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ABSTRACT

A longitudinal study designed to test hypotheses about the relationships between academic achievement, cognitive styles, and verbal competence is described. One entire class of 1,548 students of a large municipal college was followed from college entry in 1967 through entry into postgraduate and occupational training. Data were taken from tests, questionnaires, and academic records of the entire student group, and from an intensive battery of tests administered to 100 students from the original group. The various cognitive styles (field-dependent or field-independent) and their relation to choice of major and academic careers as well as postgraduate careers are described. The objectives of the study include: (1) examination of the influence of cognitive styles on academic progress; (2) examination of the influence of patterns of students' standing in the various cognitive styles on postgraduate study; (3) determination of the degree to which academic choices at the high school level are predictive of academic functioning in college and graduate school; (4) study of the effect upon various aspects of college evolution of a marked discrepancy in the level of functioning to determine the sources of cognitive style development; (5) examination of the role of cognitive styles in the verbal functioning of students who appear no different in standard tests of verbal ability. The results are presented in four sections and numerous tables provide statistical information. An extensive bibliography is included. (BH)

THE GRADUATE RECORD EXAMINATIONS

GRE

A LONGITUDINAL STUDY OF THE ROLE OF COGNITIVE STYLES IN ACADEMIC EVOLUTION DURING THE COLLEGE YEARS

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City University of New York

GRE Board Research Report GREB No. 76-10R
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This report presents the findings of a research project supported by grants from the Graduate Record Examinations Board and the National Institute of Mental Health (MH 21989)

EDUCATIONAL TESTING SERVICE, PRINCETON, NEW JERSEY □ BERKELEY, CALIFORNIA □ EVANSTON, ILLINOIS

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I. Overview

The study described in this report was designed to test some hypotheses about academic achievement and choices made by students with field-dependent and field-independent cognitive styles and with varying levels of verbal competence. In broad overview, one entire class of 1548 students of a large municipal college was followed from college entry through entry into postgraduate training. These students were tested as entering freshmen, and their academic records collected from the periods of high school and college through enrollment in graduate school. During their four years in college a selected group of these students was also given a battery of verbal tests and a vocational inventory, and an interview was conducted with each of them.

The study began in 1967 and was supported by the National Institute of Mental Health from 1967 to 1972. In 1972 the GRE Board provided support for continuation and extension of the ongoing longitudinal study. The specific objectives were: (1) to examine the influence of two important and relatively unrelated cognitive domains--the field-dependent and field-independent cognitive styles and verbal-comprehension skills--in students' academic progress through the four years of college; (2) to examine the influence of patterns of students' standing in these cognitive domains upon the decision to go on to graduate school and choice of area of study in graduate school; (3) to determine the degree to which academic choices at the high-school level, viewed from the standpoint of cognitive styles, are predictive of academic functioning in college and of orientation toward graduate school later on; (4) to study the effect upon various aspects of college evolution of a marked discrepancy in level of functioning in the field-dependence-independence and verbal-comprehension domains and to seek the sources of these cognitive splits during development; (5) to examine the role of the field-dependent and field-independent cognitive styles in the verbal functioning of students who appear no different in standard tests of verbal ability.

The first two of these objectives are the primary ones in this study and are most relevant to issues of career guidance in the higher-education period with which the GRE Board is concerned. To pursue each of these broad objectives, a number of specific research questions, enumerated later on, were pursued. The analyses bearing on these questions are described in the main body of the report. Objectives 3, 4 and 5 were of a subsidiary nature and less relevant to issues of career guidance. Analyses bearing on these objectives are considered in the Appendix of this report.

In 1976 the GRE Board provided additional funds for follow-up of two selected groups of students: 1) those who went on for post-graduate training to the end of their graduate/professional education, and 2) those who transferred from the college at which the study was conducted to other academic institutions.

On practical grounds it was not possible to collect the data from graduate schools required to meet the first of these objectives. It was possible to follow many of the transfer students, however. The addition of the transfer cases necessitated a reworking of most of the preliminary analyses presented in our progress report of January 1976 to the GRE Board. Moreover, the availability of more complete data on students who left the college of study made it possible to examine the student group who dropped out of college entirely. The present report describes our work on the extended data base.

II. Background

A. Cognitive Styles

Cognitive styles are the individual's characteristic ways of processing information. Because these processes are applied to all kinds of information—regardless of whether its primary source is in the world outside or within the [illegible], and, when in the world outside, regardless of whether the [illegible] of information is things or persons—and their [illegible] styles show themselves [illegible] throughout [illegible] functioning.

[illegible] what cognit[illegible] field-de[illegible] styles, [illegible] information processing, have [illegible] their own right,[1] and have had wide [illegible] education,[2] including those of concern in the present study. The bibliographies on these styles contain more than 2500 references.[3,4]

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[1] See, for example, Witkin, Dyk, Faterson, Goodenough, and Karp, 1962/74; Witkin, Lewis, Hertzman, Machover, Meissner, and Wapner, 1954/72.

[2] Witkin, Moore, Goodenough, and Cox (in press).

[3] Witkin, Cox, and Friedman, 1976; Witkin, Cox, Friedman, Hrishikesan, and Sigel, 1974; Witkin, Oltman, Cox, Ehrlichman, Hamm, and Ringler, 1973.

[4] A comprehensive bibliography of studies on the relation between field-dependence-independence and various aspects of career differentiation is given in Appendix E.

We now give a brief description of the field-dependent and field-independent cognitive styles. A more extended characterization of them has been given elsewhere (Witkin, [illegible]).

Considering first how they perceive, relatively field-independent persons are likely to experience parts of a stimulus field as distinct from the field as a whole, even when the field is highly organized so that its parts are strongly embedded; in other words, they perceive analytically. Relatively field-dependent persons, on the other hand, tend to experience the field according to the dominant properties of its overall organization, so that its parts are not readily apprehended as separate from the whole. To illustrate from their performance in the most commonly used test of field-dependence-independence, the one employed in the longitudinal study, the more field-independent person will find a sought-after simple figure embedded in a complex design more quickly than the relatively field-dependent person. Seated in a tilted chair in a room that is also tilted, the more field-independent person is likely to bring his body close to the upright when asked to make himself straight, thereby showing that he perceives his body as an entity discrete from the field. Under the same circumstances, the more field-dependent person is likely to move his body toward alignment with the tilted room, suggesting that the axes of the surrounding field, rather than what is experienced within the body, provide the main frame of reference for determining his own position. To consider still another situation, seated in a totally darkened room, facing a tilted luminous square frame, which has a luminous rod pivoted at its center, the relatively field-independent person is likely to bring the rod close to the upright when asked to make it straight, indicating that the rod is apprehended as an entity distinct from the frame. The more field-dependent person, in contrast, is likely to bring the rod into alignment with the tilted frame in order to perceive it as upright. Not only do people tend to be self-consistent in performance across tests like these, but their characteristic way of performing remains stable over extended periods of time, in one study over a period as long as 14 years (Witkin, Goodenough, & Karp, 1967).

Differences congruent with those observed in their ways of perceiving are found in the problem-solving behavior of relatively field-dependent and field-independent persons. When presented with a problem requiring for solution that a critical element be disembedded from the context in which it is presented and used in another context, the more field-dependent person is likely to take longer in arriving at the solution than the relatively field-independent person. The difference in problem-solving behavior between these two kinds of persons is limited, however, to tasks which require disembedding. They are not particularly different in tasks that do not have this specific requirement. For example, they are pretty much alike on the usual verbal tests.

Differences in the characteristic ways relatively field-dependent and field-independent persons use prevailing frames of reference in their perception and problem solving are found in other domains of their psychological functioning, including those ordinarily subsumed under personality. Differences between relatively field-dependent and field-independent persons in social behavior and interpersonal relations are particularly well documented in the research literature (Witkin & Goodenough, in press). Paralleling their tendency to use the surrounding room as a basis for perceiving body position, field-dependent persons show themselves, in a variety of ways, to be particularly attentive to available social frames of reference in social situations.

This tendency of field-dependent persons is evidenced, first of all, in their selective attention to social aspects of the environment. Thus, compared to field-independent persons, they literally look more at the faces of others, the primary source of information about what others are feeling and thinking. They are likely to attend more to verbal messages with social content; such messages catch their attention even when presented in the periphery of what they are focusing on at the moment. Because they pay more attention to social content, field-dependent persons are better than field-independent ones at learning and remembering social material. Reflecting in another way their responsiveness to the social field, field-dependent persons are also likely to take account of others' views in de[illegible]ing their own. Field-dependent people are also more drawn to others and like to be with others. This tendency shows itself in so literal a fashion as a preference for standing physically close to others when interacting with them.

The social characteristics of field-dependent persons that have been enumerated make it plausible that they should be liked; perceived by others as warm, tactful, considerate, socially outgoing and affectionate; and know and be known to many people. Altogether, field-dependent persons may be characterized as having an "interpersonal" orientation to the world. These qualities, taken together, are likely to contribute to skill in getting along with others. For example, studies of how groups reach a consensus on issues about which the [illegible]s initially disagree have generally shown that field-dependen[illegible]e are more willing or able to contribute effectively to [illegible]t resolution (e.g., Oltman, Goodenough, Witkin, Freedma[illegible], Friedman, 1975; Shulman, 1975).

A contrasting picture is presented by relatively field-independent persons. They are less sensitive to social cues; less responsive to others' views, sometimes to the point of being impervious to such views; and less interested in people. They have been described as insensitive to social undercurrents, cold and distant with others, unaware of their own social stimulus value and individualistic. Their interests are likely to be in the theoretical and abstract. The picture here is one of an "impersonal" orientation to the world, and qualities likely to make for limited skills in interpersonal relations.

Without extending this account to other psychological domains in which field-dependent and field-independent people have been studied, it is apparent that "style" is an appropriate designation for the contrasting modes of functioning found in field-dependent and field-independent people, representing as they do an individual's typical and pervasive manner of processing the information he receives from within himself and from the world around him.

What has been said about the attributes of field-dependent and field-independent people may be used as a basis for characterizing cognitive styles in general.

First, cognitive styles are concerned with the form rather than the content of cognitive activities. They represent individual differences in <u>how</u> people perceive, solve problems, relate to others, etc. Cognitive styles are thus defined in process terms. It is important for problems of evaluation that individual differences defined in process terms tend to be more basic than those defined in content terms.

Second, cognitive styles are pervasive dimensions of psychological functioning, finding representation in the individual's perceptual and intellectual activities and in his social behavior and personality as well. From knowledge of an individual's cognitive styles predictions can therefore be made about what he is likely to do in areas outside the cognitive domain. To the extent that cognitive styles can be "picked up" in perception, an objective route is opened to assessment of noncognitive characteristics. Particularly when applied to people outside the mainstream culture, perceptual assessment procedures have an important advantage over verbal tests, on which such people are often penalized.

Third, cognitive styles are stable over time. This characteristic makes them particularly useful in long-range guidance and counseling.

Fourth, cognitive styles are bipolar with regard to value judgment. At each pole of any cognitive-style dimension we find characteristics suitable to specified tasks and circumstances. This feature distinguishes cognitive styles from abilities, which are unipolar, in the sense that greater value is attached to having more of an ability than less of it; in other words, ability dimensions have clear "good" and "bad" ends. In the case of the field-dependent and field-independent styles the cluster at one pole includes competence in analytic functioning plus an impersonal orientation with limited social skills. The cluster at the other pole includes an interpersonal orientation with social skills plus less competence in analytic functioning. Each cluster thus includes characteristics useful in dealing with particular kinds of situations. The value bipolarity of cognitive styles has evident practical consequences for their use in guidance. The more neutral stance of cognitive styles makes it less threatening and therefore easier to communicate information about an individual's cognitive styles directly to him than it is to tell him that he has a low IQ, for example. At a time when ways are being sought to serve the student himself in the guidance process, rather than institutions, this feature of cognitive styles is an important advantage.

B. Rationale of the Longitudinal Study

The basic nature of cognitive styles and the pervasiveness of their expression makes it reasonable to expect that students' cognitive styles would influence their educational-vocational development. Consideration of the requirements of the various educational-vocational domains, against characteristics associated with a more field-dependent or field-independent style, suggests the probable nature of that influence. Specifically, it is likely that relatively field-dependent people will show interest in, choose and do better in domains which are primarily social in content, require interpersonal relations in their conduct, and do not particularly call for analytical skills. On the other hand, more field-independent people are likely to favor domains which feature analytical skills, are primarily abstract and nonsocial in content and tolerate an impersonal orientation.

Since our longitudinal study began in 1967, a number of cross-sectional studies which are consistent with this view have appeared in the literature (see Appendix D). Their results, which supplement and, on many points, support our own, will be briefly cited as relevant. There are many questions, however, that can only be answered with data gathered for the same students over an extended span of academic life. Among such questions are these: May cognitive styles be used to predict later educational choices and performance? Is stability of educational choice a function of compatibility between cognitive style and [illegible] of early choices? To explore the implications of cognitive [illegible] for practical use in academic guidance it is necessary to ad[illegible] such questions. The longitudinal study was designed with these considerations in mind.

More specifically, the analyses to be described seek to answer the following questions:

[illegible] students' cognitive styles related to their major fields [illegible] ways predicted from the cognitive and personal characteristics associated with different cognitive styles? Do cognitive styles predict students' academic majors beyond the contribution made to such predictions by aptitude measures now in common use?

2. Do changes in students' majors over their academic careers result in better congruence between major fields and cognitive styles? As a corollary, are students' initial major choices, made upon entry into [illegible], likely to remain more stable over time if these initial [illegible] are congruent with their [illegible] styles than if they [illegible] congruent? Do cognitive styles predict stability of major [illegible] time beyond the contribution made to such predictions by [illegible] measures?

3. Are students' cognit[illegible] styles differentially related to achievement in various m[illegible] domains, in ways to be expected from the nature of [illegible] cognitive styles and the requirements of parti[illegible]? Do cognitive styles predict achievement in particular ma[illegible] areas beyond the contribution made to such predi[illegible] measures?

III. Procedures

A. [illegible]

The populat[illegible] the study was on[illegible] entire class of 1548 students, 787 men and 761 women, in a large municipal college.[1]

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[1] During one of the freshman orientation sessions in the fall of 1967, the students in the entering class were given an account of this research project and invited to participate. They were informed that the results of the study would not be made available to the administration and would in no way be used in determining their academic progress. Anonymity was also assured. The student were told that they did not have to participate and could leave without taking the tests that were about to be administered for the project. [illegible] handful of students [illegible] to leave.

On entering in 1967, they were assessed for their standing on the field-dependence-independence dimension by means of the Group Embedded-Figures Test (GEFT) (Witkin, Oltman, Raskin, & Karp, 1971), and they filled out a questionnaire which identified their current (preliminary) choice of major and vocational plans, and provided us with a variety of information about their interests. The SAT-Math (SAT-M) and SAT-Verbal (SAT-V) scores of these students were made available to us at that time. The full high school transcripts were also obtained for most of the students; and college transcripts were obtained for all students who earned a degree at the college. Of those who did not graduate from college, some dropped out and others sought transfer elsewhere. Many of the transfer students subsequently enrolled in one of the other branches of the University system to which our college belongs. Data were obtained for these students on whether they received a degree and, if so, their final major was ascertained. Of the original group of 1548 students, 114 applied for transfer to other colleges where it was impossible for practical reasons to obtain further data on their academic status, and 12 were still engaged in undergraduate studies when last checked. Thus 1422 students were followed through their college careers to the point where they received a degree or dropped out of the academic process, at least until the end of the study period.

In addition to gathering all this information for most of the entering class, we also made an intensive study of a selected smaller group of 100 students to whom we administered an intensive battery of tests over their four years in college. Included in this battery were a series of cognitive tests, an interest inventory, and an intensive interview. The interview examined the subject's academic development; reactions to specific courses and subject-matter areas; reasons for choice of major and shift of major; difficulties in academic and personal adjustment during college and special achievements; extracurricular activities, interests and hobbies, currently and in the past.

Subsequently, for each student who requested that his college transcript be forwarded to one or more graduate schools, indicating intent to apply, a questionnaire was sent to the graduate school listed on the transcript in order to determine the student's present status at each of the schools. In response to our original inquiry, and a follow-up letter, questionnaires were returned by 218 of the 234 graduate schools to which they were sent. This is somewhat better than a 93% response. By the questionnaire procedure we were able to obtain whatever information the graduate schools were able to provide for all but 16 of the 643 students (97.5%) who at graduation from college had requested that a transcript be sent to graduate schools. The 16 missing cases had applied exclusively to one or more of the 14 graduate schools from which no response was received. As happened in a number of other cases, some or many of these students may not have completed the application, despite the request that a transcript be sent.

A sizable number of our college sample continued their post-graduate education in professional school rather than graduate school. It seemed important to follow up this group as well in order to obtain as complete information as possible on consistency of choices made, as a function of cognitive style, at successive points in academic development. The professional schools to which our students sought admission were, for the most part, schools of law, medicine, dentistry and business. A very small number sought admission to schools of osteopathy, optometry, podiatry, and veterinary medicine. In the case of law schools, with the help of the staff and President of the Law School Admission Council, questionnaires, essentially similar to those devised for graduate school deans, were sent to the deans of all law schools to which our students had applied. In the case of medicine and dentistry, the Association of American Medical Colleges and the Association of American Dental Schools, both of which have in their central files all the information we needed, cooperated with us and made available the data we sought on all of our students who had applied to medical school or dental school.

The data base for the longitudinal study is described in detail below:

High school transcripts: Each course taken, year in which taken, grade received; high school grade-point average; grades on New York State Regents examinations.

Test scores and entering questionnaire data: SAT-M and SAT-V scores; intended major (preliminary major) and vocational choice; Group Embedded-Figures Test (GEFT).

The GEFT consists of 20 items, on each of which the student is required to locate a simple geometric form within a complex geometric design in which it is embedded. The subject's score is the number of items in which the simple form was correctly traced in the complex design, so that the possible range of scores is 0 to 20. Higher scores represent greater field independence and lower scores greater field dependence.

College transcripts:

For all students: Number of each course taken, department and year in which taken, grade received, number of credits assigned, courses credited by exemption examination or advanced placement.

For students who earned the degree: Changes in major, final major, type of degree awarded, honors.

For students who did not complete work for the degree at the college: (a) whether or not the student requested that his college transcript be sent to another college(s), signifying an intent to continue his college education; if transcripts were sent, college(s) to which student requested transcript(s) to be sent; and where the information could be obtained, whether he earned a degree at one of these colleges and in which major area; (b) whether the student left because of suspension for poor performance.

For the selected group of 100 students tested over the four-year college period: Scores from the battery of cognitive tests given them; interviews.

Post-college information: Scores for GRE-Verbal and Quantitative tests; graduate schools to which transcripts were sent on student's request; when transcript was sent: whether student completed application; if completed, whether student was accepted or rejected; if accepted, whether student matriculated;[1] if matriculated, in which area of specialization and for which degree; corresponding data on application to professional schools.

Sample sizes, at various steps of the academic sequence, were as follows:

1. Students for whom high school transcripts were available N = 1209 (617 men, 592 women). The great majority of these students (963) attended public high schools; a small number (233) attended private (parochial) high schools.

[1]In a large number of the cases where the student did not complete the application, or where the student was accepted and did not matriculate, the record the graduate school still retained at the time of our inquiry was not adequate to supply us with much of the information we were seeking.

2. College

   a. Students in college entering class
      N = 1548 (787 men, 761 women)

   b. Students who received degree from college where study was conducted
      N = 1216 (583 men, 633 women)

   c. Students who received degree from other colleges of the University system
      N = 40 (26 men, 14 women)

   d. Students who dropped out of college
      N = 166 (92 men, 74 women)

   e. Students still in attendance at college at end of study period
      N = 12 (7 men, 5 women)

   f. Students who sought transfer to other colleges and whose subsequent academic status is unknown[1]
      N = 114 (79 men, 35 women)

3. From among those who received degree at college where study was conducted

   a. Graduate school

      1. Students who signified intent to go to graduate school by request that college transcript be sent to graduate school
         N = 643 (235 men, 408 women)

      2. Students who enrolled in graduate school
         N = 432 (167 men, 265 women)

   b. Professional school

      1. Medical school

         a. Students who applied
            N = 108 (97 men, 11 women)

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[1]These transfer cases did not differ significantly from degree students in GEFT or SAT scores.

b. Students who enrolled
N = 67 (63 men, 4 women)

2. Law school

a. Students who applied
N = 61 (49 men, 12 women)

b. Students who enrolled
N = 33 (28 men, 5 women)

3. Business school

a. Students who applied
N = 19 (16 men, 3 women)

b. Students who enrolled
N = 18 (15 men, 3 women)

c. Total graduate and professional schools

1. Students who applied
N = 831 (397 men, 434 women)

2. Students who enrolled
N = 550 (273 men, 277 women)[1]

I. Grouping of Major Fields

Wherever possible, majors were grouped, in part to gain the advantage of larger Ns in statistical analyses. Groupings were made, first, on the basis of salient similarities in the contents

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[1]For several reasons the Ns given in the tables were sometimes less than the totals reported above. High school grade-point averages, obtained from college transcripts, were not available for 6 students. At the preliminary major level 27 students indicated no choice. At the final major level 20 students had a double major which crossed the Science, Education and Other categories, defined below, with the consequence that they could not be included in analyses requiring separate consideration of these categories; and information about final major could not be obtained for one transfer student. At the graduate school level it could not be determined for 38 transfer students whether they had applied to graduate school; and for 24 students known to have enrolled in graduate school the college was not able to give us information about their majors.

of the majors brought together, and second, when such a judgment could be made, on the basis of congruence between their requirements and the characteristics associated with a more field-dependent or field-independent cognitive style.

One of the major groups consisted of mathematics and the natural sciences (hereafter designated the "Science" group), which clearly require analytical skills, are not social in content and do not depend particularly upon interpersonal relations for their conduct. At the graduate level we added the medical disciplines to this group, both because the great majority of students entering these disciplines were undergraduate Science majors and because training in these disciplines calls upon analytical skills in a very central way. We expected the Science cluster to be favored by relatively field-independent students. It should be noted that the majors in the Science group are all "narrow-gauged" disciplines in the sense that they all clearly require skill in analytical cognitive operations. Without such skill, successful performance in these disciplines is hardly possible.

For a second group of majors, henceforth called the "Education" group (overwhelmingly elementary education, but also early-childhood education, general education, speech therapy, and nursing) we expected that their social content, emphasis on interpersonal relations and generally limited need for analytical skills would cause them to be favored by relatively field-dependent persons.

While performance in the majors in the Education group is clearly benefited by interest and skill in interpersonal relations, and does not usually depend greatly on analytical skills, it is possible to function as a teacher without strong interpersonal interest and skills. Moreover, particularly beyond the elementary-school level, teachers may choose to specialize in Science subject matters which do call for analytical skills. For these reasons, we did not consider majors in the Education group as narrow-gauged as the Science group, though we did expect them to be favored by field-dependent students.

A third group of majors consists of disciplines which may be designated "broad-gauged" in the sense that there exists within them opportunities for either field-dependent or field-independent persons. Psychology, with the clinical-personality-social areas at one of its poles, and the experimental-psychophysiological-mathematical areas at its other pole, provides a prime example of such a discipline. On the assumption that the first pole is likely to be favored by field-dependent students and the other by field-independent students, taking psychology students as a group, without drawing this important distinction, is likely to produce an "averaging-out effect" with regard to standing on the field-dependence-independence dimension. Accordingly, at the undergraduate level, where the students did not yet identify an area of specialization within psychology, we expected that, because of this averaging effect, college psychology majors would earn an intermediate mean score on the GEFT.

Sociology is also viewed here as a broad-gauged discipline. To consider sociology broad-gauged in nature seems particularly appropriate at the college where our study was conducted since those going into social work and those going into the conceptual domains of sociology are listed, indistinguishably to us, as sociology majors. Thus, psychology and sociology majors form a third grouping for which we formulated an advance hypothesis about compatibility with cognitive style.

Finally, there are majors which, at the time we undertook the longitudinal study, did not seem in any obvious ways to draw upon the competences of either field-dependent or field-independent persons. These majors have been included in our analyses for empirical examination, grouped according to shared salient requirements. One group consists of English, comparative literature and foreign language majors, and is what we may designate a "verbal communication" group. Another group consists of history, political science and economics majors (the "history-political science-economics" group). A third group consists of majors in art and music, and a fourth consists of physical education and health science majors. In addition to these groups there are two majors (accounting and speech) which were considered singly, again without an advance hypothesis. There were no grounds for including these in any of the other groups we composed and each was chosen by a sufficient number of students, particularly at the preliminary major level, to allow consideration of each alone. Finally, the few remaining majors, chosen by only a very few students, form a remainder group (at the final major level, anthropology, area studies as an interdisciplinary major, dance, home economics, Judaic studies, and philosophy).

At the graduate school level, three additional areas were considered separately--media, business, and law--and the remainder group is more diversified. The remainder group here includes such majors as journalism, urban studies, linguistics, and rabbinics, in addition to anthropology, Judaic studies, and philosophy.

Because the Science major group was expected to contain the relatively field-independent extreme of the student population, and the Education group the relatively field-dependent extreme, the major groups and individual majors for which no relation to cognitive style was expected on a priori grounds, in effect constitute a cluster (hereafter designated the "Other" group) which may be expected to fall somewhere between the extremes on the field-dependence-independence dimension.

C. Sex Differences

For two reasons, we have given attention to the role of student sex as a possible moderator of the relation between cognitive style and educational-vocational development. First, numerous studies have shown a tendency for women to be more field-dependent than men, although this differences does not become established until middle adolescence and is so small that the range of scores on tests of field-dependence-independence in each sex is vastly greater than the difference in means between the two sexes. Second, sex-role stereotypes play a clearly important role in educational-vocational choices.

The same groupings of majors were used for both men and women students, but because of the expected sex-role stereotyping effect, results for the two sexes have been analyzed separately. That such an effect did operate in our sample is evident in the difference in distribution of majors for our men and women students. Majors in the Education group were chosen by 22% of the women and 0.5% of the men as a preliminary college major, and by 33% of the women and 3% of the men as a final college major. Conversely, majors in the Science group were chosen by 52% and 23% of men and women, respectively, as a preliminary major, and by 29% and 11% of the men and women as a final major. The operation of such a strong sex-role stereotype effect in our sample has had the consequence of appreciably reducing the number of male Education majors and women Science majors.

IV. Results

The results of the longitudinal study are presented in four major sections. The first section covers relationships among the cognitive style and aptitude variables; section two covers relationships with academic choices; section three, with stability and change in major fields; and section four with achievement in specific fields of study.

A. Field-Dependence-Independence and Academic Aptitudes

Before looking at the data on choice of academic fields as a function of cognitive style and aptitude it is important to know the extent to which variables that may be used as predictor variables are independent of each other. The relationships among the predictor variables are shown in Table 1.

Considering the relationships between GEFT scores and verbal aptitude, we see in Table 1 that the correlations are low, though with the very large Ns employed, they are significant with the SAT-V. This finding is consistent with an extensive literature showing little relationship between measures of field-dependence-independence and standard tests of verbal comprehension. The relationship between GEFT scores and a variety of specific verbal skills was examined in some detail in the selected group of students whom we tested extensively during their college years. In general, very little overlap was found between cognitive style and linguistic competence. This work is summarized in Appendix D to this report.

Considering the relation between GEFT scores and mathematical aptitude, as noted earlier, field-dependence theory would lead one to expect some relationship between field independence and competence in mathematics. It is not surprising to find, therefore, that GEFT scores tend to be more highly related to the math sections of the SAT than they are to the verbal sections. As may be seen in Table 1, correlations with SAT-M are significant for both men and women. Even here, however, the overlap between the GEFT and aptitude scores is limited, suggesting that much of what is represented in the cognitive style measure is not tapped by the aptitude measures.

Turning next to grade-point averages, Table 1 shows that GEFT scores are little related to either high school or college GPAs. Consistent with these findings are the results of a number of studies conducted in liberal arts college settings which, with only rare exceptions, also did not find significant relations between measures of field-dependence-independence and CGPA (e.g., Anderson, 1971; Gehlmann, 1951; Glass, 1967; Montgomery, 1971; Pohl, 1967). In one study, no relation was found with graduate school grade-point average either (Baker, 1970). Thus, relatively field-dependent and field-independent people do not make better or worse students, overall, as

Table 1

Relationships Among GEFT, SAT and Grade-Point Variables:

Pearson r's and Numbers of Students

	Group	GEFT r	GEFT n	SAT-V r	SAT-V n	SAT-M r	SAT-M n	High School Grade-Point Averages r	High School Grade-Point Averages n	College Grade-Point Averages[a] r	College Grade-Point Averages[a] n
GEFT	men			.08*	787	.24**	787	.01	786	.10*	609
	women			.22**	761	.38**	761	.03	756	.05	647
SAT-V	men					.24**	787	.15**	786	.33**	609
	women					.31**	761	.20**	756	.35**	647
SAT-M	men							.11**	786	.18**	609
	women							.20**	756	.22**	647
High School GPA	men									.53**	608
	women									.59**	644

[a] For students who graduated from college

* $p < .05$

** $p < .01$

judged by general achievement measures such as GPA. As we shall see, however, they are likely to be different in the mix of college courses they select in which they earn essentially the same grade-point averages.

In contrast with the GEFT, Table 1 shows that SAT scores are related to grade-point averages, as might be expected.[1]

The fact that cognitive style and aptitude measures are not related in the same way to overall academic achievement may also be seen in comparisons between students who drop out of the academic process at various points and students who continue their education beyond those points. Table 2 shows the mean GEFT and SAT scores for students who dropped out of college before receiving their bachelor's degree and for students who completed their undergraduate education. No significant differences were found in GEFT scores between these groups. In contrast, the college dropouts tended toward lower scores on the SAT (significantly so among women) than students who completed their undergraduate education.[2]

Table 2 also shows mean GEFT and SAT scores for college graduates who did and did not enroll in graduate school. Here again the students who continued their academic involvement to the postgraduate level were not significantly different on the GEFT from students who ended their education with a bachelor's degree. However, those students who continued their education to the graduate school level tended to have higher SAT scores than students who ended their education at the bachelor level. This tendency reached significance among men for the SAT-V.

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[1] Only 114 men and 127 women in our sample took the GRE in connection with application to graduate school. Accordingly, the number of students with GRE scores in various subgroups was too small to warrant statistical analysis. The GRE is therefore not considered in this report.

[2] A similar pattern was found when comparisons were made between a subgroup of dropouts who were expelled for academic reasons and students who received their bachelor's degree. Data on academic honors were also inspected, but these data were not further analyzed when it became apparent that honors were simply a function of grade-point averages.

Table 2

Mean GEFT and SAT Scores for

College Dropouts, College Graduates and Among College Graduates,

for Students Who Did and Did Not Go on to Graduate School

Entering Freshmen	GEFT mean	GEFT F ANOVA	SAT--V mean	SAT--V F ANOVA	SAT -M mean	SAT -M F ANOVA	N
Men							
Graduated from College	11.8	0.35	544.6	2.60	597.3	0.00	609
Dropped out	12.1		530.7		596.6		92
Women							
Graduated from College	11.5	0.03	550.5	7.23**	552.6	7.31**	647
Dropped out	11.6		524.3		528.0		74
College Graduates							
Men							
Enrolled in Graduate School	12.1	2.97	553.0	4.25*	602.6	2.38	273
Did not enroll	11.6		540.1		593.3		311
Women							
Enrolled in Graduate School	11.2	2.45	552.0	0.39	556.4	2.09	277
Did not enroll	11.6		547.9		547.7		357

* $p < .05$
** $p < .01$

In summary, aptitude scores are predictive of academic achievement, as they were designed to be. However, the field-dependence-independence dimension shows relatively little overlap with the aptitude variables and appears to be unrelated to overall academic achievement.

B. Academic Majors as a Function of Cognitive Variables

1. Cognitive Styles

For reasons already considered, it was our expectation that relatively field-independent students would tend to enter mathematics and the sciences (collectively designated "Science"), whereas relatively field-dependent students would be more likely to enter such fields as elementary education, early-childhood education, general education and speech therapy (collectively designated "Education"). For other academic majors we had no clear expectation, in some cases because the field is "broad-gauged" in nature, containing within them subspecialties appropriate to persons with different cognitive styles; in other cases because the cognitive and social characteristics of relatively field-dependent and field-independent people do not seem relevant to the requirements of the field in ways discernible to us. (These majors are collectively designated "Others.") If this view is correct, then students in the Science group of majors should show the highest mean score on the GEFT, those in the Education group should show the lowest, and those in the Other group should fall somewhere in between.

We were able to examine these expectations at three points in our students' academic evolution when choices were available to them: their preliminary choices of major at entry into college; for those who graduated from college, their final majors; and for those who enrolled in graduate schools, their fields of specialization.

Table 3 shows the mean GEFT scores, as well as standard deviations and number of cases, for each of the three academic groups, at the preliminary undergraduate, final undergraduate and graduate school levels. For ease of visualization of trends, the means are also shown in graphic form in Figures 1 and 2.[1]

[1] Because of the operation of the sex-role stereotype effect noted earlier, too few of the male students in our sample (only 4) selected disciplines in the Education group as preliminary majors for statistical analysis to be done. Although many fewer women than men are represented in the Science group, again presumably because of a sex-role stereotype effect, the number of women is adequate for statistical analysis.

On the whole, the means in Table 3 and the curves in Figures 1 and 2 show the expected trends with regard to the relation between field of major and cognitive style. At each of the three major levels, for both men and women, analyses of variance proved significant ($p < .05$ or less in each case, one-way ANOVA). To test our hypotheses more specifically, means for pairs of major groups were compared. The outcome of these comparisons is shown in Figures 1 and 2. Among women, Science majors were significantly more field independent than Education majors at all three levels ($p < .05$ in each case, Scheffé test). Among men, Science majors were significantly more field independent than Education majors at the graduate school level ($p < .05$), but not at the final undergraduate level. Science majors were also significantly more field independent than Other majors at the final undergraduate and graduate school levels for both men and women, and at the preliminary major level for men (p at least $< .05$ in each comparison).

It is interesting to note in Figures 1 and 2 that the cognitive style difference between Science and Education majors increases in the course of academic evolution. The difference in GEFT scores between these two major groups is much larger among graduate students than among entrants to college. The increase seems plausibly attributable, in part, to a tendency for students to switch majors during their academic careers from fields which are less compatible with their cognitive style to fields which are more compatible. We examine the switch-of-major phenomenon in detail in a later section.

It may be recalled that we had no clear expectation about the relationships between cognitive styles and clusters of majors within the Other category. The data for these clusters are of some interest for exploratory purposes, however. These data are summarized in greater detail in Table A-1 of the appendix to this report.

It is interesting to note in these data that students with art/music majors are the most field independent of all domains in the Other category. Though we did not at the outset have an explicit hypothesis predicting this outcome, it is consistent with the results of studies reported in the literature since our study was undertaken. Consideration of the cognitive skills likely to contribute to effective performance in the art/music domains makes the observed relation between field independence and the favoring of these domains a reasonable one.

Table 3

Cognitive Style Data for Major Groupings: GEFT Means, Standard Deviations, and Number of Students at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Enrolled in Graduate School		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Men									
Science	12.3	3.8	401	12.9	3.8	175	13.3	3.1	94
Other	11.5	3.9	373	11.4	3.9	408	11.7	4.0	137
Education	--[a]			11.6	3.8	21	10.6	3.8	35
F_{ANOVA}	7.24**			9.00**			8.42**		
Women									
Science	12.1	3.7	173	12.9	3.8	72	13.5	[illegible].6	25
Other	11.5	3.4	409	11.8	3.4	347	11.5	3.1	96
Education	11.0	3.5	161	10.5	3.3	212	10.6	3.1	139
F_{ANOVA}	3.74*			16.86**			9.27**		

[a] Too few cases for analysis

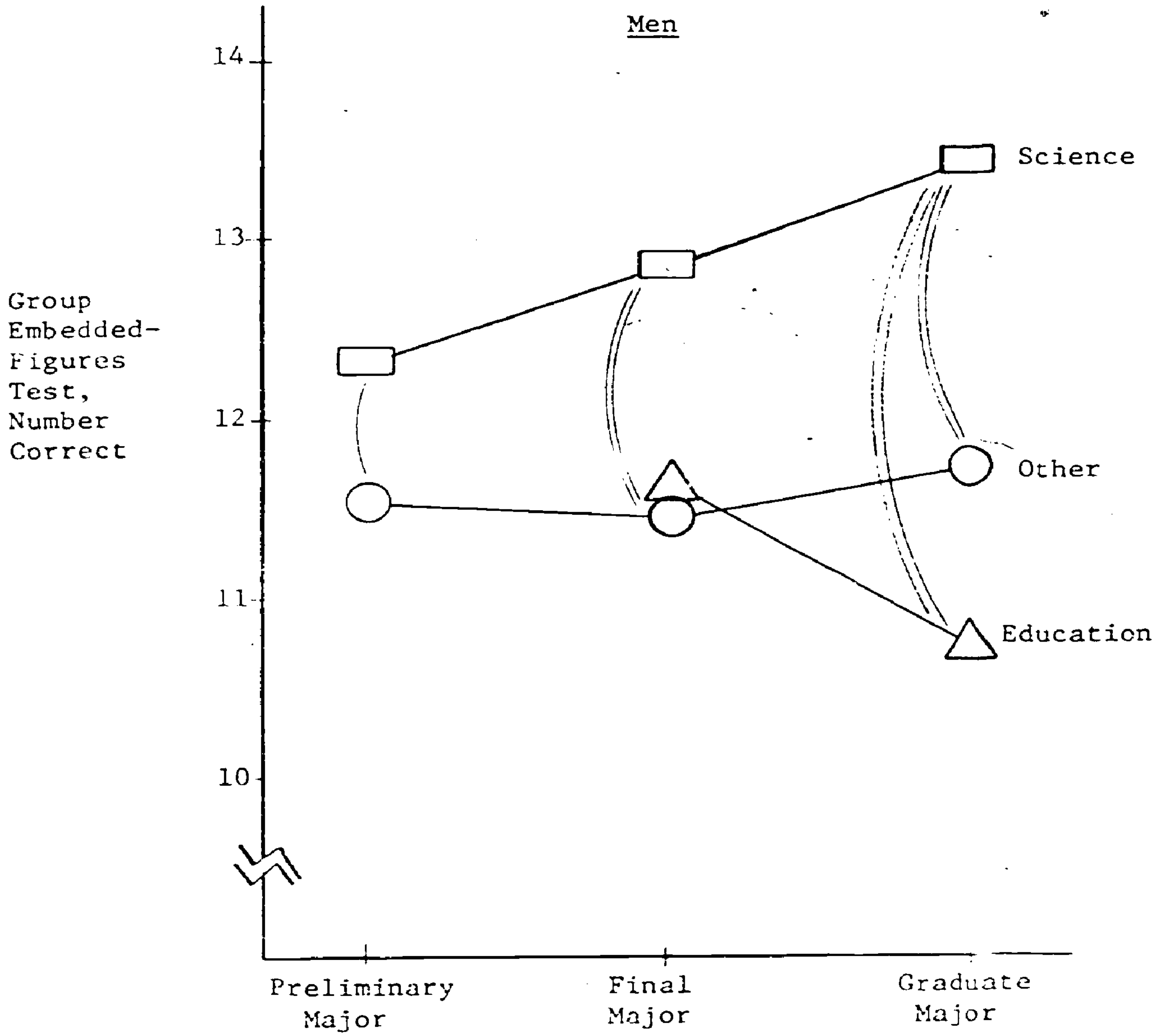
*$p < .05$

**$p < .01$

Figure 1

Mean GEFT Scores in Major Categories

At Three Levels of Academic Evolution

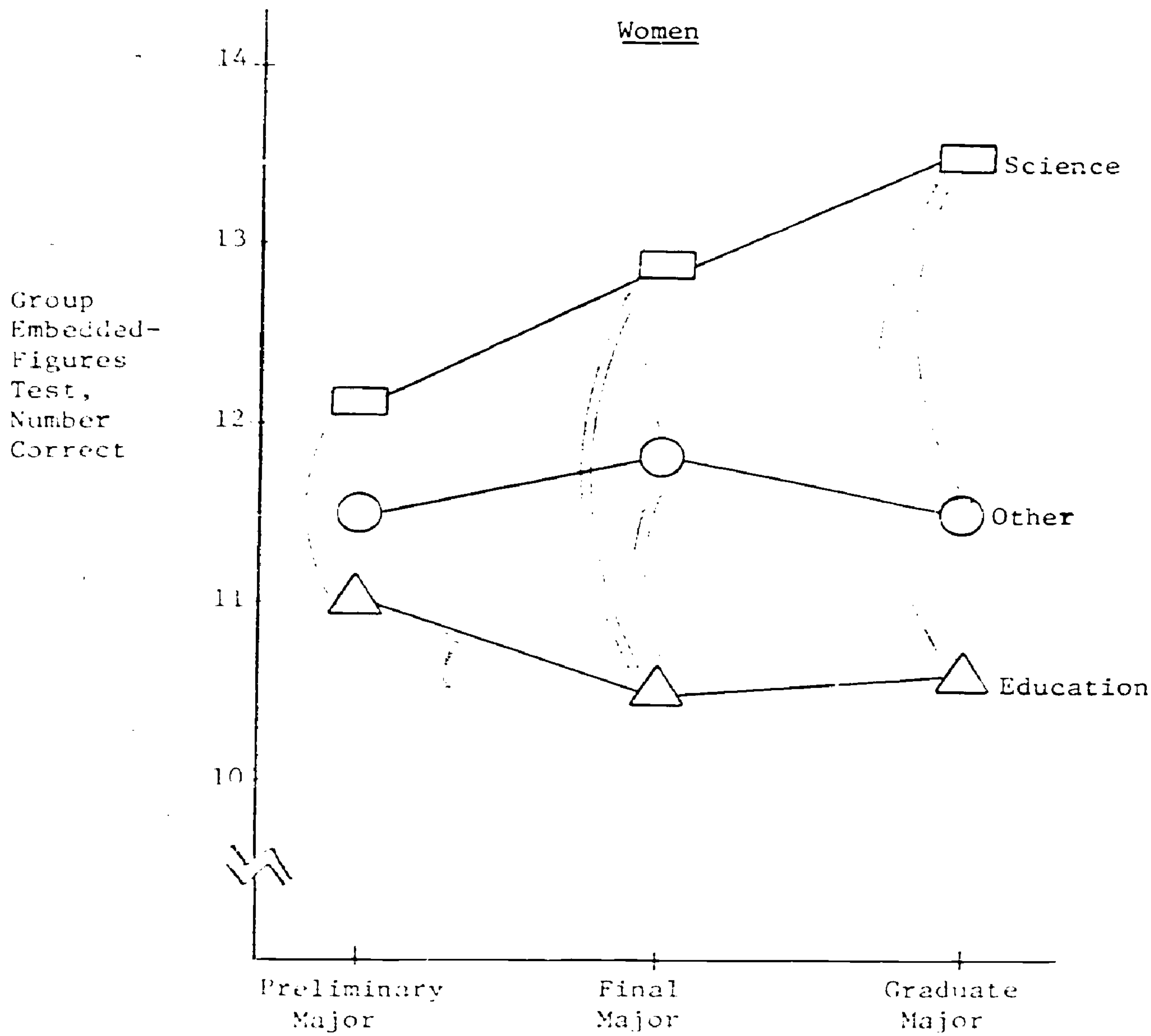


Note.--Points connected by single curved lines were significantly different at at least $p < .05$ by analysis of variance. Points connected by double curved lines remained significantly different by analysis of covariance controlling SAT-V and SAT-M.

Figure 2

Mean GEFT Scores in Major Categories

At Three Levels of Academic Evolution



Note.--Points connected by single curved lines were significantly different at at least $p < .05$ by analysis of variance. Points connected by double curved lines remained significantly different by analysis of covariance controlling SAT-V and SAT-M.

In addition to predicting differences in cognitive style between major groups, the theory of field-dependence-independence also leads to the expectation that field-dependence-independence will be related to academic choices within majors, particularly in majors we have designated broad-gauged in that they encompass sub-specialties congenial to students with different cognitive styles. Thus, in psychology, which provides a prime example of a broad-gauged discipline, it was observed in one study of first-year students in a graduate psychology program that those enrolled in the clinical psychology program were significantly more field dependent than those enrolled in the experimental psychology program (Nagle, 1967). Because students do not usually enter subspecialties until the graduate level, the data we have for our students while at college do not provide much information on within-major choice in relation to cognitive style; and the information we were able to obtain from graduate schools, limited to the period of graduate school entry, most often did not yet indicate area of subspecialization.

Some instructive information on this issue may, however, be obtained for undergraduates through examination of choices of particular courses. One such analysis has been carried out on course choices made by students in our sample who were final psychology majors. Because the department required a very large number of psychology courses of all its majors, within-psychology course choices were too limited for us to use them in distinguishing the subspecialties toward which different psychology majors might be heading. An interesting difference did emerge, however, when we examined the particular science courses psychology majors chose in fulfilling the college science requirements. This requirement could be met either by taking the traditional specialized science courses, such as chemistry, physics, biology, or by taking "softer" overview science courses which integrated the sciences without intensive study of any of them. Though the sample involved is small, a trend was found in kinds of science courses elected, consistent with expectation from field-dependence theory. As may be seen in Table 4, for both sexes, psychology majors in the most field-independent quartile on the GEFT more often took specialized science courses, whereas psychology majors in the most field-dependent quartile more often took integrated science courses. The difference was statistically significant for women ($\chi^2 = 7.05$, $p < .01$), although not for men. This finding is encouraging. However, critical questions on the role of cognitive styles in subspeciality choices within a variety of broad-gauged disciplines can only be answered by more extensive data on graduate school specialties.

Table 4

Cognitive Style of Undergraduate Final Psychology Majors Who Fulfilled Science Requirements with Integrated or Specialized Science Courses

	Men		Women	
	Integrated Science	Specialized Science	Integrated Science	Specialized Science
Field-dependent quartile	12	12	13	2
Field-independent quartile	5	12	5	8

For women, $\chi^2 = 7.05$, $p < .01$; for men, ns.

Taking the findings from the present study we may say that cognitive styles have an important influence on the orientation of people toward various educational-vocational domains. A large number of other studies have appeared in the literature, since our study began more than nine years ago, with results consistent with this conclusion. (See Appendix E.) Their results generally confirm the relations found here between cognitive styles and the academic domains relatively field-dependent and field-independent people are likely to enter. In addition, they provide some evidence, consistent with our hypothesis, on particular vocational domains they are likely to enter; and they provide evidence as well, again consistent with expectations, on educational-vocational interests (usually as expressed on interest inventories) of people with different cognitive styles. Finally, the evidence now in the literature on within-majors (and within-vocations) interest/choices is in keeping with our hypotheses.

It is noteworthy that cognitive styles show a stronger relation to the educational-vocational fields people actually enter than to the interests they express in these fields on interest inventories. In fact, 19 of the 21 studies reported in the literature on fields entered by people with different styles yielded significant results in the expected direction. The higher relation with actual entry than with interests seems consistent with the observation made earlier, and which we consider further later on, that cognitive styles relate more strongly to final majors than to preliminary majors. Final majors correspond to actual entry into a field whereas preliminary majors seem closer to expression of interest in a field.

2. Academic Majors as a Function of SAT Scores and Grade-Point Averages

Comparisons among the three major groups at college entry, college graduation, and graduate school enrollment are shown in Table 5 for SAT-V scores, Table 6 for SAT-M, Table 7 for high school grade-point averages, and Table 8 for college grade-point averages.

As can be seen from Table 5, SAT-V scores are lower for Education majors than for majors in Science or Other fields. For men, these differences do not reach significance at either the final-major or graduate-enrollment levels. This suggests that for male students, SAT-V scores are not predictive of final or graduate choices among the three major groups we are considering. For women, however, analyses of variance do show significant differences among the major groups at all three levels. A similar picture emerges for SAT-M scores (Table 6). In this case, the major groups differ significantly for both men and women, with Science majors achieving the highest, and

Table 5

SAT-V Scores for Major Groupings: Means, Standard Deviations, and Number of Students at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Enrolled in Graduate School		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Men									
Science	532.5	[illegible]	401	542.5	81.4	175	559.1	78.3	94
Other	553.6	77.4	373	546.6	75.1	408	554.3	72.4	137
Education	--[a]			[illegible]	[illegible]	21	537.9	75.5	35
F_{ANOVA}	15.04**			[illegible]			1.02		
Women									
Science	548.1	[illegible]	[illegible]	[illegible]	85.1	72	623.2	81.1	25
Other	560.9	[illegible]	[illegible]	[illegible]	[illegible]	347	577.1	75.3	96
Education	514.5	[illegible]	[illegible]	[illegible]	72.5	212	523.9	77.8	139
F_{ANOVA}	20.60**			[illegible]**			24.92**		

[a]Too few cases for analysis.

*$p < .05$

**$p < .01$

Table 6

SAT-M Scores for Major Groupings: Means, Standard Deviations, and Number of Students at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Enrolled in Graduate School		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Men									
Science	610.1	74.1	401	618.9	75.0	175	630.7	80.4	94
Other	586.9	66.7	373	589.2	69.7	408	590.7	68.8	137
Education	--[a]			576.4	68.1	21	571.6	83.7	35
F_{ANOVA}	20.75**			11.63**			11.28**		
Women									
Science	586.3	83.1	173	612.9	83.5	72	626.7	90.2	25
Other	543.6	70.6	409	553.1	71.5	347	568.7	68.4	96
Education	533.8	62.2	161	530.1	56.7	212	539.1	67.4	139
F_{ANOVA}	27.54**			36.24**			18.09**		

[a]Too few cases for analysis.

*$p < .05$

**$p < .01$

Table 7

High School Grade-Point Averages for Major Groupings: Means, Standard Deviations, and Number of Students at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Enrolled in Graduate School		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Men									
Science	88.0	3.4	401	89.2	3.4	175	90.2	3.4	94
Other	87.6	3.6	372	87.9	3.4	407	[illegible]	3.6	136
Education	--[a]			86.3	3.2	21	[illegible]	3.2	35
F_{ANOVA}	2.16			11.01**			[illegible]		
Women									
Science	90.7	3.2	172	91.8	3.1	71	[illegible]	3.0	25
Other	89.6	3.4	406	89.7	3.4	346	90.6	3.2	96
Education	88.8	3.2	160	89.4	3.0	211	90.1	3.3	139
F_{ANOVA}	14.79**			14.44**			3.85*		

[a]Too few cases for analysis

*$p < .05$

**$p < .01$

Table 8

College Grade-Point Averages for Major Groupings: Means, Standard Deviations, and Number of Students at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Enrolled in Graduate School		
	Mean	Standard Deviation	N	Mean	Standard Deviation	N	Mean	Standard Deviation	N
Men									
Science	2.58	0.56	399	2.86	0.43	175	3.04	0.42	94
Other	2.60	0.60	372	2.75	0.42	408	2.95	0.38	137
Education	--[a]			2.70	0.31	21	2.79	0.37	35
F_{ANOVA}	0.33			4.39**			5.13**		
Women									
Science	2.88	0.50	171	3.04	0.43	72	3.14	0.42	25
Other	2.87	0.48	407	2.94	0.39	347	3.11	0.35	96
Education	2.78	0.45	161	2.90	0.33	212	2.97	0.35	139
F_{ANOVA}	2.34			3.52*			5.99**		

[a] Too few cases for analysis

*$p < .05$

**$p < .01$

Education majors the lowest scores. Considering grade-point averages, these too are related to major choices with Education majors showing somewhat lower and Science majors somewhat higher grades (Tables 7 and 8).

These data indicate that, except for SAT-V in the case of men, students' final choice of college major can be estimated with some accuracy from aptitude and achievement measures available at college entry, and that choice of graduate school field can also be estimated at the point of college entry or graduation.

3. The Relation between Cognitive Styles and Academic Majors with SAT Variables Controlled

While the many studies reported in the literature have demonstrated that cognitive styles are related to academic majors at various points in academic evolution, none of them has attempted to determine whether, in predicting major fields students are likely to enter, cognitive style measures add any useful information beyond the information on aptitudes, achievement and major preferences available at college entry. As we have seen in the preceding section, choice of major can be forecast with some accuracy on the basis of SAT scores and grade-point averages. Although the relationships between the SAT scores and the GEFT were relatively low, the fact that some correlation does exist makes it important to know whether the relationship between cognitive styles and academic majors may be accounted for on the basis of aptitude alone.

To explore this question, analyses of covariance were conducted, examining GEFT scores for the various major groups after adjusting for SAT-M and SAT-V scores. Table 9 presents mean GEFT scores after covariance adjustment for both SAT-M and SAT-V scores.

For men the analysis of covariance was significant at both the final undergraduate level ($p < .01$) and at the graduate level ($p < .01$); for women only the final undergraduate level was significant. To check our hypotheses on the relation of cognitive styles to major groups, pairwise comparisons were made of the GEFT means for the various major groups, adjusted for SAT-V and SAT-M. The results are indicated in Figures 1 and 2. For men, the adjusted means for the Science and Other major groups were significantly different at the final and graduate major levels; the difference was significant for the adjusted Science vs. Education means at the graduate major level only; and the difference was not significant at any of the major levels for adjusted Education vs. Other means. (It will be recalled that for men there were too few male preliminary Education majors to allow comparisons using this group of majors.) For women, Table

Cognitive Style Data for Major Groupings: Mean GEFT Scores and GEFT Means Adjusted for the Effects of SAT-V and SAT-M at Each of Three Levels of Academic Evolution

	Preliminary Major			Final Major			Graduate School Major		
	Mean	Adj. Mean	N	Mean	Adj. Mean	N	Mean	Adj. Mean	N
Men									
Science	12.3	12.1	401	12.9	12.6	175	13.3	12.9	94
Other	11.5	11.6	373	11.4	11.5	408	11.7	11.8	137
Education	--[a]	--[a]		11.6	11.9	21	10.6	11.0	35
F_{ANCOVA}		3.58			5.29**			4.38**	
Women									
Science	12.1	11.5	173	12.9	12.0	72	13.5	12.5	25
Other	11.5	11.6	409	11.8	11.7	347	11.5	11.4	96
Education	11.0	11.5	161	10.5	10.9	212	10.6	11.0	139
F_{ANCOVA}		.07			4.46**			2.24	

[a]Too few cases for analyses

$^{**}p < .01$

the differences in adjusted means between Science and Education majors and between Other and Education majors at the final undergraduate level proved to be significant.

These analyses indicate that the GEFT adds significantly to SAT scores in pred. ting academic majors.

C. Stability and Change in Major Field as a Function of Cognitive Style

To explore the guidance implications of cogn. . . styles we need answers to the following questions: Knowing . . nts' cognitive styles at college entry, how well can we predict their academic majors at later junctures? A similar question may be asked about prediction from college graduation to graduate school. Even more important, how much does knowledge about cognitive styles contribute to predictions about majors, beyond what is possible with the sources of information now ordinarily available?

To this point we have . oked at predictions made about academic ma . r choices at several points in time on the basis of cognitive st . e and aptitude information available at entry to college. Another source of information at the time of college entry is students' preliminary choices of fields. Obviously, preliminary choices ar. highly related to subsequent academic majors. If one is to attempt predictions of final undergraduate major or field of graduate study from information available at college entry, students' expressed preliminary major preferences must be considered as one of the more important predictor variables; and it is also one of the most accessible predictor variables. Since this variable is also related to cognitive style, it is appropriate to ask whether GEFT scores add useful information about preliminary choices in the prediction of subsequent academic majors. From a practical point of view, a guidance counselor may wish to answer this question about a student at the time of his entry into college. If the student has selected Science (for example) as his preliminary major, will knowledge about his cognitive style help to predict whether he will graduate with a Science major, and, beyond that, whether he will enroll as a Science major in graduate school?

To answer this question the relationship between GEFT and subsequent majors was exam . . . rately for student groups whose preliminary choices w . . . ience and Education categories. In effect, what is be . . . hese analyses is whether, keeping maj . r prefer . . . entry into college constant by taking students w . . . the same preference, do cognitive styles pred . . . ajor fields? At issue is the influence of cogni . . . continuity or discontinuity in maj . r field through the . . . s academic career.

A specific hypothesis to which cognitive style theory leads us is that a student will be more likely to continue in the same major field if that field is compatible in its requirements with his cognitive style than if it is not. Students in the Science domain are a particularly good group to use in examining our hypothesis because of the "narrow-gauged" character of the disciplines in this domain. As already discussed, without analytical competence, the particular province of field-independent people, it is difficult to succeed in the Science disciplines. Accordingly, we may expect field-independent students who choose one of the Science disciplines as a preliminary major to continue in Science over time, and for field-dependent students to move out of Science. Our expectations are not as clear-cut for students with preliminary Education majors, for several reasons. First, as noted earlier, it is more possible for field-independent students, limited in interpersonal interest and skills, to get by in education than it is for field-dependent students, limited in analytical skills, to get by in mathematics and the sciences. Second, as has also been noted, field-independent education students, particularly those preparing to teach at a more advanced level, have the option of choosing a subspecialty within education (as the teaching of science) compatible with their cognitive style. Finally, also working, overall, against shifts out of education for the women in our study--the only sex for which there was a sufficient number of education majors to allow an analysis of shifts--is the sex-role-stereotype effect considered earlier. It seems reasonable that the same sex-stereotype effect which served to bring so large a percentage of women in our sample into the education domain worked against their leaving that domain once they had entered it. Consistent with these views is the finding that the percentage of students, overall, who continued in Science, after choosing it as a preliminary major, is considerably lower (44% of men and 41% of women) than the percentage of students who continued as majors in Education (77% of the women; too few men were preliminary Education majors to allow this comparison).[1]

Another question that arises, in considering stability and change in major fields as a function of cognitive styles, is where do students go who leave fields of their own preliminary choice? One possibility is that they shift into other major fields which are more compatible with their cognitive styles and so continue their academic careers in other fields. The opportunity to identify a more compatible field may come through taking first-level courses in other fields in satisfying degree requirements. Another possibility is that they leave school entirely, as a result of negative experiences engendered by the mismatch between cognitive style and choice of major field. Are one or both of these fates characteristic of students whose cognitive styles are incongruent with their preliminary choices?

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[1] Of those in the Other category as preliminary majors, 94% of the men and 78% of the women continued. It should be recalled here that the Other category contained a quite large number of disciplines.

As a first step in addressing these questions, GEFT scores were compared for three subgroups of men and women with preliminary Science majors: students who graduated with Science degrees, students who shifted majors and graduated with nonscience degrees; and students who dropped out of college entirely. Table 10 presents mean GEFT and SAT scores and mean GEFT scores after adjustment for SAT-V and SAT-M for these subgroups. As can be seen from the table, the subgroups differed significantly in GEFT scores for both men and women. The "stayers" were more field independent than students who shifted majors by the time of graduation ($p < .05$). Dropouts also tended to be relatively field dependent, but the differences were not significant, perhaps because of the small numbers of these cases. Significant differences among subgroups were also found for both SAT-V and SAT-M, with Science graduates scoring highest, and dropouts lowest in all cases. Analyses of covariance showed that GEFT means adjusted for SAT scores were significantly different for men, with Science majors more field independent than nonscience majors, but not different from dropouts. The groups were not different for females.

A similar picture was found at the graduate school level (Table 11). For both men and women the subgroups of preliminary Science majors who enrolled in graduate school Science departments were significantly more field independent than those who enrolled in other graduate programs. In this case, the comparison in the analysis of covariance was not significant for either sex group.

The data summarized to this point indicate that field-dependent students tend to leave the study of Science, moving into nonscience fields, as expected on the basis of cognitive style compatibility. All the major academic areas into which students could shift are less demanding of analytical skills than are the Sciences, which because of their clear and specific requirement of such skills, we designated narrow-gauged disciplines. Accordingly, being relatively field dependent, those who left the Sciences inevitably moved into areas more congruent with their cognitive styles. Inspection of the particular major fields these relatively field-dependent students entered after abandoning an earlier choice of Science provides more specific evidence of movement into more compatible domains. These data are shown in Table A-2 of the appendix.

It is interesting to note here that the most field-independent shifters of both sexes tend to enter art/music domains which, because of the cognitive skill they involve, may be as compatible with their cognitive styles as the science/math domains from which they came. In contrast, the relatively field-dependent shifters move to economics, history, political science, verbal communications, accounting, physical education, and health for men, and to education, verbal communication, sociology, speech, physical education, and health for women.

Table 10

Cognitive Style and SAT Data for Preliminary Science Majors Who Graduated with a Degree in Science, in Nonscience, and Who Dropped out of College: Mean GEFT, SAT-V, SAT-M, and Adjusted GEFT Scores

	GEFT		SAT-V		SAT-M		Adjusted GEFT		
	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANCOVA}	N
Men									
Science Graduates	13.0	5.06**	541.0	3.98*	620.5	3.20*	12.9	3.85*	153
Nonscience Graduates	11.7		530.2		601.5		11.7		160
Dropouts	11.9		504.6		597.1		12.1		42
Women									
Science Graduates	12.9	3.04*	573.4	4.74**	612.3	6.79**	12.2	0.30	64
Nonscience Graduates	11.4		532.5		565.9		11.8		83
Dropouts	11.6		520.8		558.3		12.2		12

*$p < .05$

**$p < .01$

Table 11

Cognitive Style and SAT Data for Preliminary Science Majors Who Entered Graduate School Science Departments, Graduate School Nonscience Departments, and Did Not Enter Graduate School: Mean GEFT, SAT-V, SAT-M, and Adjusted GEFT Scores

	GEFT		SAT-V		SAT-M		Adjsuted GEFT		
	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANCOVA}	N
Men									
Science Graduate Students	13.4		558.5		634.6		13.1		81
Nonscience Graduate Students	11.7		533.8		596.7		11.8		59
Nongraduates Students with BA/BS	12.0	3.29*	526.5	5.73**	604.5	4.35**	12.1	1.79	176
Dropouts	11.9		504.6		597.1		12.1		42
Women									
Science Graduate Students	13.5		615.3		628.8		12.3		20
Nonscience Graduate Students	10.7		536.9		580.9		10.8		43
Nongraduates Students with BA/BS	12.4	3.49*	543.3	4.92**	580.1	2.52	12.5	2.82*	89
Dropouts	11.6		520.8		558.3		12.2		12

*$p < .05$

**$p < .01$

Turning next to preliminary Education majors, Table 12 shows mean GEFT, SAT, and adjusted GEFT scores for the three subgroups of women who graduated with Education degrees, who graduated with non-Education degrees, and who dropped out of college. It may be recalled that our prediction here is that relatively field-dependent students would more often continue in Education, and in fact, the data summarized in Table 12 show such a trend. Mean GEFT scores are lower for Education graduates than for either noneducation graduates or dropouts. The differences among subgroups were not significant, however, perhaps because of the relatively small numbers of students involved in the latter two groups.

The majors into which these shifters moved are shown in Appendix Table A-3. Although the numbers of cases are very small here, it is interesting to note that the most field-independent shifters tend to enter math/science and art/music.

A similar pattern emerged in analyses of graduate school enrollment among preliminary education majors (Table 13).

We also examined the issue of stability of major field choice as a function of cognitive style in another way. This analysis addressed itself to the question a counselor might ask when dealing with a student at an advanced college level, rather than at the time of college entry, the level on which the preceding analyses focused. If the student has already chosen Science as his final major field, will knowledge about his cognitive style help predict whether he will one day enroll as a Science major in graduate school?

To answer this question, mean and adjusted mean GEFT scores were compared for three subgroups of students who graduated with Science majors; students who subsequently enrolled in graduate Science departments, students who enrolled in nonscience graduate departments, and students who did not enroll in graduate school. These data are shown in Table 14.

Analysis of variance showed significant differences in GEFT scores for women, but not for men. Analyses of covariance, adjusting for aptitude measures, were not significant for either sex. Considering the nonstayer subgroups individually, those who enrolled in nonscience graduate school departments tended to be more field dependent than those who continued in Science, but those who left school were not.

Data on the specific nonscience fields into which the Science graduates shifted are particularly interesting. Of 37 women Science graduates who went on to graduate school, 24 remained in Science

Table 12

Cognitive Style and SAT Data for Preliminary Education Majors Who Graduated with a Degree in Education, in Noneducation, and Who Dropped out of College: Mean GEFT, SAT-V, SAT-M, and Adjusted GEFT Scores

	GEFT		SAT-V		SAT-M		Adjusted GEFT		
	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANCOVA}	N
Women									
Education Graduates	10.6		510.4		526.5		10.7		106
Noneducation Graduates	11.8	1.92	547.0	3.05*	558.3	3.49*	11.4	1.34	29
Dropouts	11.7		500.0		519.4		11.9		17

*$p < .05$

**$p < .01$

Table 13

Cognitive Style and SAT Data for Preliminary Education Majors Who Entered Graduate School Education Departments, Graduate School Noneducation Departments, and Did Not Enter Graduate School: Mean GEFT, SAT-V SAT-M, and Adjusted GEFT Scores

	GEFT		SAT-V		SAT-M		Adjusted GEFT		
	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANCOVA}	N
Women									
Education Graduate Students	10.6		509.6		535.7		10.6		51
Noneducation Graduate Students	12.4	1.03	539.0	0.81	526.4	0.39	12.5	1.46	10
Nongraduates With BA/BS	10.8		522.3		535.8		10.8		76
Dropouts	11.7		500.0		519.4		11.9		17

$^{*}p < .05$

$^{**}p < .01$

Table 14

Cognitive Style and SAT Data for Final Science Majors Who Entered Graduate School Science Departments, Graduate School Nonscience Departments, and Did Not Enter Graduate School: Mean GEFT, SAT-V, SAT-M, and Adjusted GEFT Scores

	GEFT		SAT-V		SAT-M		Adjusted GEFT		
	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANOVA}	Mean	F_{ANCOVA}	N
Men									
Science Graduate Students	13.4		555.3		633.2		13.2		80
Nonscience Graduate Students	10.9	2.16	530.4	0.61	600.1	2.51	11.2	1.27	8
Nongraduate Students with BA/BS	12.6		544.0		607.1		12.7		68
Women									
Science Graduate Students	13.6		626.7		632.2		13.0		24
Nonscience Graduate Students	10.4	3.56*	527.8	8.19**	573.5	2.11	11.3	1.79	13
Nongraduate Students with BA/BS	13.3		558.5		609.3		13.4		31

*$p < .05$
**$p < .01$

at the graduate level. Twelve others shifted into Education and one into "business." The mean GEFT score of those who remained in Science was 13.6 whereas the mean score of those who left Science for Education was 10.4. (The student who left for Business had a GEFT score of 10.0.) The quite field-dependent students who abandoned Science for Education had clearly moved into a domain more compatible with their cognitive style. A similar picture is found in the corresponding data for male students. Of 88 enrolled graduate students whose final major field in college was Science, 80 remained in Science as graduate students (mean GEFT = 13.4) and 8 others shifted out of it. Seven of these shifters went into Education (mean GEFT = 11.0) and one into counseling psychology (GEFT = 10), both domains more compatible with their relatively field-dependent cognitive style than their earlier choice of Science.

Analyses of students who graduated with a degree in Education and subsequently shifted into other graduate school fields were not done because there were too few cases (10) in this category. Among Education graduates, no significant difference was found in GEFT scores between those who went on to graduate school in departments of Education and those who left school with a bachelor's degree.

When we view together the data for GEFT, SAT-V and SAT-M, we see, first of all, that the groups of Science majors considered in Tables 10, 11 and 14, relative to all the groups with which they are compared, not only score high on GEFT, but they also tend to achieve high scores on SAT-V and SAT-M. Education majors, on the other hand, score lower on GEFT in comparison to the other groups in Tables 13 and 14, and they also tend to score low on SAT-V and SAT-M relative to these other groups, with the exception of dropouts. Dropouts, on the whole, are not particularly different on the GEFT from the other groups except for the groups of Education majors, in comparison to which the dropouts score higher. On both SAT-V and SAT-M, dropouts tend to do less well than other groups; the difference is particularly marked in the case of SAT-V.

To this point we have examined continuity in academic majors. It is of interest to know whether stability of choices of a more directly vocational nature is also influenced by cognitive styles. We have some information for a group of students, sufficiently large to allow analyses to be done, who identified a specific vocational goal at the time of entry into college. These are the students who declared themselves to be premeds. We have carried out the same analyses for the premed students that have just been described for the preliminary Science students in order to explore the question of continuity of occupational goals as a function of cognitive style.

The first analysis we have done was directed at answering the question a premed counselor might want answered when dealing with a student who has declared himself to be a premed at college entry: Does the student's cognitive style help predict whether he will later apply to medical school, and, beyond that, whether he will eventually be accepted and enroll? This is similar to the question we earlier asked about preliminary Science majors. Because college students aiming to apply to medical school need to take a number of courses in the Sciences domain, are counseled and assessed by premedical advisers whose own disciplines usually fall in the Sciences, and are expected to have competence in the Sciences by medical school admission committees, we hypothesized that relatively more field-independent than field-dependent students who declared themselves to be premeds at college entry would continue with that choice, as shown, first, by the act of applying to medical school, and, second, by becoming enrolled medical students.

Table 15 shows, for each GEFT quartile,[1] the number of men[2] who were premeds at college entry, and of these the number who applied to medical school and the number who enrolled. Analyses of variance showed a significant difference ($p < .01$) in mean GEFT scores for "stayers" (13.1) vs. "leavers" (10.9) from premed choice to medical school application. Significant ($p < .01$) analyses of variance were also found comparing "stayers" (13.7) with "leavers" (11.2) from the premed-choice time to actual medical school enrollment. Moreover, in both instances, analyses of covariance, adjusting for aptitude measures, were also significant ($p < .01$), indicating that cognitive style made a contribution, beyond the contribution made by aptitude measures, in predicting both which premeds at college entry were likely to apply to medical school at graduation and which were likely actually to enroll in medical school later on. For the counselor dealing with students who profess an interest in medicine at the outset of their college careers, knowledge about these students' cognitive styles can add to the counselor's ability to foretell two critical events in the students' career development: whether they will apply to medical school and whether they will one day actually become medical students.

The second question we addressed for students heading toward the vocation of medicine is the practical one that arises for the premed counselor at a later point in the advisory process, when

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[1] In composing quartiles, GEFT scores for all students who took that test were used.

[2] There were too few women premeds to allow analyses.

Table 15

Application and Enrollment in Medical School, as a Function of Cognitive Style, Students Who Were Premeds on College Entry (Men)

GEFT Quartile	Total No. Premeds at College Entry	No. Applied	No. Enrolled	% Applied	% Enrolled
Q1 (most field-dependent)	43	12	4	28%	9%
Q2	27	14	9	52%	33%
Q3	34	20	16	59%	47%
Q4 (most field-independent)	47	31	21	66%	45%

dealing with a college senior seeking admission to medical school: Does cognitive style help predict which students will become enrolled in medical school? Table 16 presents data on frequency of medical school enrollment, as a function of students' cognitive styles, of all men who applied to medical school.[1] The data show that proportionately more field-independent than field-dependent medical school applicants are likely to become medical school students. The difference in mean GEFT scores of "stayers" (13.6) vs. "leavers" (12.4) did not quite reach significance, however ($p < .06$, one-way analysis of variance).

The data on continuity in major field we have examined suggest that information about students' cognitive styles at the time of college entry may contribute to predictions at the time of college entry about these students' actual major field at the time of college graduation and at entry to postgraduate education. Since the analyses on this issue were done with students who all had similar initial major preferences, thereby in effect controlling for initial preference, we may say that cognitive styles can add useful information to the prediction of final college major and major at postgraduate enrollment beyond what the student can tell us in his preliminary choice. Moreover, the contribution of cognitive styles remained significant for most of these analyses after the contribution of aptitude measures was removed as well.

Finally, cognitive styles were found not to contribute particularly, beyond information currently used, to predicting at the time students made their final major choices whether they will eventually enroll in graduate school. This outcome may signify that cognitive styles make their main contribution to prediction of major fields at the time of college entry. In considering such a conclusion, it is necessary to recognize that enrollment or nonenrollment in Science, after choosing Science at an earlier point, may be the product of many factors, making the fact of graduate enrollment in Science a rather complex prediction criterion. Nonenrollment may be the result of the student choosing to continue his graduate studies in another field than Science but more often it is the result of leaving the educational system with only a baccalaureate. (Fifty-five percent of the students who earned a degree at our college did not go on to graduate school.) It seems clear that GEFT scores are

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[1]Since not all applicants were premeds on entry to college the N for applicants here is larger than in Table 15.

Table 16

Application and Enrollment in Medical School, as a Function of Cognitive Style, of Students Who Were Premeds at College Graduation (Men)

GEFT Quartile	Total No. Applied to Medical School	No. Enrolled	% Enrolled
Q1 (most field-dependent)	13	4	31%
Q2	22	12	55%
Q3	31	21	68%
Q4 (most field-independent)	39	24	62%

unrelated to this criterion. The decision not to go on to graduate school may rather reflect the influence of many different kinds of motivational factors.[1] It is not surprising to find, therefore, that field-dependence measures do not predict whether the student will continue with his education. Given that the student goes on to graduate school, however, shifts in major out of Science appear to be more frequent among field-dependent students.

D. Cognitive Styles and Achievement in Specific Fields of Study

We have seen that field-dependent people tend to move out of Science majors, and there may be some tendency (although not significant in our sample) for field-independent people to move out of Education majors. These findings are consistent with our hypothesis that students may abandon fields which are incompatible with their cognitive styles. Clearly one reason that students may leave a major field is because their academic performance is less than satisfactory.[2] As noted earlier, there is little relationship, if any, between the field-dependence-independence dimension and overall academic achievement. It seems reasonable to suppose, however, that GEFT scores may be related to achievement in particular fields of study. Specifically, we hypothesized that field-independent students would achieve higher grade-point averages in Science courses, and field-dependent students would do better in Education courses.

We tested these hypotheses in several ways. First, among college graduates, grade-point averages were computed for all courses taken in their major field of study. We expected that GEFT scores would be positively related to major grades for Science majors, and negatively related to major grades for Education majors. These hypotheses were clearly not supported in our data. Correl[illegible]ns between major grades and GEFT scores were all near zero and nons[illegible]ificant. These data are presented in Table A-4 of the Appendix.

The basis of the lack of a relation between cognitive styles and achievement, as reflected in MGPAs, is not clear, but there are several possibilities that merit consideration. First, it may be that cognitive styles are related to academic interests rather than

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[1] In the case of our particular student population, one of these motivational factors, already mentioned, may have been a reaction against the "system" in a period of intense student protest, which was especially pronounced at our college.

[2] Reasons for shifting majors were explored in the interviews with the selected group of students. Student responses were usually too general and the N of shifters too small to be informative on the question, however.

academic achievement. However, it does not seem reasonable to suppose, as such a conclusion would imply, that interest and achievement are unrelated. Second, in the analyses we have done, final majors were used as a basis for classifying students into major groups; students who shifted to other major fields or left the college entirely before college graduation were not included. It is perhaps among these students that poor achievement in areas incompatible with their cognitive styles is most likely to have been found. To explore this possibility, we examined the relation between GEFT scores and grades in introductory Science and Education courses. Course descriptions are given in Table 17 and correlations with grades in Table 18.

Correlations with math-science grades are all positive indicating that field-independent students tend to receive higher grades than do field-dependent students. The correlations are usually not high, but most are significant. The results are less clear for Education courses. For women, the correlations are in the expected direction, but low and insignificant. For men, however, the relationships are more variable.

Table 18 also shows correlations between grades and SAT scores, and between grades and GEFT scores after partialling out the SAT variables. The effect of controlling for SAT scores is to reduce most of these correlations to insignificance, indicating that the GEFT does not add to information available from the SAT in the attempt to predict introductory course grades. The exceptions are noteworthy, however. The partial correlation between GEFT scores and the introductory physics course grades remains significantly positive for women ($r = .31$, $p < .05$), and just misses significance for men ($r = .11$, $p < .06$). Several of the partial correlations with Education grades also become significantly negative. These findings are consistent with our hypothesis, although the relationships are probably too low to be of practical importance.

To examine these relationships further, correlations were also computed separately for students who were preliminary majors in the specific field of study introduced by the course, and for students who were nonmajors in that field. In most cases the correlational picture was unchanged. For the introductory math courses, however, the subdivision of students into preliminary math and nonmath majors had a dramatic effect. For male math majors,[1] the raw and partial correlations between GEFT and introductory course grades were relatively large and significant. For Math 3.2, the raw correlation was .31 ($p < .01$) and the partial correlation was .33 ($p < .01$). For Math 4.1, the raw correlation was .50 ($p < .05$) and the partial correlation was .56 ($p < .05$).[2]

[1] There were too few (4 M and 3 F) preliminary math majors who took the Math 1.1 course to warrant analyses.

[2] The complete set of correlations is presented in Table A-5 of the appendix to this report.

Table 17

Introductory Course Descriptions

Biology 1.0	General Biology. Fundamental biological principles with emphasis on man and the forms of life with which he has important relationships; nature of the living organism, the green plant and its importance as a source of food; organization of vertebrates with special references to the structure and physiology of man.
Chemistry 1.0	General Che[illegible]ry. An enriched introduction to chemical r[illegible]ions and their interpretation, using various con[illegible]pts about the particulate nature of matter. Pr[illegible]arily for science majors, particularly those planning to take elective courses in chemistry.
Mathematics 1.1	Basic Concepts of Arithmetic and Algebra. Analysis, on an elementary level, of the fundamental ideas and methods of arithmetic and algebra.
3.2	Analytic Geometry and Calculus. The first part of a three-semester integrated course in the elements of coordinate geometry, differential and integral calculus, with applications. Emphasis in this part will be on algebraic functions of a single variable.
4.1	Analytic Geometry and Calculus. The first part of a two-semester integrated course in the elements of coordinate geometry, differential and integral calculus, with applications. Emphasis in this part will be on algebraic functions of a single variable.
Physics 1.0	General Physics. Introductory course in mechanics, heat, and sound, primarily for students interested in the biological sciences, medicine and dentistry.
Science 1.0	Science in the Modern World. A series of integrated courses in the physical and biological sciences, stressing fundamental concepts and the methods, growth, and usefulness of scien[illegible]. F[illegible]r students whose major [illegible] t in science.
Education 27.1	Child Develo[illegible] and the Educative Process. For students in [illegible]tary education. Study of the individual from birth to adulthood, with major emphasis on the years preceding adolescence. Biological and social influences on the development of physical, emotional, intellectual, personality,

Table 17 (continued)

	language, and social characteristics, with application to the educative process in early childhood and in the elementary school. Observation of child behavior in the Early Childhood Center and the Educational Clinic; special attention to the development of skills in working with children individually and in groups.
Education 28.0	Learning, Evaluation and Mental Health. Study of the learning process, evaluation in education, mental hygiene and mental health. Observation of child behavior in the Early Childhood Center and the Educational Clinic, and of school and community programs in fields related to course study.
30.3	Education in Modern Society. Study of educational processes in relation to contemporary society. Cultural forces and institutions helping to shape education, and some resulting issues and problems. The school as an institution of education, its guiding theories and basic practices. Role of the teacher. Pertinent references to education in other countries.
35.0	The School Curriculum. Rationale, analysis, and evaluation of the American School curriculum. The program of study on each of the school levels, its strengths and limitations; current experiments and innovations in curriculum development. Types of organization in instruction and their underlying conceptions of the teaching-learning process. Policies and practices in differentiating education, providing for the needs of exceptional children, and meeting special problems in urban education. Facilities and resources of educational significance in the school and the community.

Table 18

Correlations between GEFT and SAT Variables and Introductory Science and Education Course Grades

	Men					Women				
		GEFT	SAT-V	SAT-M	Partial GEFT		GEFT	SAT-V	SAT-M	Partial GEFT
Course	N	r	r	r	r	N	r	r	r	r
Biol. 1.0	292	.12*	.37**	.23**	.07	135	.17*	.42**	.30**	.02
Chem. 1.0	365	.16**	.30**	.46**	.05	84	.26**	.28**	.63**	.02
Math 1.1	255	.05	-.06	.23**	-.01	469	.07	.07	.29**	-.05
Math 3.2	399	.10*	.22**	.24**	.04	214	.09	.13*	.38**	-.07
Math 4.1	100	.18*	.33**	.39**	.10	33	.25	.33*	.73**	-.06
Phys. 1.0	196	.14*	.17**	.13*	.11	38	.38**	.27*	.22	.31*
Sci. 1.0	295	.12*	.17**	.35**	.04	533	.12**	.18**	.38**	-.04
Educ. 27.1	28	.32*	.19	.09	.31	256	-.08	.09	-.19**	-.02
Educ. 28.0	186	-.05	.03	.04	-.06	418	-.02	.13**	.14**	-.09*
Educ. 30.3	344	-.02	.14**	.04	-.03	542	-.07	.09*	-.08*	-.06
Educ. 35.0	200	.12*	.14*	.06	.11	420	-.06	.15**	-.03	-.08

*$p < .05$

**$p < .01$

For women, the raw correlations were similar, but the partials were near zero. The fact that GEFT-grade relationships are clearer among these math majors may be attributable to the greater homogeneity of background within this subgroup. These data clearly support our hypotheses.

We also looked at relationships between GEFT scores and grades achieved in introductory psychology courses. Psychological studies obviously deal with people, and so may be compatible with a field-dependent cognitive style. As noted earlier, however, we conceived of psychology as a broad-gauged discipline with conge .l pathways for more field-independent students in the more impersonal and abstract experimental subspecialties and for more field-dependent students in the more interpersonal clinical and social subspecialties. We were particularly interested, therefore, in looking at grades in two introductory courses taught at our college, one concerned with basic processes of perception, learning, etc., and the other with individual and social processes, with the hypothesis that field-independent students might do better in the former, and field-dependent students in the latter.

The data bearing on these hypotheses are shown in Table 19. As can be seen from the table, the correlations between GEFT scores and grades are low, but almost invariably negative for both courses. These data disconfirm our hypotheses, and suggest instead that field-dependent students tend to do slightly better than field-independent students at the early stage of training in psychology. As an ad hoc explanation of these data, it seems possible that the more impersonal, abstract subject matter of some experimental subspecialities in which we expect field-independent students might excel is not emph. .ized in the introductory work in either course.

Another set of analyses we did to explore the relationships between cognitive style and achievement made use of the high school records of our students. Specifically, we computed grade-point averages for students who had attended public high schools[1] and for high school courses taken in natural sciences, in math, in social studies and in verbal communications. In addition, Regents exams were available for most of the students. Here again mean scores were compiled separately for all natural sciences, for math and for social studies Regents. Correlations with these achievement measures are shown in Table A-6 of the appendix.

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[1]The relatively small group of students who attended private high schools was not included since these schools were very heterogeneous with regard to course offerings, requirements and grading standards.

Table 19

Correlations between GEFT and SAT Variables and Introductory Course Grades in Psychology

Course	N	GEFT r	SAT-V r	SAT-M r	Partial GEFT r
All Students					
Basic Psychological Processes					
Men	278	-.01	.25**	.14**	-.05
Women	194	.04	.32**	.26**	-.11
Individual and Social Processes					
Men	529	.02	.26**	.13**	-.02
Women	530	.02	.29**	.18**	-.08*
Preliminary Psych Majors					
Basic Psychological Processes					
Men	27	-.41*	.42*	.55**	-.48*
Women	34	-.11	.33*	.22	-.20
Individual and Social Processes					
Men	28	.08	.55**	-.03	.10
Women	47	-.01	.28*	.29*	-.09
Preliminary Nonpsych Majors					
Basic Psychological Processes					
Men	251	.02	.25**	.25**	-.02
Women	160	.06	.32**	.27**	-.10
Individual and Social Processes					
Men	501	.01	.13*	.14**	-.03
Women	483	.02	.30**	.17**	-.07*

*$p < .05$ **$p < .01$

The correlations between GEFT scores and math and science achievement measures were generally positive, and most were significant, indicating that field-independent students did better in these academic areas, as expected. These results are consistent with the finding, reported earlier, that field-independent students do better on the math section of the SAT. When SAT scores were partialled out, the correlations between GEFT and math-science grades were invariably reduced to insignificance, a result that might be expected if the SAT math test is viewed as another measure of high school math achievement.

Relationships between GEFT scores and measures of high school achievement in social studies and in verbal communication are similar to the correlations with college education grades reported earlier. In general, these correlations are low, but most are negative, and a few significantly so, particularly after SATs are partialled out, indicating that field-dependent students tend to do better in these areas.[1]

As another approach to achievement in relation to cognitive style, it seems reasonable to consider students' acceptance or rejection into advanced programs compatible with their cognitive styles as an achievement indicator. Acceptance in effect signifies a judgment that the student is suited to the field of endeavor into which he is accepted and that he is likely to benefit from advanced training in that field; rejection signifies a contrary judgment. Following this rationale, we had planned to look at acceptance vs. rejection into different graduate school specialties of students who had applied to these programs. Unfortunately, the mode of record keeping at most of the colleges from which we sought information about our students made it impossible for them to provide information on the department to which application was made for students who did not actually enroll in the school. Accordingly, the acceptance-rejection analysis is not practical in our data, though clearly important.

It has, however, been possible to perform the acceptance-rejection analysis with a subgroup of our students--those who applied to medical school. Because of the central record keeping on all medical school applicants at the Association of American Medical Colleges, it was possible to obtain, in quite complete fashion, the data we needed for an acceptance-rejection analysis for this group. Premedical students in our sample were markedly field independent and, particularly because of the demands of their basic science years, medical schools stress analytical competence in their admissions procedures. Since medical school advisory committee selection judgments take into account omnibus aptitude-achievement criteria, it seems reasonable to hypothesize that relatively

[1]The number of high school courses taken in these various areas shows a similar pattern of relationships with GEFT scores (Table A-7 of the appendix).

field-independent applicants are more likely to be accepted into medical school than relatively field-dependent ones. This hypothesis seems plausible despite the restriction in range of GEFT scores among medical school applicants, resulting from the previously described failure of more field-dependent premedical students to apply to medical school as seniors. An unpublished study we performed earlier had already confirmed our hypothesis. Using a group of over 800 applicants to a large state university medical school, we found accepted applicants to be significantly more field independent than the rejected applicants. In that population, cognitive-style test scores showed no relation to first-year medical school grade-point average.

The data for the much smaller group of medical school applicants from the present study are given in Table 20, which shows the frequency of accepted and rejected applicants, according to GEFT quartiles.[1] The students accepted into medical school had a higher mean GEFT (13.2) than the rejected students (11.7), but the difference is not significant. The absence of a significant difference in the present study, in contrast to the significant outcome of the earlier study, may be due to the much smaller N in the present study. It may also reflect the use of applicants from a single undergraduate college in this study and students from a single medical school but from a large number of different colleges in the earlier study. In this connection it may be noted that, although we do not have comparison figures, the overall acceptance rate for our medical school applicants appears rather high (79%).

Several studies reported in the literature have found relations between cognitive style and achievement in particular vocations consistent with expectations from cognitive style theory. In one study (MacKinnon, 1962) practicing architects chosen as outstandingly creative by their peer group were found to be markedly field independent. Architecture is also one of the fields favored by field-independent students in the academic setting. In view of the

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[1]The number of applicants in Table 20 is lower than in Table 16 since in Table 20 only those applicants are considered who had completed the application process and who were known to have been accepted or rejected by the medical school(s) to which they had applied.

Table 20

Acceptance and Rejection by Medical School, as a Function of Cognitive Style, for Students Applying to Medical Schools (Men)

GEFT Quartile	Total No. Applied	No. Accepted	No. Rejected	% Accepted	% Rejected
Q1 (most field-dependent)	10	7	3	70%	30%
Q2	18	15	3	83%	17%
Q3	25	21	4	84%	16%
Q4 (most field-independent)	29	25	4	86%	14%

importance of analytical skills in architecture and the relative unimportance of interpersonal skills, both during the training period and when practicing the profession, it is not surprising that it should be chosen by field-independent students or that professional architects selected as outstanding should be field independent. In another study on the relation between vocational achievement and cognitive styles (Quinlan & Blatt, 1972), student nurses rated as doing well in psychiatry were relatively field dependent, whereas student nurses rated highly in surgery were relatively field independent; the difference in mean scores in the test of field-dependence-independence used was significant. In view of the emphasis on interpersonal relations and lack of emphasis on analytical skills in psychiatric nursing, and the impersonal orientation characteristic of surgical nursing as commonly practiced, with probably more emphasis on analytical competence (as in quickly disembedding the appropriate instrument from a tray of instruments during a rapidly-moving surgical procedure), the relation found between cognitive style and achievement in these two nursing subspecialties makes sense.

It is worth noting that in both the MacKinnon and Quinlan-Blatt studies performance criteria of achievement were used; these appear to have a more specific and identifiable basis than do teachers' grades, and, moreover, they reflect competence in the domain being assessed more directly. This observation, added to the earlier observation that scores on standard achievement tests tend to relate to extent of field-dependence-independence of students in sciences, suggests that standard achievement tests and actual performance in a field may provide more effective outcome criteria than teachers' grades against which to assess the predictive value of cognitive styles.

IV. Conclusions

The results of this study are generally consistent with cognitive style theory. The data show that, in keeping with the results of many other studies, the field-dependence-independence dimension is only slightly related to verbal skills and is unrelated to overall academic achievement (Appendix D). However, academic choices of and achievement in specific fields of study appear to be a function of cognitive styles in many cases, as expected. The results are clearest for mathematics and the natural sciences. In keeping with their cognitive style, field-independent students tend to choose these analytical, abstract, and impersonal domains. Moreover, they tend to do better in math-science, as evidenced by such diverse achievement measures as SAT-M scores, Regents exams, and course grades.

In contrast, field-dependent students tend to be found in education and other nonscience fields which feature more of an interpersonal orientation. Some evidence was found that students with a field-dependent cognitive style may also do better in the interpersonal fields of their choice. The evidence here was not very consistent, perhaps because of the broad-gauged nature of these domains, which may make it possible for field-independent students to focus on subspecialties within a major that are more congenial with their cognitive style. Nevertheless, it is noteworthy to find some tendency for low GEFT scorers to earn higher scores on certain academic achievement measures. Although used as a convenient index of cognitive style, the GEFT is, after all, an ability test in the sense that students are asked to find the embedded figures if they can, and their scores are higher if they are able to do so. If any relationship exists between an ability test of this sort and academic achievement, the usual expectation would be that students with more of the ability would also achieve more. It is dramatic, therefore, to find just the opposite result for several achievement measures in education, social studies and psychology. The evidence from our data that field-dependent students are higher academic achievers in interpersonal domains is hardly conclusive. However, this evidence is consistent with a growing body of literature, and suggests that studies in achievement in graduate school and vocational subspecialties may be more definitive.

While the theoretical implications of the data are important, the GRE Board may be more interested in practical considerations. From a theoretical perspective we may be satisfied with the finding that field-dependent and field-independent students choose domains that are compatible with their cognitive styles as hypothesized. A simple confirmation of these hypotheses is not sufficient to warrant the use of cognitive style measures for purposes of academic guidance, however. Useful measures of academic preference (preliminary major choice) and achievement (SAT-M) are already available at college entry. From a practical standpoint, the critical question is whether, even though the theory of cognitive styles is valid, GEFT scores contribute useful additional information in the attempt to predict subsequent academic events. When does the complex process of self-selection and institutional selection that leads to greater compatibility between cognitive styles and choice of fields reach completion? If it continues through the undergraduate and postgraduate years, then information about his/her cognitive style may be useful to the college student at points of academic choice.

We have addressed these practical questions in the analyses of stability and shift in choice of major. The evidence on this point indicates that cognitive-style information collected at college entry does add useful information in the attempt to predict which students will continue in their chosen fields during their subsequent academic careers. In general, the data suggest that students tend to leave major areas initially chosen by them if the area is incompatible with their cognitive style.

The results of this study do not permit a conclusion as to whether measures of cognitive style can be used at this time to practical advantage in the guidance process; nor was the study designed to provide an answer to the practicality question. Feasibility questions have yet to be answered, and, in addition, there are many unresolved details in the theoretical and empirical analyses of major fields from the point of view of their cognitive-style compatibility. On the basis of the data from this study we would suggest, however, that a cognitive-style approach has some potential applications to academic guidance at the undergraduate and postgraduate levels, and that, accordingly, further work be done in the attempt to realize this potential.

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Appendix A

Supplementary Tables of Data

Table A-1

Cognitive Style and SAT Data for Major Clusters in the Other Categories Chosen by More Than Five Students: Mean GEFT, SAT-V, and SAT-M Scores

Preliminary Majors	Men GEFT	Men SAT-V	Men SAT-M	Men N	Women GEFT	Women SAT-V	Women SAT-M	Women N
Economics Political Sci. History	10.8	553.0	583.5	111	11.5	557.6	525.4	36
Verbal Communications	12.5	584.7	578.8	40	11.2	570.[illegible]	536.0	138
Accounting	10.8	524.6	607.2	33	11.1	506.7	563.7	7
Psychology	11.0	560.8	582.8	33	11.1	573.8	546.8	53
Sociology	–	–	–	2	10.0	537.5	510.3	15
Speech	12.1	592.7	569.3	7	12.7	556.0	546.6	16
Art/Music	13.8	590.5	580.5	8	14.1	566.8	568.7	22
Phys Ed/Health	10.6	520.6	584.6	8	11.6	527.2	542.0	14

Table A-1 (continued)

	Men				Women			
	GEFT	SAT-V	SAT-M	N	GEFT	SAT-V	SAT-M	N
Final Major								
Economics History Political Sci.	10.8	541.5	583.1	118	11.5	577.0	564.3	41
Verbal Communications	11.5	559.1	584.8	55	11.7	574.7	543.7	126
Accounting	10.8	528.2	601.8	53	12.0	559.3	598.3	6
Psychology	11.4	560.6	596.2	71	11.9	567.1	574.3	48
Sociology	11.8	527.8	594.0	25	10.8	531.1	535.1	38
Speech	11.9	573.1	591.3	31	10.8	578.4	543.9	21
Art/Music	14.6	558.8	578.7	16	13.4	563.9	573.5	30
Phys Ed/Health	11.6	498.6	570.3	21	12.2	536.4	524.6	11
Graduate School Department								
Economics History Political Sci.	11.1	569.0	582.1	19	12.0	591.2	599.2	10
Verbal Communications	12.4	576.3	593.1	29	11.2	583.3	562.5	42
Psychology	08.2	547.8	588.5	6				3
Speech	-	-	-	4	10.9	537.2	548.9	13
Art/Music	15.3	515.2	582.8	6	-	-	-	2
Phys Ed/Health	11.5	502.5	557.4	10	-	-	-	4
Business	10.2	511.6	586.9	15	-	-	-	3
Law	12.0	571.7	606.0	28	-	-	-	5

Table A-2

Cognitive Style and SAT Data on Students Who Shifted Out of Science into Nonscience Majors (Preliminary to Final Major): Mean GEFT, SAT-V, and SAT-M Scores

	Men				Women			
Final Major	N	GEFT	SAT-V	SAT-M	N	GEFT	SAT-V	SAT-M
Education	7	13.3	504.1	630.7	27	10.5	485.3	554.15
Econ/History/ Poli Sci	34	10.9	516.3	592.6	8	12.5	582.0	603.3
Verbal Communication	20	11.6	516.2	577.8	10	10.3	552.3	538.3
Accounting	25	10.0	506.5	601.8	0	-	-	-
Psychology	37	12.1	560.9	610.8	13	12.5	589.0	607.7
Sociology	9	12.4	532.4	617.8	10	10.5	528.4	565.2
Speech	11	14.1	588.1	611.2	2	10.5	540.0	565.0
Art/Music	3	15.3	477.7	602.0	6	15.0	535.2	563.5
Phys Ed/Health	7	11.4	494.9	573.4	3	10.3	503.7	500.0
Others	6	11.5	559.2	641.8	3	12.0	563.7	561.3

Table A-3

Cognitive Style and SAT Data on Students Who Shifted Out of Education into Noneducation Majors (Preliminary to Fi- Major): Mean GEFT, SAT-V, and SAT-M Scores

Final Major	Men				Women			
	N	GEFT	SAT-V	SAT-M	N	GEFT	SAT-V	SAT-M
Science	0	–	–	–	2	14.5	641.0	561.0
Econ/History/ Poli Sci	1	10.0	641.0	636.0	1	6.0	662.0	478.0
Verbal Communication	0	–	–	–	7	12.9	542.6	548.4
Psychology	1	6.0	621.0	496.0	4	7.5	523.3	566.3
Sociology	1	9.0	456.0	584.0	9	13.0	508.7	549.3
Speech	0	–	–	–	3	9.7	598.0	567.3
Art/Music	0	–	–	–	2	14.5	586.5	640.5
Others	0	–	–	–	1	12.0	484.0	561.0

Table A-

Correlations between GEFT and SAT Variables and

Grades in Course Work within the Final Major Field

	N	GEFT	SAT-V	SAT-M	Partial GEFT
Science Majors					
Men	155	.07	.28**	.37**	-.05
Women	67	.19	.29*	.30*	.03
Education Majors					
Men	21	.04	-.14	-.00	.07
Women	209	-.07	.18*	-.13	-.21*

Table A-5

Correlations between GEFT and SAT Variables and

Introductory Course Grades in Mathematics

Course	Men N	Men GEFT	Men SAT-V	Men SAT-M	Men Partial GEFT	Women N	Women GEFT	Women SAT-V	Women SAT-M	Women Partial GEFT
All Students										
Math 1.1	255	.05	-.06	.23**	-.01	469	.07	.06	.29**	-.05
Math 3.2	399	.10*	.22**	.24**	.04	214	.09	.13*	.38**	-.07
Math 4.1	100	.18*	.33**	.39**	.10	33	.25	.33*	.73**	-.06
Preliminary Math Majors										
Math 1.1	4	--	--	--	--	3	--	--	--	--
Math 3.2	50	.31**	.11	-.11	.33**	69	.29**	.31**	.49**	.05
Math 4.1	15	.50*	.16	-.27	.56*	23	.28	.38*	.77**	-.18
Preliminary Non Math Majors										
Math 1.1	251	.04	-.04	.23**	-.01	466	.06	.05	.30**	-.04
Math 3.2	349	.07	.23**	.28**	-.00	145	-.01	.10	.29**	-.12
Math 4.1	85	.14	.36**	.46**	.03	1C	.06	.17	.56*	-.17

$^{*}p < .05$

$^{**}p < .01$

Table A-6

Correlations between GEFT and SAT Variables and

High School Achievement Measures

(Public School)

	Men					Women				
Area	N	GEFT	SAT-V	SAT-M	Partial GEFT	N	GEFT	SAT-V	SAT-M	Partial GEFT
Course GPA										
Science	522	.09*	.18**	.16**	.04	441	-.01	.17**	.14**	-.08
Math	522	.17**	.07	.39**	.07	441	.06	.01	.34**	-.05
Social Studies	522	-.09	.25**	-.05	-.09*	441	-.10*	.25**	.03	-.15**
Verbal Communication	522	-.05	.22**	.03	-.08	441	-.06	.26**	.08	-.13*
Regents										
Science	519	.15**	.36**	.34**	.05	438	.12*	.40**	.29**	-.02
Math	521	.11*	.10*	.33**	.02	440	.11*	.10*	.36**	-.01
Social Studies	11	.32	.53	.19	.30	13	.02	.17	.39	-.14
Verbal Communication	470	-.00	.34**	.14**	-.06	421	.04	.28**	.15**	-.04

*$p < .05$

**$p < .01$

Table A-7

Relationships between GEFT and SAT Variables and Number of High School Courses Taken in Mathematics, Natural Sciences and Social Sciences: Pearson r's and Numbers of Students

	GEFT		SAT-V		SAT-M		Partial GEFT	
Men	r	N	r	N	r	N	r	N
N of math courses	.13*	522	-.05	522	.30**	522	.06	522
N of nat. science courses	.10*	522	.16*	522	.19**	522	.04	522
N of social studies courses	-.15*	522	.12*	522	-.08	522	-.14*	522
N of verbal communication courses	-.13*	522	.01	522	-.16*	522	-.09*	522
Women								
N of math courses	.09	441	-.01	441	.28**	441	.02	441
N of nat. science courses	.19*	441	.11	441	.23**	441	.12*	441
N of social studies courses	-.06	441	.07	441	-.01	441	-.08	441
N of verbal communication courses	-.10	441	.08	441	-.05	441	-.10	441

*$p < .05$

**$p < .01$

Table A-8

Cognitive Style, SAT, Achievement and Academic Progress Data for Students with Discrepant and Congruent Cognitive Patterns

	Men					Women				
	High Verbal		Low Verbal		Midrange Verbal	High Verbal		Low Verbal		Midrange Verbal
	FI	FD	FI	FD	FI/D	FI	FD	FI	FD	FI/D
Cognitive Style, Aptitude, and Achievement Means and Number of Cases										
GEFT	17.0	6.9	16.4	7.0	11.5	16.8	7.7	16.7	7.1	11.4
	(64)	(47)	(50)	(62)	(45)	(58)	(47)	(22)	(67)	(36)
SAT V	648.4	635.3	453.6	453.7	538.9	672.6	636.7	454.8	448.3	542.3
	(64)	(47)	(50)	(62)	(45)	(58)	(47)	(22)	(67)	(36)
SAT M	641.5	598.0	595.0	556.0	607.2	623.9	533.3	543.2	502.2	558.3
	(64)	(47)	(50)	(62)	(45)	(58)	(47)	(22)	(67)	(36)
GRE V	629.3	685.0	528.3	526.0	564.6	699.1	612.1	505.0	488.3	570.0
	(14)	(6.0)	(6)	(5)	(11)	(11)	(14)	(2)	(6)	(7)
GRE M	660.0	575.0	621.7	582.0	577.3	605.5	491.4	515.0	436.7	582.9
	(14)	(6)	(6)	(5)	(11)	(11)	(14)	(2)	(6)	(7)
High School GPA	89.1	88.1	87.0	88.0	87.5	90.8	90.5	88.7	89.3	88.9
	(64)	(47)	(50)	(62)	(45)	(58)	(46)	(21)	(67)	(36)
College GPA	3.0	2.8	2.6	2.6	2.8	3.2	3.1	2.8	2.8	3.0
	(56)	(37)	(34)	(48)	(34)	(48)	(43)	(16)	(54)	(31)
Academic Progress (Percent)										
Scholastic Difficulty	4.7%	10.6%	16.0%	12.9%	11.1%	5.2%	2.1%	9.1%	6.0%	2.8%
Preliminary Major										
Science	43.8%	27.7%	62.0%	58.1%	51.1%	36.2%	17.0%	13.6%	29.9%	38.9%
Other	56.3%	66.0%	36.0%	40.3%	48.9%	50.0%	63.8%	45.5%	32.8%	47.2%
Education	0.0%	2.1%	0.0%	1.6%	0.0%	10.3%	19.1%	40.9%	32.8%	13.9%

Table A-8 (continued)

	Men					Women				
	High Verbal		Low Verbal		Midrange Verbal	High Verbal		Low Verbal		Midrange Verbal
	FI	[illegible]	FI	FD	FI/D	FI	FD	FI	FD	FI/D
Final Major (if graduated)										
Science	31.6%	2.6%	36.8%	23.5%	32.4%	2[illegible].0%	9.3%	0.0%	9.3%	76.1%
Other	66.7%	92.3%	60.5%	70.6%	61.8%	62.[illegible]%	[illegible].5%	75.0%	27.8%	61.3%
Education	0.0%	2.6%	2.6%	5.9%	2.9%	10.[illegible]%	[illegible]7.9%	25.0%	61.1%	19.4%
Graduated with Bachelor's Degree	89.1%	83.0%	76.0%	82.3%	75.6%	8[illegible].2%	[illegible]1.4%	72.7%	80.6%	86.1%
Applied to Graduate School	67.2%	38.3%	42.0%	43.5%	62.2%	[illegible].3%	66.0%	27.3%	56.7%	69.4%
Enrolled in Graduate School	46.9%	25.5%	26.0%	32.3%	46.7%	[illegible]7.6%	42.6%	22.7%	38.8%	52.[illegible]%
Graduate Major										
Science	40.0%	0.0%	23.0%	15.0%	47.6%	[illegible]	5.0%	0.0%	3.8%	15.8%
Other	46.7%	83.3%	61.5%	50.0%	42.9%	50.0%	30.0%	40.0%	23.1%	31.6%
Education	13.3%	8.3%	7.7%	35.0%	9.5%	12.5%	66.7%	60.0%	65.4%	42.1%
Shift in Major Preliminary to Final Selection	19.3%	41.0%	31.6%	41.2%	38.2%	34 %	27.9%	31.3%	40.7%	32.3%
Shift in Major Preliminary to Graduate Selection	33.3%	66.6%	53.8%	60.0%	33.3%	31.3%	50.0%	40.0%	61.5%	47.4%
<u>Professional Development</u>										
Premedical Student	17.2%	21.3%	30.0%	24.2%	24.4%	3.4%	0.0%	0.0%	3.0%	8.3%
Enrolled in Medical School	12.5%	0.0%	4.0%	1.6%	13.3%	3.4%	0.0%	0.0%	0.0%	2.8%

Table A-8 (continued)

	Men					Women				
	High Verbal		Low Verbal		Midrange Verbal	High Verbal		Low Verbal		Midrange Verbal
	FI	FD	FI	FD	FI/D	FI	FD	FI	FD	FI/D
Shifted out of Medicine from Premedical Selection to Enrollment in Medical School	54.5%	100.0%	88.7%	93.3%	72.7%	50.0%	--	--	100.0%	67.7%
Certification to Teach in Public Schools	10.9%	10.6%	12.0%	24.2%	8.9%	27.6%	48.8%	31.8%	64.2%	38.9%

Table A-9

Students with 9 or more math or science courses in high school

Level	Sex	Group	GEFT Mean	SD	N
Preliminary Major	Males:	Science	12.8	3.8	151
		Nonscience	12.5	4.0	54
	Females:	Science	13.1	3.6	40
		Nonscience	11.9	3.3	33
Final Major	Males:	Science	12.9	3.7	88
		Nonscience	12.6	3.9	119
		Dropouts	11.6	3.6	9
	Females:	Science	14.1	3.4	24
		Nonscience	11.8	3.3	47
		Dropouts	11.0	---	2
Grad. Major	Males:	Graduate Science	13.3	3.1	55
		Graduate Nonscience	12.4	4.0	54
		BA/BS Only	12.3	3.9	79
		Dropouts	11.6	3.6	9
	Females:	Graduate Science	15.8	4.2	8
		Graduate Nonscience	11.9	3.1	24
		BA/BS Only	12.1	2.8	24
		Dropouts	11.0	---	2

Appendix B

Academic choices at the high-school level, viewed from the standpoint of cognitive styles, as predictive of academic functioning in college and graduate school

To examine this issue we selected students who had shown particular interest in the mathematics and science areas in high school by going beyond the required number of courses in these areas and took more than one course per semester in mathematics, more than one course per semester in science, or more than one course per semester in both. Exercise of the option to take a large number of courses in mathematics and/or science, at the high school level, where the phenomenon of majors does not exist, may be taken as roughly indicative of the kind of interest usually expressed in choice of major at later levels.

Within this group selected for apparent interest in the math/science domain, we compared the GEFT scores of those who subsequently entered these domains as majors, at various levels, with those who selected some other alternative, either another major or discontinuing their education. The GEFT means for the various subgroups in the analysis, at the preliminary, final, and graduate major levels, are shown in Table A-9. Analysis of variance proved to be significant for women at both the final major and graduate school levels. When analysis of covariance was used to eliminate the effect of SAT-V and SAT-M, none of the differences was significant, suggesting that the preselection process, along with the statistical removal of the effect of the SAT's, eliminated that part of the variance in selection of science which was predictable by the GEFT

Appendix C

The effect upon various aspects of college evolution of a marked discrepancy in level of functioning in the field-[illegible]ce-independence and verbal-comprehension domains and the sources of these cognitive splits during development

On the one hand, with the great weight usually assigned to verbal-comprehension ability in both precollege work and in college selection tests, students find their way into college who, while high in level of verbal comprehension, are quite low in analytical functioning--that is, are field dependent. On the other hand, students with a discrepancy in favor of analytical competence over verbal ability are also likely to be found in college populations. It seemed to us, when we undertook the study, that students with such cognitive discrepancies might not function well academically, as reflected both in low achievement and instability in academic choices.

To explore this hypothesis we selected for special study small groups of male and fema students who showed the two kinds of discrepancy cited. For comparison with these groups, we also identified groups of men and women who were high in verbal ability and field independent, groups low in verbal ability and field dependent and groups intermediate on both dimensions.

As may be seen in the data summarized in Table A-8 no differences were found between the discrepant and nondiscrepant groups.

Interviews were conducted with small groups of male and female students who were field dependent and high in verbal ability and, for comparison, groups who were field independent and low in verbal ability. In part, these interviews attempted, in an exploratory way, to identify factors contributing to the development of cognitive discrepancies. No obvious factors of this kind were discernible in analyses made of these interviews.

Appendix D

The role of field-dependent and field-independent cognitive styles in the verbal functioning of students who appear no different in standard tests of verbal functioning

Three types of verbal media were used in investigating this issue: verbal tests, group administered and of the short-answer or objective type; written verbal productions; and spoken verbal productions, both monologues and communications to another person in the course of an interaction. These various verbal samples were obtained from the selected group of 100 male and female students who were in the top quartile of the SAT-V and whom we tested during their four years in college.

The battery of verbal tests we used was designed to test the hypothesis that competence at disembedding in the stimulus-configurational domain (as, for example, in the embedded-figures test) is associated with competence at disembedding in the verbal domain. Some of the verbal tests included in the battery which were presumed to involve disembedding were taken from the literature, either in their original form or modified for our purposes; others were devised for this study. Also included in the battery were some tests which did not require disembedding and for these we expected no relation with the tests of field-dependence-independence. Of the tests conceived to require disembedding, and therefore expected to relate to the cognitive tests, some were symbolic in nature (that is, they required primarily the manipulation of letters or words) and others were semantic (that is, the task operations were concerned primarily with word meanings).

Because all the subjects in our selected subsample to whom this verbal battery was given were in the top quartile of the SAT-V, the range in verbal ability was restricted but this selection procedure did not adequately control for verbal ability. Accordingly, the same battery of verbal tests was given to another group of 291 college students, both men and women, unselected with regard to verbal ability. For this independent sample, verbal ability (as measured by a vocabulary test) was partialled out in examining the relation between field-dependence-independence and scores from tests of the verbal battery.

The findings for both the subgroup from our longitudinal sample and the unselected college group gave some support to the expectation that competence in disembedding in perceptual tests of field dependence tends to be related to competence in disembedding in verbal tasks, both symbolic and semantic, although the results were not entirely consistent. Studies by others have shown similar relations, although again not consistently (for example, Dershowitz, 1966; Pemberton, 1952; Rosen, 1963). In keeping with expectations, verbal tests which did not involve disembedding for the most part showed little relation to the cognitive style tests.

Since 1967, when our study was designed and begun, a factor analytic literature has appeared which suggests that field-dependence-independence probably represents a separate dimension of individual differences from disembedding and restructuring in verbal-linguistic functioning. The most comprehensive of these studies has been conducted by Messick and French (1975). In that study, discrete first-order factors emerged for flexibility of closure (on which tests like the embedded-figures test characteristically load) and speed of closure, in both figural and verbal forms. More important, the figural-closure factors fused to form a second-order symbol-articulation factor as did the verbal-closure factors. These two second-order factors showed no relationship. Since the Messick and French study used a test battery far more comprehensive than ours (including marker tests for more dimensions than were represented in our battery), and had the advantage of a factor analytic design, the evidence from that study must be taken as more definitive than our own. Aside from the negative answer it provides to our starting question about self-consistency in functioning across perceptual tests of field-dependence-independence and tests of verbal linguistic functioning, the evidence from the Messick and French study provides still another demonstration that the field-dependence-independence cognitive style domain is separate from the verbal domain.

The written productions used to compare verbal-linguistic functioning of field-dependent and field-independent subjects in the subsample from our longitudinal study included autobiographies and TAT-type stories written on a variety of themes. The spoken productions included 5-minut monologues on a topic selected by the subject as personal and important. They also included the subject's contribution to a dialogue with another person, directed at resolving a conflict about an issue on which subject and partner were known to be in initial disagreement These verbal materials were analyzed in a variety of ways, suggested by known differences in cognitive functioning between field-dependent and field-independent people. Some of the analyses used both written and spoken productions, others used one kind of production alone. Following are some examples of the analyses that were done:

One analysis considered complexity of syntactic structure, with the idea that the cognitive skills of field-independent people might result in the production of more complex structures. The code developed to assess syntactic complexity in both written and spoken verbal productions, included the following indicators of complexity: T-unit length in words; number of surface structure clauses per T-unit; number of deep structure clauses; and ratio of surface structure to deep structure clauses.

Another analysis, using the dialogue transcripts, examined frequency of floor-taking interruptions of the partner's utterance by field-dependent and field-independent subjects. Such interruptions may have several different purposes, but the one we considered paramount is the intent to control the conversational flow. On this basis we expected that floor-taking interruption would be more frequent for the field-independent than the field-dependent partner in the interaction. Four types of floor-taking interruption expressions were identified and used in comparing field-dependent and field-independent speakers: close to simultaneous repetition of the partner's speech: a conti er or back-channel response (such as "but" or "well"), or a com ation of these followed by a new sentence; a continuer alone or followed by a string of continuers uttered noninterruptively; an interfering new sentence introduced dire tly without a continuer; laughter.

Another analysis had a similar intent to the one which guided the study of interruptions. On the premise that field-dependent subjects would tend to allow converstional structuring and control by their partners to a greater de ee than field-independent subjects, it was expected that in a dial ue field-dependent subjects would more often use "free-pass" type of turn-taking device--that is, a brief utt ance which lets the partner know that the subject is willing to give up his or her turn and allow the partner to talk again if the partner wishes. In the analysis that was carried out, free passes were defined as one or more sets of words or phrases which were uttered non-interruptively and which composed the subject's entire utterance (for example, "yeah," "mmhm," "well").

Still another analysis, which again used the dialogues, examined the hypothesis that field-independent people, because of their greater sense of separate identity, might have a greater tendency to self-monitor or judge the adequacy of their own encoding of messages than field-dependent subjects. This tendency may manifest itself in a greater frequency of sp ch modifications, that is, qualifications or self-corrections. Five types of speech modification formed the basis of the analysis that was carried out: sentence fragments or false starts; word, clause or phrase reformulations with an introductory word or phrase, such as "that is"; clause or phrase reformulations without introductory word or phrase; independent clause inserted in a sentence--for example, "I guess"; self-imitation or repetition.

None of these or other analyses we carried out showed the expected difference between field-dependent and field-independent subjects. In viewing this negative outcome, there is a possibility that should be considered: It may be that the differences in verbal-linguistic functioning we looked for are evident during the growth years, in the period of development of verbal-linguistic skills, but that whatever differences may exist in the rate of development of these skills as a function of cognitive style have been leveled out by adulthood. This may be particularly true of adults of the educational status of our subjects, who, in addition, were selected as being very high in verbal skills, scoring in the top quartile of the verbal SAT.

Appendix E

Bibliography of Studies on Relation Between Field-Dependence-Independence and Career Differentiation

This listing covers the literature on field-dependence-independence and educational-vocational interests, choices and achievement. The references were selected from three recent bibliographies on field-dependence-independence and psychological differentiation (Witkin et al., 1973, 1974, 1976), using the following index categories in those bibliographies: Achievement, academic; Achievement, vocational; Interests, academic; Interests, vocational; and Occupation. The literature on field-dependence-independence and aptitude and abilities, though relevant, have not been included because of its very extensive size. That literature may be identified by reference to the appropriate index categories in the three bibliographies.

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