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COGNITIVE STYLE AS A VARIABLE IN SCHOOL LEARNING

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December 4, 1973

ABSTRACT

The purpose of the study was to investigate the relationship between cognitive style and school learning among fifth-grade children. The findings indicated that cognitive styles are differentially related to school learning outcomes for both boys and girls after verbal and nonverbal intelligence have been taken into consideration. The results suggested that cognitive style may be a relevant variable to consider both in analyzing school learning tasks and in assigning children to alternative learning environments.

COGNITIVE STYLE AS A VARIABLE IN SCHOOL LEARNING[1]

December 4, 1973

The possible effects of individual differences in cognitive style on school learning has been speculated upon since the notion of cognitive style was introduced by Gardner twenty years ago (Gardner, 1953; Witkin, et al., 1962 , Kagan, Moss and Sigel 1963; Wallach and Kogan, 1965; Messick, 1970; Kogan, 1971; Glaser, 1972, Nunney and Hill, 1972). Empirical evidence, however, has led to few conclusions concerning the relationships among cognitive style, learning conditions, and learning outcomes (Cronbach, 1968; Huckabee, 1969; Coop and Brown, 1970).

Although the relationship between cognitive style and school learning may be masked because individual differences in style are not commonly matched with learning conditions, a more basic problem may lie in style tests themselves. Among the problems most often cited in the literature are poor item characteristics, scoring based on ipsative formats and the irrelevance of performance on style tests in relation to school learning tasks (Wallach and Kogan, 1965; Annesley, 1971; Davis, 1971; Denmark, Havlena, and Murgatroyd, 1971; Denney, 1971; Gatewood, 1971; Brozovich, Hall, and Watson, 1972).

The purpose of the present study was to investigate further the relationship between cogntive style and school learning among fifth-grade children. A test was designed for this study which featured independent scales for each cognitive style and tasks similar to school learning tasks. Performances on the subtests of the Iowa Test of Basic Skills (ITBS) were used as measures of school learning. Since past studies have suggested that interactions among cognitive style, intellectual ability, and sex may mask the relationship between cognitive style and school learning, intellectual ability and sex were included as additional variables for investigation. The Lorge-Thorndike Test of Intelligence (L-T) was used as the measure of intellectual ability.

The cognitive style dimension under study was earlier identified by Kagan et al. (1963). Kagan et al. defined cognitive style as "stable individual preferences in modes of perceptual organization and conceptual categorization of the external environment." These investigators, subsequently, identified three cognitive styles among children: categorical, descriptive, and relational. Categorical responses refer to the use of common class membership in relating stimuli (e.g., a dog and a sheep are both animals). This style has been referred to as an inferential mode of conceptualization in that the use of abstract labels is a means of summarizing the detailed relationship among stimuli. Descriptive responses may be defined as concepts formed on the basis of shared physical attributes of stimuli (e.g., a dog and a sheep both have four legs). This style has been called an analytical mode of conceptualization in the sense that an individual deals with similarities among the concrete detail of stimuli. Relational responses are those in which functional relationships among stimuli are used in associating stimuli (e.g., a dog is used to drive sheep). The relational style has been referred to as a global, contextual, thematical mode in that an individual associates a whole stimulus with another whole stimulus in making an interdependent functional relationship rather than forming a concept. The definitions of each of these styles, characteristics of items on tests, and scoring criteria for classifying items from earlier investigations were used as the basis for designing the instrument for the present study (Kagan et al., 1963; Wallach and Kogan, 1965; Achenbach, 1970; Brozovich, 1972).

A preliminary task analysis of the items on the ITBS suggested a considerable range of cognitive style requirements for items between and within subtests. For example, attention to graphic symbols (descriptive style) and recognition of common graphic patterns (categorical style) seemed relevant to performance on the spelling subtest. While performance on the reading comprehension subtest would appear to be

facilitated by the ability to comprehend abstract relationships (categorical) and attend to graphic symbols (descriptive) within their syntactical context (relational). Because of the lack of research relevant to the approach taken in this study and the use of a new style instrument, two general questions seeking to investigate all possible relationships were used to guide the data analysis. First, what is the relationship between cognitive style as measured by the verbal analogy instrument and school learning as measured by the ITBS? Second, what additional information do measures of cognitive style add beyond that obtained from a traditional test of intelligence in the prediction of school learning?

METHOD

Subjects

Two-hundred-fifty-eight fifth grade children (132 boys, 126 girls) from twelve classrooms in five schools in a midwestern city served as Ss.

Tests

The ITBS and the L-T were administered as a regular part of the school district's evaluation program. Verbal and non-verbal deviation IQ scores (approximately 18 months old) for the L-T and grade-equivalent scores (6 months old) for each subtest of the ITBS were subsequently obtained by Es.

The cognitive style test consisted of verbal analogy items.[2] Each cognitive style scale (categorical, descriptive, and relational) included 14 items. The cognitive style test was administered orally by Ss classroom teachers and scored by Es.

Verbal content was chosen for the cognitive style test as most school-related tasks are predominantly verbal. Analogy items were chosen because this type of test item provided the possibility of eliminating unnecessary ambiguities in interpreting Ss responses. Although the possibility still exists of an S using cues other than those intended to select the correct answer, considerable control can be exercised over this problem with an analogy format.

A basic assumption underlying most research has been that cognitive style is an individual's manner rather than one's level of intellectual functioning. Consequently, precautions were taken to select words for expressing analogous relationships which were familiar to fifth-grade Ss. Two reading specialists reviewed 90 items initially constructed for the test and concluded that fifth-grade children would be familiar with the vocabulary. The 60 items were then administered to four fourth grade children of above average intellectual ability by Es. Based on teacher and student reactions, modifications of item characteristics were made.

The preliminary test was then administered to 50 fifth-grade children. Based on an item analysis of this data, 42 items were selected for the cognitive style instrument. The instrument was then administered to the 258 Ss.

Characteristics of Cognitive Style Test

Based on the performances of the Ss in the present study, reliabilities (KR 20) for the scales were categorical (C) .84; descriptive (D) .80; and relational (R) .78. Thus, Ss performed fairly consistently on each of the 14 item scales.

The intercorrelations among the scales were C-D .68, C-R .78, and D-R .75. Hence, Ss tended to occupy the same relative position on each scale. As these intercorrelations suggested that multiple modes of conceptualization or equal facility with each style may be more prevalent among children than a single cognitive style, relative frequencies of single and multiple modes of conceptualization were investigated.

A median split for each of three scales was used to classify Ss into the eight possible combinations of above and below median groups. Ninety Ss performed above the median on the three scales, 87 below the median on all scales, and 81 above the median on at least one scale and below the median on at least one scale. Based on this procedure, 31% of the Ss could be classified as not having equal facility in the use of all three styles.

RESULTS AND DISCUSSION

Table 1 presents the correlation coefficients between the raw scores on the three style scales, deviation IQ scores for the verbal and nonverbal batteries of the L-T , and grade-equivalent units for the ITBS subtests. Of the 129 correlation

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Insert Table 1

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coefficients reported there were only two significant differences between boys and girls when the same set of correlations were calculated separately for each sex. The correlation between reading comprehension and usage and between descriptive style and vocabulary were significantly higher ($p < .05$) for girls than boys.

Correlations were then calculated between each measure of cognitive style and each measure of school learning with both verbal and nonverbal IQ partialled out of the school learning measure. The results of this series of analysis are reported

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Insert Table 2

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in Table 2 for the total, boy and girl samples. Significant partial correlations were based on F-values for each cognitive style when entered as a third variable in the multiple regression equation.

Twenty-six of the 33 partial correlations were significant for the total sample. Nineteen partial correlations were significant for boy Ss, and thirteen for girl Ss. Thus, it may be concluded that cognitive style contributed significantly beyond the variance accounted for by verbal and nonverbal IQ in the prediction of school learning.

A comparison of the uniform zero order correlations of Table 1 and the highly variable partial correlations from Table 2 suggest a complex interaction of cognitive style, intellectual ability, sex, and school learning. Because of the high intercorrelations among the three style measures, no additional interpretations were made of these results at this point in the data analysis.

A series of multiple regression analysis were performed to partial out common variance of the cognitive style measures in relation to school learning. The results of this series of analysis are reported in Table 3 for both sexes. Six

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Insert Table 3

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of the ITBS subtests (vocabulary, reading comprehension, capitalization, map reading, graphs and tables, and mathematical concepts) involve multiple cognitive style orientations based on significant style contributions across sex. The five remaining subtests were less complex in cognitive style requirements.

Descriptive style contributed significantly in 19 of the 22 analysis for both sexes. A reversal occurred, however, for categorical and relational styles. For boys, relational style accounted for seven of ten additional significant style contributions. Seven of the nine significant style contributions for girls were for categorical style.

The only school learning variable in which a style other than descriptive entered the regression equation first for both sexes was mathematical concepts. A task analysis of this subtest suggested that this is the purest measure of categorical style behavior among the ITBS subtests.

In the other two instances (reading comprehension and graphs and tables) in which descriptive style did not enter the regression equation first, relational style entered first for boys. These are both subtests in which considerable contextual cues are provided to the test examinee. In addition, these were the only two subtests in which relational style made a significant contribution in relation to school learning for girls.

SUMMARY

The results of this study support earlier contentions that standardized-intellecutal ability and school achievement tests are quite heterogeneous with respect to cognitive style requirements. The findings indicated that additional

variance is accounted for by cognitive style measures in relation to school learning beyond that of verbal and nonverbal IQ. In addition, cognitive style provided a basis for task analyzing the various subtests of the ITBS.

Of the three style measures, descriptive style was the most important contributor in the prediction of school learning. For boys, a relational style contributed more often in the prediction of school learning than a categorical style. A categorical style accounted for additional variance in the prediction of school learning more frequently for girls than a relational style.

Based on the findings of this study, it would seem that differential instruction of children with different cognitive styles may be a fruitful line of investigation. However, it must be pointed out that the frequency of equal facility with each style was found to be more prevalent among fifth-grade Ss than a single mode style. In addition, over one-half of the school learning tasks involved multiple mode styles.

TABLE 1

INTERCORRELATIONS AMONG ALL VARIABLES*

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	Categorical Style															
2	Descriptive Style	.68														
3	Relational Style	.78	.75													
4	Verbal IQ	.58	.59	.56												
5	Nonverbal IQ	.62	.60	.59	.72											
6	Vocabulary	.51	.54	.51	.69	.51										
7	Reading Comprehension	.50	.54	.54	.70	.57	.81									
8	Spelling	.52	.57	.47	.71	.56	.69	.70								
9	Capitalization	.47	.52	.44	.63	.59	.58	.64	.68							
10	Punctuation	.48	.55	.46	.63	.55	.60	.69	.79	.78						
11	Usage	.45	.56	.45	.58	.51	.69	.71	.67	.67	.69					
12	Map Reading	.52	.53	.51	.64	.68	.61	.67	.60	.60	.62	.59				
13	Graphs and Tables	.46	.46	.47	.56	.58	.61	.67	.51	.56	.55	.54	.69			
14	Reference Materials	.46	.51	.45	.65	.59	.68	.76	.67	.66	.72	.63	.70	.68		
15	Mathematical Concepts	.56	.54	.51	.64	.69	.56	.65	.62	.61	.63	.57	.66	.61	.63	
16	Mathematical Problems	.51	.55	.48	.68	.65	.55	.63	.67	.66	.68	.57	.63	.62	.67	.74

* All correlation coefficients are significant at the .001 level.

Table 2

Partial Correlations of Cognitive Styles
after Variability Attributed to Verbal and Nonverbal IQ
has been removed from School Learning

Variable	Total Sample			Boys			Girls		
	C	D	R	C	D	R	C	D	R
Vocabulary	**20	**23	**21	13	11	13	**29	**37	**31
Reading	**12	**19	**21	*16	*14	**23	07	**22	**18
Spelling	**17	**24	10	*15	*18	05	**19	**27	13
Capitalization	09	**18	06	13	**24	**18	05	11	-05
Punctuation	*13	**24	*12	13	*18	*16	12	**27	09
Usage	*13	**29	*14	13	**25	*15	12	**33	12
Map Reading	*10	*14	*13	**20	**23	**23	-05	06	04
Graphs and Tables	10	*11	*15	*16	11	**18	04	12	12
Reference Materials	05	*15	08	-05	-03	-04	14	**29	*17
Mathematical Concepts	**18	*14	*12	*17	12	14	**19	**18	10
Mathematical Problems	09	*16	07	13	**21	07	04	13	08

* significant at the .05 level
** significant at the .01 level

Table 3

Results of Multiple Regression Analysis of
Cognitive Styles in Relation to School Learning

Variable	Sex	Style	Contribution of Highest Single Style		Style	Multiple R with Additional Style		F
			r	r^2		r	r^2	
Vocabulary	b	D	44	19	R	47	03	4.92**
	g	D	63	40	C	66	04	8.04**
Reading Comprehension	b	R	51	26	C	54	03	5.60**
	g	D	58	34	R	60	02	4.28*
Spelling	b	D	52	27				
	g	D	59	38	C	61	03	6.27**
Capitalization	b	D	56	31	R	58	02	4.52*
	g	D	48	23	C	51	03	4.61*
Punctuation	b	D	50	25	R	52	02	4.31*
	g	D	57	33				
Usage	b	D	51	26				
	g	D	59	34				
Map Reading	b	D	58	34	R	62	05	9.34**
	g	D	48	23	C	52	03	5.57**
Graphs and Tables	b	R	50	25	C	54	04	7.92**
	g	D	45	20	R	48	03	4.16*
Reference Materials	b	D	40	16				
	g	D	58	34	C	60	02	3.13*
Mathematical Concepts	b	C	54	29	R	58	05	10.00**
	g	C	58	34	D	61	03	5.70**
Mathematical Problems	b	D	55	30				
	g	D	54	29	C	57	03	6.24**

* significant at .05 level
** significant at .01 level

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Footnotes

1. Requests for reprints should be sent to the first author as indicated on cover sheet.
2. The following are examples of each type of item. Categorical: Dog is to cat as chicken is to (a) feather (b) eggs *(c) pig (d) bark; Descriptive: Chair is to legs as lamp is to (a) furniture (b) light (c) hand *(d) light bulb; Relational: Key is to lock as saw is to (a) keys *(b) board (c) tool (d) teeth.

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* correct alternative