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ABSTRACT

This study explores the relationships between nonconservation, conservation, field dependence/field independence and the following school variables: achievement, screening measures, sex and race. A sample of 72 students in grade one in a southern rural elementary school were grouped into three sections by ability and given a series of tests. Instruments used were the Children's Embedded Figures Test (CEFT), Piaget's Conservation Tasks (PCT), Comprehensive Test of Basic Skills (CTBS) and the First Grade Screening Test (FGST). A positive relationship between conservation category (PCT) and cognitive style (CEFT) was found. Students who were conservers tended to be field independent and high achievers. The reverse was also apparent in the data. Unexpectedly, the girls' mean score on the CEFT was higher than the boys' mean score. White students who were more field independent and were conservers did better on achievement measures than those who were black, field dependent and/or nonconservers. It is concluded that educational experiences appropriate for the student's cognitive level and consistent with his/her processing style may help students achieve at a higher level. (Author/RH)

Piaget Conservation and Cognitive Style As Related to School Variables

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Piaget's Conservation and Cognitive Style

As Related to School Variables

Statement of Problem:

The study explores the relationships between non conservers/conservers and field dependence/field independence with school variables: achievement, screening measures, sex, and race.

Perspective(s) or Theoretical Framework:

Despite the popularity of Piagetian psychology in studies of learning, the relevance of this theory to teaching and achievement in schools has often been contested. There is a paucity of studies in the literature that would establish its meaningfulness to school achievement. Almy, Chittenden, and Miller (1966) found moderate correlations (r = .37 and .39) between a measure of conservation and a measure of reading readiness in kindergarten children and with a measure of reading (r = .37 and .39) in second grade children. In addition, Briggs and Elkind (1973) found that readers as compared to nonreaders were significantly superior on conservation tasks. De Vries (1974) found correlations between Piagetian tasks and the Metropolitan Achievement Tests, Reading (MAT-R) to be low ranging from .01 to .33. Orpet, Meyers, and Grein (1976) also found a nonsignificant r of .13 between a measure of liquid conservation and the Stanford Achievement Test. Taken altogether, the studies have yielded inconsistent relationships as evidenced by substantial correlations as found in the Almy et. al. (1966), Kaufman and Kaufman (1972) study and essentially the absence of any relationship in the De Vries (1974) and Orpet et. al. (1976) studies.

Although there are also some inconsistencies, a positive correlation between conservation and mathematics and the sciences seems to be indicated. Wallman (1977), for example, suggested in a study with three math classes that performance on a Piagetian task improves with math ability and with grade. Sayre and Ball (1975) found correlations of .33 and .46 between Piagetian tasks and science grades for junior high and high school students, respectively.

From a structural point of view, conservation tasks resemble Witkin's field-independence-dependence tasks. According to Case and Pascual-Leone (1975) failure in conservation tasks may be related to field dependence. Field dependence (FD) and field independence (FI) are cognitive styles originally described by Witkin in 1949 and extensively researched (1977).

A correlation between the FI dimension and various Piagetian tasks has been demonstrated (Case and Pascual-Leone, 1975; Willemsen, Buckholz, Budrow, and Geannacopulas, 1973; and Fleck, 1972).

Witkin (1977) cites numerous studies that demonstrated a lack of any relationship between the FD-FI dimension and achievement at the college level, moderate relationships at the high school level and a definite relationship at the elementary school level (Cropley, 1966; Erginel, 1970; Frederick, 1967; Wagner, 1974).

Method:

Sample:

The sample consisted of 72 students in grade one in a Southern rural elementary school. Students were grouped into three sections

by ability. The student assignment was made by the principal based on recommendations of the kindergarten teachers and the results of the First Grade Screening Test. All sections were included in the study.

There were 36 boys and 36 girls. Thirty three of the students were white and 39 were black. The total number of students was 76. Two were omitted from the sample because parents did not sign the permission; two others could not participate because of handicaps.

Instruments:

Instruments used were the Children's Embedded Figures Test (CEFT), Piaget's Conservation Tasks (PCT), Comprehensive Test of Basic Skills (CTBS) and the First Grade Screening Test (FGST).

The results of the CEFT, Tent Version, were used to classify children as field dependent (FD), mixed (FD-FI) or field independent (FI).

The PCT consisted of 8 tasks, 2 on conserving liquids, 2 on conserving mass, 2 on conserving number and 2 on conserving weight.

Two points were awarded for each task: one for the correct answer and one for the correct rationale. Results of this instrument were used to classify students as non conservers, transitional or conservers. The tasks were assembled by the investigators consistent with typical Piagetian conservation tasks.

Achievement was measured by the CTBS, Form S, Level B, which was administered at the end of the first grade.

First grade placement was determined by the FGST which was administered during the first two days of school to all first graders and by recommendations

of kindergarten teachers for those who had attended kindergarten (90% of 76 students).

Procedures:

Prior to the testing on the CEFT and PCT by the investigators the FGST and the CTBS had been given by school personnel. The screening test (FGST) was one of the determinants of placement by ability and was given in August. The CTBS was to measure achievement at the end of grade one and was administered in April. During the last of April and May the investigator individually administered the CEFT and PCT to students in the sample.

Students were classified as field dependent (FD) if their score on the CEFT was from 0 to 3; mixed (FD-FI) if their scores were from 4 to 6; field independent (FI) if their scores were from 7 to 11.

On the Piaget Conservation Tasks (PCT) students were classified as non conservers if their scores were from 0 to 4, transitional from 5 to 10, and conservers from 11 to 16.

Data were analyzed by computer using the Statistical Analysis System (SAS). Correlations, means, and analyses of variance were computed.

The results were divided into six sections. The first section reports the general descriptive data; the second, the results by conservation category; third results by FD-FI classification; fourth results by sex; fifth by race; and the last, interaction effects.

Results:

Descriptive Data:

Means and standard deviations of the four measures for the total sample,

by sex, by race, by conservation category and by CEFT classification are reported in Table 1.

Insert Table 1 About Here

Conservation:

There were significant differences between students in Piagetian categories on CEFT, FGST, and CTBS. The correlation between PCT and CEFT was .45 ($p < .0001$). Sex was not a significant variable when the two-way analysis of variance by Piagetian category and sex was computed. Race as well as Piagetian category was significant on CEFT, FGST, and the CTBS when a two-way analysis was computed by Piagetian category and race. There was no significant interaction between Piagetian category and sex or race. (see Table 2)

Two-way analysis of variance by Piagetian category and FD/FI category showed each to be significant on the CTBS and the FGST but with no significant interaction. (see Table 3) No conservers were field dependent.

Insert Tables 2 and 3 About Here

Field Dependence/Field Independence:

Analysis of variance between the group classed as field dependent (FD, score 0-3) and the group classed as field independent (FI, score 7-11) showed significant differences in conservation (PCT), achievement (CTBS), and the First Grade Screening Test (FGST), all in favor of the field independent group. (see Table 4)

Insert Table 4 About Here

Sex:

Analysis of variance by sex showed no significant difference between boys and girls on conservation tasks. However, the girls scored higher on conservation tasks than the boys and the difference approached significance ($p < .08$).

In the Piagetian categories, 67% of the boys and 47% of the girls were non conservers. More girls (44%) were transitional than the boys (28%) and about the same number of each sex conserved. (see Table 5)

Insert Table 5 About Here

There was a significant difference in achievement (CTBS) in favor of the girls. Girls scored higher (more field independent) on the CEFT than boys but the difference was not statistically significant. This is contrary to the literature.

Although about the same number of boys as girls were FI, there were more FD girls (36%), than boys (22%). This is consistent with previous research by Witkins. (see Table 6)

Insert Table 6 About Here

Race:

Analysis of variance showed that white students scored significantly higher on the CEFT, conservation tasks, (PCT), and achievement (CTBS)

than black students which is also consistent with previous research.

The majority of the black and white students were non conservers in the first grade: 48% of the white students were non conservers as compared to 64% of the blacks. Of the white students 4 (12%) conserved and 1 (2%) of the blacks conserved. (see Table 7)

Insert Table 7 About Here

On the FD-FI, 42% of the whites were FI as compared to 8% of the blacks; 18% of the whites and 38% of the blacks were FD. (see Table 8)

Insert Table 8 About Here

Interactions:

Interactions of conservation status and sex and conservation status and race are reported in Figures 1-4. None is statistically significant.

Interactions of field dependent/independent and sex and field dependent/independent and race are shown in Figures 5-8. None is statistically significant.

As reported in an earlier section there was no significant interaction between conservation and FD/FI. (see Figure 9)

Insert Figures 1-9 About Here

Discussion:

A positive relationship (r=.45) between conservation category (PCT) and cognitive style (CEFT) was found. Students who were cognitively

developmentally advanced over other students scored more field independent. They also scored higher on achievement measures. Thus students who were conservers tended to be field independent and high achievers. The reverse was also apparent in the data. These results raise the question of which of the variables, if any, causes the outcomes on the other variables. Additional research will have to explore this issue. One might ask if all of these might not be the result of an additional but unmeasured variable, namely that of intelligence of g factor (in a more traditional definition of intelligence). Witkins et al. (1977) has reported a low positive relationship between intelligence and FD/FI, but he believes there is no difference in the learning ability between FD's and FI's but a difference in their psychological differentiation. The investigators are currently collecting conventional intelligence score data on the sample.

Sex and race variables were also explored in relation to conservation and FD/FI and achievement. The Figures 1-9 show what might be expected to be interaction effects, but the N's in the higher categories were small. The findings on sex and race differences for the variables were generally consistent with previous studies with the exception of the girls' mean score on the CEFT; it was higher than the boy's mean score. This is inconsistent with past research which reported boys as more field independent than girls. If cognitive style is another dimension of a g factor, the higher mean score for girls would be consistent with the studies on achievement and intelligence which have shown girls in the early grades score higher than boys on such measures.

White students who are more field independent and are conservers do better on achievement measures than those who are black, field dependent and/or non conservers. The CEFT and PCT contributed 39% of the variance in achievement. Teachers who assess student's cognitive style and conservation category and plan curriculum consistent with these, may be able to help students to achieve at a higher level. The results of such intervention was not found in the literature. Efforts to train students to be more field independent or to advance their level of conservation attainment have been reported with varying success.

Perhaps training to change the child's category on the FD/FI dimension and/or level of conservation attainment is not where significant results will be attained. Appropriate educational experiences at the student's cognitive level and consistent with his/her processing style may be the rewarding approach.

Table I

Means and Standard Deviations of Total Sample and Sub Groups

Variable		Total	Sex: Male	Sex: Female	Race: White	Race: Black	Non.cons.	Trans.	Cons.	Fld.Dep.	Mixed	Fld. Ind.
N=		72	36	36	33	39	41	26	5	21	34	17
Piaget Conservation Tasks (PCT)	$\bar{x}$	4.76	4.08	5.44	5.70	3.97	2.41	6.92	12.8	3.67	4.24	7.18
	SD	(3.28)	(3.16)	(3.49)	(3.84)	(2.74)	(1.32)	(1.32)	(1.64)	(2.29)	(3.10)	(3.97)
Children Embedded Figures Test (CEFT)	$\bar{x}$	4.86	4.75	4.97	5.67	4.18	4.07	5.65	7.2	2.29	4.91	7.94
	SD	2.17	(2.12)	(2.44)	(2.50)	(1.83)	(1.93)	(2.35)	(1.64)	(1.06)	(.87)	(1.09)
First Grade Screening Test (FGST)	$\bar{x}$	17.24	16.16	17.48	21.17	12.75	14.66	19.14	21.80	13.2[illegible]	16.34	21.00
	SD	6.46	(6.63)	(6.53)	(4.33)	(5.63)	(6.66)	(5.52)	(4.87)	(6.88)	(5.57)	(5.80)
CTBS	$\bar{x}$	205.19	188.92	222.42	233.30	180.11	191.48	218. 4	248.84	176.84	204.26	238.71
	SD	(58.81)	(53.41)	(60.11)	(54.85)	(50.84)	(58.78)	(56.72)	(36.48)	(49.80)	(60.23)	(49.97)

Table 2

Analysis of Variance between Nonconservers and Conservers on CEFT, CTBS and FGST

Measure	N	DF	F	P
FD/FI (CEFT)	46	1	12.01	.001*
Achievement (CTBS)	45	1	4.48	.04*
Screening (FGST)	40	1	5.38	.03*

* significant p values

Table 4

Analyses of Variance between Field Dependent and Field Independent Groups on PCT, CTBS, FGST

Measure	N	DF	F	P
Conservation (PCT)	38	1	11.29	.002*
Achievement (CTBS)	36	1	14.37	.001*
Screening (FGST)	33	1	11.87	.002*

* significant p values

Table 5

Number of Students by Sex in each Piagetian Category

	Nonconservers	Transitional	Conservers	Total
boys	24 (67%)	10 (28%)	2 (6%)	36 (100%)
girls	17 (47%)	16 (44%)	3 (8%)	36 (100%)
total	41 (57%)	26 (36%)	5 (7%)	72 (100%)

Table 6

Number of Students by Sex in Each FD/FI Group

	FD	Mixed	FI	Total
boys	8(22%)	20 (56%)	8 (22%)	36 (100%)
girls	13(36%)	14 (39%)	9 (25%)	36 (100%)
total	21(29%)	34 (47%)	17 (24%)	72 (100%)

Table 7

Number of Students by Race in Each of Piagetian Categories

	Nonconservers	Transitional	Conservers	Total
White	16 (48%)	13 (39%)	4 (12%)	33 (100%)
Black	25 (64%)	13 (33%)	1 (2%)	39 (100%)
Total	41 (57%)	26 (36%)	5 (7%)	72 (100%)

Table 8

Number of Students by Race in Each FD/FI Group

	FD	Mixed	FI	Total
White	6 (18%)	13 (39%)	14 (42%)	33 (100%)
Black	15 (38%)	21 (54%)	3 (9%)	39 (100%)
Total	21 (29%)	34 (47%)	17 (24%)	72 (100%)

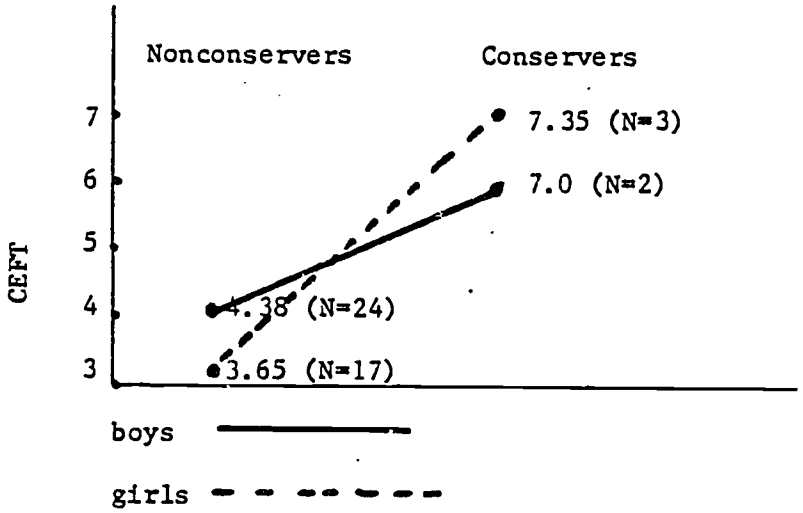

Figure I
Mean CEFT Scores for Nonconservers and Conservers by Sex

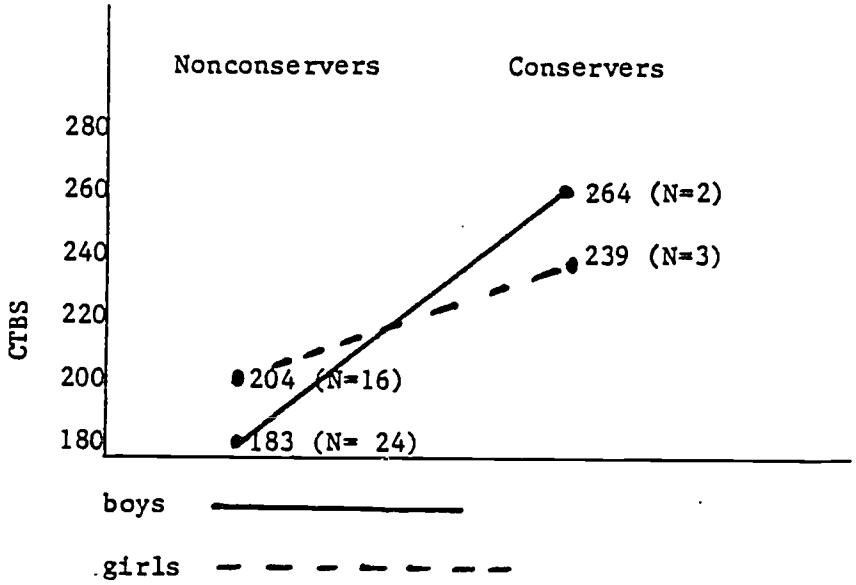

Figure 2
Mean CTBS Scores for Nonconservers and Conservers by Sex

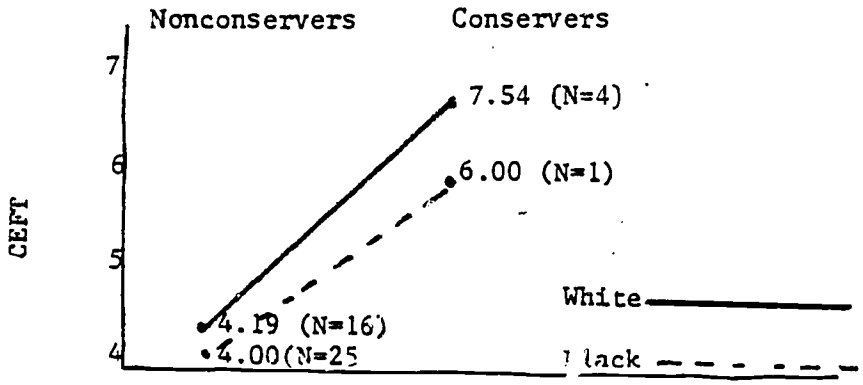

Figure 3
Mean CEFT Scores for Nonconservers and Conservers by Race

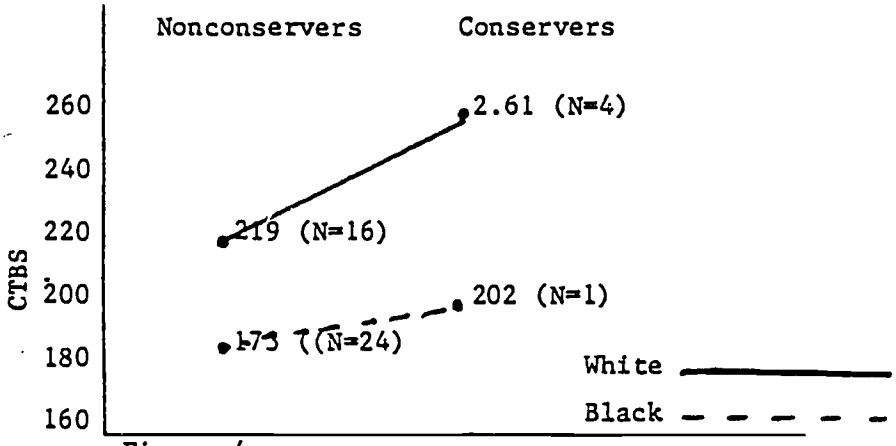

Figure 4
Mean CTBS Scores for Nonconservers and Conservers by Race

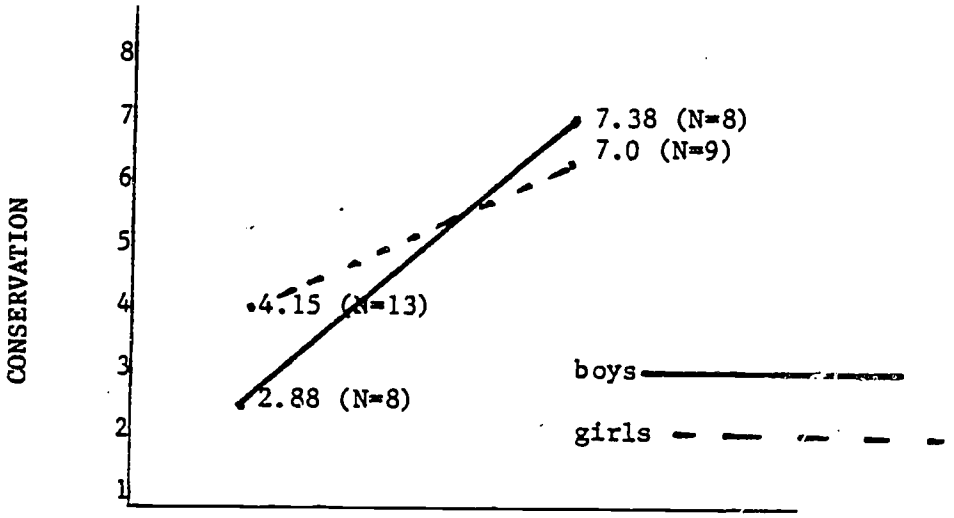

Figure 5
Mean Conservation Score for FD and FI Groups by Sex

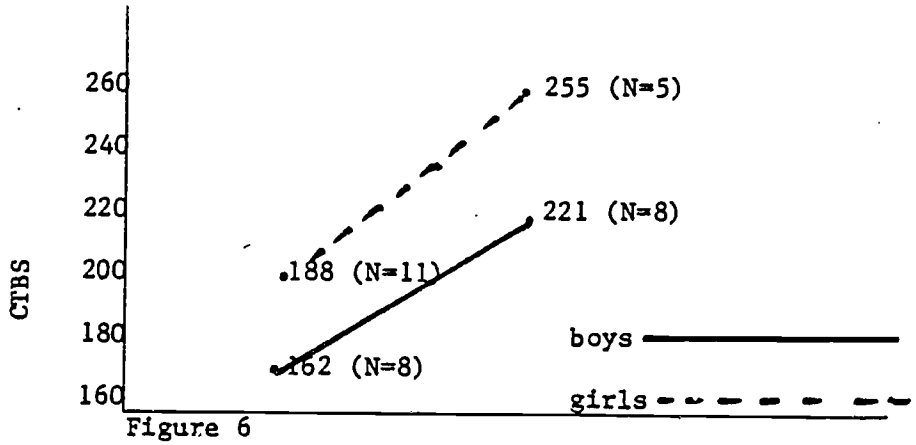

Figure 6
Mean CTBS Scores for FD and FI Groups by Sex