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ABSTRACT

Students in grades K, 1, 3, and 5 were administered the Rod and Frame Test (RFT), the Matching Familiar Figures (MFF) Test, and the Piagetian tasks of Discontinuous Quantity, Class Inclusion, Multiplication of Classes, and Multiplication of Relations. Cross-sectional trends were found in all tasks with older children being less impulsive, more field independent, and more able to correctly perform the Piagetian tasks. In spite of similarities among the tasks with regard to perceptual salience of cues, ambiguity of stimulus situation, and problem solving set, performance on the tasks was independent over age. Also unreflected in these data is the synchronous development of class inclusion, multiplication of classes, and multiplication of relations reported by Inhelder and Piaget (1964). Findings are discussed in light of the Kagan and Kagan (1970) differentiation and integration of cognitive development. (Author/CS)

A CROSS-SECTIONAL STUDY

OF

COGNITIVE VARIABLES*

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Much recent development and learning research has utilized measures of field independence, impulsivity and Piagetian seriation and classification tasks to assess cognitive abilities. However, little research has been reported on the interrelations of performance on these tasks. Pragmatic questions arise: for example, is an incorrect response on the Piagetian Discontinuous Quantity task a function of preoperational thinking, the result of an impulsive cognitive style, an inability to overcome an embedding context, or an interaction. Theoretical questions arise: are distinctions between cognitive level of development and cognitive style real or semantic? Since several cognitive style variables have been demonstrated to have longitudinal reliability while Piagetian stages of cognitive development demonstrate discontinuous growth, does cognitive style in some fashion mediate development through Piagetian stages?

An essential initial step in resolving such questions, both pragmatic and theoretical, is to examine the interrelations among performances on tasks traditionally used to quantify the variables. The question posed by this study was: Are field independence, impulsivity, and the concrete operations of seriation and classification as measured by traditional tasks, independent cognitive variables over age?

Field independence (FI) and reflection-impulsivity (R-I) are cognitive style variables which measure individual differences (ID's) in approaches to interaction with the environment. FI is a measure of

the ability to overcome an embedding context (Witkin, et. al., 1962). One operational task used to assess FI is the Rod and Frame Test (RFT). The RFT requires the S to return to vertical position a line surrounded by a line square which is tilted 45 degrees to the right or left. It reflects an underlying tendency for greater or lesser differentiation of experiencing surrounding which is viewed as an ontogentic phenomenon changing from less to more differentiation, but, at the same time, as reliably describing ID's cross-sectionally and longitudinally from ages 8 to 24 (Faterson and Witkin, 1970).

Kagan (1966a) describes R-I as an ID continuum that is (1) relevant for problems with response uncertainty, (2) a function of "the balance between ... answer quickly versus do not make a mistake," and (3) related to the Ss' anxiety about committing errors. Kagan, Rosman, Day, Albert and Phillips (1964) explored the question of impulsivity by placing Ss, usually elementary school children, in ambiguous situations which require a decision in a stressful atmosphere.

The instrument they devised is called the Matching Familiar Figures Test (MFF). The reflection-impulsivity ID continuum thus measured reflects a combination of time to first response and number of errors. The construct has demonstrated operational reliability and intertask generality (Kagan 1965a, 1965b, 1966a; Yando and Kagan, 1968).

Piagetian seriation and classification tasks are used as indices of cognitive level of development. As delineated by Piagetian research, cognitive skills are constructed through interaction with the environment as the child progresses through three invariant periods of development: preoperatory, concrete operational, formal operational (Piaget, 1970). The tasks utilized in this study (Discontinuous Quantity, Class

Inclusion, Multiplication of Classes, and Multiplication of Relations) map the transition from preoperatory to concrete operational thinking to groupings within concrete operational thought. (Tasks were derived Smedslund, 1964, SRCD Monograph).

Preoperatory children reason about states or static configurations. While they are aware that transformations have taken place, they do not attend to the transformations as indices of invariance. Therefore, the preoperatory child, confronted by a problem of Discontinuous Quantity, responds to the perceptually different configurations and is unable to conserve quantity. Once the child attends to the transformation (the rearranging of elements), and can mentally reverse the rearrangement, he is able to conserve quantity.

In like manner, to solve a Multiplication of Relations problem, the child must work through (1) comparing two things on one dimension, (2) arranging a series in order empirically, (3) coming to an understanding of transitivity. The child with this final operational scheme can handle a double entry table which varies on two dimensions, e.g., size and color. In the area of classification schemes, the preoperatory child, when instructed to "Put things that are alike together," will initially create figural collections (arrangements in space). Later he will create non-figural collections which still do not reflect class inclusion schemes. The preoperatory child is unable to separate parts from the whole while mentally retaining them. Acquisition of concrete classification operations is reflected in the child's ability to understand relative quantities of an included class to the entire class. According to Inhelder & Piaget (1964) the appearance of Class Inclusion skills is paralleled by Multiplication of

Classification skills wherein the child can classify two dimensions over four cells.

PROCEDURE: Public school children in grades K, 1, 3, and 5 were individually administered the Rod and Frame Test (RFT), the Matching Familiar Figures (MFF) test, and the Piagetian tasks of Discontinuous Quantity, Class Inclusion, Multiplication of Classes, and Multiplication of Relations.

The sample included 113 children (K = 29; 1 = 29; 3 = 26; 5 = 29) from a large lower-middle class suburban school district.

Cross-sectional trends were found in all tasks with older children being less impulsive, more field independent and more able to correctly perform the Piagetian tasks. Means and standard deviations for all tasks are displayed in Table 1 as a function of grade. Sex was not found to be strongly related to any of the tasks, except for grade one. Field independence and reflection-impulsivity were independent at all grade levels. The four Piagetian tasks were, with one exception, unrelated to RFT, MFF or each other.

Correlations among the variables for kindergarten (n = 29) are in Table 2. The only significant correlation is the expected negative correlation (-.61) between MFF latency and MFF error (impulsive Ss make more errors). There is no indication of interrelationships between or among the variables tested for grade K.

Grade one (n = 29) (Table 3) shows a similar lack of interrelationships among the variables. Girls took longer than boys for first response to MFF (MFF lat), but this sex difference was not reflected in total number of errors (MFF err). Grade one girls were also the only girls cross-sectionally to replicate the oft-reported greater field

dependence of female subjects.

Grade three correlations (Table 4) are based on a sample of 26. The only significant correlation among the variables is between RFT and Discontinuous Quantity. Third graders who were more independent in field approach were more likely to correctly conserve Discontinuous Quantity.

A sample of 29 fifth graders produced no significant correlations among the variables.

A split-half reliability coefficient was computed for each grade for the RFT. The instrument was highly reliable at all grade levels: Grade K (.89); Grade 1 (.83); Grade 3 (.94); Grade 5 (.97). It appears that eight trials are not necessary to assess degree of field independence.

DISCUSSION: Are field independence, impulsivity, and the concrete operations of seriation and classification, as measured by traditional tasks, independent over age? With very minor reservations, the answer would appear to be "yes" for this sample. The superficial similarities among the tasks with regard to perceptual salience of cues, ambiguity of stimulus situation, and problem solving set were not reflected by performance on the tasks. Also unreflected in these data is the synchronous development of class inclusion, multiplication of classes, and multiplication of relations reported by Inhelder and Piaget (1964).

Kagan and Kogan (1970) discuss the recurring theme of differentiation and integration in child development literature as explanators of cognitive development. They point out that while most researchers agree that cognitive structures become increasingly differentiated and

increasingly hierarchically integrated, there is little agreement on definitions of "differentiation" or "integration." They also suggest that much research on cognitive development suffers from "tunnel-vision." Not only is there a reluctance to resolve the continuous-discontinuous question by accepting a multilinear view of development; there is also a tendency to assume that cognitive styles and/or abilities have absolute transfer value, e.g., "a field independent person is field independent in all situations that require restructuring" (p. 1352).

In the service of redirecting thinking in these areas, Kagan and Kogan offer their view "that the accurate discrimination of differences can be considered an index of differentiation. The accurate apprehension of similarities can be considered an index of hierarchic integration" (p. 1292). They suggest that these processes analog analysis and synthesis and that their interrelation explains the transition from perceptual to conceptual systems of thought. Differentiation is a primary, a necessary, but not sufficient condition for hierarchic integration.

Within such a view, the lack of correlation between cognitive style variables and cognitive tasks might be seen as reflecting continuity within discontinuity. For example, the increasing ability over age to overcome an embedding context may facilitate differentiation, but does not contribute to apprehending similarities. Since solution of Piagetian conservation problems requires both differentiation and integration, developing field independence may become a necessary, but not sufficient, condition for correct solution. Some minimal degree of field independence necessary for later integration is developed by all correct solvers, who, nevertheless, remain in essentially the same rank order on an individual difference

continuum of field independence. This may explain the phenomenon of the here reported study that the only significant correlation between RFT and Discontinuous Quantity was among third graders. Perhaps third graders were more critically divided between those whose differentiation skills were minimally competent and those whose were not. Among fifth graders, perhaps all possess minimal differentiation skills, but vary on the ability to integrate.

Piaget (1970) speaks similarly to the issue of the transition from perceptual to conceptual thought systems. The preoperatory child's thinking is dominated by his percepts which become more and more accurate as he is able to differentiate observations from operations. His successful transition into the stage of concrete operations is dependent upon his construction of operations which are only initially dependent upon perception. Differentiation permits the emergence of invariances, but operations (reversible schemes) are the building blocks of integration.

If the necessary but not sufficient theory has heuristic value for formulating research, a next step in assessing the relationships among cognitive style variables and cognitive levels of development might attempt to delimit spheres of influence. For example, if a minimum level of field independence is a necessary condition for the conservation of discontinuous quantity, what <u>is</u> that minimum level in quantitative terms.

<u>SUMMARY</u>: Witkin (1965) suggested that one aim of cognitive research might be to delineate for individual children patterns of cognitive abilities. The thrust of his paper was that better instructional

environments might be conceived if educators thought in terms of cognitive style/cognitive abilities rather than in terms of quantitative amounts of "g" or "IQ".

Both cognitive style and stage of cognitive development have been shown to be related to success in academic activities. The lack of correlation among tasks purporting to measure some of these style/ability variables emphasizes the need to view development as multilinear and the individual child as unique.

While cognitive levels of development may delineate limits of cognitive activity within an academic area, cognitive style variables may facilitate or inhibit transition between states in a "lower-bound" threshold model. Piaget (1970) talks about the very real possibilities for pedagogic intervention in cognitive development. Cognitive style variables may suggest appropriate approaches for structuring academic content along individual difference variables that will facilitate both acquisition of content and emergence of more integrated cognitive schemes.

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