeys the equal-weight averaging rule, therefore, it will appear that a person of lower ability can gain as much by trying as a person of higher ability. The practice of keeping reserved seats in academic institutions and at work places for the down-trodden people of Indian society perhaps reflects this philosophy.

From a social-cultural angle, therefore, the equal-weight averaging model for prediction of performance portrays a more egalitarian outlook. Perhaps students in India believe that each person, regardless of native ability, has equal opportunity to improve upon his or her lot. This egalitarian attitude is a healthy sign for progress in India, for Indian people have been described as high in dependency (Murphy, 1953; Pareek, 1968; Winter, 1969)

ALTERNATIVE HYPOTHESES

Can the difference between Indian and American results be explained in ways other than the cultural-difference hypothesis proposed above? At least three other hypotheses may be suggested. First, perhaps subjects did not understand the instructions or tasks. Second, Indian subjects may lack the ability to use a multiplying rule. Finally, they may have simplified the experimental task as did American subjects in prediction of motivation and ability (Anderson & Butzin, 1974). Let us examine the plausibility of these three alternative hypotheses.

Misunderstanding of Instruction or Task

In studies of information integration, experimenters usually take great pains to ensure understanding of the experimental task. Singh et al (1979), therefore, gave a good deal of practice on the task, and also required the subjects to read the entire set of descriptions before beginning their actual judgments. In the study of Gupta and Singh (Note 2), the experimenter asked subjects to recall information about each stimulus student before rating. She also removed misunderstanding of task by giving detailed instructions and demonstration. Although subjects rated the stimuli thrice, the first replication was considered as additional practice and only the data from the second and third replications were analyzed. Moreover, the single subject analyses showed that most of the children took account of all pieces of information in a sensible way. Misunderstanding of the task thus seems most unlikely.

Inability to Use Multiplying Rule

If Indian subjects lack the ability to use the multiplying rule in social perception, then evidence for multiplying-type rule should not be obtained at all. However, judgments of gift size from information about generosity and income of the donors, shown in Figure 9, exhibit linear fan shape. This experiment parallels that of Graesser and Anderson (1974) on Gift Size = Generosity x Income, and exactly similar results are obtained.

Figure 9 about here

The linear fan pattern in prediction of gift size shown in Figure 9 is highly reliable, for it invariably appeared in a series of six experiments performed by the author (Singh, Note 3) on subjects from the same population as in experiments by Singh et al (1979). These experiments employed simple two-factor design similar to that of Graesser and Anderson as well as complex designs with one to four factors. Nevertheless, all experiments yielded clear linear fan pattern. Distinguishing tests further indicated that subjects indeed obeyed the multiplying rule. This clearly shows that Indian subjects are able to use the same integration rule as the Americans.

Further evidence against the hypothesis of lack of ability in Indians to use multiplying rule comes from another series of four experiments by the author (Singh, Note 4). Subjects received information about salary and competence of stimulus engineers and estimated how much influence those engineers exercised in getting their present job. Results from one experiment are shown in Figure 10 for purpose of illustration. The five salary curves show a nice convergence to the right, as though a dividing model, Influence = Salary ÷ Competence, was operative.

Figure 10 about here

Results from these two series of experiments on prediction and postdiction processes convincingly establish that Indian college students are able to use the multiplying and dividing rules whenever they are demanded by the experimental tasks. The hypothesis that

Indian students lack ability to employ the multiplying rule is, therefore, not tenable.

Task Simplification

When subjects are given complex tasks which may require multiplying or ratio rule, they sometimes tend to simplify them by adopting an adding-type rule. Anderson and Butzin (1974) suggested that task-simplification strategy may perhaps account for the mathematical inconsistency between prediction of performance and postdiction of motivation and ability. This tendency was suggested by Shanteau and Anderson (1972) as well as by Farkas and Anderson (1979) who failed to receive support for their multiplying and ratio models. As indicated earlier, it is possible that Indian students also simplified the multiplying task by adopting the adding-type integration strategy.

The possibility of task simplification can also be rejected on the basis of the multiplying-type and dividing-type results reported in Figures 9 and 10. Furthermore, task simplification would be expected to yield an adding rule, and not the more complex averaging rule which has received support in experiments by Singh et al (1979) and by Gupta and Singh (Note 2). It should also be mentioned that the author and his associates obtained strong evidence for the averaging rule in two other developmental studies of Indian children (Singh, Sidana, & Saluja, 1978; Singh, Sidana, & Srivastava, 1978). There was no evidence for adding rule at all.

It should be mentioned that task simplification is not the usual mode of information integration by Indian subjects. Two recent experiments on reward allocation have clearly revealed that subjected followed very complex process in distribution of reward. They first calculated equity ratios (Anderson, 1976b), using adding, dividing, and multiplying rules, and then averaged the equity ratios to decide fair reward for claimants. This happened in distribution of monetary reward (Singh, Note 5) and nonmonetary rewards such as work facilities and praise time (Singh, Note 6). Although the allocation task was perhaps the most difficult and the equity integration model (Farkas & Anderson, 1979) was the most complex to follow, the subjects obeyed the equity integration model rather well. In fact, results from Indian subjects were much clearer than those from American subjects reported by Farkas and Anderson. The task simplification hypothesis would expect the subjects to follow a simple subtractive model instead of the more complex equity integration model. But this did not happen. Accordingly, the task simplification hypothesis can not provide a parsimonious explanation for the equal-weight averaging process in prediction of performance.

Conclusion

From the preceding discussion, it is quite clear that the equal-weight averaging rule for prediction of performance by Indian subjects does not seem to be attributable to the subjects' inappropriate understanding of the experimental task, their attempt to simplify it, or their inability to use the same integration rule as the Americans.

It can, therefore, be concluded that the discripancy between American and Indian results reflects a genuine difference in cultural outlook on how motivation and ability produce performance.

CONCLUDING COMMENTS

All in all, the research presented in this chapter indicates that prediction of performance from motivation and ability information obeys an averaging rule in India, and that the differences between Indians and Americans in this attributional task reflect true cultural differences. Americans follow multiplying rule envisaged in most current behavioral theories of motivation, such as those of Hull and Tolman (see Anderson 1974b, p.29), whereas Indians obey an averaging rule consistent with the egalitarian philosophy and practices in India. Cognitive algebra employed in the two cultures thus directly bear upon the causal conceptions prevalent in the two countries.

It should, however, be noted that the data on the equal-weight averaging rule for India and on the multiplying rule for America rest on a very narrow cultural sample, namely, students. If the cognitive algebra of achievement prediction is to be useful in cross-cultural comparison, then it is necessary to study many other cultural strata, both in India and in the United States.

Cultural differences in social perception and cognition are no doubt difficult to study. The same physical stimuli may have different meanings in different cultures. Even if equal-interval scales for responses can be obtained, the number may not be comparable because the zero point and unit of such scales are always arbitrary, as with the Calsius and Farenheit scales. However, if cultures are compared with respect to psychological processes represented in integration rules, many of these problems are automatically rendered insignificant.

An important advantage with the integration rules, it should be emphasized, is that they deal with patterns of responses, not the numerical value of single responses. This aspect is vital for cross-cultural research. No a prior knowledge of value of stimuli or origin and unit of personal reference scales (Ostrom & Upshaw, 1968) is required. Groups as well as individuals are thus readily comparable with respect to the pattern in their judgments of stimuli constructed from factorial design. Search for integration rule also permits comparison of groups along the criteria of information utilization and information processing as already shown in work of the author and his associates. The author thus hopes that the present chapter will draw attention of Indian psychologists to the potential power that information integration approach provides for experimental research in developmental and social psychology.

REFERENCE NOTES

1. Dalal, A.K., & Singh, R. An integration theoretical analysis of expected job attractiveness and satisfaction. Working Paper 304. Ahmedabad: Indian Institute of Management, 1979.

2. Gupta, M., & Singh, R. An integration- theoretical analysis of cultural and developmental differences in attribution of performance. Working Paper 322. Ahmedabad: Indian Institute of Management, 1980.

3. Singh, R. Experiments on attribution of gift size. Unpublished data. Ahmedabad: Indian Institute of Management, 1980.

4. Singh, R. Consistency in social judgments of success in getting job, salary, influence, and competence. Unpublished data. Ahmedabad: Indian Institute of Management, 1980.

5. Singh, R. An integration analysis of reward allocation. Working Paper . Ahmedabad: Indian Institute of Management, 1980.

6. Singh, R. Equity integration model applied to distribution of money, work facilities, praise time, and encouragement time. Working Paper . Ahmedabad: Indian Institute of Management, 1980.

REFERENCES

Anderson, N.H. Information integration theory: A brief theory. In D.H. Krantz, R.C. Atkinson, R.D. Luce, & P. Suppes (Eds.), *Contemporary developments in mathematical psychology* (Vol. 2). San Francisco: Freeman, 1974. (a)

Anderson, N.H. Cognitive algebra: Integration theory applied to social attribution. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (Vol. 7). New York: Academic Press, 1974. (b)

Anderson, N.H. How functional measurement can yield validated interval scales of mental quantities. *Journal of Applied Psychology*, 1976, *61*, 677-692. (a)

Anderson, N.H. Equity judgments as information integration. *Journal of Personality and Social Psychology*, 1976, *33*, 291-299. (b)

Anderson, N.H. *Foundations of information integration theory* (Vol. 1). New York: Academic Press, in Press.

Anderson, N.H., & Butzin, C.A. Performance = Motivation x Ability: An integration - theoretical analysis. *Journal of Personality and Social Psychology*, 1974, *30*, 598-604.

Anderson, N.H., & Butzin, C.A. Integration theory applied to children's judgments of equity. *Developmental Psychology*, 1978, *14*, 593-606.

Farkas, A., & Anderson, N.H. Multidimensional inputs in equity theory. *Journal of Personality and Social Psychology*, 1979, *37*, 879-896.

Graesser, C.C., & Anderson, N.H. Cognitive algebra of the equation: Gift Size = Generosity x Income. Journal of Experimental Psychology, 1974, 103, 692-699.

Heider, F. The Psychology of interpersonal relations. New York: Wiley, 1958.

Hull, C.L. Principles of behaviour. New York: Appleton Century - Crafts, 1943.

Kun, A., Parsons, J.E., & Ruble, D.N. Development of integration processes using ability and effort information to predict outcome. Developmental Psychology, 1974, 10, 721-732.

Lampel, A.K., & Anderson, N.H. Combining visual and verbal information in an impression formation task. Journal of Personality and Social Psychology, 1968, 9, 1-6.

Murphy, L.B. Roots of tolerance and tension in Indian child development. In G. Murphy (Ed.), In the minds of men. New York: Basic Books, 1953.

Ostrom, T.M., & Davis, D. Idiosyncratic weighting of trait information in impression formation. Journal of Personality and Social Psychology, 1979, 37, 2025-2043.

Ostrom, T.M., & Upshaw, H.S. Psychological perspective and attitude change. In A.G. Greenwald, T.C. Brock, & T.M. Ostrom (Eds.), Psychological foundations of attitudes. New York: Academic Press, 1968.

Pareek, U. A motivational paradign of development. Journal of Social Issues, 1968, 2, 115-124.

Shanteau, J.C., & Anderson, N.H. Integration theory applied to the value of information. Journal of Experimental Psychology, 1972, 92, 266-275.

Singh, R., Bohra, K.A., & Dalal, A.K. Favorableness of leadership situations studied with information integration theory. European Journal of Social Psychology, 1979, 9, 253-264.

Singh, R., Gupta, M., & Dalal, A.K. Cultural difference in attribution of performance: An integration-theoretical analysis. Journal of Personality and Social Psychology, 1979, 37, 1342-1351.

Singh, R., Sidana, U.R., & Saluja, S.K. Playgroup attractiveness studied with information integration theory. Journal of Experimental Child Psychology, 1978, 25, 429-436.

Singh, R., Sidana, U.R., & Srivastava, P. Averaging processes in children's judgments of happiness. Journal of Social Psychology, 1978, 104, 123-132.

Winter, S.K. Case studies. In D.C. McClelland and D.G. Winter (Eds.), Motivating economic achievement. New York: Basic Books, 1969.

Table 1

F Ratios for Two-Way and Three-Way Interactions in Single-Subject Analyses (Experiment 3, Three-Cue Design)

Subject	AB $F(4,52)$	AC $F(4,52)$	BC $F(4,52)$	ABC $F(8,52)$
1	2.69*	.58	.94	.84
2	2.23	3.33*	1.28	1.79
3	1.64	.74	1.77	.98
4	.84	1.19	3.73*	1.41
5	1.72	1.14	1.22	.87
6	.78	1.15	.77	.53
7	.35	.59	.95	.93
8	2.75*	1.09	1.18	3.50*
9	.42	.16	.91	.75
10	.51	.23	1.29	.91
11	1.36	.51	1.73	.27
12	1.65	.76	1.32	.68

Note. A = Past Performance; B = Laboriousness; C = IQ.

*$p < .05$.

Figure Captions

Figure 1. Mean judgments of performance from information about motivation and ability of applicants to graduate school (left side) and athletes try out for college track (right side). The curves are based on the data reported by Anderson and Butzin (1974).

Figure 2. Mean judgment of performance as a function of interest in studies (curve parameter) and IQ (listed on the horizontal axis). Data from Singh, Gupta, & Dalal, 1979; Experiment 1, Figure 1. (VH = very high, MM = more than most; S = slight, LM = less than most; NS = interest in studies information not specified). Reprinted with permission from the American Psychological Association, Inc.

Figure 3. Mean judgment of performance as a function of laboriousness and IQ. (Levels of laboriousness are listed as curve parameters: NAL = not at all laborious; SL = slightly laborious; FL = fairly laborious; VL = very laborious; NS = laboriousness not specified. Classification of subjects into adding, constant-weight averaging (CWA), and differential-weight averaging (DWA) subgroups was based on results from single-subject analyses). Data from Singh, Gupta & Dalal, 1979; Experiment 2, Figure 2. Reprinted with permission from the American Psychological Association, Inc.

Figure 4. Two-way factorial graphs for Past Performance x Laboriousness, Past Performance x Ability, and Laboriousness x Ability effects on performance from the 3 x 3 x 3 (Past Performance x Laboriousness x Ability) design. (The dashed curve of each panel is based on just the single factor listed on the horizontal axis. Digits 5, 7, and 9 represent levels of past performance. NAL, FL, and VL represent not at all laborious, fairly laborious, and very laborious, respectively. NS = row information not specified). Data from Singh, Gupta, & Dalal, 1979; Experiment 3, Figure 3. Reprinted with the permission from the American Psychological Association, Inc.

Figure 5. Mean judgment of performance as a function of laboriousness and IQ. (NAL = not at all laborious; FL = fairly laborious; VL = very laborious; NS = laboriousness information was not specified). Data from Singh, Gupta, & Dalal, 1979; Experiment 3, Two-cue design, Figure 4. Reproduced with the permission from the American Psychological Association, Inc.

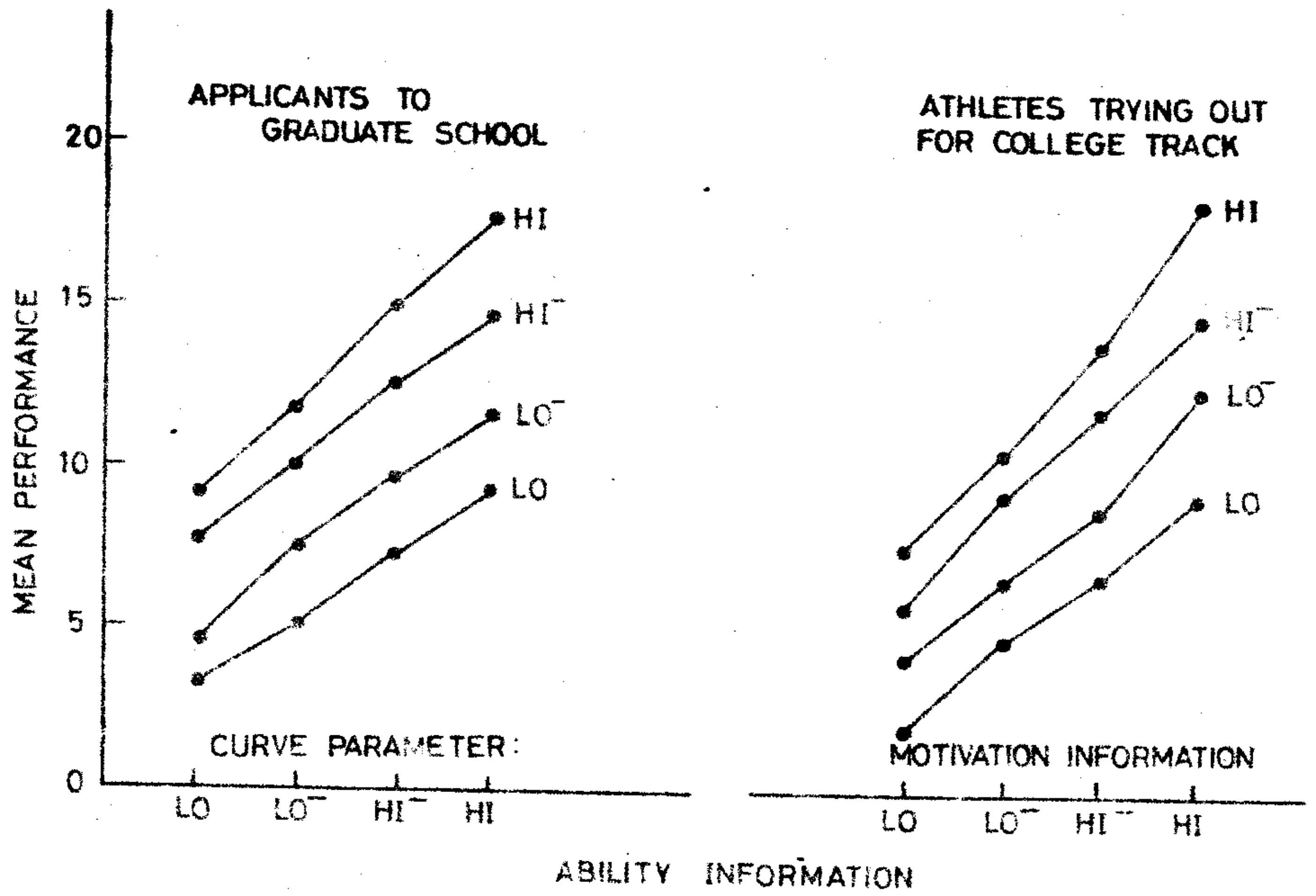
Figure 6. Mean prediction of performance as a function of past performance and motivation (upper part) and past performance and ability (lower part) for each of the five age groups. Data from Gupta & Singh, Note 2; Three-cue design, Figure 1. Copyright © 1980 Ramadhar Singh.

Figure 7. Mean prediction of performance as a function of motivation and ability information for each of the five age groups. The upper and lower sets of curves are from the three-cue and two-cue designs, respectively. Data from Gupta & Singh, Note 2; Figure 2. Copyright © 1980 Ramadhar Singh.

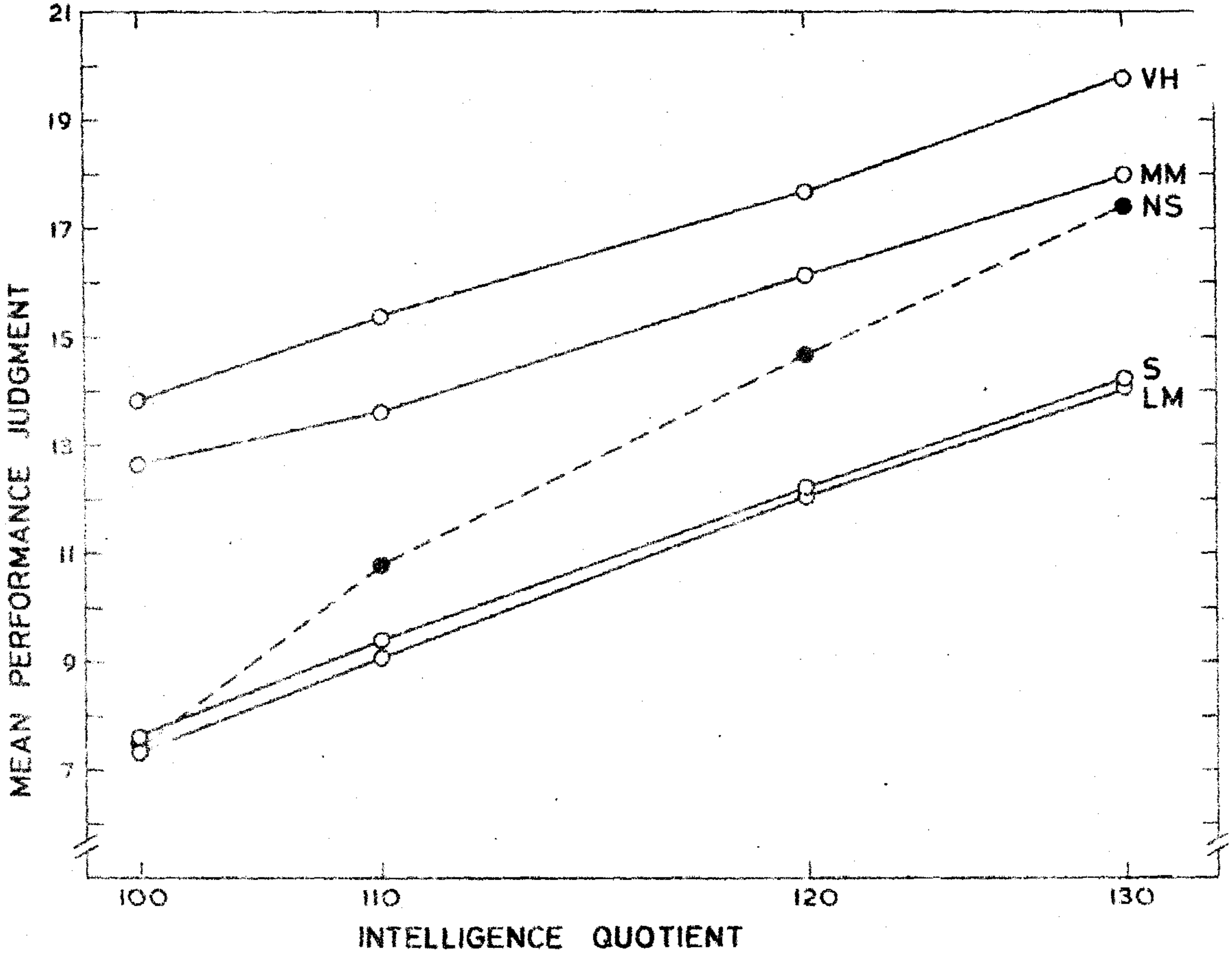
Figure 8. Distinguishing tests between alternative rules of information integration in prediction of performance at each of the five age levels. The upper sets of curves show how the subjects integrated information about ability (A), and Past Performance (P) with information about motivation (M). The lower sets of curves show how subjects integrated information about motivation and past performance with ability information. The curves connected by circles, by triangles, and by squares are based on the main effect of the factor listed on the horizontal axis in single -, two -, and three-cue designs, respectively. Data from Gupta & Singh, Note 2; Figure 3. Copyright © 1980 Ramadhar Singh.

Figure 9. Mean judgments of gift size from information about generosity and income of the donors. The diverging linear fan supports the multiplying rule. Data from Singh, Note 3. Copyright © 1980 Ramadhar Singh.

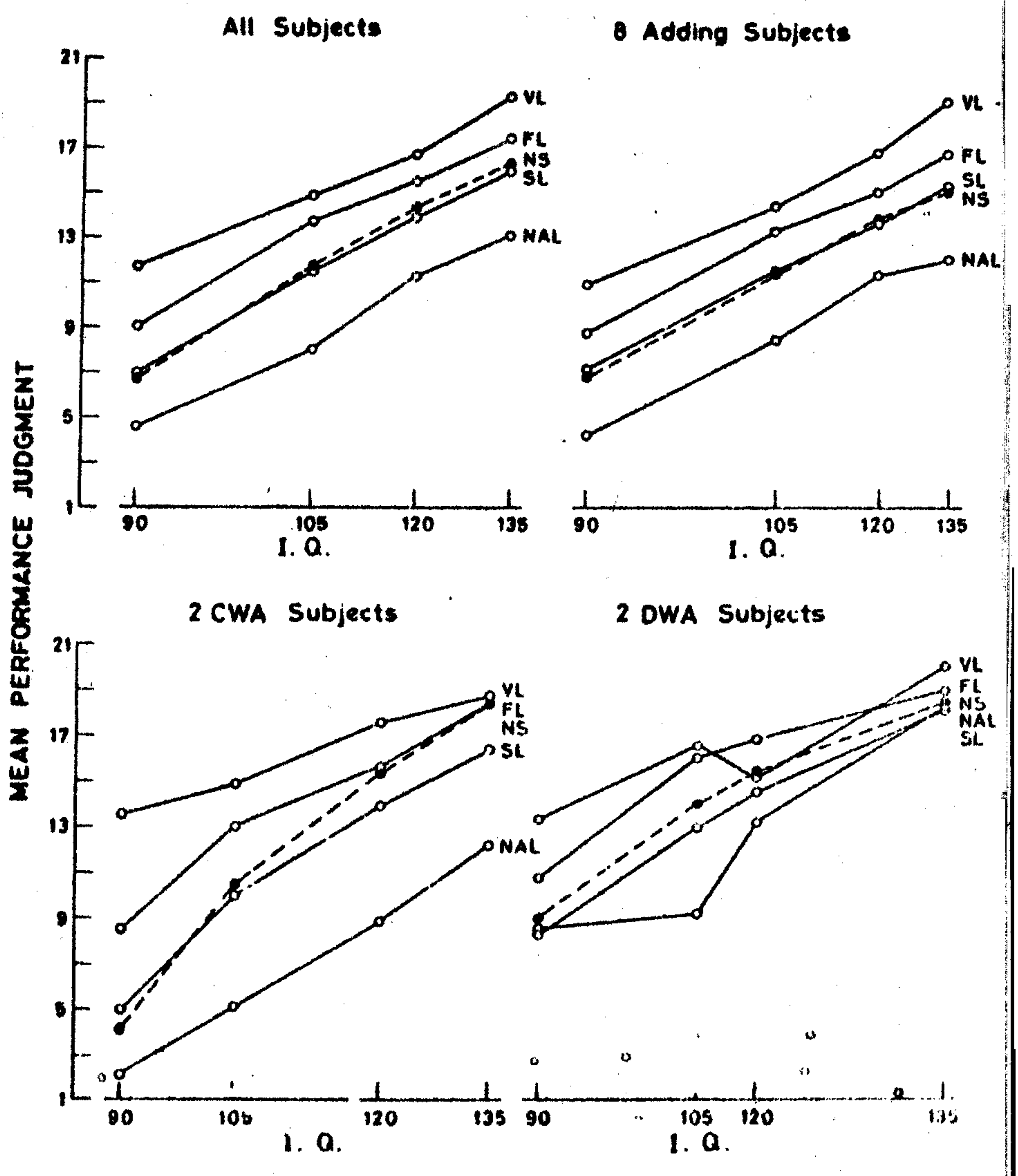
Figure 10. Mean judgments of influence as a function of salary and competence information. The dividing rule predicts a fan of lines converging to the right. Data from Singh, Note 4. Copyright © 1980 Ramadhar Singh.



APPLICANTS TO GRADUATE SCHOOL
ATHLETES TRYING OUT FOR COLLEGE TRACK
MEAN PERFORMANCE
0
5
10
15
20
HI
HI⁻
LO⁻
LO
CURVE PARAMETER:
MOTIVATION INFORMATION
LO
LO⁻
HI⁻
HI
ABILITY INFORMATION



MEAN PERFORMANCE JUDGMENT
21
19
17
15
13
11
9
7
100
110
120
130
INTELLIGENCE QUOTIENT
VH
MM
NS
S
LM


All Subjects
8 Adding Subjects
2 CWA Subjects
2 DWA Subjects
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I. Q.
VL
FL
NS
SL
NAL
21
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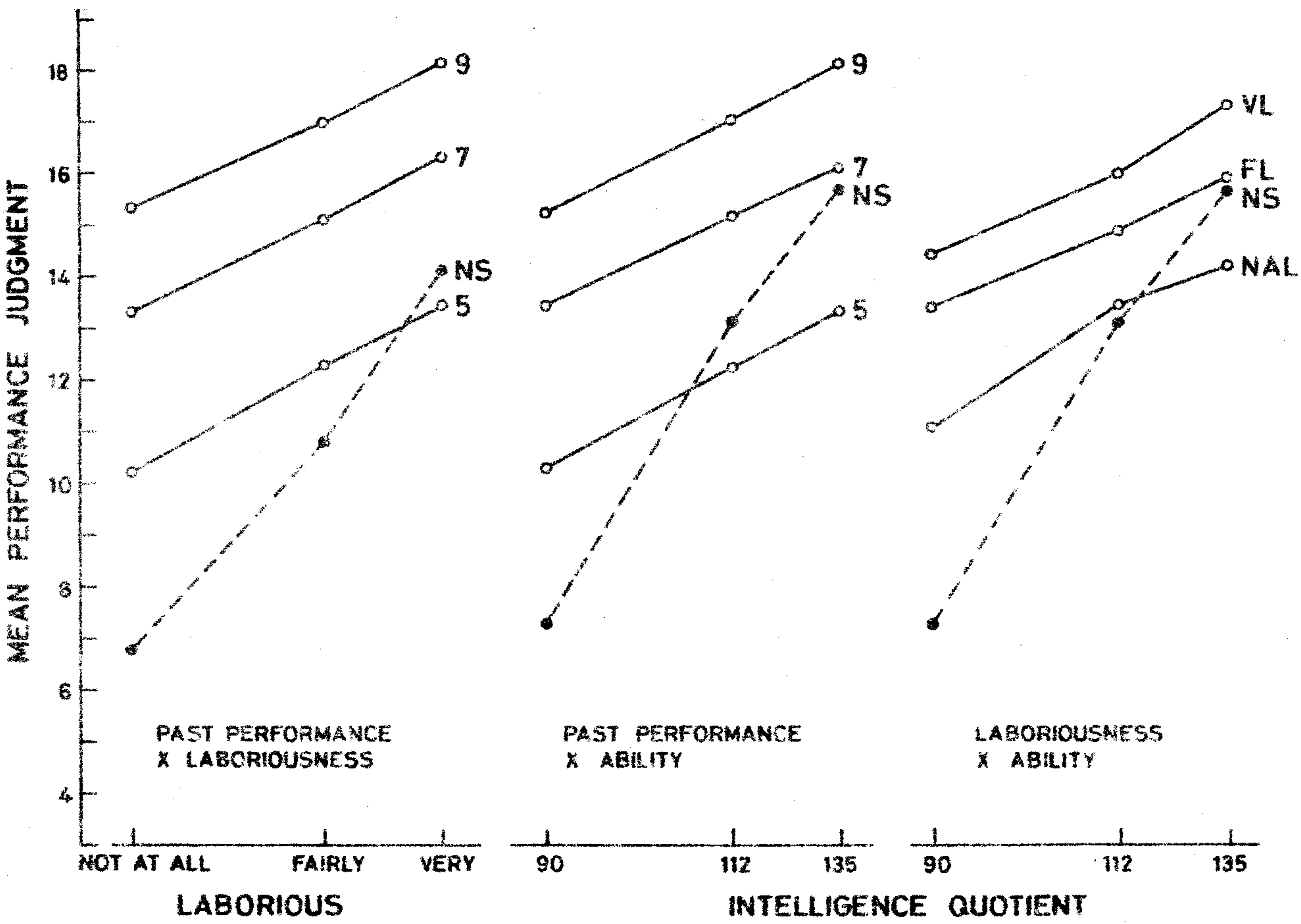
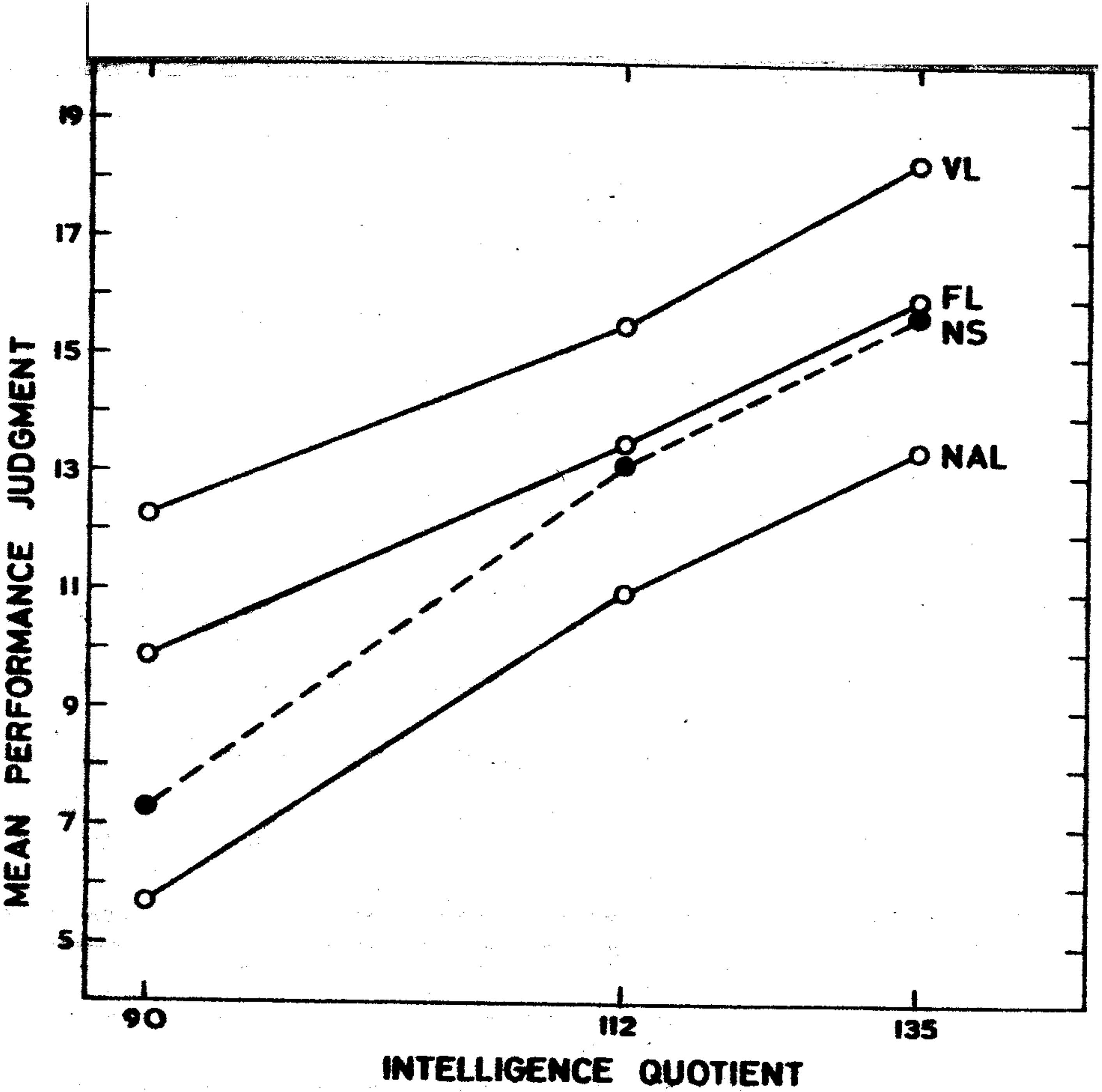
13
9
5
1
90
105
120
135



MEAN PERFORMANCE JUDGMENT
18
16
14
12
10
8
6
4
9
7
NS
5
PAST PERFORMANCE
X LABORIOUSNESS
NOT AT ALL
FAIRLY
VERY
LABORIOUS
9
7
NS
5
PAST PERFORMANCE
X ABILITY
90
112
135
VL
FL
NS
NAL
LABORIOUSNESS
X ABILITY
90
112
135
INTELLIGENCE QUOTIENT



VL
FL
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19
17
15
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MEAN PERFORMANCE JUDGMENT
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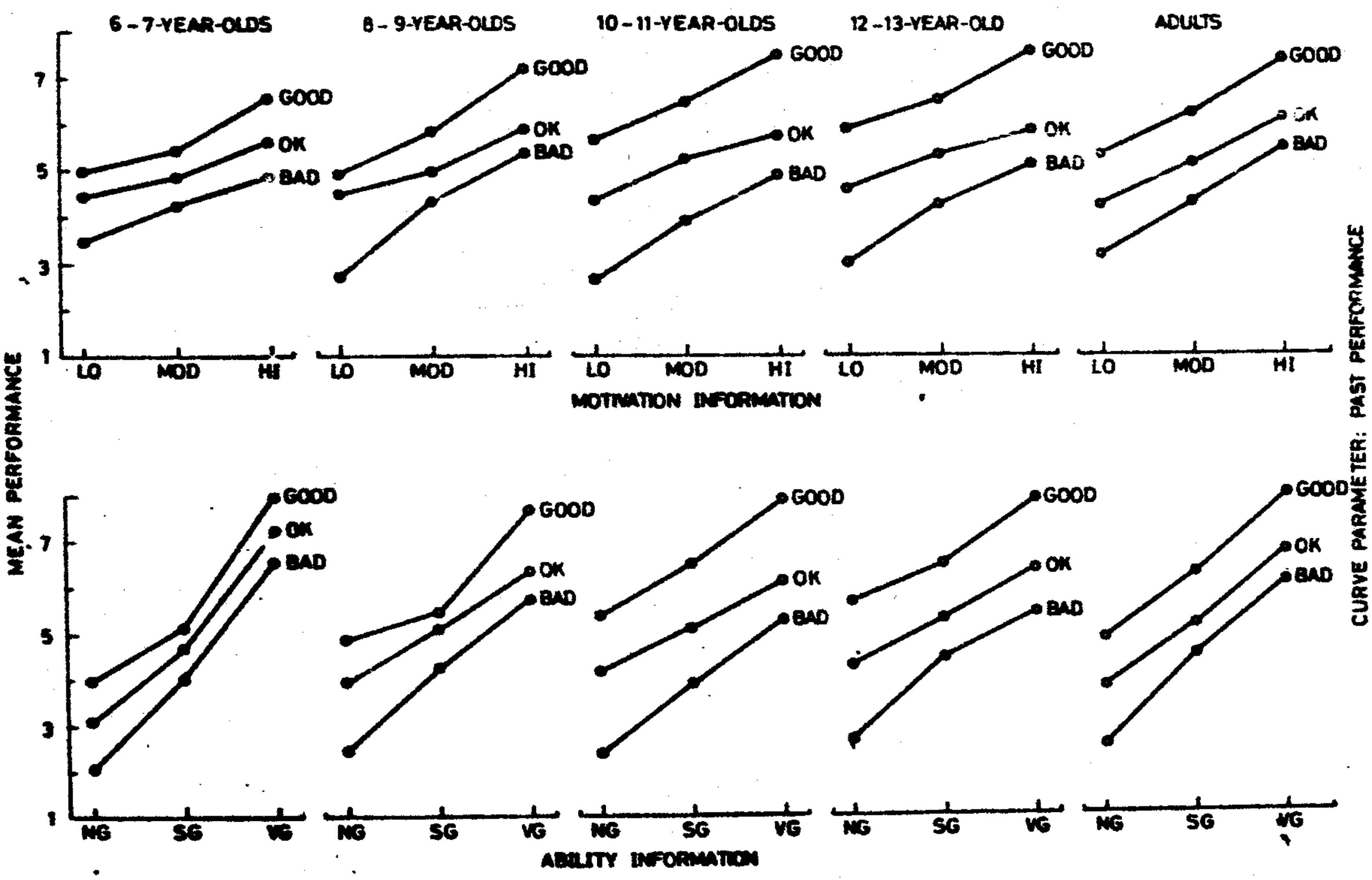
135
INTELLIGENCE QUOTIENT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8 - 9-YEAR-OLDS
10 - 11-YEAR-OLDS
12 - 13-YEAR-OLD
ADULTS
MEAN PERFORMANCE
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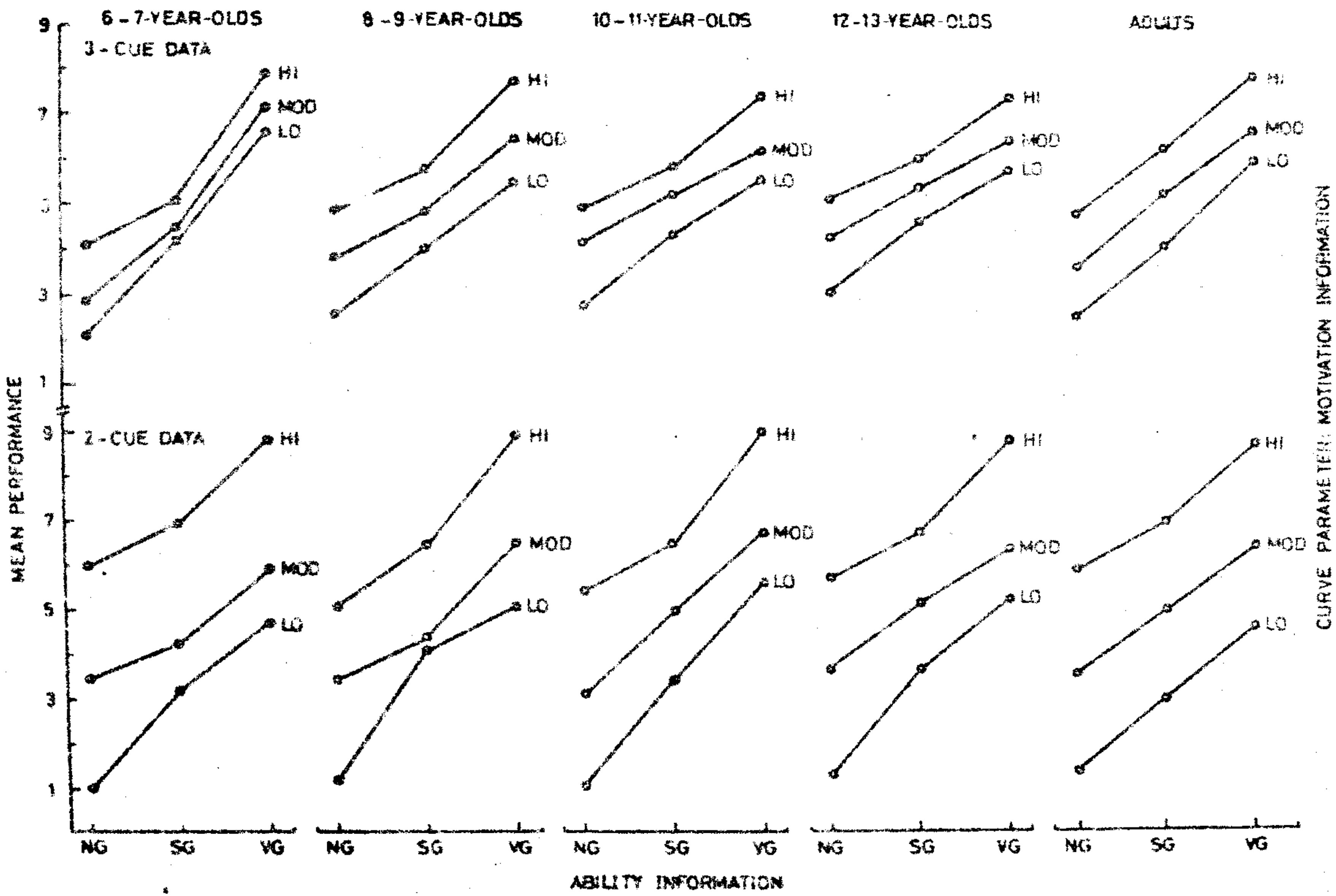
CURVE PARAMETER: PAST PERFORMANCE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ADULTS
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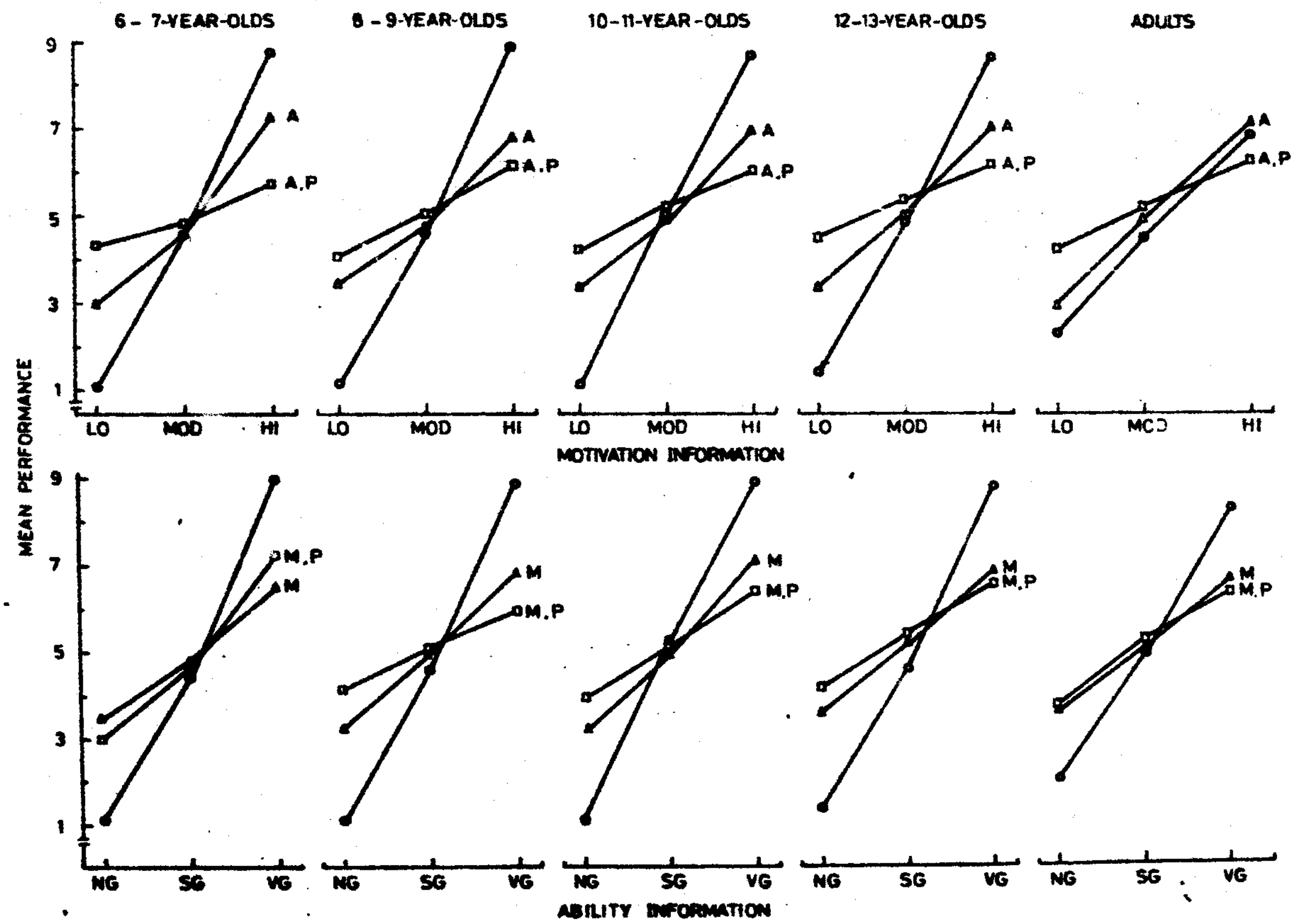
ABILITY INFORMATION
CURVE PARAMETER: MOTIVATION INFORMATION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8 - 9-YEAR-OLDS
10-11-YEAR-OLDS
12-13-YEAR-OLDS
ADULTS
MEAN PERFORMANCE
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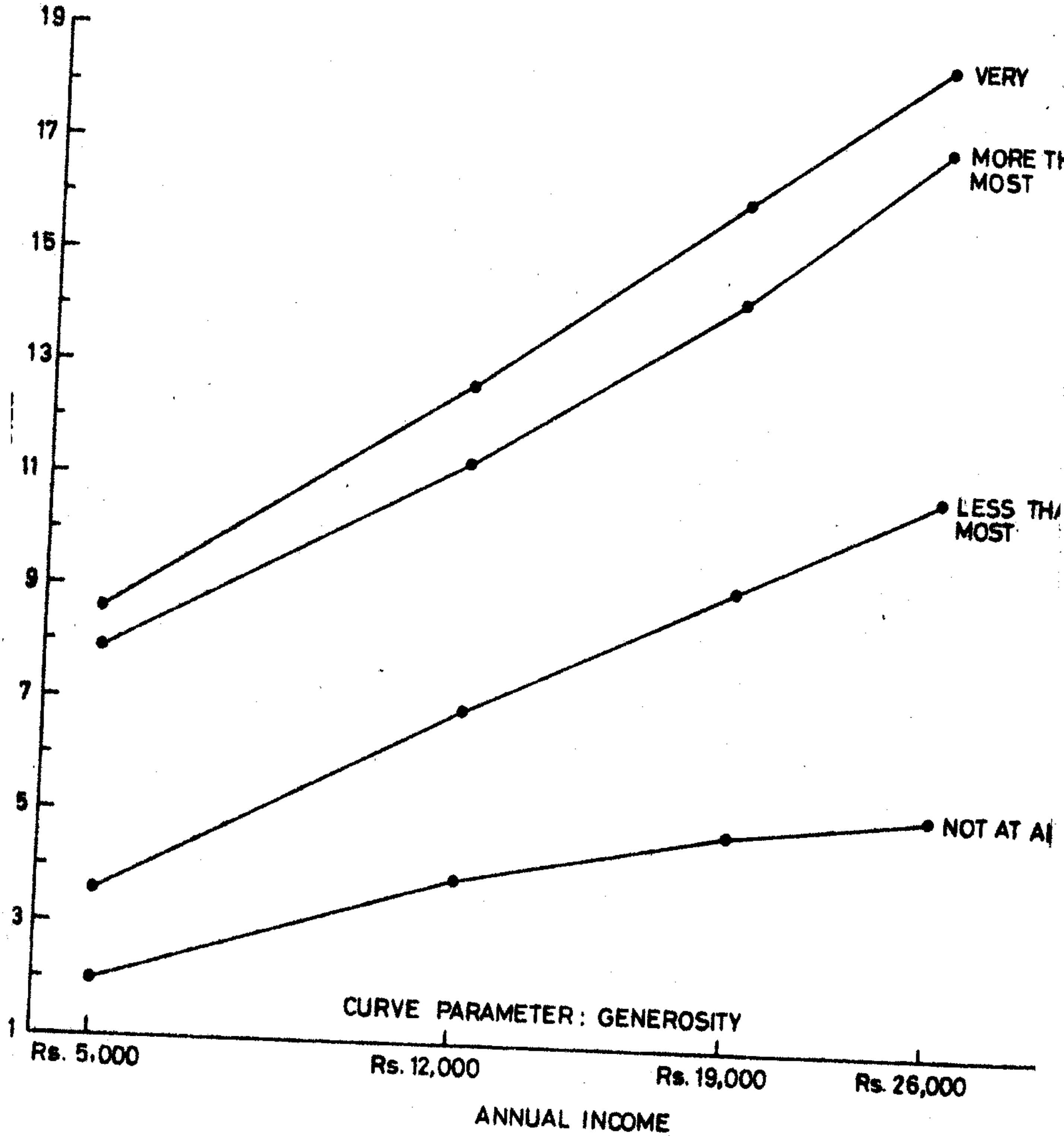
ABILITY INFORMATION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VERY
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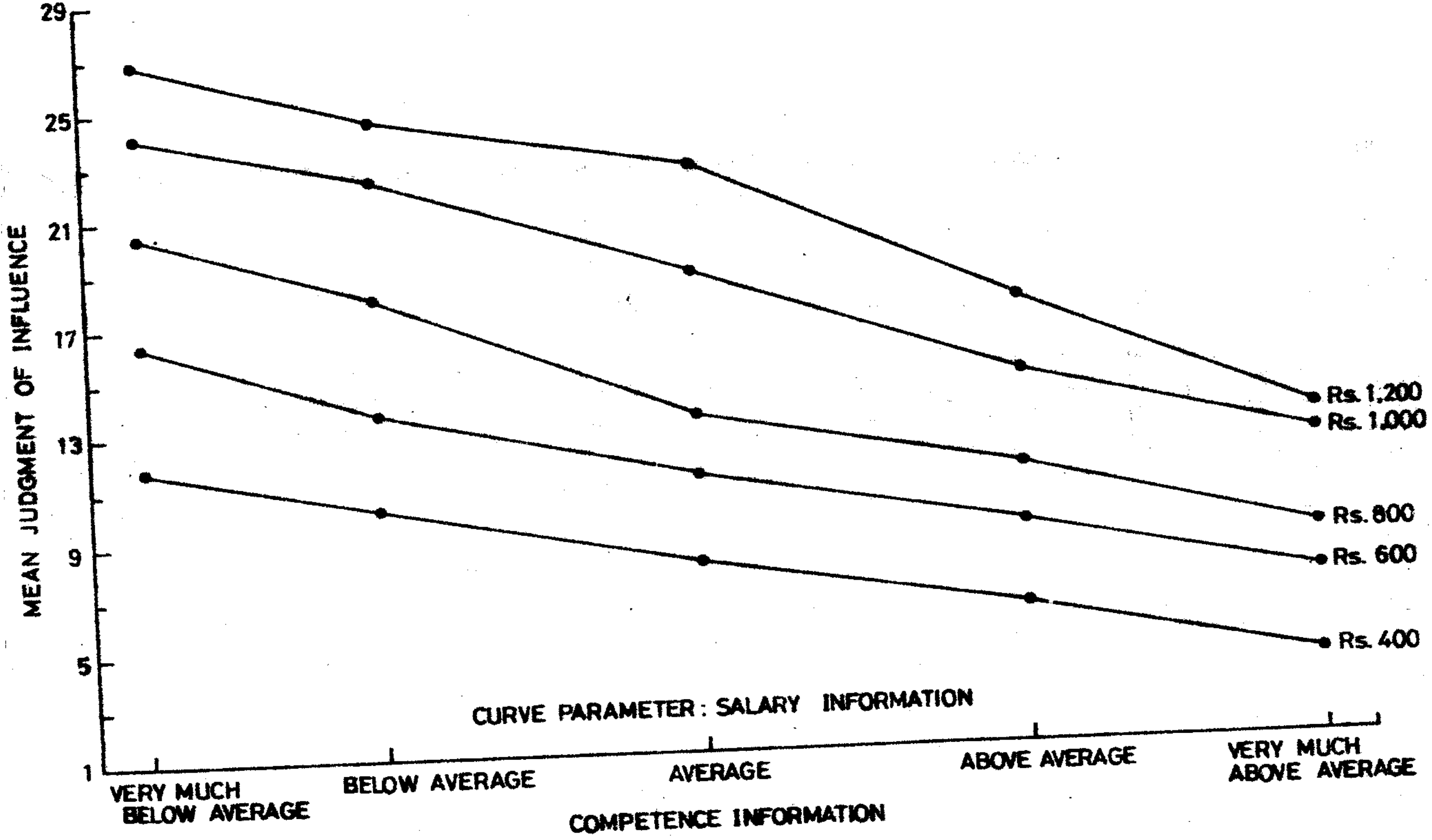
NOT AT A
CURVE PARAMETER: GENEROSITY
Rs. 5,000
Rs. 12,000
Rs. 19,000
Rs. 26,000
ANNUAL INCOME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25
21
17
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9
5
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Rs. 1,200
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Rs. 600
Rs. 400
CURVE PARAMETER : SALARY INFORMATION
VERY MUCH BELOW AVERAGE
BELOW AVERAGE
AVERAGE
ABOVE AVERAGE
VERY MUCH ABOVE AVERAGE
COMPETENCE INFORMATION