Developmental level and concept learning: Confirmation of an inverse relationship'

Stanley R. Friedman
LOUISVILLE CHILD GUIDANCE CLINIC

Abstract

The expected positive direct relationship between intellectual skill and school grade level has been noted by several investigators to show an unexpected depression at the 4th grade level. Two-hundred ninety-nine children in the 1st through 5th grades were tested with a series of sequential-pattern problems. The 4th grade depression phenomenon was observed, and a tentative explanation of the results was offered.

Problem

Several authors (Torrance, 1961; Klugh et al, 1964) have noted that though there appears to be a relatively simple direct relationship between developmental level and intellectual skill, especially with regard to concept-formation problems, there is often a depression in this developmental curve at the 4th grade school level. As Klugh et al state (1964, p. 90) "This inversion must reverse somewhere along the developmental continuum." The present study is one of a series on the development of mediational processes in human thought; it offers a confirmation and tentative explanation of this unexpected developmental phenomenon.

Method

Each subject was seated in front of a wooden display panel having five hinged doors. At the verbal signal "Go," the subject was instructed he was to open any one of the five doors. If he opened the correct door, he would find a plastic token behind the door. The subject was instructed to find as many tokens as he could, as he would have many chances to open the doors.

The tokens were placed behind the doors in four different sequential orders (except in the case of the 1st graders who, due to time limitations, were tested only with the first sequence): 2,2....; 4,2,4,2....; 1,3,5, 1,3,5....; 3,3,5,3,3,5.... (the numbers refer to the doors; door 1 being the door to the subject's left). Fifty trials (a trial consisting of a single choice) were given for each sequence, and a token was kept behind the appropriate door until it was found by the subject, at which time a token was placed behind the next door in the sequence. The children collected the tokens in a box placed in front of them. A record was kept of the choices made by each subject, and, after each series of 50 trials, the child was asked to show where he had found the tokens.

Scoring of the data was done in the following way: expectancies were calculated for the number of times each sequence would be produced by chance within 50 trials. Using these expectancies as a minimum level, scoring criteria were decided upon (after the data from a pilot study had been examined). Each sequence

protocol was called either + or - depending upon whether the subject had reached criterion. If the overall protocol (50 trials) did not reach criterion, then the last 25 trials were scored separately for another similarly calculated criterion, still enabling the protocol as a whole to be called +. This scoring of the last 25 trials was introduced to provide a realistic appraisal of those children who spend an inordinate number of trials experimenting before restricting themselves to the appropriate doors (these children are more "unsure" than "unaware"); this "late start" might prevent them from reaching criterion within 50 trials, though they would have reached it within about 55 trials (as had been noted in the pilot study). For the sequences 2,2; 4,2; 1,3,5; 3,3,5; respectively, the overall criteria were: $\bar{5}18$; $\bar{5}3$; $\bar{5}3$; $\bar{5}3$. "Last half" criteria were $\bar{5}10$; $\bar{5}2$; $\bar{5}2$; $\bar{5}2$. The last two sequence protocols were also considered + if the sequences were at any point correctly produced twice consecutively. It is interesting to note that a number of other scoring systems were tried and found to produce approximately the same final results.

The subjects were 80 1st graders, 65 2nd graders, 53 3rd graders, 52 4th graders, and 49 5th graders from three Louisville public schools. All the students from each participating class served as subjects.

Results

With the exception of the 4th grade level (see Fig. 1), there appears to be a continuous increase with grade level in the percentage of children correctly producing the sequences. The 4th graders, however, fall below the 3rd grade level (except for the 4,2 sequence).

At the end of each 50 trials, each child was asked to show where he found the plastic tokens. At this discrimination aspect of the task, the 4th graders did very well, but, of those children who knew where the discs had been placed, except for the 4,2 sequence, a consistent and significantly smaller percentage of 4th graders than 3rd graders actually produced the sequence (many of the children seemed to start the testing session with the expectancy that the discs would be placed in a simple two-door alternation pattern, such as 4,2,4,2....).

Discussion

It is apparent from the raw data that a number of separate "skills" enter into the successful production of the various sequences, for example, the first three sequences appear to be initially spatial discrimination tasks. Then, when the correct doors have been isolated, the task is to impose order on the elements. Both these

Fig. 1. Percent children at each level correctly producing sequences.

aspects appear, for the younger children, to increase in difficulty level as a direct function of the number of elements in the sequence. A mediated hypothesis, if available, is an efficient way of encoding the many elements into a simple rule. Thus, where the young child has to remember individually each door in the sequence 1,3,5, the older child simply encodes the sequence in the form of a rule "skip one door each time." This explains why for the 5th graders, the 1,3,5 sequence is not significantly more difficult than the 4,2 sequence. Both sequences utilize the same basic rule.

The 3,3,5 sequence presents an additional difficulty not found in the previous sequences. After isolating the correct doors (3 and 5), the child must modify what

appears initially to be a simple alternation task. Many (indeed, most!) of the children seemed unable to produce this modification and so continually alternated the two doors, explaining later that sometimes they found a disc behind door 5 and sometimes they didn't find a disc there.

If mediated thought is so efficient, what explanation is there for the observed developmental inversion? As the child begins to be able to process sequences of information, he is laying the foundation for a stage of hypothesis formation which apparently begins to come into fruition at the 4th grade level. However, he is trying out a technique at which he is but a novice. The younger child appears to learn in a manner best characterized by the classical Stimulus-Response model; repetition of trial-and-error is sufficient to easily master the simple problems. The 4th grader has progressed beyond this stage, but he has not yet learned to use his new tool efficiently. He is so rigid in the application of this newly developing ability that his predictions (i. e. hypotheses) mask the actual regularity of events, thus he is unable to modify his hypotheses so as to include new information (ex. as might be gotten from negative feedback). As Bruner put it (1957, p. 250), "...hypotheses and responses serve to mask the regularity of events in the environment."

References

- BRUNER, J. S. On perceptual readiness. *Psychol. Rev.* 1957, 64, 223-252.
- KLUGH, H. E., COLGAN, KAY, & RYBA, JUDITH A. Developmental level and speed of relational concept formation: a possible inverse relationship. *Psychon. Sci.*, 1964, 1, 89-90.
- TORRANCE, E. P. Factors affecting creative thinking in children: an interim research report. *Merrill-Palmer Quart.* 1961, 7, 171-180.

Note

1. The author is indebted to Gay Ewing, Nancy McElwain, Shirley Dumesnil, Betty Brook McCord, Mimi Horner, Carita Smock, and Sarah Haycraft for their assistance in data collection. Dr. Lovick C. Miller provided many valuable insights and suggestions. Sincere appreciation is extended to the Board of Education of the City of Louisville for providing access to the school system.