DOCUMENT RESUME

ED 268 474 CG 019 033

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TITLE Cognitive Style Correlates of Mathematical Ability among College Students.
PUB DATE Aug 85
NOTE 10p.; Paper presented at the Annual Convention of the American Psychological Association (93rd, Los Angeles, CA, August 23-27, 1985).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Cognitive Style; College Students; *Field Dependence Independence; Higher Education; Individual Differences; *Intelligence Quotient; *Mathematics Skills; *Sex Differences; *Sex Role
IDENTIFIERS *Mathematical Aptitude

ABSTRACT

The field dependent-independent cognitive style has been noted by researchers to be related to mathematical achievement. Researchers have also noted a relationship between field dependence and measures of intelligence, and between sex and mathematical achievement. A multiple regression framework was used to examine the effects of field dependence, intelligence quotient (IQ), sex, and sex role on several types of mathematical ability for 33 female and 35 male college students. Subjects completed the Harris Test of Lateral Dominance, the Embedded Figures Test, Bem Sex Role Inventory, and the Slosson Intelligence Test. Subjects were also administered a mathematics test measuring ability with basic mathematics facts and word problems, ranging from simple addition and subtraction to first-level algebra. Field dependence was found to correlate significantly with both IQ and some mathematical abilities. Regression analyses revealed that although IQ was the single best predictor of mathematical ability, field dependence and self-reported masculine sex role were also significant predictors. Males and females did not differ in mathematical ability. These findings suggest that biological sex may not be as predictive of mathematical ability as perceived sex role. Based on results of this study, it would appear that classroom practices designed to match mathematics instruction to students' cognitive styles may prove useful. (NB)

Cognitive Style Correlates of Mathematical Ability Among College Students

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Abstract

The relationships among field dependence, IQ, sex, sex role, and mathematical abilities were investigated in this study which used 33 female and 35 male college students. Field dependence was found to correlate significantly with both IQ and some math abilities. Regression analyses revealed that although IQ was the single best predictor of math ability, field dependence and self-reported masculine sex role were also significant predictors. Males and females did not differ in math ability. Implications for classroom practices are discussed.

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The field dependent-independent cognitive style has been noted by many researchers to be related to mathematical achievement. For example, such a relationship has been found for 10- and 11-year-old English boys (Satterly, 1976), for Pennsylvania elementary school children (Vaidya & Chansky, 1980), for middle school students (Roberge & Flexer, 1983), and for female undergraduates (DuBois & Cohen, 1970). The general finding is that field-independent students display superiority in math achievement over field-dependent students.

Researchers have also noted a relationship between field dependence and measures of intelligence (e.g. DuBois & Cohen, 1970). Since intellectual measures would be anticipated to correlate strongly with math achievement, this raises the possibility that the relationship between field dependence and math achievement could be spurious.

There have also been numerous reports of sex differences in math achievement. In their review on this issue, Maccoby and Jacklin (1974) concluded that it was fairly well established that boys excel in math ability, especially after the onset of adolescence. However, it is still not clear why such sex-related differences occur even though the literature currenty abounds with studies on the topic (e.g. Benbow & Stanley, 1980, 1982, 1983; de Wolf, 1981; Meece, Parsons, Kaczala, Goff, and Futterman, 1982; Sherman, 1982, 1983; Paulsen & Johnson, 1983).

This study used a multiple regression framework to examine the effects of field dependence, IQ, sex, and sex role on several types of math ability for college students.

Method

Subjects

A total of 68 (33 female and 35 male) college students were tested. They were all enrolled in an introductory psychology course.

Materials

Tests employed in this study were the Harris Test of Lateral Dominance (Harris, 1974), the Embedded Figures Test (Witkin, Oltman, Raskin, & Karp, 1971), the Bem Sex Role Inventory (Bem, 1974), and the Slosson Intelligence Test (Slosson, 1961). Subjects were also administered a tailor-made mathematics test which was divided into three parts. Part 1 consisted of 60 items that measured knowledge of basic math facts. The items included were simple single and double digit addition, subtraction, and mutiplication problems. Part 2 consisted of 32 items involving addition, subtraction, and multiplication of two digit terms. Each item required the process of carrying or borrowing. Part 3 consisted of 15 "word" problems ranging from simple addition and subtraction to first-level algebra.

Procedure

Each of the 68 subjects was tested individually on the Harris Test, the Embedded Figures Test, the Bem Sex Role Inventory, and the Slosson Intelligence Test. Subjects were administered the math test as a group in a classroom. Each part of the math test was timed in order to allow approximately 80% of the subjects to complete all of the items.

Results

The first step in data analysis was an examination of the correlation matrix (Table 1). The Embedded Figures Test scores were significantly correlated with Slosson Intelligence Test scores, $r = -.43$, $p < .001$. Field independent subjects displayed higher IQ scores. IQ scores were significantly correlated with all parts of the math test, with correlations ranging from .40 to .68. Embedded Figures Test scores were also correlated with Part 3 of the math test, $r = -.40$, $p < .001$.

It should be noted that Part 1 and Part 2 of the math test were highly correlated, $r = .82$, $p < .0001$, and were added together to provide a single measure for the remainder of the analysis.

Stepwise multiple regression analyses (with backward elimination) were conducted on three math test criterion variables, the combined Parts 1 and 2, Part 3, and a total math score combining all three parts. The predictor variables were the Embedded Figures Test scores, the Slosson

Intelligence Test scores, sex, the masculinity and femininity scores from the Bem, and a difference score from the Bem (masculinity minus femininity).

The regression analysis on the combined math test scores from Parts 1 and 2 resulted in Slosson Intelligence Test scores, the Embedded Figures Test scores, and the masculinity scores being entered into the final equation (in that order). The equation accounted for 28% of the variance. The second regression analysis on math scores from Part 3 resulted in the Slosson Intelligence Test scores and the difference score from the Bem being entered into the final equation which accounted for 49% of the variance. The final regression analysis on the combined total math scores resulted in the Slosson Intelligence Test scores, the masculinity score, and the Embedded Figures Test scores being chosen as significant predictors. This equation accounted for 38% on the variance.

Discussion

These data clearly indicate that, as anticipated, intelligence is correlated with both mathematical ability and field dependence (as represented by the Embedded Figures Test). They also demonstrate that the often reported correlation between field dependence and math ability is inflated by the fact that these variables each correlate with intelligence. However, with certain types of math ability, prediction based solely on IQ scores can be significantly improved with additional knowledge of an individual's Embedded Figures Test score.

It must be noted that in this sample sex was not predictive of math ability. However, self-reports of typical masculine behavior on the Bem (sometimes as a difference score compared to self-reports of feminine behavior) were predictive of math ability.

This study resulted in two important findings. First, although IQ and field dependence are correlated, field dependence is still predictive of some types of math ability when the effects of intelligence have been statistically controlled. Second, biological sex may not be as predictive of math ability as perceived sex role.

These findings suggest that classroom practices designed to match math instruction to students' cognitive

styles may prove useful. Cognitive styles such as field dependence-independence are related to mathematical ability. The study also suggests that math ability is not necessarily related to sex. However, sex role attitudes and self-perceptions are certainly very important in math achievement.

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Table 1

Correlation Matrix for Predictor and Criterion Variables

Variables	2	3	4	5	6	7	8	9
1. EFT	-.05	.07	-.10	-.43[3]	.03	.04	-.40[3]	-.07
2. Bem (Masc.)		.20	.72[3]	.12	.25[1]	.25[1]	.15	.27[1]
3. Bem (Fem.)			-.54[3]	-.15	.01	-.05	-.23	-.07
4. Bem (difference)				.20	.21	.25[1]	.29[1]	.28[1]
5. Slosson					.40[3]	.42[3]	.68[3]	.55[3]
6. Math - Part 1						.82[3]	.32[2]	.94[3]
7. Math - Part 2							.34[2]	.90[3]
8. Math - Part 3								.56[3]
9. Math - Total								

[1] $p < .05$

[2] $p < .01$

[3] $p < .001$