CULTURAL, DEVELOPMENTAL, AND TASK DIFFERENCES IN PREDICTION OF PERFORMANCE: AN INFORMATION INTEGRATION ANALYSIS

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W P No. 629

September 1986

INDIAN INSTITUTE OF MANAGEMENT
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Cultural, Developmental, and Task Differences in Prediction of Performance: An Information Integration Analysis

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Running Head: TASK PERFORMANCE

September 16, 1986

Abstract

Past research showed that Indian children average information about motivation and ability in prediction of performance. However, a multiplying-type rule develops from an adding-type rule in American children. The present research tested the hypothesis that integration rule depends upon age and culture of children and nature of task. Consistent with the hypothesis, Experiment 1 ($\underline{n}$ = 96) obtained evidence for no difference between children of fourth and eighth grades in prediction of performance in puzzle contest but for development of an adding-type rule from a multiplying-type rule in prediction of performance in singing contest. As the latter finding was surprising, Experiment 2 ($\underline{n}$ = 144) studied kindergarten through eleventh grade children. Results indicated that a multiplying-type rule evolves out of an adding-type rule but gets replaced by the adding-type rule during sixth and seventh grades. Of the three interpretations, namely, changes in weight of information, changes in integration rule, and changes in response reproduction processes, of the age differences, the first one seemed to be the most parsimonious.

How do children integrate information about motivation and ability of a child when they predict his or her performance? Research by Kun, Parsons, and Ruble (1974) and by Surber (1980) show that integration rules depend upon the age of children. Younger children (5-6 years) follow an adding-type rule, whereas children of second and onward grades follow a multiplying-type rule. Contrary to these American results, prediction of performance by Indian children indicated no age-trend at all. Kindergarten children to undergraduate college students all employed the same adding-type rule (Gupta & Singh, 1981; Srivastava & Singh, 1986).

Two hypotheses may be proposed to account for the discrepancy between results of the American and Indian studies. The first hypothesis is of a cultural difference between Americans and Indians in their outlook on how motivation and ability determine performance (Singh, 1981; Singh & Bhargava, 1985; Singh, Gupta, & Dalal, 1979). The multiplying-type rule for Americans reflects on their elitist belief that effort or trying is more effective with persons of high than of low ability. In contrast, the adding-type rule for Indians reflects on their egalitarian belief that effort or trying is equally effective with persons of low and high ability.

The plausibility of the above hypothesis is suggested by two lines of evidence in the literature on social cognition. First, Americans and Indians differ in their causal explanations (Miller, 1984) and value systems (Murphy-Berman, Berman, Singh, Pachauri, & Kumar, 1984). Those differences arise from a basic difference in the importance they assign to individualism and collectivism in social behaviors (Hofstede, 1980). The multiplying-type rule for

Americans and the adding-type rule for Indians may be reflective of their respective individualistic and collectivistic orientations (Singh & Bhargava, 1985).

Second, evidence has been accumulating that Americans generally employ multiplying rule in prediction of performance (Anderson, 1983; Anderson & Butzin, 1974; Kun et al., 1974; Surber, 1980), whereas Indians uniformly employ the constant-weight averaging rule (Gupta & Singh, 1981; Singh et al., 1979; Srivastava & Singh, 1986). Even manipulations of task difficulty (Singh & Bhargava, 1985) and of information reliability (Singh & Bhargava, 1986) do not yield results identical to those of American studies (Surber, 1981a, 1981b). This indicates that prediction of performance is perhaps susceptible to cultural influences.

It should be noted that all Indian studies cited above were confined to prediction of exam performance. But the American studies considered both academic and nonacademic tasks. Fluctuations from the linear fan pattern prescribed by the multiplying rule (Anderson, 1983; Anderson & Butzin, 1974) were observed with academic tasks (Surber, 1978, 1981a, 1981b, 1985a) and not with nonacademic tasks of puzzle-solving (Kun et al., 1974) or weight-lifting (Surber, 1980). This raises the possibility that the nature of task may perhaps be an alternative to the hypothesis of cultural difference mentioned earlier.

Two kinds of evidence argue for this second hypothesis of nature of task (Singh & Bhargava, 1985; Surber, 1984a, 1984b). First, Surber (1978) found the linear fan pattern in prediction of performance in a weight-lifting contest but the convergence pattern in prediction of performance in a math test of elementary school with a group of American subjects. Second, Indian subjects from the same population of post-graduate students of management followed the constant-weight averaging rule in prediction of exam performance (Singh & Bhargava, 1985, 1986) but the multiplying rule in prediction of life performance (Singh, 1986; Singh, Bhargava, & Norman, 1986).

The linear fan pattern in the Motivation x Ability effect on life performance does not, however, seem to be a simple task effect. Bhargava (1983) repeated Experiment 1 of Singh et al. (1986) on children of fifth, seventh, ninth, and eleventh grade of a school and on undergraduate and postgraduate students of business administration. He found evidence for the multiplying rule only at the level of postgraduate students, a group comparable to the one used in Singh et al. (1986). Subjects from other age groups followed the constant-weight averaging rule as required by the cultural difference hypothesis (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Singh et al., 1979). It is interesting that the linear fan pattern is present in judgments of 8-and-9-year-olds in the United States (Kun et al., 1974; Surber, 1980) but of 20-year-olds in India. Bhargava concluded, therefore, that cognitive algebra of task performance depends upon age and culture of subjects as well as nature of task.

If this hypothesis of interaction between nature of tasks and characteristics (age and culture) of judges is correct, then the fan pattern in Motivation x Ability effect is not necessarily a characteristic of 20-year-olds (Bhargava, 1983) but can also be obtained with younger children in India.

The main purpose of the present research was to test this interactional hypothesis by using nonacademic tasks.

Experiment 1

Experiment 1 studied prediction of performance in the puzzle and singing contests with children of fourth and eighth grades. As prediction of performance in nonacademic tasks by children of second (Kun et al., 1974) and third (Surber, 1980) grades in the United States conform to the linear fan pattern, the same pattern in predictions by those two groups of slightly older children can be expected from the hypothesis of nature of task (Singh & Bhargava, 1985; Surber, 1984a, 1985b).

The first task of prediction of performance in puzzle contest was comparable to that of Kun et al. (1974). So it allowed a direct test of the hypothesis of cultural difference (Bhargava, 1983; Gupta & Singh, 1981; Singh & Bhargava, 1985; Singh et al., 1979). If the cognitive algebra of task performance is culture-specific at younger ages, then the Motivation x Ability effect on prediction of performance in puzzle contest would also exhibit the parallelism pattern required by the constant-weight averaging rule.

The second task of prediction of performance in singing contest was completely new. It has not been studied so far. But this is one task in which both motivation and ability are necessary: Trying or rehearsal cannot be expected to compensate for lack of singing ability. It was hypothesized, therefore, that prediction of performance in singing contest may obey the multiplying rule.

Method

Stimuli and designs. Stimulus children were 10-year-olds who were to participate in either a puzzle or singing contest to be organized in the school. They were described with respect to their motivation and ability. Each type of information was shown by a series of seven vertical bars. The bars had width of 1 cm but varied in height from 1 to 7 cm.

Motivation of the stimulus student was described by the number of days of prior preparation for participation in the context. It ranged from 1 to 7 days, and came from the mother of the stimulus student. The ability to solve puzzle was described by the opinion of a math teacher who had known the student very well. The teacher indicated how good the student was in problem- and puzzle-solving. Ability to sing was described by the opinion of a music teacher based on the clarity, sweetness, and tenderness of voice of the stimulus student.

Profiles of nine stimulus students were prepared according to a 3 x 3 (Motivation x Ability) factorial design. The three levels of the two factors were second, fourth and sixth vertical bars from the series of seven vertical bars. The levels of motivation and ability of a stimulus student were indicated by marks in the appropriate vertical bars.

Five practice examples were also constructed. Four examples were based on extreme levels of motivation and ability, and they were intended to serve as end anchors (Anderson, 1981). One example was taken from the set of main stimuli. These practice examples and one additional filler profile were also presented along with the main set of nine stimuli during data collection.

Profiles of the stimulus students were presented in a 20-page booklet. The first five pages consisted of five practice examples in a randomized order. The remaining fifteen pages of the booklet had profiles of the nine main stimulus students, five practice examples, and one filler description. These profiles had new identification number between 1-15.

Procedure. Each child completed the judgmental task individually in a small room of the school. The same female experimenter collected data from all the 96 subjects. The moment the subject entered the experimental room, the experimenter gave her name, asked subject's name, and appreciated its attractiveness. All conversations were in Hindi.

The experimental task was presented to the subject as one dealing with prediction of performance of some unidentified same-sex 10-year-old students who were to participate in a puzzle or singing contest in their school. It was emphasized that each participant would be described with respect to their number of days of prior preparation or rehearsal for the contest as well as capacity to solve puzzles or sing. To illustrate the highest level of singing capability, the experimenter reminded the subject of two currently most popular songs by one female and one male famous playback singer from the Indian movies.

The measure of contest performance was a 21-step ladder which had digits 1-21 written on the corresponding steps. The experimenter placed a copy of the ladder in front of the subject and trained him or her to use the entire ladder. She described the bottom most step as poorest performance, the top most step as excellent performance, and other steps as performance denoting intermediate levels. She demonstrated the use of ladder by asking 10 different questions. Subjects were able to use the response measure without any difficulty.

To make the task clear and meaningful, the experimenter asked the subject to work with the practice examples of the experimental booklet. The subject looked at the levels of motivation and ability present in the stimulus contestant, and indicated his or her expected performance from the stimulus student by pointing out at one of the 21 steps of the ladder.

After the practice session, the main points of the instructions and definitions of motivation and ability were summarized by the experimenter. She answered all the queries of the subject, and asked him or her to judge the remaining 15 profiles of the booklet one by one. After all stimulus children of the first booklet were rated, two other 15-page booklets which had profiles of the very same 15 stimulus students presented in different shuffled orders were given. Subject rated the 30 stimulus students of these two booklets also one by one without referring back to previous judgments. The orders of presentation of the two kinds of information in student's description were balanced over equal number of subjects of each group.

Immediately after data collection, the experimenter gave five toffees and five balloons to the subject for his or her cooperation in the experiment. She also expressed here gratitude to the subject and thanked him or her.

For data analyses, 21 steps of the ladder were treated as a rating scale corresponding to digits 1 to 21. Ratings of the stimulus persons of the first booklet were regarded as additional practice for the subject just as in the past work (Gupta & Singh, 1981; Singh, Sidana, & Saluja, 1978; Singh, Sidana, & Srivastava, 1978; Srivastava & Singh, 1986). Only the ratings from the second and third booklets were coded and analyzed.

Subjects. Ninety-six children from the Central School, Shahibaug, Ahmedabad, Gujarat, India served as subjects. They were selected to complete 16 cells of a 2 x 2 x 2 x 2 design, having standard of subjects (Standard IV versus Standard VIII), nature of task (puzzle versus singing contest), sex of subjects (male versus female), and order of presentation of information (motivation-ability order versus ability-motivation order) as factors. There were six subjects in each of these 16 cells. The mean ages for the children of Standard IV ($n = 48$) and VIII ($n = 48$) were 9 years 7 months and 13 years 6 months, with respective ranges of 8 years 7 months to 10 years 2 months and 12 years 8 months to 14 years 4 months.

Results

Group analyses. Results indicated that the hypothesis of interaction between nature of task and age and culture of subjects can account for the variations in cognitive algebra of task performance. This can be seen from Figure 1 which presents mean judgments of performance in puzzle and singing contests by children of Standard IV and VIII as a function of motivation (curve parameter) and ability of stimulus students. The levels of ability factor are spaced on the horizontal axis according to their marginal means in the factorial design as prescribed by information integration theory (Anderson, 1980).

Figure 1 about here

It is quite evident from Figure 1 that prediction of performance in both the puzzle and singing contests undergo different kinds of developmental changes. Whereas prediction of performance in puzzle contest by children of

Standard IV evince a pattern of parallelism (left-most graph), those by children of Standard VIII evince a pattern of convergence (second graph from left). In contrast, prediction of performance in singing contest by children of Standard IV show a pattern of divergence (third graph from left),but those by children of Standard VIII show a pattern of parallelism (right-most graph).

The above interpretations were supported by statistical analyses as well. The three-way, Standard x Motivation x Ability effect was statistically significant in prediction of performance in both the puzzle and singing contests, $\underline{F}$ (4, 160) = 2.55 and 10.42. The overall four-way, Task x Standard x Motivation x Ability effect was also significant, $\underline{F}$ (4, 320) = 2.74, $\underline{p} < .05$.

In addition, Shanteau's (1977) POLYLIN analyses disclosed that the left-most and right-most graphs of Figure 1 indeed have perfect parallelism, for none of the four trend components, namely, Linear x Linear, Linear x Quadratic, Quadratic x Linear, and Quadratic x Quadratic, was present in the Motivation x Ability effect. The convergence pattern in the second graph from left was supported by the presence of the Linear x Linear trend, $\underline{F}$ (1, 23) = 7.61, $\underline{p} < .01$, and absence of the remaining three trends, $\underline{F}$ (1, 23) = 3.99, 0.36, and 0.01. However, the linear fan pattern was not perfect in the third graph. An exact fan pattern requires that the entire Motivation x Ability effect reside in just the Linear x Linear trend. But both the Linear x Linear and Linear x Quadratic trends were present, $\underline{F}$ (1, 23) = 150.42 and and 15.06, $\underline{p} < .01$. As the Linear x Linear component is substantial, it may be said that prediction of performance in singing contest by children of Standard IV can best be represented by a multiplying-type rule.

The overall trend displayed in Figure 1 was readily generalizable across male and female subjects as well as orders of presentation of motivation and ability information. These two factors or their combinations did not moderate Motivation x Ability, Task x Motivation x Ability, Standard x Motivation x Ability, or Task x Standard x Motivation x Ability effect at all.

Individual subject analyses. Separate analyses were made for each of the 96 subjects (Shanteau & Anderson, 1969; Singh, 1986; Singh et al., 1979) to obtain further support for the interpretations made earlier. In those analyses, main effects of motivation and ability information from analysis of variance and four trend components in the Motivation x Ability effect from POLYLIN were considered. The error term for tests of trend components came from analysis of variance of each individual subject. When the mean error variance of a subject was zero, the average of the mean error variance of the 24 subjects of the age-task group to which the subject belonged was used as error term.

These two analyses at the level of individual subject disclosed that subjects adopted five different strategies in prediction of contest performance. First, 17.71% of subjects used just one of the two given pieces of information. Second, 32.29% of subjects used an adding-type rule, for they had two significant main effects and all four nonsignificant trend components in the Motivation x Ability effect. Third, 10.42% of subjects followed a multiplying-type rule, for they had two significant main effects and their Motivation x Ability effect concentrated in just the Linear x Linear trend.

Fourth, 1% subject followed an inverted multiplying rule. He had all statistical properties of a multiplying rule but convergence instead of divergence pattern. Finally, 38.54% of subjects employed rules other than adding and multiplying. They had at least one higher-order trend component in their Motivation x Ability effect which made their prediction irregular with the requirements of the hypothesized adding and multiplying models.

Table 1 about here

Table 1 presents the number of children from Standard IV and VIII who followed different rules in prediction of performance in puzzle and singing contests. Four aspects of the results are notable. First, the developmental change in prediction of performance in puzzle contest detected by group analysis is not corroborated by the individual subject analyses. It seems that children of Standards IV and VIII followed nearly the same strategy. Perhaps their prediction may be represented by a simple adding-type rule found in previous work (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Singh et al., 1979). This result agrees with the cultural difference hypothesis but disagrees with the hypothesis of nature of task (Singh & Bhargava, 1985; Surber, 1984a, 1985b).

Second, there is a developmental change in prediction of performance in singing contest. Nine children (37.5%) of Standard IV followed a multiplying-type rule, whereas none of the 24 children of Standard VIII followed this rule. Interestingly, nine children (37.5%) of Standard VIII obeyed an ability-only rule. The developmental change in this task thus appears to be from a multiplying-type rule to ability-only rule. This result is in sharp contrast of the age-trends in prediction of performance in nonacademic tasks found by Kun et al. (1974) and by Surber (1980) with American children.

Third, the ability-only rule was employed by five children (20.83%) of Standard IV in prediction of performance in puzzle contest and by nine children (37.5%) of Standard VIII in prediction of performance in singing contest. These results cast serious doubt on the plausibility of the thesis that the number of significant main effects in individual child analysis denotes integrational capacity of children (Anderson, 1980; Anderson & Butzin, 1978). However, they appear to favor the interpretation that main effects reflect on relevance of cues for judgment (Singh, 1982; Srivastava & Singh, 1986).

Finally, approximately 37.5% of subjects of each of the four groups adopted a strategy which was irregular with the specifications of both the adding and multiplying rules. Some subjects made mistakes in distinguishing between different combinations of information pertaining to motivation and ability of stimulus students but others indicated an altogether different causal schema. This is evident in Figure 2 which exhibits profiles of Motivation x Ability effect for eight such subjects. Data from two subjects having common statistical properties from Standards IV and VIII of the puzzle and singing contests are shown to illustrate these points.

Figure 2 about here

Look at the profiles of Subject Nos. 7 and 9 of Standard IV and Subject Nos. 7 and 18 of Standard VIII in singing contest (four right-side graphs) and Subject No. 17 of Standard IV in puzzle condition (second bottom graph from left). They all appear to have erred in ratings of one or two combinations of motivation and ability information. On the contrary, Subject Nos. 15 and 16 of Standard VIII and Subject No. 12 of Standard IV in puzzle contest seem to have a different belief: Motivation is most effective when ability is moderate.

Not much importance can be given to the individual strategies of these subjects. Nevertheless, the strategies that they adopted call attention to the need to consider individual differences along with age differences in developmental research (Leon, 1980, 1982; Surber, 1984a, 1985b).

Discussion

The main finding of the present experiment is that cognitive algebra of task performance depends upon nature of task as well as age of children. Whereas prediction of performance in puzzle contest by children of both Standard IV and VIII were consistent with the adding-type rule, prediction of performance in singing contest disclosed a developmental shift. The shift arose primarily because nine fourth graders followed a multiplying-type rule but the same number of eighth graders followed the ability-only rule.

Although the hypothesis of interaction between nature of task and age of subjects can account for the results of the present experiment as well as of past research in India (e.g., Gupta & Singh, 1981; Srivastava & Singh, 1986), it cannot account for all the extant literature. For example, absence of fan pattern in prediction of performance in puzzle contest is highly inconsistent with the result of Kun et al. (1974). Similarly, the shift from a multiplying-type rule to the ability-only rule in prediction of performance in singing contest is in sharp contrast with the American finding that the multiplying rule evolves out of the adding rule around the age of 7 or 8 years (Kun et al., 1974; Surber, 1980). All these results in children's judgments cannot be explained without taking cultural factors into consideration.

The finding of multiplying-type rule in prediction of performance in singing contest with nine fourth graders is the first demonstration of the linear fan pattern with Indian children. Its reliability thus needs to be checked. No less important, the developmental shift from a multiplying-type rule to an adding-type rule or an ability-only rule is counter-intuitive as well as inconsistent with literature on development of social cognition (Surber, 1984a, 1985b). Therefore, replication of results was considered to be necessary.

Experiment 2

The main purpose of Experiment 2 was to replicate and extend the results of Experiment 1 pertaining to prediction of performance in singing contest. Children from six age groups, beginning kindergarten to eleventh grade, were used in order to trace developmental shifts in prediction of performance in singing contest.

Method

Stimuli, design, and procedure. The stimuli, design, and procedure were exactly the same as in the previous experiment. The only notable change was that the subject was urged to use information about both the motivation and ability of the stimulus student. In fact, the experimenter checked five practice examples of the subject to ensure that he or she used both types of information in prediction of performance.

Each subject received detailed instructions, worked on practice examples, and then rated profiles of three different booklets. After the third trial of judgments, each subject received five balloons, five toffees, and thanks from the experimenter. In general, kindergarten children took much more time in completing the task than did other five groups of children.

Subjects. The subjects consisted of 144 children. The kindergarten children were from the Thumbelina Nursery and Kindergarten School, Narayanpura, Ahmedabad, Gujarat, India. Children of Standards II, IV, VI, VIII, and XI were from the same population as in Experiment 1.

There were 12 boys and 12 girls in each age group. Mean ages for the six groups of children were 4 years 6 months, 6 years 6 months, 8 years 7 months, 10 years 8 months, 12 years 8 months, and 15 years 7 months with respective ranges of 4 years 2 months to 5 years 4 months, 5 years 11 months to 7 years 3 months, 7 years 10 months to 9 years 4 months, 9 years 11 months to 11 years 8 months, 12 years 3 months to 13 years 7 months, and 14 years 9 months to 17 years 2 months.

Results and Discussion

Group analyses. Results basically confirmed the developmental change from multiplying-type to adding-type rule found in Experiment 1. Kindergarten through sixth standard children employed a multiplying-type rule; those of eighth and eleventh standards employed an adding-type rule.

These results are quite evident in Figure 3. The three bottom graphs and the top left graph are for kindergarten through sixth standard children.

All the four graphs show a similar divergence toward right. The center and right graphs in the top of Figure 3 are for eighth and eleventh standard children, respectively. Both graphs have a clear pattern of parallelism. Such a change in the pattern displayed by the six Motivation x Ability effects indicates that an adding-type rule in fact develops out of a multiplying-type rule in prediction of performance in singing contest.

Figure 3 about here

The developmental change shown in Figure 3 was also supported by statistical analyses. If the six graphs differ in their pattern, then the Standard x Motivation x Ability effect should be statistically significant in the analysis of variance. This three-way interaction was indeed significant, F (20, 480) = 9.51, $p < .01$. Further analyses indicated that judgments by kindergarten through sixth standard children had similar fan pattern, F (12, 320) = 1.27, and those by eighth and eleventh standard children had similar parallelism pattern, F (4, 160) = 1.08. This indicates that the developmental shift from the divergence pattern to the parallelism pattern takes place around Standard VII, that is, the end of middle school.

The foregoing results were readily generalizable to the sex of subjects and order of presentation of motivation and ability information. These two factors or their combination did not moderate the Motivation x Ability effect in either the overall analysis of variance or the separate analysis of variance for each of the six groups of subjects.

<u>Model analyses</u>. Results from POLYLIN analyses of the Motivation x Ability effect for each of the six groups of children are listed in Table 2. Three trends are evident. First, judgments by children of Standards II and IV conform to the precise requirements of the linear fan pattern. The Linear x Linear trend is highly significant in each case, whereas the other three trends are nonsignificant. Second, judgments by children of Standards VIII and XI have a perfect pattern of parallelism, for none of the four trend components is significant in either group. Finally, judgments by kindergarten and sixth standard children have a strong Linear x Linear trend along with a weak Quadratic x Linear trends. Therefore, the bottom and top graphs on the left side of Figure 3 cannot be regarded as an exact fan pattern.

Table 2 about here

The above interpretations also received support from the individual subject analyses. The classification of subjects of the six age groups according to the rule they followed is shown in Table 3. It can be seen that the majority of the children from Standards II and IV followed a multiplying-type rule, whereas the majority of the eighth and eleventh standard children followed an adding-type rule. The number of children from kindergarten and sixth standard who followed a multiplying-type rule is relatively less as if children of these two groups were in a transition stage. It is also notable that the emphasis that both types of information be used in prediction of performance has eliminated usage of the ability-only rule by children of Standard VIII.

Table 3 about here

What stands out most clearly from the quantitative analyses just mentioned is that the integration rule underlying prediction of performance in singing contest undergoes several developmental changes. Perhaps children younger than kindergarten as well as high school students follow an adding-type model. Kindergarten children are in a stage of transition from adding-type to multiplying-type model, whereas sixth standard children are in a stage of transition from a multiplying-type to adding-type model. Only second and fourth standard children follow a really multiplying-type model.

Irregular models. Table 3 shows that 28.47% of the total subjects followed models which were irregular with the hypothesized adding-type and multiplying-type models. Kindergarten (50%) and eleventh standard (37.5%) groups had slightly greater number of such subjects than the other four groups. Did these children have different views on how motivation and ability determine singing performance?

Figure 4 presents profiles of Motivation x Ability effects from three kindergarten and three eleventh standard children who had comparable statistical properties in POLYLIN analyses. What is most striking is that there is not only an obvious age effect (i.e., differences between top and bottom graphs) but also a marked difference between subjects at each age level. In fact, the six subjects seem to think in six different ways.

Figure 4 about here

Let us examine their causal reasonings. Subject No. 17 thinks that motivation is more effective with a person of low than of moderate or high singing ability. In contrast, Subject No. 21 thinks that motivation is less effective with a person of low than of moderate or high singing ability. Subject No. 3 believes that the effectiveness of motivation is about the same at the low and moderate levels of ability but less when ability is high. He also appears to have assumed that the singing ability manifests itself most with moderate practice or rehearsal. Subject No. 4 believes that motivation is least effective when singing ability is moderate. On the contrary, both Subject Nos. 8 and 20 think that motivation is most effective when singing ability is moderate. However, they differ in their views on effectiveness of motivation at the low and high levels of ability. Whereas Subject No. 20 feels that motivation is more effective with a child of low than of high singing ability, Subject No. 8 feels exactly the opposite.

The above interpretations of the causal reasonings followed by the six subjects suggest that information about motivation and ability of a singer are handled in many other ways than the prescriptions of the adding and multiplying models. May be these subjects employed different versions of the general averaging model (Anderson & Butzin, 1974, p. 602; Gupta & Singh, 1981; Singh & Bhargava, 1986; Singh et al., 1979; Srivastava & Singh, 1986; Surber, 1980, 1981a, 1981b, 1985a). Accordingly, individual differences in predictive models (Norman & Singh, 1986; Singh, 1986) should be a subject of interest to developmental psychologists also (Surber, 1985b).

General Discussion

Findings and Implications

There are two main findings of the present research. First, prediction of performance in puzzle contest shows no age-trend at all just as does prediction of exam performance (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Srivastava & Singh, 1986). This result disagrees with that of Kun et al. (1974). Furthermore, it questions the hypothesis of nature of task (Singh & Bhargava, 1985; Surber, 1984a, 1985b) as an explanation for the discrepancy between predictions by American and Indian children mentioned at the outset.

Second, the pattern in the Motivation x Ability effect on singing performance undergoes at least three developmental changes. Perhaps judgments by kindergarten children represent a transition from the parallelism to fan pattern, whereas those by the sixth standard children represent a transition from the fan to parallelism pattern. This means that the multiplying-type rule indeed evolves out of the adding-type rule but it gets replaced again by the adding-type rule by the end of middle school. The multiplying-type rule is employed by only second through fourth standard children.

This demonstration of the linear fan pattern with 6- to 9-year-olds and of the parallelism pattern with teenagers in India has two important theoretical implications. One is that even young children in India can obey the prescriptions of the multiplying model (Anderson & Butzin, 1974) in prediction of performance. It appears, therefore, that Bhargava's (1983) finding of developmental shift from parallelism to fan pattern around the age of 20 years is confined to the task of life performance.

Another implication is that the integration rules underlying prediction of performance depend upon subjects' own experiences or culturally transmitted information about the task (Surber, 1984a). The role of individual experiences can be appreciated by considering the predictions which were irregular with the requirements of the hypothesized adding and multiplying models. The role of the culturally transmitted information is evinced by the reemergence of the parallelism pattern around the end of middle school. Since American students of this very age follow a multiplying-type rule in nonacademic tasks of puzzle-solving (Kun et al., 1974) and weight-lifting contest (Surber, 1980), the difference in predictions by American and Indian high school students reinforces the past work which emphasized role of cultural influences in social cognition (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Singh et al., 1979; Srivastava & Singh, 1986).

But the importance of the finding of the present research lies in showing that the applicability of the cultural difference hypothesis (Singh, 1981) is restricted to only high school and undergraduate college students in India and America. As the primary and middle school children of the present Experiment 2 and the postgraduate students of management studied by Bhargava (1983), Singh (1986), and Singh et al. (1986) evinced the linear fan pattern in the Motivation x Ability effect, only high school and undergraduate college students of the two countries have different outlook on how motivation and ability determine performance.

Considered together, results of the present investigation and those of the past research indicate that predictions of performance depend upon nature and difficulty of task as well as on age and culture of subjects. The significance of the cultural background of subjects is buttressed by four principal differences in predictions made by Indian and American students. First, predictions by high school and undergraduate college students in India uniformly conform to the parallelism pattern irrespective of the nature of task, whereas predictions by American students of this age group conform most often to the linear fan pattern (Anderson, 1983; Anderson & Butzin, 1974; Kun et al., 1974; Surber, 1978, 1980, 1981a) and sometimes to a pattern of near-parallelism (Surber, 1978, 1981b, 1985a). Second, the nature of task engenders different patterns in the Motivation x Ability effect in India with children below 10 years of age shown in the present work and with adults above 20 years (Bhargava, 1983). But it causes differences in patterns at all age levels in the United States (Surber, 1978, 1980, 1984a, 1985b). Third, exam difficulty produces different patterns in the Motivation x Ability effect in the United States (Surber, 1981a) but not in India (Singh & Bhargava, 1985). Finally, all American studies show that the linear fan pattern develops out of parallelism pattern (cf. Surber, 1984a, 1985b). However, the present research showed that such a trend is true in India in prediction of singing performance alone and only upto the age of nine years. The parallelism pattern reappears around the age of 10 years. Keeping these differences in mind, it may be said that the generality of the normative multiplying model suggested by Heider (1958) is rather limited.

An objection to the foregoing interpretation for cultural difference between Indian and American subjects must be considered. The experiments which disclosed differences between students of the two countries were not exactly the same in methodological respects. The culture of the judges did not enter as an independent variable in the experimental design either. So doubt on the plausibility of the interpretation of cultural difference can easily be raised.

Singh and Bhargava (1985) dismissed the above objection by citing a number of Indian studies from different judgmental domains which differed in method but yielded results identical to those of American studies. They argued, "Similar results in other tasks but discrepant result in the present task suggest that there may in fact be a genuine difference in cultural outlook on how motivation and ability determine exam performance" (p. 477). In addition, differences in achievement judgments are expected due to the differences in value systems of Indian and American people as already mentioned in the introduction. Accordingly, the cultural differences detected by the various experiments on prediction of performance may be accepted without any qualification.

Interpretations of Developmental Differences

The chief finding of Experiment 2 is that predictions by younger children conform to the fan pattern but those by older children conform to the parallelism pattern. What do these developmental differences mean? Three interpretations, namely, changes in integration rules, changes in information weighting, and changes in response reproduction processes, must be considered.

Changes in integration rules. Anderson and Butzin (1974) and Kun et al. (1974), who were the first to obtain the linear fan pattern in the Motivation x Ability effect, interpreted it as indicative of the multiplying rule hypothesized by Heider (1958). Following this logic, it may be stated that younger children in India follow a multiplying rule; older ones follow an adding rule.

When we consider the predictions by children of Standards II and IV and those by children of Standards VIII and XI, the above interpretation seems correct. But this does not mean that an adding rule evolves out of a multiplying rule. As kindergarten children represented a transition from the parallelism to fan pattern, it was speculated that the children younger than kindergarten perhaps use the adding rule and that the multiplying rule develops subsequently. This development of multiplying rule from adding rule is consistent with American results (Kun et al., 1974; Surber, 1980). What is unique with Indian children is the reemergence of the adding rule toward the end of middle school.

While changes in integration rules can account for the parallelism and fan patterns and can make the results consistent with American studies (cf., Surber, 1984a, 1985b), it cannot explain individual differences at various age levels. Besides, acceptance of the parallelism pattern in predictions by high school students as indicative of the adding rule would be discordant with the previous finding that Indian children average information about motivation and ability (Bhargava, 1983; Gupta & Singh, 1981; Srivastava & Singh, 1986).

<u>Changes in information weighting</u>. The parallelism pattern is not unique to the adding rule, nor is the fan pattern unique to the multiplying rule. Both patterns can also be engendered by the averaging rule (Anderson, 1981). When motivation and ability maintain the same relative weight in all possible combinations, the averaging rule predicts a pattern of parallelism (Singh & Bhargava, 1985, 1986). However, when lower values of motivation and/or ability assume greater weight, then the averaging rule produces an approximate linear

fan pattern. Anderson and Butzin (1974), therefore, also considered a conjunctive averaging rule with differential weighting as an alternative to the multiplicative interpretation of their linear fan pattern.

If it is accepted that all children followed an averaging rule, then developmental differences can be explained by changes in the weight of motivation and ability information. It would also be possible to explain the patterns which were "irregular" with the requirements of the adding and multiplying rules. An additional advantage with this position is that it can account for the previous averaging results obtained in not only India (Bhargava, 1983; Gupta & Singh, 1981; Srivastava & Singh, 1986) but also the United States (Surber, 1980).

Changes in response reproduction processes. Surber (1984a, 1984b) argues that the same scale values and an additive integration rule can produce convergence, parallelism, and fan patterns if the subjects reproduce their implicit responses on the judgmental scale by logarithmic, linear, and exponential functions, respectively. According to her hypothesis, age differences in patterns may be reflective of changes in response reproduction processes.

Surber (1984a) thought that the developmental changes demonstrated by Kun et al. (1974) may possibly be explained by the response reproduction processes and by the changes in integration rules. However, her own experiment (Surber, 1980), which included the "scale free method" (Birnbaum, 1974), found no evidence for developmental shifts in response reproduction process. No less important, the manipulations of exam difficulty, which invoked different response reproduction processes in American adults (Surber, 1981a), did not do so in Indian adults (Singh & Bhargava, 1985). Accordingly, the possibility of developmental changes in response reproduction processes in the present research can be ruled out.

Comments. From the preceding discussion, it is obvious that the developmental and task differences obtained in the present work may perhaps best be accounted for by the changes in weight of motivation and ability information. This means that all children followed the averaging rule in prediction of contest performance. While this interpretation appears to be reasonable in the light of previous findings (Bhargava, 1983; Gupta & Singh, 1981; Srivastava & Singh, 1986), the other two possibilities cannot be completely eliminated.

The main goal of the present research was to demonstrate changes in patterns in the Motivation x Ability effect as a function of age of subjects and nature of task. This goal has undoubtedly been accomplished. Future research should, therefore, take up the issue of loci of developmental changes in predictions of singing performance by Indian children.

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Author Note

This research was supported by Grant F1/146/80-RG from the Indian Council of Social Science Research, New Delhi to Ramadhar Singh. This arti article is adapted from the first author's doctoral dissertation, under the direction of the second author, submitted to Gujarat University, Ahmedabad. The authors thank S.M. Jain, principal of the Central School, Shahibaugh, Ahmedabad, and Perinben Lalkaka, principal of the Thumbelina Nursery and Kindergarten School, Narayanpura, Ahmedabad, for their best cooperation in data collecting; Shivganesh Bhargava and Madhu Singh for their assistance in data analyses; Ajay Shah and R. Usha for their cooperation in completion of the project; and Norman H. Anderson and Jai B.P. Sinha for their comments on an early report.

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Table 1

Number of Standard IV and VIII Children Following Different Rules in Prediction of Performance in Puzzle and Singing Contests

Rules	Puzzle IV	Contest VIII	Singing IV	Contest VIII
Motivation-only	1	0	0	0
Ability-only	5	2	0	9
M + A	8	11	6	6
M x A	1	0	9	0
Inverted Multiplying	0	1	0	0
Irregular	9	10	9	9

Note. Each individual child analysis had *dfs* of 2 and 8 for tests of the main effects and of 1 and 8 for trend components. Only *F* ratios reaching at least .05 level of significance were accepted for classification of subjects. Inverted multiplying refers to a pattern of convergence in the Motivation x Ability effect, and irregular rule refers to the presence of at least one higher-order trend in the Motivation x Ability effect.

Table 2

Trend Components in the Motivation x Ability Effect of Each of the Six Groups of Subjects of Experiment 2

Groups	*F* Ratios for Trend Component			
	L x L	L x Q	Q x L	Q x Q
Kindergarten	76.73*	2.19	8.21*	0.01
Standard II	192.99*	1.02	1.08	0.57
Standard IV	136.37*	0.04	2.55	1.02
Standard VI	144.99*	0.44	6.31*	0.15
Standard VIII	0.05	2.79	2.51	0.13
Standard XI	0.12	1.10	2.60	1.59

Note. L and Q refer to linear and quadratic components, respectively. Each *F* test had *dfs* of 1 and 23.

* $p < .01$

Table 3

Number of Children from Six Age Groups of Experiment 2 Following Different Rules in Prediction of Performance in Singing Contest

Rules	Age Groups KG	II	IV	VI	VIII	XI
Ability-only	0	0	0	1	0	0
M + A	4	5	5	7	19	14
M x A	8	15	13	10	1	1
Irregular	12	4	6	6	4	9

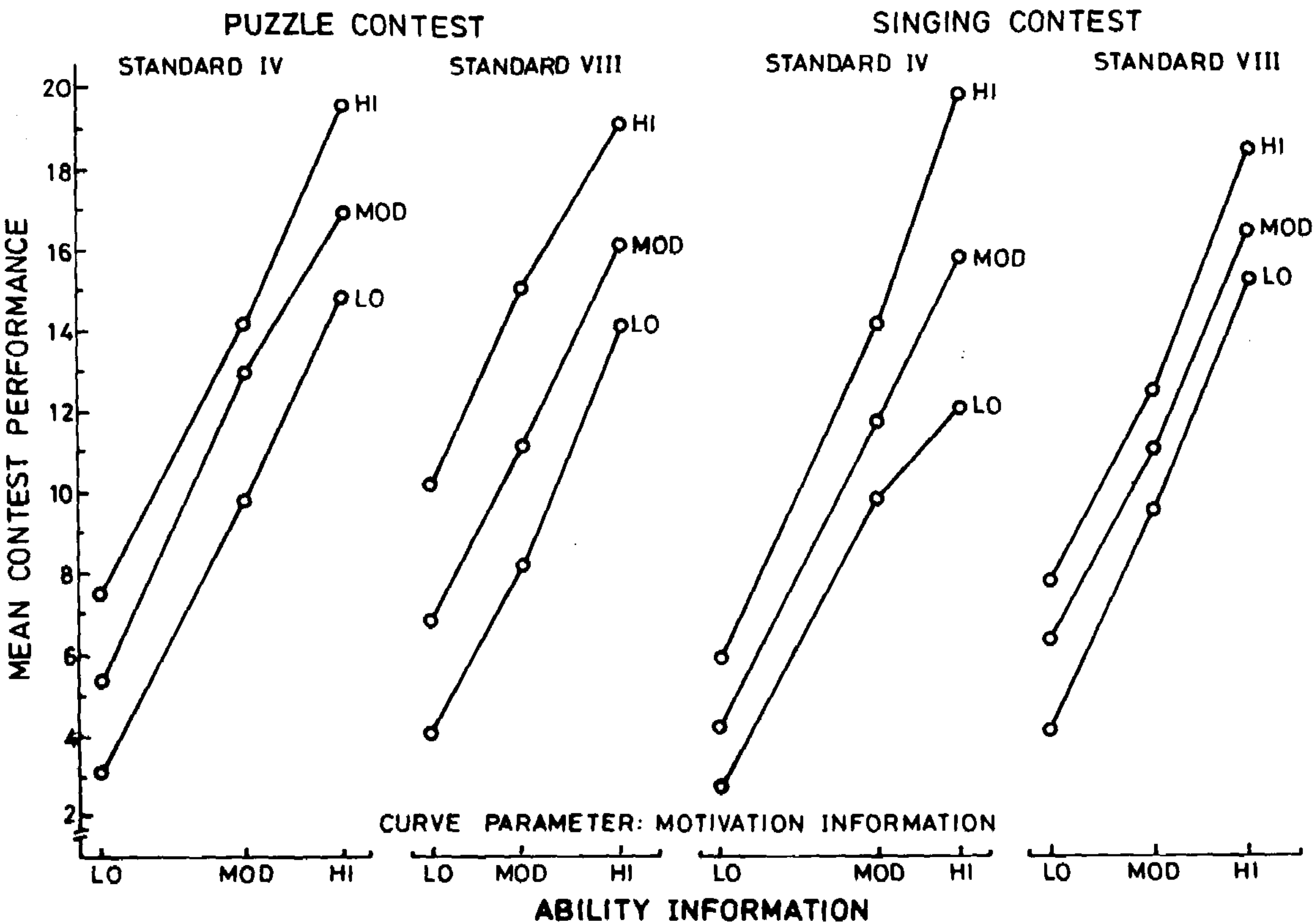
Figure Captions

Figure 1. Mean contest performance as a function of motivation (curve parameter) and ability (listed on horizontal axis) of stimulus child. The four graphs show Motivation x Ability effects on predicted performance in puzzle and singing contests by children of Standards VI and VIII. Data from Experiment 1.

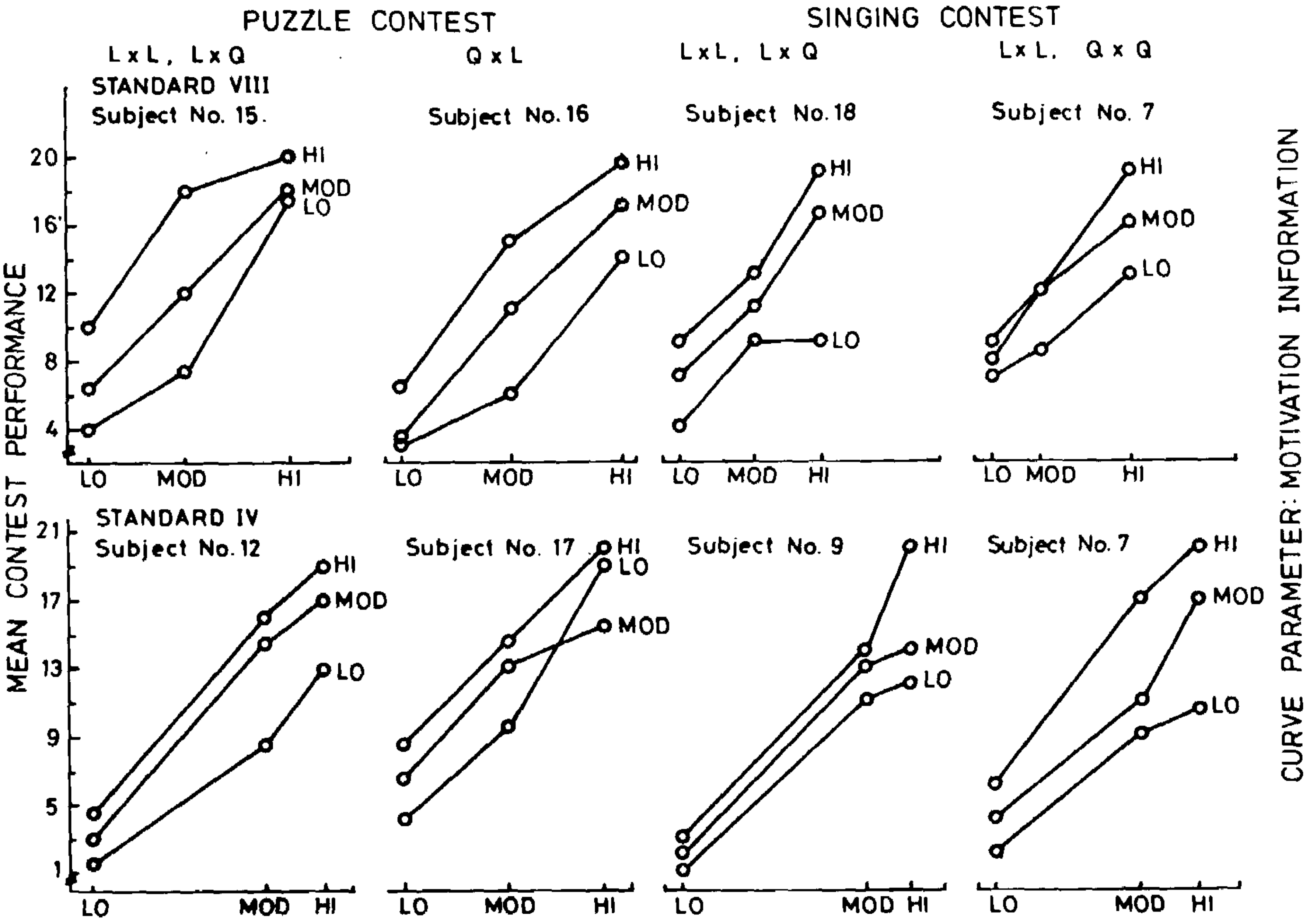
Figure 2. Examples of subjects from Standards IV and VIII who followed irregular rules in prediction of performance in puzzle and singing contests. The abbreviations L and Q refer to linear and quadratic trend, respectively. Data from Experiment 1.

Figure 3. Mean performance in singing contest as a function of motivation (curve parameter) and ability (listed on the horizontal axis) of stimulus child. Data from kindergarten through Standard IV children are shown from left to right in the lower part and those from Standard VI through XI are shown from left to right in the upper part. Data from Experiment 2.

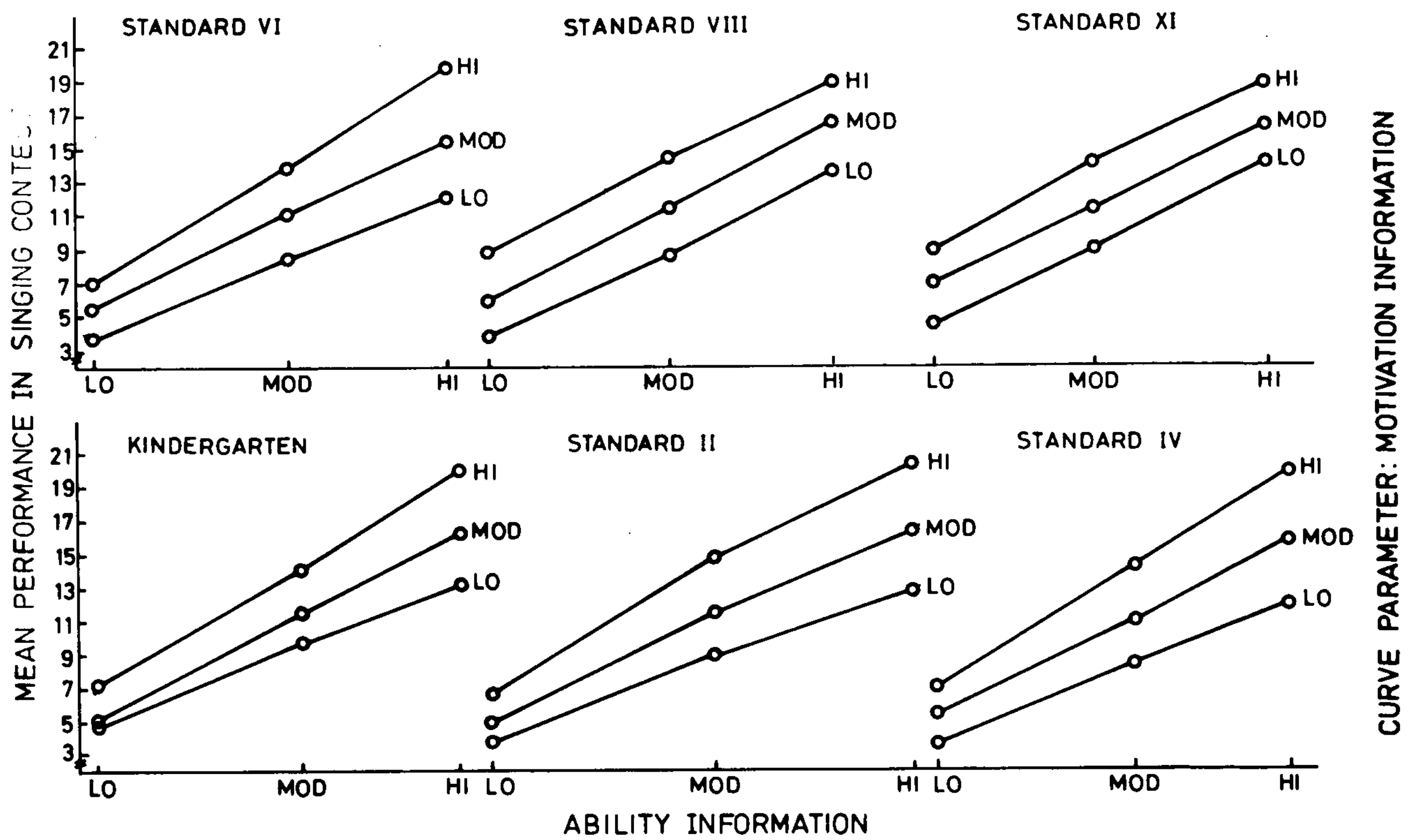
Figure 4. Examples of subjects from kindergarten and Standard XI who followed three kinds of irregular rules in prediction of performance in singing contest. Data from Experiment 2.

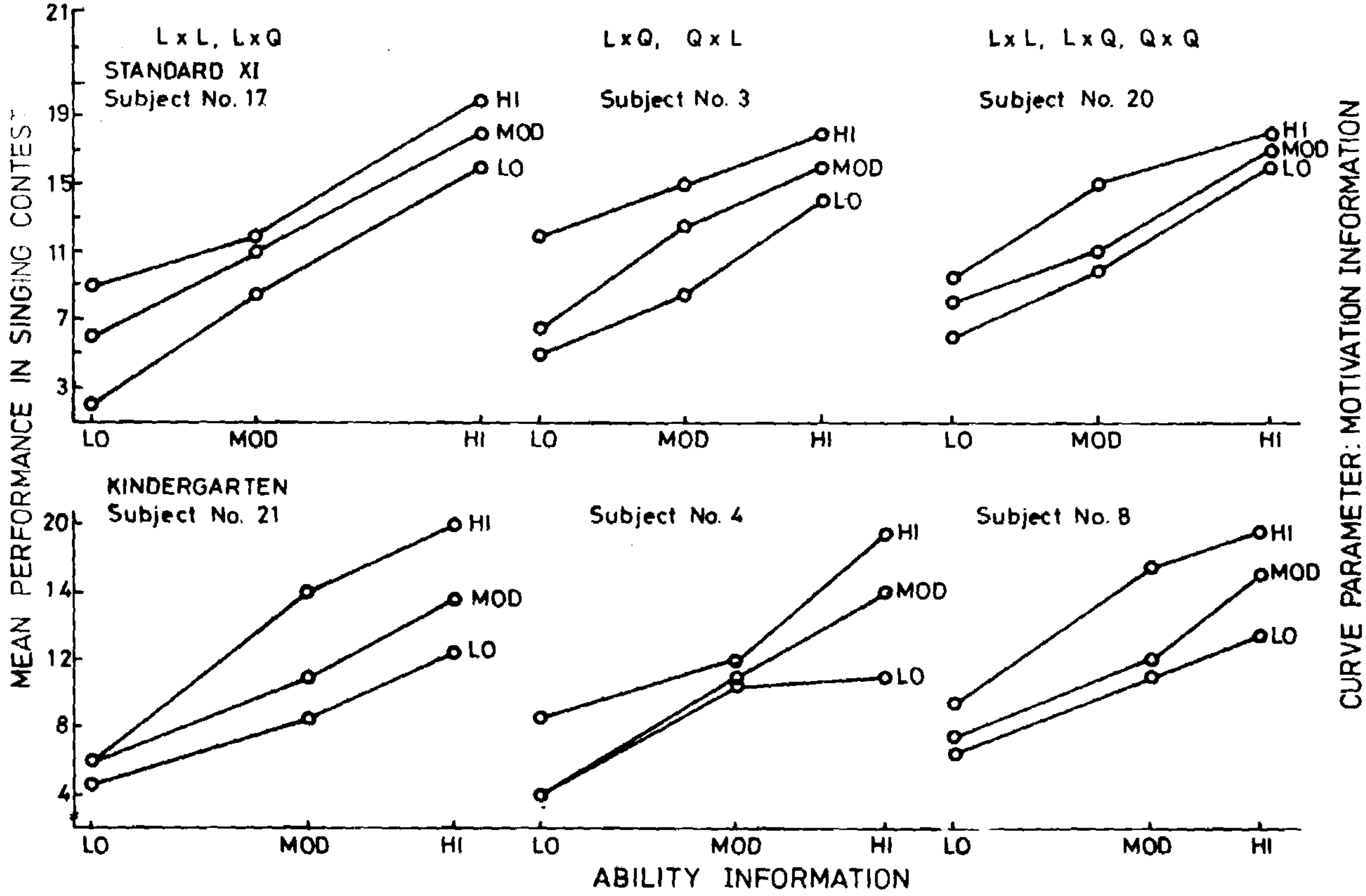

PUZZLE CONTEST
SINGING CONTEST
STANDARD IV
STANDARD VIII
STANDARD IV
STANDARD VIII
MEAN CONTEST PERFORMANCE
20
18
16
14
12
10
8
6
4
2
HI
MOD
LO
CURVE PARAMETER: MOTIVATION INFORMATION
LO
MOD
HI
ABILITY INFORMATION

2



PUZZLE CONTEST
SINGING CONTEST
L x L, L x Q
STANDARD VIII
Subject No. 15.
Q x L
Subject No. 16
L x L, L x Q
Subject No. 18
L x L, Q x Q
Subject No. 7
STANDARD IV
Subject No. 12
Subject No. 17
Subject No. 9
Subject No. 7
HI
MOD
LO
20
16
12
8
4
21
17
13
9
5
1
MEAN CONTEST PERFORMANCE
CURVE PARAMETER: MOTIVATION INFORMATION


STANDARD VI
STANDARD VIII
STANDARD XI
KINDERGARTEN
STANDARD II
STANDARD IV
HI
MOD
LO
21
19
17
15
13
11
9
7
5
3
MEAN PERFORMANCE IN SINGING CONTEST
ABILITY INFORMATION
CURVE PARAMETER: MOTIVATION INFORMATION



MEAN PERFORMANCE IN SINGING CONTEST
L x L, L x Q
STANDARD XI
Subject No. 17
L x Q, Q x L
Subject No. 3
L x L, L x Q, Q x Q
Subject No. 20
KINDERGARTEN
Subject No. 21
Subject No. 4
Subject No. 8
HI
MOD
LO
ABILITY INFORMATION
CURVE PARAMETER: MOTIVATION INFORMATION