DOCUMENT RESUME

ED 306 162 SO 019 833

AUTHOR McCorkle, Sarapage; Cohen, Margaret W.
TITLE Field Dependence/Field Independence and Student Achievement in Economics.
PUB DATE Apr 88
NOTE 28p.; Paper presented at the Annual Meeting of the American Educational Research Association (69th, New Orleans, LA, April 4-9, 1988).
PUB TYPE Reports - Research/Technical (143) -- Speeches/Conference Papers (150)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Academic Achievement; *Cognitive Ability; *Cognitive Measurement; Cognitive Processes; Economics; *Economics Education; *Field Dependence Independence; *Intelligence Tests; Postsecondary Education; Regression (Statistics); Statistics

ABSTRACT

This study was designed to test the hypothesis that relatively field independent students will perform at a significantly higher level than relatively field dependent students in college-level, introductory economics courses. Previous studies focused on comparative pedagogies, or an examination of the student variables of gender, ability, socioeconomic status, and age. The study employed one theory of cognitive style to examine the relationship between field dependence/field independence as a process variable and student achievement in economics. Field dependent students were viewed as being more globally oriented, more accepting of the "whole", while field independent students were more analytical in their information processing characteristics, and would be more successful in applying the basic analytical methodologies employed by introductory economic texts. Students in two introductory microeconomics courses at an urban, midwestern university made up the sample. Data were collected through the use of four instruments: (1) the Group Embedded Figures Test (GEFT); (2) the Revised Test of Understanding in College Economics (TUCE); (3) the Attitude Towards Economics (ATE) section of the Survey of Economic Attitudes; and (4) a student questionnaire, as well as SAT (Scholastic Aptitude Test), ACT (American College Test and SCAT (School and College Ability Test) scores. Achievement and learning were measured and tested using a linear regression model. Statistical significance of cognitive style occurred when achievement was specified as the change in knowledge relative to the initial level of understanding. A discussion of the possible implications of the research, tables of statistics from the research, and a 17-item bibliography are included. (PPB)

FIELD DEPENDENCE/FIELD INDEPENDENCE AND STUDENT ACHIEVEMENT IN ECONOMICS

Sarapage McCorkle and Margaret W. Cohen

University of Missouri-St. Louis

Paper presented at the annual meeting of the American Educational Research Association, New Orleans, April, 1988

Field Dependence/Field Independence and Student Achievement in Economics

Research in economic education has examined the effectiveness of varying methods of instruction in improving achievement in economics in introductory, college-level courses. Studies have investigated the effects of instructional methodologies such as classroom lecture, computer-assisted instruction, programmed learning, and the use of student laboratories.

These studies generally employed either an explicit or implicit production function analysis. Siegfried and Fels (1979) indicated that most studies used a production function in the absence of an established theory of learning which presents researchers with model specification concerns. Although these reviewers noted that research on teaching college economics shows that "students learn economics in different ways" (p. 953), research has failed to identify many factors that may explain those differences.

In addition to comparative pedagogies, researchers have examined the impact of such variables as ability, gender, socioeconomic status, attitude towards economics, age, and class standing. The contribution of student psychological attributes other than ability to achieve in economics has remained relatively unexplored. Yet, educational psychologists continue to emphasize that there are many important characteristics from the cognitive domain that influence student performance. Specification bias may occur in models of economic education if these cognitive characteristics influence achievement and are excluded from the models.

Shipman and Shipman (1985) noted that "informed practice requires an informed knowledge base" (p. 229). If the results of studies on methodology in economic education are translated into practice, learning models must be correctly specified and possess accurate functional form. Meaningful research requires a theoretical model that is as complete as possible. Other input variables that may account for student differences must be included to give learning models strong explanatory power.

A variable that educators have suggested influences achievement is cognitive style. Although this student characteristic has been researched extensively in the field of education, it has been largely ignored by economic educators. As Shipman and Shipman stated:

> We do need to expand our static and generally pedagogically irrelevant status categories, such as socioeconomic status, age, sex, and ethnicity, with process variables that focus on the how rather than the what. . . . Cognitive styles take on importance in this new educational context to the extent that they reliably describe meaningful behavioral differences in people's approaches to learning situations. (pp. 285-286)

The purpose of this study, then, was to employ one theory of cognitive style to examine the relationship between cognitive style as a process variable and student achievement in economics.

Cognitive style describes a consistent mode of perceiving, processing, and utilizing information. Cognitive process refers to "how" learners acquire and retain knowledge as opposed to "what" they learn. The construct of cognitive style emanates from the information-processing school of thought and refers to the general tendencies of learners to use various cognitive processes such as selecting, encoding, organizing, storing, retrieving, decoding, and generating information. Cognitive styles are considered to be

relatively stable psychological characteristics of learners. They describe how learners process information and should not be confused with levels of skill. Although there are many different dimensions of cognitive style (Messick, 1979), this paper investigates the relationship between the cognitive style of field dependence/field independence and achievement in introductory, college-level economics courses.

Field Dependence/Field Independence

The cognitive style of field dependence/field independence has been one of the most widely researched variables describing cognitive style. The pioneer work in this area was conducted by Herman Witkin and his associates (1948, 1949, 1950, 1971, 1976, 1977). This research has indicated that relatively field independent individuals are more analytical in their information- processing characteristics than relatively field dependent individuals who tend to be more globally oriented, accepting the "whole" rather than breaking the whole into its components. Given the analytical nature of economics, it was hypothesized that relatively field independent students will achieve at a higher level than relatively field dependent students in college-level introductory economics courses, ceteris paribus.

Most introductory economics textbooks begin by explaining that economics is a way of thinking that requires a set of analytical tools. Indeed, introductory economics textbooks include a section on economic methodology that elaborates the scientific method and advises that economic principles are abstractions from reality. Texts inform that both inductive and deductive approaches are used in developing theories.

Students investigate and learn about the economic world using the basic concepts and analytical models presented in the texts.

To acquire economic reasoning skills, learners must use analytical thinking to understand economic problem solving. Field independent learners use an analytical approach more readily than field dependent learners. Research has indicated that field independent learners have an advantage in analytical courses such as mathematics and science (Witkin, 1976). The ability to analyze or break into parts may be important when students learn economics using complex graphical techniques; and field independent students, therefore, may have a comparative advantage in learning the economic way of thinking. This study was designed to test the hypothesis that relatively field independent students will perform at a significantly higher level than relatively field dependent students in college-level, introductory economics courses, ceteris paribus.

Methodology

This empirical study used a single group, pretest-posttest, ex post facto research design. Hypotheses were tested using multiple linear regression analysis to determine the level of significance of the explanatory variables.

Subjects for the study were selected from a sample of students enrolled in two, introductory microeconomics courses at an urban, midwestern university. Both classes were taught by instructors using similar lecture methodologies. Students took the same number of exams that were administered at approximately the same times during the semester.

Data and Instrumentation

Student data for the dependent and independent variables that test the research hypothesis were collected through the use of four instruments.

The Group Embedded Figures Test (GEFT) (Oltman, Raskin, and Witkin, 1971) was used to measure the cognitive dimension of field dependence/field independance (Spearman-Brown = 0.82). The test includes 18 complex figures that contain a simple figure to be located and outlined. For example, "the outlines of the simple figure might form the boundaries of several different prominent subpatterns in the complex figure, so that the simple figure in effect lost its identity as a separate perceptual unit" (Witkin, Oltman, Raskin, and Karp, 1971, p. 15). The student's score is the total number of simple figures correctly traced. Higher scores indicate relative field independence and lower scores indicate relative field dependence.

The Revised Test of Understanding in College Economics (TUCE) was used to measure pre- and post-course knowledge of economics. The TUCE, Micro Form A, (Suanders, 1981) is a nationally-normed instrument designed to test microeconomic concepts and principles (KR 20 = 0.74; s_e = 2.51).

The Attitudes Toward Economics (ATE) section of the Survey on Economic Attitudes (cf. Soper and Walstad, 1983) was used to measure student interest in economics at the beginning of the course. The ATE consists of fourteen statements where scores range from 14 to 70 (Cronbach Alpha = 0.88; s_e = 3.18).

Students were also asked to complete a questionnaire to identify their sex, age, class standing, number of semester credit hours, and

college math background. Ability measurements were obtained for students from entering SAT, ACT, and SCAT scores.

Specification of the Research Models

The basic research hypothesis that relatively field independent students will perform at a higher level than relatively field dependent students in college-level, introductory economics courses, ceteris paribus, was tested using the following linear regression model:

$$Y_i = a_i + b_j X_{ij} + e_i$$

where $i = 1,..,3$; $j = 1,..,13$; and e_i represents the stochastic error term. The error term is assumed to be normally distributed with mean zero and constant variance and to be statistically independent of the included explanatory variables.

Achievement in economics was investigated using the following three measures: (1) overall achievement in economics as measured by the TUCE, (2) overall achievement in economics as measured by the correct/total response percentage on course exams, and (3) learning in economics as measured by a gap-closing procedure between the preTUCE and postTUCE where:

Y_1 = POSTTUCE: achievement in economics as measured by the student's score on the Revised Test of Understanding in College Economics (TUCE), Micro Form A

Y_2 = PERCENT: achievement in economics as measured by the correct/total response percentage on course exams

Y_3 = GAPTUCE: achievement in economics as measured by the gap-closing measure defined as (postTUCE-preTUCE)/(30-preTUCE)

Data derived from the instruments were included as independent variables in each model where:

X_1 = GEFTM: score on the Group Embedded Figures Test as a measurement of the cognitive style of field dependence/field independence in males

X_2 = GEFTF: score on the Group Embedded Figures Test as a measurement of the cognitive style of field dependence/ field independence in females

X_3 = PRETUCE: score on preTUCE as a measurement of the initial level of overall knowledge in economics

X_4 = PREATE: score on the Attitude Towards Economics (ATE) survey as a measurement of student attitudes upon entering the course

X_5 = AGE

X_6 = CLASS: dummy variable for class standing (freshman = 0; other = 1)

X_7 = SEMHRS: course load as measured by the number of semester hours enrolled

X_8 = MATH: dummy variable for calculus (yes = 1; no = 0)

X_{10} = SAT: score on the Scholastic Aptitude Test

X_{11} = ACT: score on the American College Testing Program

X_{12} = SCAT: score on the School and College Ability Test

X_{13} = TEACHER: dummy variable (first instructor = 1; else = 0)

Each basic model was estimated using ordinary least squares (OLS). The models incorporate the basic Gauss-Markov assumptions about the distribution of the error term. The empirical model specifications and expected coefficient signs are presented in Table 1.

Since males and females perform differently on the GEFT (Witkin et al., 1971), this study allowed for the effects of cognitive style on achievement to differ by sex. The variable was separated into scores for males and females (GEFTM and GEFTF, respectively) so that the coefficients could vary by sex and reflect any differences that may exist.

Table 1
Empirical Model Specifications and Expected Coefficient Signs

	Dependent Variables		
Independent Variables	POSTTUCE	PERCENT	GAPTUCE
GEFTM	+	+	+
GEFTF	+	+	+
PRETUCE	+	+	-
PREATE	+	+	+
SEX	+	+	?
AGE	+	+	+
CLASS	-	-	-
SEMHRS	?	?	?
MATH	+	+	+
SAT	+	+	+
ACT	+	+	+
SCAT	+	+	+
TEACHER	?	?	?

The SAT/ACT/SCAT ability measures were entered into the regressions separately since they had different ranges: SAT scores vary from 0 to 1600 points; ACT scores vary from 0 to 36 points; and SCAT scores vary from 0 to 100 points. To include ability measures, it was necessary to create a dummy variable to indicate which exam a student took. The parameter estimate for the ability measure, therefore, is the dummy variable times the actual score. Consequently, the parameter estimate demonstrates the within-groups difference of students who took that specific exam. All data were analyzed using the SYSTAT (1985) statistical package.

RESULTS

Descriptive Statistics

Table 2 presents a summary of the mean ($\bar{X}$), standard deviation (s), and sample size (N) for each of the proposed measures of student achievement in economics. Missing data account for variation in sample size.

Table 2
Descriptive Statistics of the Dependent Variables

Dependent Variables	$\bar{X}$	s	N
POSTTUCE	14.38	4.64	126
PERCENT	69.94	11.92	176
GAPTUCE	0.27	0.19	117

The PERCENT mean may appear low, but the percentage scores of some students who withdrew from the course, likely because of poor performance, were included. If these students were omitted, sample selection bias may have been introduced had relatively field dependent (field independent) students tended to drop the course. For this reason, these observations were retained.

The GAPTUCE mean indicates that students, on average, increased their level of economic understanding by 27 percent, or closed 27 percent of the gap between the maximum preTUCE score and their initial score. Students who scored higher on the preTUCE than on the postTUCE were dropped from the dataset following the precedent set by Becker and Salemi (1977). They argued that "it is possible that a student who learned little and guessed a lot might score higher on the preTUCE than on the postTUCE . . . These were the cases for which it was most likely the guessing dominated learning in accounting for the TUCE scores observed" (p. 86).

Table 3 presents a summary of the mean ($\bar{X}$), standard deviation (s), and sample size (N) for the noncategorical independent variables considered in this study.

Table 3
Descriptive Statistics of Noncategorical Independent Variables

Independent Variables	$\bar{X}$	s	N
GEFTM	12.86	4.24	109
GEFTF	11.16	4.22	67
PREATE	47.25	6.60	173
SAT	914.29	131.66	14
ACT	20.37	5.24	103
SCAT	61.13	15.46	31
AGE	20.82	4.11	175
SEMHRS	13.41	2.48	174

Of the 176 student sample, 109 (62%) were male and 67 (38%) were female. The two classes were represented by 63 (36 %) freshmen, 67 (38%) sophomores, 44 (25%), and two (1%) seniors. Thirty-six (21%) students had taken a calculus course.

Regression Analyses

POSTTUCE Model. Table 4 includes the ordinary least squares regression results. The correlation coefficients are presented in the appendix. The POSTTUCE regression model was statistically significant indicating that the null hypothesis failed to be accepted.

The PRETUCE, PREATE, AGE, MATH, ACT, SCAT, and TEACHER variables were positively and significantly related to POSTTUCE. CLASS and SEMHRS appeared to have no relationship to POSTTUCE achievement. Both the ACT and SCAT scores were positively and significantly related to POSTTUCE achievement. SAT was positively correlated to POSTTUCE and statistically significant at the .10 level.

The primary research interest of this study was the relationship between the cognitive style of field dependence/field independence and student achievement in economics. GEFTM and GEFTF were positively related to POSTTUCE performance, but not at a statistically significant

Table 4
OLS Parameter Estimates for POSTTUCE and GAPTUCE

Independent Variable	POSTTUCE	GAPTUCE
CONSTANT	-10.403**	-0.672**
	(4.666)	(0.206)
GEFTM	0.056	0.008**
	(0.092)	(0.004)
GEFTF	0.063	0.007*
	(0.107)	(0.005)
PRETUCE	0.453***	-0.005
	(0.131)	(0.006)
PREATE	0.127**	0.006**
	(0.059)	(0.003)
AGE	0.331***	0.014***
	(0.118)	(0.005)
CLASS	-0.232	0.001
	(0.887)	(0.040)
SEMHRS	0.221	0.012♦
	(0.159)	(0.007)
MATH	1.826**	0.048
	(0.887)	(0.039)
SAT	0.003*	0.000**
	(0.002)	(0.000)
ACT	0.159***	0.008***
	(0.062)	(0.003)
SCAT	0.050**	0.003***
	(0.022)	(0.001)
TEACHER	1.694♦♦	0.055
	(0.761)	(0.034)
$\bar{R}^2$	0.261	0.197
F	4.540***	3.171***
N	121	107

Note. The numbers in parentheses represent the standard errors of the coefficients.
* p < .10, one-tailed. ** p < .05, one-tailed. *** p < .01, one-tailed. ♦♦ p < .05, two-tailed.

level. An explanation for its lack of statistical significance is important in this exploratory study. Although the theory of field dependence/field independence would lead to an hypothesis of a positive relationship, statistically the observed relationship was not significant. Multicollinearity may be a problem. Although the cognitive style literature has indicated that ability and cognitive

style are dissimilar constructs, the possibility that a relationship between the two existed was explored by regressing other exogenous demographic student variables. The regression equation obtained was

$$GEFT = 8.384^{***} + 1.464\ SEX^{**} + 0.022\ AGE + 0.003\ SAT^{**} + 0.154\ ACT^{***} + 0.039\ SCAT^{**}$$

where $\bar{R}^2 = 0.94$, $F = 4.630^{***}$ and $N = 175$ (** $p < .05$; *** $p < .01$). This regression indicated that SEX was significantly related to GEFT where males, on average, scored 1.5 points higher than females. AGE was not a statistically significant factor. Both of these results were expected since mean performance on the GEFT of males is generally higher than females. Age was not expected to be statistically significant since stability in field dependence/field independence at college age was reported by Witkin (1977).

Although Witkin reported that ability and cognitive style aptitudes are not the same characteristic, SAT, ACT, and SCAT scores were positively and significantly related to GEFT. It is not apparent why such a high relationship existed between GEFT and college entrance exam scores. One possible explanation is that the SAT, ACT, and SCAT tests contain questions that are favorable towards relatively field independent students. Whatever reason, the lack of statistical significance of the GEFT variable can partially be explained by its collinearity with ability. If ability were dropped from the models of this study, the GEFT coefficient may have become more statistically significant; however, specification bias would be introduced into the model. For this reason, ability variables remained in the regression models.

PERCENT Model. Table 5 presents the regression results for PERCENT. The correlation coefficients are presented in the appendix.

Complete data were available for 170 students. PERCENT was calculated by computing the percentage of correct responses on the number of exams completed during the semester.

If the number of observations differs for each student's mean PERCENT, heteroscedasticity is present. As a result, weighted least squares (WLS) regression analysis was used to derive efficient parameter estimates for this case (see Kmenta, 1971, pp. 322-326).

Table 5
WLS Parameter Estimates for PERCENT

Independent Variable	Coefficient
CONSTANT ($\sqrt{N_i}$)	-22.815**
	(10.481)
GEFTM	0.203
	(0.190)
GEFTF	0.168
	(0.225)
PRETUCE	0.586**
	(0.272)
PREATE	0.328***
	(0.110)
AGE	1.329***
	(0.198)
CLASS	0.079
	(1.837)
SEMHRS	1.589♦♦♦
	(0.310)
MATH	7.291***
	(1.941)
SAT	0.008**
	(0.004)
ACT	0.527***
	(0.116)
SCAT	0.054
	(0.042)
TEACHER	1.929
	(1.600)
$\bar{R}^2$ = 0.614	
F = 23.396***	
N = 170	

Note. The numbers in parentheses represent the standard errors of the coefficients.
* p < .10, one-tailed. ** p < .05, one-tailed. *** p < .01, one-tailed. ♦♦♦ p < .01, two-tailed.

PRETUCE, PREATE, AGE, SEMHRS, MATH, SAT, and ACT were positively and significantly related to student performance on course exams. TEACHER was not statistically significant in this model as compared to the POSTTUCE model. This result may indicate that course exam questions in the sample classes were similar but different from the postTUCE questions.

The parameter estimates of GEFTM and GEFTF were positively related to student performance in the course. Although the coefficients were more statistically significant than in the POSTTUCE model, they failed to attain statistical significance.

GAPTUCE Model. The regression results for the GAPTUCE model are included in Table 4. The correlation coefficients are presented in the appendix. GAPTUCE indicates the gain in knowledge that students achieved during the semester demonstrating the percentage increase in performance on the pre- to postTUCE. Compared to the POSTTUCE and PERCENT measures of absolute level of achievement, the gap-closing score has the advantage of demonstrating that students have learned a statistically significant amount of economics relative to their initial level of understanding. Although some students may score relatively low on the postTUCE, they may have, nonetheless, improved their knowledge significantly.

Previous studies in economic education have reported a negative coefficient on the preTUCE when included as an explanatory variable in gain-score models. The parameter estimate of PRETUCE was negative, but not statistically significant.

PREATE, AGE, and ability measures (SAT, ACT, and SCAT) were positively and significantly related to the amount of knowledge gained.

The CLASS, SEMHRS, MATH, and TEACHER variables were not statistically significant.

GEFTM and GEFTF became more statistically significant in explaining achievement than in the previous models. The research hypothesis failed to be rejected for male students at the .05 level and for female students at the .10 level. The GEFT coefficients of males and females were similar at 0.008 and 0.007, respectively.

DISCUSSION

Statistical significance of field dependence/field independence was present in the GAPTUCE model, but not in the POSTTUCE and PERCENT models. An explanation for this lack of significance is important in this exploratory work.

Conceptually, a null hypothesis of no relationship may be accurate. Field dependence/field independence may be unrelated to achievement if the analytical modes of information processing described by Witkin are dissonant with the analytical processes used in economics. Under these circumstances, construct validity becomes a concern of the study. Second, relatively field dependent students may acquire pertinent processing skills through the use of appropriate mediators and salient cues from the instructors and/or instructional materials, thereby eliminating any significant comparative advantage of those students who are relatively field independent. Third, relatively field dependent students tend to learn material with social content better than relatively field independent students. Since economics is a social science, it is possible that the advantage of social referents in the content may overcome the disadvantage of required analytical thinking for relatively field dependent students, thereby reducing the importance of a strong analytical mode of processing information.

It is difficult, however, to accept the null hypothesis of no relationship. The GEFT parameter estimates were consistently positive as hypothesized; and in the GAPTUCE model, the significance of field dependence/field independence became apparent. If instructional processes are designed where field dependent students are provided with cognitive strategies that correct analytical deficiencies, then, no achievement differences will be demonstrated. Since instructional strategies were not investigated in this study, the existence of appropriate mediation and salient cues cannot be detected.

In addition, the argument that the social context of economics will eliminate the comparative advantage of field independent learners in an analytically-oriented discipline is questionable. Introductory economics courses typically devote the bulk of time to the analysis of abstract economic models. In-depth application to "real-world", social cases typically occurs at the end of the textbooks and semester.

Statistically, this empirical study may have failed to explain the significance of cognitive style. A lack of variance in student scores on the Group Embedded Figures Test was demonstrated. Although the norming sample had a distribution that was relatively normal, this sample had a distribution that was negatively skewed. Consequently, the parameter estimates that resulted may have been limited by the lack of variance.

The most disconcerting statistical result in this study was the positive and significant relationship between GEFT scores and ability scores. Frank (1986) also found a high correlation between ability and field independence for teacher-education students. Since cognitive style and ability have been described as independent cognitive characteristics by Witkin et al. (1977), the relationship is puzzling

unless it is the case that college entrance examinations are biased toward relatively field independent students. Whatever the cause, the lack of statistical significance of the GEFT variable may be explained partially by its collinearity with ability.

The results of the GAPTUCE model tended to support the hypothesis that relatively field independent students learn more economics than relatively field dependent students at the introductory level. In this model, GEFT was statistically significant for males at the .05 level and for females at the .10 level. It should be noted that the sample size of females (46) was smaller than the sample size of males (75). This difference in sample size may account for the difference in levels of significance since the standard error of the parameter estimate increases with a decrease in sample size thereby reducing the significance of the coefficient.

In the research models, field dependence/field independence was not statistically significant when achievement was defined as the absolute level of economic knowledge when measured by performance on either the Test of Understanding College Economics (TUCE) (Saunders, 1981) or by the correct/total response percentage on course-specific exams. Statistical significance of cognitive style occurred when achievement was specified as the change in knowledge relative to the initial level of understanding. The statistical impact of cognitive style, therefore, may depend on the specification of educational outcomes.

Despite these limitations, the relative importance of the cognitive style of field dependence/field independence remains an educational issue. Consistent and significant relationships were found. Given

these results and the statistical concerns of the sample and models, it is difficult to reject the notion that cognitive style has no influence on student achievement.

The statistical concern of the lack of variation in student GEFT scores may have been a sample phenomenon. This sample may have had more field independent students than other college samples. Future research needs to expand the sample size by including a larger number of males and females so that the distributions of the scores approximate the population distributions. The addition of samples from other colleges would help address the concern of sample selection bias by college with regard to field dependence/field independence.

Ability has been demonstrated to be a significant predictor of achievement in college economics. As a result, educational production function models need to control for this variable when investigating other explanatory variables. Future research, however, should examine the possible intercorrelations between ability measures and cognitive style. If the measures of ability included in educational production functions are highly related to cognitive style, the statistical significance of cognitive style will be reduced, and the results will be questionable. The ability measures should be examined to determine if they are biased towards field dependent or field independent students.

Witkin et al. (1977) concluded that field dependent students are not particularly different from field independent students in their learning ability. The statistical results of this study do not concur with that conclusion. As a result, additional research on the links between specific ability measures and field dependence/field independence are recommended so that educational production functions may be correctly specified.

If the cognitive style of field dependence/field independence significantly influences learning in economics, the implications for future research are far-reaching. As indicated previously, researchers in economic education are interested in identifying instructional methodologies/strategies that yield the greatest amount of learning or achievement in economics. The development of new teaching strategies may need to incorporate cognitive style differences. This does not necessarily indicate that teachers need to individualize instruction completely. The comparative disadvantage that field dependent students may possess in analytical tasks in economics may be eliminated through the judicious use of mediating mechanisms and salient cues that assist field dependent students with their information processing. Field dependent students may require more instruction on how to analyze an economic problem successfully. Rather than provide a single example to students, instructors may need to provide additional examples and explicit instructions on how students should tackle a specific analysis.

Studies that are more experimental in nature would be beneficial where instructional methods are more controlled to determine if aptitude-treatment interaction exists (Cronbach and Snow, 1981). According to Shipman and Shipman (1985), "as the limited research data indicate, individuals reveal a particular style to varying degrees depending on the task, setting, purpose of the assessment, prior experiences, and other cognitive, affective, and social characteristics" (p. 283). The greater the control for many of these variables in an experimental study, the stronger the interpretation of the statistical results. This study included and controlled for student characteristics other than cognitive style through the use of multiple linear regression analysis. Although a control variable for teacher was included in the

models, instructional methods were not a concern of this exploratory study. The explanation of teacher differences that occurred in the POSTTUCE model cannot be explained. Future research may need to increase the number of instructors used in studies and/or more accurately describe the pedagogies employed in different classes to strengthen the research models.

Past research in economic education has focused on identifying variables that explain why college students learn economics in different ways. Although many student characteristics have been included in the models, researchers have largely ignored psychological attributes such as cognitive style which may account for individual differences in student learning. The cognitive style of field dependence/field independence is a characteristic of learners that may have broad educational implications at the college level. Future research into the exact nature of this relationship is warranted and recommended to ensure that economic educators attend to how students acquire and retain knowledge.

REFERENCE LIST

Becker, W. E., & Salemi, M. K. (1977). The learning and cost effectiveness of AVT supplemented instruction: Specification of learning models. Journal of Economic Education, 8(2), 77-92.

Cronbach, L. J., & Snow, R. E. (1981). Aptitudes and instructional methods. New York: Irvington Publishers, Inc.

Frank, B. M. (1986). Cognitive styles and teacher education: Field dependence and areas of specialization among teacher education majors. Journal of Educational Research, 80(1), 19-22.

Kmenta, J. (1971). Elements of econometrics. New York: The Macmillan Company.

Messick, S. (1979). Potential uses of noncognitive measurement in education. Journal of Educational Psychology, 71, 281-292.

Oltman, P. K., Raskin, E., & Witkin, H. A. (1971). Group embedded figures test. Palo Alto, Calif.: Consulting Psychologists Press.

Saunders, P. (1981). Revised test of understanding in college economics. New York: Joint Council on Economic Education.

Shipman, S., & Shipman, V. C. (1985). Cognitive styles: Some conceptual, methodological, and applied issues. In E. W. Gordon (Ed.), Review of Research in Education, 12, (pp. 229-291). Washington, D. C.: American Educational Research Association.

Siegfried, J. J., & Fels, R. (1979). Research on teaching college economics: A survey. Journal of Economic Literature, 17, 923-969.

Soper, J. C., & Walstad, W. B. (1983). On measuring economic attitudes. Journal of Economic Education, 14(4), 4-17.

Systat, Inc. (1985). SYSTAT, Version 3.0. [Computer program]. Evanston, IL: Author.

Witkin, H. A. (1948). The effect of training and of structural aids on performance in three tests of space orientation. Report No. 80, Division of Research, Civil Aeronautics Administration, Washington, D. C.

Witkin, H. A. (1949). Perception of body position and of the position of the visual field. Psychological Monographs, 63 (Whole No. 302), 1-46.

Witkin, H. A.(1950). Individual differences in ease of perception of embedded figures. Journal of Personality, 19, 1-15.

Witkin, H. A. (1976). Cognitive style in academic performance and in teacher-student relations. In S. J. Messick (Ed.), Individuality in learning: Implications of cognitive styles and creativity for human development, San Francisco: Jossey-Bass.

Witkin, H. A., Moore, C. A., Goodenough, D. R., & Cox, P. W. (1977). Field-dependent and field-independent cognitive styles and their educational implications. Review of Educational Research, 47, 1-64.

Witkin, H. A., Oltman, P. K., Raskin, E., & Karp, S. A. (1971). A manual for the embedded figures tests. Palo Alto, Calif.: Consulting Psychologists Press.

Table A.1

Pearson Correlation Matrix for POSTTUCE Model

	POSTTUCE	GEPTM	GEPTF	PRETUCE	PREATE	AGE	CLASS	SEMHRS	MATH	SAT	ACT	SCAT	TEACHER
POSTTUCE	1.000												
GEPTM	0.059	1.000											
GEPTF	0.100	-0.794	1.000										
PRETUCE	0.381	-0.019	0.151	1.000									
PREATE	0.250	0.064	0.028	0.197	1.000								
AGE	0.124	-0.133	0.090	0.129	-0.020	1.000							
CLASS	-0.001	-0.006	0.009	-0.079	0.175	-0.358	1.000						
SEMHRS	0.078	0.002	0.082	-0.008	0.084	-0.360	0.068	1.000					
MATH	0.199	0.167	-0.068	-0.023	-0.034	0.021	-0.034	-0.003	1.000				
SAT	-0.073	0.091	-0.104	-0.189	0.002	-0.060	0.128	0.038	-0.009	1.000			
ACT	0.142	0.100	-0.001	0.107	0.033	-0.455	0.315	0.144	0.158	-0.331	1.000		
SCAT	0.054	-0.029	0.095	0.036	0.049	-0.022	-0.090	0.049	-0.121	-0.118	-0.491	1.000	
TEACHER	0.165	0.003	0.018	-0.020	0.029	-0.019	0.063	-0.106	0.009	-0.012	0.079	-0.0[illegible]	1.000

Table A.2

Pearson Correlation Matrix for PERCENT Model

	PERCENT	DEPTH	DEPTV	PRETUCE	PREATK	AGE	CLASS	SEMHRS	MATH	SAT	ACT	SCAT	TEACHER
PERCENT	1.000												
DEPTH	0.207	1.000											
DEPTV	0.052	-0.767	1.000										
PRETUCE	0.384	0.075	0.129	1.000									
PREATK	0.552	0.202	-0.000	0.292	1.000								
AGE	0.399	-0.038	0.091	0.223	0.324	1.000							
CLASS	0.072	0.053	-0.028	-0.023	0.144	-0.249	1.000						
SEMHRS	0.509	0.116	0.084	0.198	0.411	0.031	0.060	1.000					
MATH	0.315	0.152	-0.047	0.035	0.082	0.071	-0.010	0.090	1.000				
SAT	-0.009	0.110	-0.095	-0.139	0.027	-0.046	0.131	0.029	0.017	1.000			
ACT	0.330	0.185	-0.023	0.157	0.153	-0.274	0.315	0.215	0.146	-0.303	1.000		
SCAT	-0.093	-0.105	0.144	0.066	-0.003	-0.035	-0.083	0.058	-0.109	-0.123	-0.478	1.000	
TEACHER	0.050	-0.003	0.028	0.070	0.021	-0.045	0.069	-0.082	-0.014	0.046	0.051	-0.028	1.000

Table A.3

Pearson Correlation Matrix for GAPTUCE Model

	GAPTUCE	GEPTH	GEPTV	PRETUCE	PREATE	AGE	CLASS	SEMHRS	MATH	SAT	ACT	SCAT	TEACHER
GAPTUCE	1.000												
GEPTH	0.177	1.000											
GEPTV	0.038	-0.779	1.000										
PRETUCE	0.027	-0.040	0.156	1.000									
PREATE	0.252	0.077	0.006	0.146	1.000								
AGE	-0.000	-0.146	0.111	0.147	-0.035	1.000							
CLASS	0.114	-0.004	0.016	-0.084	0.221	-0.336	1.000						
SEMHRS	0.158	0.019	0.073	-0.024	0.065	-0.361	0.050	1.000					
MATH	0.175	0.174	-0.052	-0.001	-0.073	-0.007	-0.007	0.028	1.000				
SAT	0.036	0.076	-0.090	-0.181	0.007	-0.051	-0.103	0.038	-0.005	1.000			
ACT	0.173	0.157	-0.054	0.091	0.046	-0.453	0.312	0.133	0.203	-0.322	1.000		
SCAT	0.053	-0.098	0.165	0.054	0.016	-0.051	-0.049	0.065	-0.186	-0.120	-0.480	1.000	
TEACHER	0.180	0.028	0.013	-0.049	0.083	-0.048	0.106	-0.090	0.012	0.007	0.105	-0.055	1.000