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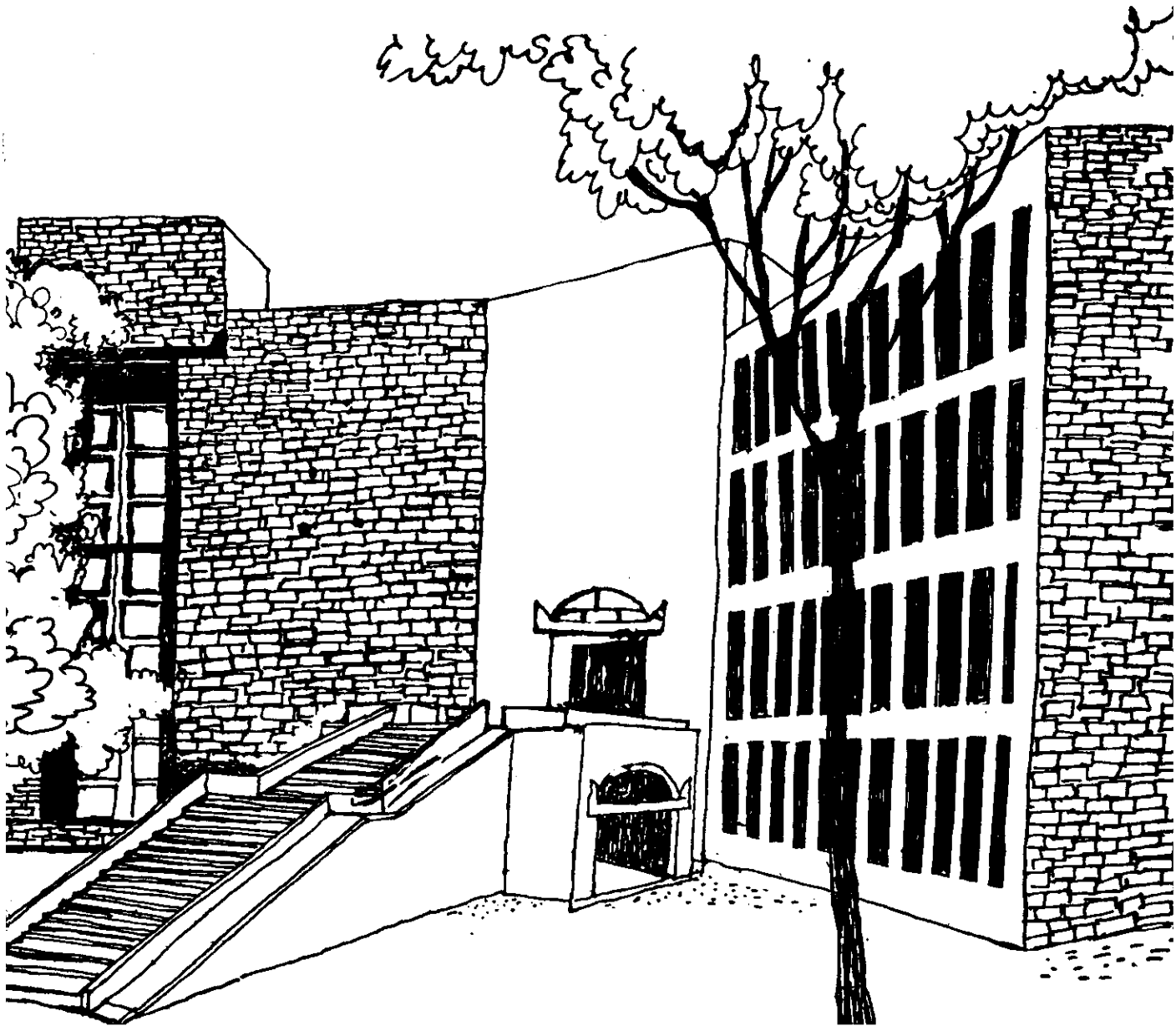

PREDICTION OF EXAM PERFORMANCE BY CHILDREN: EVIDENCE FOR UTILIZATION OF FOUR PIECES OF INFORMATION

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Prediction of Exam Performance by Children: Evidence for Utilization of Four Pieces of Information

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Running Head: EXAM PERFORMANCE

Abstract

Kindergarten through fourth grade children (n = 120) predicted exam performance of stimulus students from information about their current motivation and ability. Each kind of information came from two independent sources and so children had to integrate four opinions. Contrary to the previous finding that kindergarten through second graders lack capacity to utilize three or four pieces of information, all children of the present research did remarkably well in integrating opinion of four sources. Nonsignificant main effects in individual child analyses of the past research appeared to be attributable to memory constraints in stimulus presentation, low motivation of subjects, insensitivity of statistical tests, and/or irrelevance of information for judgment and not necessarily to integrational incapability in children. Results also showed that children in India average information about motivation and ability in prediction of exam performance in much the same way as do adults.

In Piagetian theory, children upto the age of 7 are assumed to have a general tendency to "center" on some particular aspect of the stimulus field. Their perception and judgment are supposed to be "caught and held by one or another dominant aspect of the perceptual field" (Elkind, 1975, p. 553). In other words, preoperational children are unable to attend or decenter to multiple aspects of the stimulus. As Flavell's (1963) exposition of Piagetian theory puts it, "The child is unable to decenter... is confined to the surface of the phenomena he tries to think about, assimilating only those superficial features which clamor loudest for his attention" (p. 159).

If preoperational children are really unable to coordinate or decenter, then they cannot be expected to follow any algebraic rule in their judgment. However, applications of information integration theory (Anderson, 1980) to children's judgments have indicated that centration in young children is attributable to Piagetian choice method and not to their inability to decenter. More interestingly, preoperational children have been found to be using adding, subtracting, multiplying, dividing, and averaging rules contingent upon their age and task requirements (Anderson, 1980; Leon, 1980; Surber, 1984a, 1984b, 1985; Wilkening, 1980, 1981).

A special virtue of the integration-theoretical approach is that it allows analysis of data at the level of individual child. Hence, integrational capacity is ascertained by the number of statistically significant main effects in analysis of variance for each child (Anderson & Butzin, 1978; Anderson & Cuneo, 1978; Gupta & Singh, 1981; Kun, Parsons, & Ruble, 1974). Such analyses have revealed that preoperational children have had no difficulty in attending to at least two aspects of the stimulus.

However, difficulty in integrating three and four pieces of information has been noted. In three-cue tasks, for example, only 58% second graders in India (Gupta & Singh, 1981) and 56% 6-7-year-olds in the United States (Leon, 1982) were able to use all the three given pieces of information. In a four-cue task (Anderson & Butzin 1978), only 40% kindergarten, 60% first graders, and 70% second graders had three statistically significant main effects. These percentage for the three respective groups of children came further down to 20, 50, and 60 when all the four main effects were considered. None of the 10 children from the third grade (i.e., 8 years 6 months), however, had any difficulty in utilizng all the four pieces of information. Results from these three studies suggest that preoperational children perhaps lack capacity to handle three and four pieces of information.

One implication of the above interpretation is that the nonsignificant main effects should be equally distributed over all the given pieces of information. This did not happen in any one of the three studies referred to above. The nonsignificant main effects were primarily for "objective dead information" in the Anderson and Butzin (1978) study of reward allocation, for "past performance" or "ability" in the Gupta and Singh (1981) study of prediction of exam performance, and for "intent" or "damage" in the Leon (1982) study of morality judgments. In the last study, information about intent and damage were utilized by some children only when the actor had admitted his guilt. Considered together, results from the three studies suggest an alternative hypothesis: Children ignored a particular piece of information probably because of its irrelevance for judgment and not because they lacked capacity to handle three or four items of information simultaneously.

Heffalump' (Kilby, 1971), it serves as a useful construct for explaining the birth and growth of organizations.

The present paper proposes to examine the literature on entrepreneurship and the applicability of its major theories to developing countries with a special focus on entrepreneurship in India. Research on entrepreneurship does not offer any conclusive evidence on what kind of factors - economic, social, psychological or skill and training, or what combination of these - contribute to the development of entrepreneurship. Studies have, at times, produced conflicting results; and apparently they do not emerge from a single paradigm. Perhaps a contingency approach to the study of entrepreneurship would lead to more concrete and reliable propositions which may serve as the basis for a sound development policy. Hence, it is also important to analyse the environmental influences on the innovative entrepreneur.

A word of clarification on the term 'innovative entrepreneur' should be added here. To those who accept the Schumpeterian definition of the entrepreneur, 'innovative entrepreneur' would surely sound redundant, for the entrepreneur is by definition an innovator. However, it may be noted that a large number of studies on entrepreneurship have gone 'beyond' the Schumpeterian definition. They feel that the phenomenon of organizational birth need not always be a consequence of hard core innovation. Further, the so-called 'non-innovative' entrepreneurs also have a role in the development of the economy while it is reasonable to accept this argument and the widened definition, we would still maintain that entrepreneurial breakthroughs can come

Another purpose of the present research was to determine the rule that young children follow in integration of information about motivation and ability of a stimulus child when they predict his or her exam performance. Past research has shown that Indian subjects employ the averaging rule. The averaging rule was supported by the results that the factorial plot of the Motivation x Ability effect exhibited a pattern of parallelism, and that the effect of motivation or ability information presented alone was greater than that of both motivation and ability information presented together (Gupta & Singh, 1981; Singh & Bhargava, 1985, 1986; Singh, Gupta, & Dalal, 1979). The present study tested the generality of this rule to kindergarten and first grade children.

Method

Stimuli and Designs

There were three designs. The first and main design was a 2 x 2 x 2 x 2 factorial which produced descriptions of 16 stimulus students. The two factors were current motivation and ability of the stimulus students. Each kind of information came from two independent sources. The two sources of motivation information were mother and neighbor of the stimulus student. They had indicated how much time the stimulus student spent in study at home. The two levels of mother's opinion were <u>does not study at all</u> (NS) and <u>always studies</u> (AS); the two levels of neighbor's opinion were <u>studies little bit</u> (SL) and <u>studies very much</u> (SVM). Information about ability came from two teachers of

the stimulus student. The ability of the stimulus students was defined by their potential for learning. The two levels of the opinion of Teacher 1 were not at all good in studies (NAG) and very good in studies (VG); the two levels of opinion of Teacher 2 were slightly good in studies (SG) and good in studies (G).

Designs 2 and 3 were 2 x 2 factorials. Design 2 had information about motivation alone from mother and neighbor of the stimulus student, whereas Design 3 had information about ability alone from the two teachers. The levels of the factors of these designs were identical to those in the main design. Each design generated four two-cue stimulus children. These designs were intended to serve as checks on the results pertaining to information utilization in main design and also to provide distinguishing tests between the adding and averaging rules of information integration (Anderson, 1980; Singh, Sidana, & Saluja, 1978; Singh, Sidana, & Srivastava, 1978).

Fourteen practice examples were also constructed. Six practice examples had six pieces of information, three about motivation and three about ability. Information about motivation came from two neighbors and mother; information about ability came from three teachers. These cases were more extreme than the regular four-cue stimuli. They were prepared with a view to orient the children toward the use of entire response scale (Anderson, 1980, 1982). Also, they served as end anchors. The remaining eight practice examples were taken from the four-cue and two-cue designs. All the 38 stimuli (24 test and 14 practice) were typed on separate index card.

Procedure

Each child completed the experimental task individually in the small room of the school over three consecutive days. The same female experimenter collected data from all the 120 children.

Day 1. The moment the child entered the experimental room, the experimenter gave her name, asked child's name, and appreciated its attractiveness. All conversations were in Hindi.

The experimental task was introduced to the child as one dealing with prediction of future exam performance of some unidentified students of the same sex, age, and class as the subject. It was emphasized that some students would be described by the opinion of 6 persons, some by opinion of 4 persons, and some by opinion of 2 persons. Therefore, prediction of future performance of students must be made on the"basis of all the informations given about him or her".

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

To make the task clear and meaningful, the experimenter gave the practice examples described earlier. The information about each stimulus child was read aloud to the subject, and he or she was asked to indicate his or her judgment by pointing at one of the 21 steps of the ladder.

After the practice session, the main points of the instructions were summarized by the experimenter. She also answered all the queries of the subject. Finally, the main stimuli were presented one by one in random order. Description of each stimulus person was read aloud from the index card to the subject and he or she was asked to reproduce it. This was done in order to enable the subject pay attention to all pieces of the available information, and also to enable him or her keep the information in immediate memory. When the subject was able to reproduce the information, he or she was asked to indicate his or her expectation of exam performance from the stimulus student. Ratings of all the stimulus children were made in this way. The orders of presentation of the two types of informations were balanced over equal number of subjects over each age group.

After the subject rated all the stimulus students, the experimenter gave him or her five toffees and five balloons for the cooperation in the experiment. She also thanked the child, and asked him or her to show up on the next day for further work.

Days 2-3. The procedure of Day 2 and 3 were identical to those of Day 1. Subjects received detailed instructions, worked with the practice examples, and finally rated the stimulus persons twice in different shuffled orders. As on Day 1, the subject received five toffees, five balloons, and thanks for his or her cooperation.

For data analysis, 21 steps of the ladder were treated as a rating scale corresponding to digits 1-21. Judgments made on the first day were treated as additional practice for the subject. Only the data from the

second and third days were coded and analyzed. Thus, there were 4 trials of judgments.

Subjects

Subjects were 120 children from Kindergarten, Standard I, Standard II, Standard III, and Standard IV of the Campus School, Indian Institute of Technoloy, Kanpur, Uttar Pradesh, India. Mean ages for the five groups of children were 4 years 6 months, 5 years 10 months, 7 years, 8 years, and 9 years 2 months with the respective ranges of 4 years 3 months to 5 years 3 months, 5 years 5 months to 6 years 4 months, 6 years 5 months to 7 years 6 months, 7 years 7 months to 8 years 5 months, and 8 years 6 months to 10 years 2 months. There were 12 boys and 12 girls in each age group. Since sex of subjects did not produce any reliable effect, results related to sex variable will not be presented.

Results

Information Utilization

The first goal in data analysis was to ascertain whether children from all the five groups utilized the four pieces of information available for judgment. Ratings of predicted exam performance by the five groups of children were thus subjected to separate analyses of variance. From these analyses, the F ratios for the four main effects of the opinion of mother, neighbor, and two different teachers for each of the five groups of children are reproduced in Table 1.

Table 1 about here

According to the centration hypothesis, kindergarten to the second standard children should not be able to utilize more than one piece of information in prediction of performance. Thus, just one main effect should be statistically significant in these three group analyses. Contrary to this prediction, all the four main effects listed in Table 1 are highly significant in each of the five groups of subjects. It can be said, therefore, that children of all groups utilized all the four pieces of information in prediction of exam performance.

Even though all the children of each group might not have used all the pieces of information available in their individual judgment, the group analysis may yield significant F ratio for each piece of information (Anderson, 1980; Anderson & Cuneo, 1978). To rule out this possibility, data of each individual child were subjected to separate analyses of variance (Gupta & Singh, 1981). Also, the differences between marginal means of the four factors at each trial of judgment of each of the 120 children were examined to determine whether different factors were used at different trials by a child (Anderson, 1980; p. 27). Such analyses disclosed that 119 children had used all the four pieces of information, and the general trend was much the same over the four trials of judgment. Only one child used three pieces of information, and he was from the fourth standard and not from any preoperational group. It can thus be said that centration is not the dominant attentional strategy of preoperational children at least in social judgment.

Evidence against centration was also present in the individual child analysis of the data of two-way, Mother x Neighbor and Teacher 1 x Teacher 2

designs. All the 120 children had significant main effects of both factors, and their marginal means for both factors had similar differences over the four trials of judgments. The statistical tests of main effects in the two designs had degrees of freedom of 1 and 9 only. Nevertheless, the main effects were substantial. This suggests that utilization of all the given four pieces of information in the main four-way design is not an artifact of the statistical power.

The foregoing analyses clearly show that all the five groups of children utilized all the four given pieces of information in a similar manner. So there is no evidence for any developmental change in information utilization.

Averaging Rule

The second goal in data analysis was to find out the pattern in the Motivation x Ability effect and to discriminate adding from averaging both of which predict the same pattern in factorial plot of the Motivation x Ability effect. The results were as follows.

Near-parallelism pattern. Figure 1 presents mean ratings of exam performance as a function of motivation (curve parameter) and ability (listed on the horizontal axis) of the stimulus children. The four levels of motivation information represent the combinations of opinions of mother and neighbor; the four levels of ability information represent the combinations of opinions of the two teachers.

Figure 1 about here

Of direct interest in the five graphs of Figure 1 is the pattern in judgments. The three sets of curves on the right side of the Figure 1 are

from children of second to fourth standards. All these three groups have the prevailing pattern of near-parallelism. This confirms the result reported by Gupta and Singh (1981).

Data of the two younger group of children, namely, kindergarten and first standard, also show the very pattern of near-parallelism. On the basis of these graphs, it can be said that kindergarten to fourth standard children all followed the same adding-type rule.

A strict adding-type rule requires parallelism in the factorial graph and hence a nonsignificant interaction term in analysis of variance (Anderson, 1980, 1982). In analyses of variance of the data of these five groups of subjects, however, interaction terms were significant, F (9, 180) = 20.57, 15.18, 11.50, 11.39, and 7.03, $p < .01$. Decomposition of the Motivation x Ability effect into Linear x Linear, Linear x Quadratic, Quadratix x Linear, and Quadratic x Quadratic trends (Anderson, 1982) indicated presence of at least two higher-order trends without any clear relationship with the age of subjects. Presence of these higher-order components indicate that parallelism is not perfect in any of the five groups. Nevertheless, the pattern is closer to the prescriptions of the averaging rule (Gupta & Singh, 1981; Singh et al., 1979) than to those of the multiplying rule (Anderson, 1980; Kun et al., 1974; Wilkening, 1980, 1981).

A closer examination of the five graphs in Figure 1 suggests that deviations from parallelism are due to end effects in the response scale. There is a tendency for the highest point to be too high and the lowest point to be too low as though the children had preference for the end portions of the response

scale (Gupta & Singh, 1981). In any case, the deviations from parallelism are relatively minor, and so, they do not require any serious qualification on the adding-type rule. It may be said, therefore, that there is no developmental trend in prediction of exam performance: Kindergarten to fourth standard children all adopted an adding-type rule in integration of information about motibation and ability of stimulus children.

Adding-versus-averaging. Both the adding and averaging rules can account for the pattern of near-parallelism in the five graphs of Figure 1. The dashed curves of Figures 1 and 2 are based on information about ability alone and motivation alone, respectively. The adding rule requires these dashed curves to plot parallel to the other four solid curves. This is because the added information would have the same directional effect across the four levels of the factor listed on the horizontal axis. Figures 1 and 2 show no sign of parallelism. Instead all the ten graphs exhibit very strong crossovers. These crossovers are convincing evidence against the adding rule.

Figure 2 about here

The averaging rule predicts the crossover interaction that is visible in all the 10 graphs displayed in Figures 1 and 2. The dashed curve for ability-only of Figure 1 crosses over the middle two solid curves convincingly. The dashed curve for motivation-only of Figure 2 crosses over all the four solid curves. These crossovers are too strong to require any formal statistical test of the crossover interaction.

Nevertheless, the slope of each of the two middle solid curves were compared separately with that of the corresponding dashed curve. All the 20 2 x 4 analyses of variance, 10 for data of Figure 1 and 10 for data of Figure 2, yielded F ratio greater than 20.00. In individual subject analyses, such interaction tests obtained F ratio greater than 4.00 at dfs of 3 and 21. Accordingly, it is correct to conclude that all the 120 children followed the same averaging rule in integration of information about motivation and ability of the stimulus child.

Discussion

Overall, the findings of the present study lead to two main conclusions. First, children as young as 4 years and 3 months are capable of utilizing four pieces of information when they predict exam performance of others. This result not only refutes Piagetian claim that centration is the dominant attentional style of preoperational children (Elkind, 1975; Flavell, 1963) but also calls attention to the need to identify factors that prevent young children from using three or more pieces of information in their judgments (Anderson & Butzin, 1978; Gupta & Singh, 1981; Leon, 1982).

Second, young children in India average information about motivation and ability of a person when they predict his or her exam performance in much the same way as do adults. The present evidence for averaging rule, therefore, reinforces the previous work (Gupta & Singh, 1981; Singh & Bhargava, 1986; Singh et al., 1979) and extends its generality down to 4-year-3-month-olds. It seems that 4- to 53-year-olds (Singh & Bhargava, 1985) in India all share the same causal schema regarding how to do well in an exam. Perhaps they all believe

that effort or trying is equally effective with persons of low and of high ability, and that motivation and ability are compensatory and not necessarily nullifying or amplifying as Heider (1958) thought.

The fact that all the preoperational children utilized the four given pieces of information in their judgments in the present study but not in the past ones (Anderson & Butzin, 1978; Gupta & Singh, 1981; Leon, 1982) needs to be explained. Four methodological differences between the present and past experiments are worth mentioning.

First, the experimenter made each child reproduce the description of stimulus student read to him or her before predicting performance. This was done because of the concern that young children's capability to use multiple pieces of information may be limited by their relatively small immediate memory storage (Trabasso, 1977). Since Gupta and Singh (1981) had also followed this very method and Anderson and Butzin (1978) had put pictorial materials in front of the child and read the verbal descriptions, the discrepancy between their and present results cannot be fully explained by memory constraints. But consequences of memory constraints may be serious in Leon's (1982) study, for he presented stories on cassette recorder.

Second, children were motivated to take the task seriously by giving five toffees and five balloons on each day. While balloons and toffees of the first day might have served as positive reinforcements, they might have become incentives for the second and third days. Importance of these incentives was actually not realized until some children who did not have an opportunity to serve as subjects came to the experimenter and requested that he or

she be also allowed to participate in the experiment. Gupta and Singh (1981) had given five toffees to the subjects. From the descriptions of method of Experiment 3 of Anderson and Butzin (1978) and of Leon (1982), it is not clear whether subjects worked for some incentives. In case children did not receive any thing, their poor performance on the task may be attributed to lack of interest. It should be emphasized that Kun et al. (1974) did not use any reinforcement/incentive and so all of their kindergarten and second graders did not utilize even two pieces of information (see Table 1, p. 729).

Third, each child was studied for three consecutive days and judgments made on the first day were considered to be additional practice for the subjects. This allowed a supposedly much clearer understanding of the task in children than in the studies which took data on the first day itself (Anderson & Butzin, 1978; Leon, 1982). In addition, data from four trials of judgments —two from the second and two from the third day—were used which provided perhaps the most sensitive statistical test of the main effects in analysis of variance for each individual child. Statistical sensitivity of tests is an important consideration, for less sensitive tests failed to yield significant main effects of even two pieces of information at the reduced alpha level of .10 (Kun et al., 1974, p. 729). It should be added that Leon (1982) did not directly test significance of three main effects in individual child analysis, for he had only one replication of the main stimuli. In addition, the df for the error term in analysis of variance for individual child were 8 in Kun et al. (1974), 16 in Anderson and Butzin (1978), and 26 in Gupta and Singh (1981), but 45 in the present study.

Finally, the present integration task consisted of only two qualitatively different kinds of information, motivation and ability, and not three as in the studies by Gupta and Singh (1981). This was done purposely to avoid the problems created by irrelevant cue as already noted in the introduction. However, each kind of information was obtained from two independent sources which made it a four-opinion integration task. From the angle of composition, therefore, the present task is similar to that of Anderson and Butzin (1978). As subjects integrated all the four cues in the present task but ignored "objective deed information" in the Anderson and Butzin task, it may be said that failure of the subjects to utilize all four pieces of information reflects on irrelevance of cues and not on lack of integrational capacity. This interpretation will also account for the results of Singh (1982) and Anderson and Cuneo (1978) mentioned in the introduction.

It is pertinent to raise here that presence of main effects of all the pieces of information given for judgment beyond doubt illustrates integrational capacity of children. But absence of such effects does not necessarily show lack of integrational capacity. Some of the main effects may not be statistically significant because of low power of the tests, memory constraints in stimulus presentation, low motivation on the part of children, or irrelevance of the given pieces of information themselves. To conclude in favor of just lack of integrational capacity may not, therefore, be always correct.

The reader may be surprised with how preoperational children can utilize four pieces of information in their judgment as the current study showed. But the element of surprise will tend to diminish when he or she will remember the findings that the 3- and 4-year-olds use an adding-type rule: Numerosity = Length + Density (Cuneo, 1978), that the 5-year-olds judge distance by an

exact multiplying rule: Distance = Time x Velocity (Wilkening, 1981), and that some of the 4- and 5-year-olds predict performance in singing contest by multiplying rule: Performance = Motivation x Ability (Srivastava & Singh, 1986). It appears that young children are much more complex and capable that what is commonly believed to be true. With proper method of cognitive analysis, their complexity and development can easily be detected. For this purpose, the method of information integration theory (Anderson, 1980, 1982) offers a more promising and powerful analytic approach than any other approach currently in existence (Leon, 1980; Wilkening & Anderson, 1982). The present work further illustrates the diagnostic capability of this approach.

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Table 1

F Ratios for Four Main Effects from 2 x 4 x 2 x 2 x 2 x 2 (Sex of subjects x Trials x Mother x Neighbor x Teacher 1 x Teacher 2) Analysis of Variance for Each of the Five Groups of Children

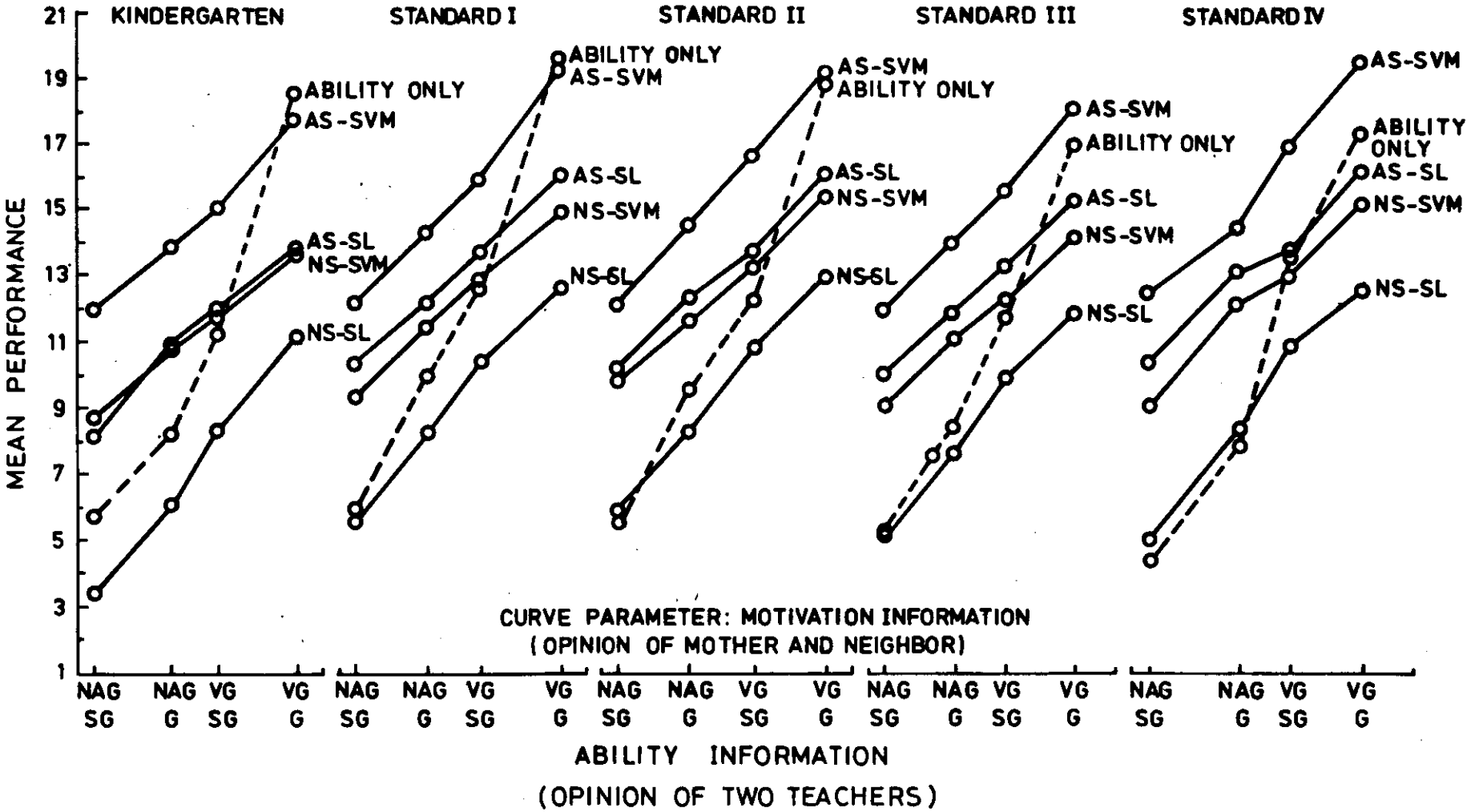
Groups	F Ratios for Main Effects			
	Mother	Neighbor	Teacher 1	Teacher 2
Kindergarten	508.75	1780.71	914.64	708.28
Standard I	1996.97	283.57	652.82	485.01
Standard II	2827.04	236.98	1361.13	800.25
Standard III	966.62	384.15	1357.11	1169.07
Standard IV	542.31	124.01	403.75	228.78

Note. Each F ratio had dfs of 1 and 22. The critical F ratios at .05 and .01 levels of significance are 4.30 and 7.94, respectively.

Figure Captions

Figure 1. Mean judgment of exam performance as a function of motivation and ability of the stimulus students. The solid curves are based on data from the main four-cue design. The dashed curve is based on ability information alone (i.e., Data from Design 3). The abbreviations NS, SL, SWM, and AS denote does not study at all, studies little bit, studies very much, and always studies, respectively. The abbreviations NAG, SG, G, and VG refer to not at all good in studies, slightly good in studies, good in studies, and very good in studies, respectively.

Figure 2. Mean judgment of exam performance as a function of ability and motivation of the stimulus children. The dashed curve is based on motivation information alone (i.e., Design 2). The middle two levels of motivation had nearly the same mean values for kindergarten children (see Figure 1). So they were pooled together in the plot of the graph. The abbreviations have the same meaning as in Figure 1.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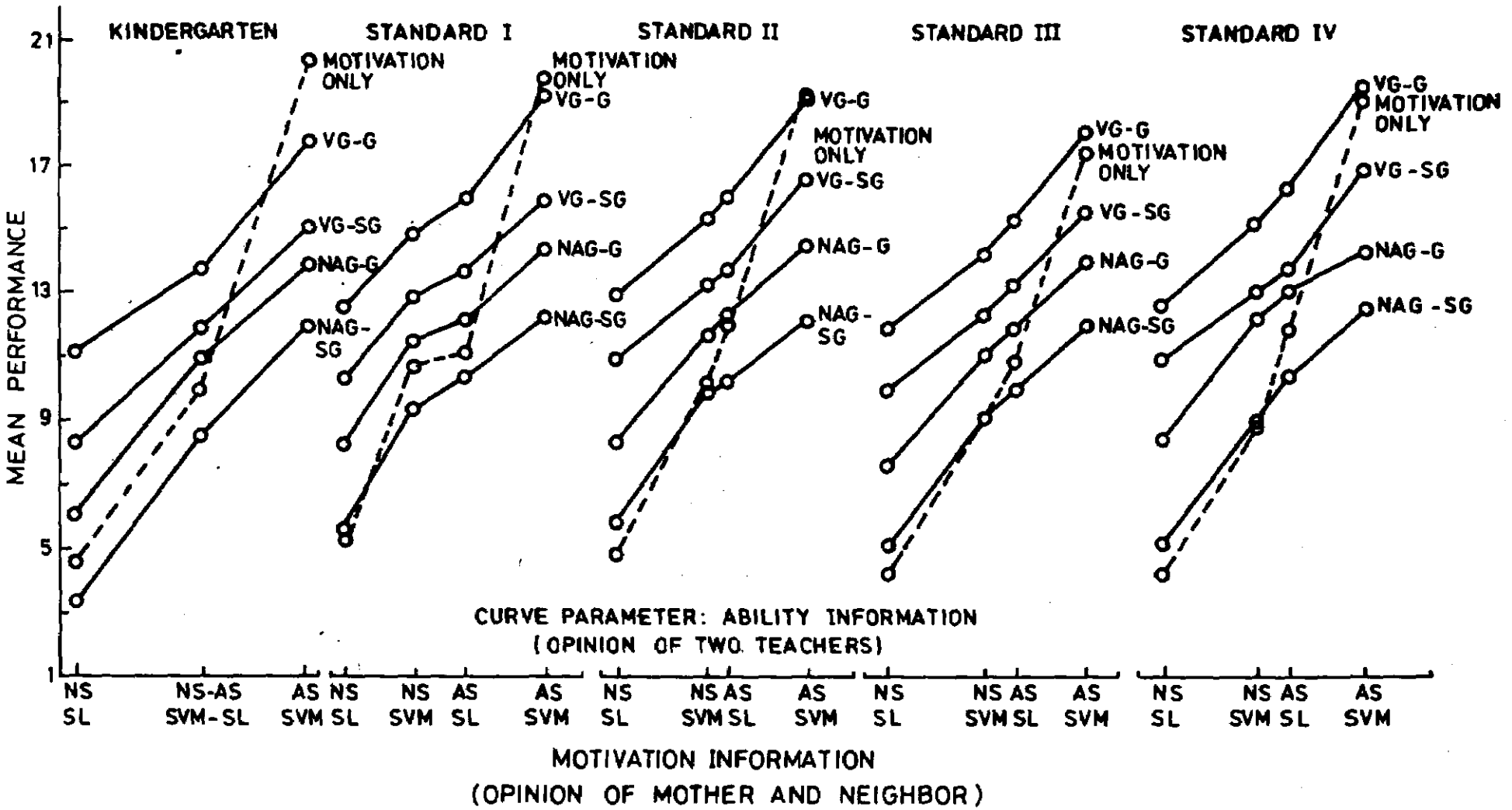
ABILITY ONLY
AS-SVM
AS-SL
NS-SVM
NS-SL
CURVE PARAMETER: MOTIVATION INFORMATION
(OPINION OF MOTHER AND NEIGHBOR)
NAG SG
NAG G
VG SG
VG G
ABILITY INFORMATION
(OPINION OF TWO TEACHERS)


KINDERGARTEN
STANDARD I
STANDARD II
STANDARD III
STANDARD IV
MEAN PERFORMANCE
21
17
13
9
5
1
MOTIVATION ONLY
VG-G
VG-SG
NAG-G
NAG-SG
CURVE PARAMETER: ABILITY INFORMATION
(OPINION OF TWO TEACHERS)
NS SL
NS-AS SVM-SL
AS SVM
NS SL
NS SVM
AS SL
AS SVM
NS SL
NS AS SVM SL
AS SVM
NS SL
NS AS SVM SL
AS SVM
NS SL
NS AS SVM SL
AS SVM
MOTIVATION INFORMATION
(OPINION OF MOTHER AND NEIGHBOR)