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RESEARCH STRATEGIES IN STUDYING COLLEGE IMPACT

Kenneth A. Feldman

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P. O. BOX 168, IOWA CITY, IOWA 52240

Abstract

This paper presents a broad overview of the research on the impact of college on students. The ways in which such research has been done, and the underlying theories and analytical strategies are outlined. Some generalizations based on integration of available studies are presented first, followed by a discussion of the difficulties involved in conceptualizing and measuring "impact." Next, the various orientations used in predicting the nature and direction of impacts are analyzed. They are actuarial, avowed goals and functions of higher education, personality development, life-cycle movement within the general social system, and distinctive social organizational structures and pressures. Ways of measuring college environments and inferring their impacts are then discussed. Finally, some future research topics are suggested along with an analysis of alternative research methodologies.

The comparative analysis of research methodologies for college impact studies is an extended and integrative treatment of this topic. The appropriateness of the various methods now used are evaluated and the need to learn the conditions and dynamics of college effects is emphasized.

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RESEARCH STRATEGIES IN STUDYING COLLEGE IMPACT[1]

Kenneth A. Feldman

The effects of colleges on their students have been intensively studied—long before, it might be added, the current explosion of interest in student unrest. Much more is known about the impact of college on students than certain skeptics would have us believe. But it is certainly true that our knowledge is not very great given the immense amount of effort that has been exerted in research, analysis, and discussion of college effects.

There are at least two broad and overlapping approaches that can be used in reviewing studies on the impacts of college. One is primarily substantive, the other primarily methodological. The purpose of the substantive approach is to summarize the research in the area and to offer empirical generalizations warranted by the results of available studies. This goal has not lacked pursuers. Works by Bloom and Webster (1960), Chickering (1969), Freedman (1960), Jacob (1957), Sanford (1962), and Strang (1937) come most readily to mind. And, recently, Theodore M. Newcomb and I attempted a comprehensive summary (Feldman & Newcomb, 1969).

The methodological approach, sought somewhat less frequently than the first, focuses on outlining the ways in which research has been done, pointing out the theoretical orientations and analytic strategies underlying these studies and highlighting some of the attendant methodological problems and research issues. The present effort uses this second approach, preceding it with an initial discussion of the substantive generalizations that can be made about college impacts.

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[1]This report is a modification and extension of two recent works by the author, one an article published in *Sociology of Education* (Feldman, 1969), the other a background paper for a seminar on college effects held in Iowa City, February 19, 1970, cosponsored by The American College Testing Program and the University of Iowa. Feldman is an Associate Professor of Sociology, State University of New York at Stony Brook. The author is grateful to Robert H. Fenske and Leo A. Munday of The American College Testing Program for their assistance in the preparation of this report.

Overview of the Impact of College on Students

Newcomb and I recently attempted to assess the evidence about the characteristics of American college students as their colleges have influenced them.[2] We reviewed a wide variety of published and unpublished studies done during the forty-year period from the mid-twenties to the mid-sixties that were either directly or indirectly relevant to college impacts. Our search for extant studies was not intended as a total flight into exhaustiveness, although we did try to be as comprehensive as possible within the limitations of the resources available to us. By systematically juxtaposing relevant information from the hundreds of reports, articles, books, and papers that we collected and through secondary analysis of certain of the data in these materials, we hoped to contribute to the understanding of the processes and effects of higher education. It is impossible, of course, to discuss all of our findings; and even the few generalizations that will be made herein cannot be properly qualified. Nonetheless, it is important to review what has been found before discussing and comparing research strategies.

Freshman-to-Senior Changes

Several studies have compared students by college-class level (freshmen and seniors in particular) in order to answer the following question: Do American students, regardless of who they are or where they go to college, typically change in definable ways during their undergraduate years? Freshman-to-senior changes in several characteristics have been occurring in recent decades with considerable regularity in many American colleges and universities. Numerous studies show that during their college years students, *on the average,* decline in authoritarianism, dogmatism, and prejudice. They become more liberal with regard to social, economic, and political issues. In addition, they come to value aesthetic experiences more highly. These freshman-to-senior changes indicate an increasing openness to multiple aspects of the contemporary world, presumably paralleling wider ranges of knowledge, contact, and experience. Somewhat less consistently across studies, but nevertheless evident, are increasing intellectual capacities and interests. Declining commitment to religion, especially in its more orthodox forms, is also apparent. Also, certain kinds of personality changes—particularly trends toward greater independence, self-confidence, and readiness to express impulses—are the rule rather than the exception.

Average scores on various scales and responses to questionnaire items are not the only group characteristics of interest in the study of freshman-senior differences. Changes in the dispersion of scores as measured, say, by changes in standard deviations may also indicate college impact. We examined freshman-senior differences in standard deviations of scores and found that across college, for almost all domains of change under investigation, increases in heterogeneity were as likely as increases in homogeneity. Contrary to Jacob's assertion (1957) in his much-quoted *Changing Values in College,* colleges vary markedly in the increasing homogeneity or uniformity of their student body on some important characteristics. (Some hypotheses about this variance are presented in Feldman & Newcomb, 1969, and in Feldman, 1970.)

It is useful to add information from sophomores and juniors to freshman-senior comparisons. The timing of greatest college impact can be inferred from comparisons of the means of contiguous college-class levels. It might be expected that freshman-sophomore differences would be larger than either sophomore-junior or junior-senior differences. More than one investigator has argued that the major changes in college occur early in the college experience due to the special sensitivity of freshmen and perhaps sophomores to the influences they encounter. Juniors and seniors, in particular, are considered to be in a different developmental phase, one where change is leveling off and where little more happens to them. (For example, see Freedman, 1965; Lehmann & Dressel, 1962; and Sanford, 1965.)

On the other hand, there are grounds for not expecting to find, as an invariable occurrence, that the effects of college are greatest during the freshman year. There is no reason to anticipate that the curves of change will be the same for all individual attributes or in all colleges. For some characteristics, the early college years may indeed be where the greatest change occurs; but other characteristics may change during later college years. And at some colleges the challenges of the early years may be greater than those of the later years, whereas the structural arrangements of other colleges may create greater pressures for change on upper division than on lower division students. Perhaps the timing of change depends upon individual rhythms of adaptation. Even if most students find the challenges of their first year to be heavier than those of later years, they

[2]Our project was commissioned and financially supported by The Carnegie Foundation for the Advancement of Teaching.

may still differ in the timing in which such challenges are "registered" in terms of change. For some, change may be almost immediate; for others there may be a longer period of "working through," with observable change surfacing only in later college years. Some students find the challenges of their freshman year so threatening that they become resistant to change, only to become less defensive and more likely to change in their junior or senior year.

Because of possibilities such as these, we were not particularly surprised to find no indication that freshman-sophomore differences were larger than sophomore-junior or junior-senior differences in most change-areas surveyed. The major exception in the majority of studies is in the area of authoritarianism where freshman-sophomore differences (decreases) are larger than sophomore-junior and junior-senior differences.

Institutional Sources of Impact

The very general statements about change and stability that may be inferred from overall differences among college-class levels, while interesting in themselves, are nevertheless of limited importance in understanding the *nature* of the college experiences that influence students. Moreover, no generalizations about freshman-senior change and the like could be expected to apply equally to all colleges nor, *a fortiori,* to all individual students. General trends in differences among class levels serve best as a backdrop for the necessarily more detailed examination of the *conditions* of student change and resistance to change. The more challenging and fascinating question is this: What kinds of students change in what kinds of ways, following which sorts of experiences, mediated by what kinds of institutional arrangements? Consideration of this question would include an analysis of the distinctive impacts of different kinds of colleges, as well as the effects of more specific influences on students within a college, e.g., the effects of a student's major field, the impacts of his residence, and the importance of his interpersonal experiences as embedded in the interplay between student and faculty cultures.

Colleges clearly differ with respect to their social structure, type of control, faculty attributes, and environmental characteristics and pressures. Moreover, we found relatively large differences among colleges with respect to the attitudes, values, and personality traits of their "average" student. From these differences, we predicted—and found—that the nature and degree of impacts vary by college.

Within a college, students do not have the same kinds of experiences. We found that a particularly important locus of differential experiences is that of the activities connected with the students' major fields. Our initial point of interest was to find whether students enrolled in different major fields had distinctive characteristics. A large number of studies show such major-field differences; and, more important, we found a relatively consistent pattern in many of these differences among studies. This consistency was true even taking into account the lack of uniformity among the studies with respect to such factors as the calendar year of the study, class level of students, the particular instrument used to measure the attributes in question, the range of curricula under investigation, and the classification scheme used to categorize and combine major fields.

A few examples of findings in this area are worth noting. Consistently across studies, students in engineering, physical science and mathematics, pre-law, English, and languages—compared with students in other academic majors—scored higher on tests measuring general intellectual ability. Students in biology, pharmacy, and applied medical fields were typically medium in this regard. Students in business, education, home economics, and agriculture usually were relatively low. With respect to measures of authoritarianism, dogmatism, and prejudice, students in the humanities hardly ever ranked high, whereas students in engineering, home economics, education, pharmacy, veterinary medicine and other applied fields were unlikely to rank low. Students in different major fields differed in their expressions of future job or career requirements. For example, students in physics, pre-law, political science, economics, business, and engineering were more likely than other students to place high importance on jobs and careers that provide security and in which one has the opportunity to earn a great deal of money or gain social status and prestige (indicating endorsement of what Rosenberg, 1957, has termed extrinsic reward-oriented career requirements). On various scales purporting to measure psychological well-being, students in the natural sciences tended to score higher than students in the social sciences, who, in turn, tended to be higher than humanities majors. Finally, compared with students in other fields, students in business administration quite consistently ranked higher than students in other majors on dominance and confidence as well as on sociability and gregariousness as measured by various personality scales.

Such "static" major-field differences, even when fairly consistent across studies, have only an indirect bearing upon the matter of major-field impacts because of the fact that each field tends to attract and recruit students who are in many ways similar to students already in the field. Students major in different fields because of their academic

and vocational interests; and interests are related to attitudinal and personality traits. The apparent college outcome in student differences may be entirely due to different student input characteristics.

We found indications that experiences associated with the pursuit of different academic majors do have effects over and beyond those that can be accounted for by initial selection into academic majors. In re-analyzing certain data in some of the major-field studies, we found a particularly interesting phenomenon which we called the accentuation effect. This effect refers to the increase, or accentuation, of the initial differences among students entering different major fields during their progression through their majors.

This accentuation of initial differences among groups is not limited to within major fields. From other studies, we discovered not only that students entering college are typically different in certain ways from students who do not attend college but also that these differences between the two groups were likely to become sharpened during the ensuing years. Likewise, the initial diversity of students entering different kinds of colleges tended to be accentuated, as were initial differences of students attracted to different subcultures within a college.

In short, we found that whatever the characteristics of an individual that selectively propel him toward particular educational settings—going to college, selecting a particular one, choosing a certain academic major, acquiring membership in a particular group of peers—these same characteristics are apt to be reinforced and extended by experiences in these selected settings. Consequently, the initial average differences among students entering different educational settings are increased over time. What the general proposition really asserts is that processes of attracting and selecting students into various environments are interdependent with processes of impact. Put more conditionally, if students initially having certain characteristics choose a certain setting (a college, a major, a peer group) in which those characteristics are prized and nurtured, accentuation of such characteristics is likely to occur.

Background and Personality Characteristics Related to College Impact

In addition to the effects of campus-wide influences and the pressures of subenvironments, we have observed that college impacts are conditioned by the background and personality of the student. For example, it appears that the more incongruent a student is with the overall environment of his college, the more likely he is to withdraw from that college or from higher education in general. We did not find much support, however, for the often-voiced notion that, for students who remain in college, change will be greatest for those whose backgrounds are initially the most discordant with the college environment. Our best guess at the moment is that a college is most likely to have the largest impact on students who experience a continuing series of not-too-threatening divergencies. Too great a difference between student expectations and college experiences, especially at first, may result in the student's marshaling of resistance. Too little might mean no impetus for change. From this point of view, a college's objectives might be to provide discrepancies that can stimulate change and growth.

Students vary in the degree to which they are open to change in terms either of their willingness to confront new ideas, values, and experiences nondefensively or of their willingness to be influenced by others. Current evidence suggests that the more open to change and influence an entering student is, the greater is the impact of college. And a student's openness to change can be changed by experiences on the campus. Therefore, the amount and nature of college impacts are not necessarily predetermined by the student's initial degree of openness to change.

Regardless of the amount of confidence that can be placed in the above or any other generalizations about the impacts that colleges have on students, some degree of uncertainty must remain because researchers in the area have been faced with a number of serious methodological problems, not all of which have as yet been completely resolved. It is to some of these issues that the present discussion now turns.

Impact as Change

To begin with, the meaning of "impact" is problematic. Usually the phrases "college impacts" or "college effects" refer to college-induced *change* in any of a wide variety of such student attributes as knowledge, skills, personality traits, interests, attitudes, orientations, values, beliefs, opinions, and behaviors. The most common way to "measure" such change is to compare two college-class levels, usually freshmen and seniors. The comparison is typically made in terms of average differences between seniors and freshmen in their "scores" on scales, their responses to questionnaire items, ratings by observers, or other indicators.

Change, so specified, rests on a number of inferences and assumptions:

(a) The measuring instrument (scale, questionnaire item, rating) indicates a real attribute of the student.
(b) The fact and amount of change are indicated by a difference between the average score of seniors and that of freshmen.
(c) Change is due to the college experience.

The reliability and validity or "goodness" of each of these assumptions and inferences can be tested in a variety of ways. The use of these procedures helps to increase confidence in the inference that a score on a certain instrument does in fact consistently indicate a particular, real student attribute. A researcher is essentially addressing himself to the question of whether or not the fact and amount of change can be meaningfully inferred from a difference between the average score of seniors and that of freshmen when he concerns himself with any of the following: the best way of calculating a change score, the use of statistical tests to determine the significance of freshman-senior differences, the effort to make a scale unidimensional, the attempt to determine whether the instrument measures the same attribute at different times, the concern with whether equal units of change on different locations of a given scale represent equal psychological change, and the like. Finally, two of the ways of "checking out" inferences that change is due to the college experience are by comparing students undergoing the college experience with a control group of young persons not attending college and by directly asking college students specifically what it is about college that they feel is or is not changing them.

The point we wish to make is that too often these assumptions and inferences are not explicitly noted in researches on college impacts—let alone "validated"— and thus they do not contribute systematically to the interpretation of the results in these studies.

Longitudinal comparison of students at different college-class levels is methodologically preferred to cross-sectional comparisons. Conclusions based on cross-sectional studies are particularly susceptible to the following distortions: the "current" freshmen may not resemble the "current" seniors when they themselves were freshmen, and there may have been selectivity in dropout of members of the senior class during their four years at college. With this in mind, it is significant that conclusions about average freshman-senior changes reached from longitudinal and cross-sectional methods have been generally similar (see Feldman & Newcomb, 1969, Ch. 3). Longitudinal studies of students who remain in college, incidentally, are incomplete when they do not follow up students who do not stay in college long enough to be "tested" a second time. The changes (if any) of students who start but do not remain in college are not taken into account. Though it is possible to obtain the same range of information from students no longer in college as from their classmates who are still in college, this has been done only infrequently.

Assuming a longitudinal design, the average difference between freshman and senior scores in part may be artifactually dependent upon initial freshman scores. Because of this possibility the common-sense method of subtracting freshman scores from senior scores is not necessarily the best means of determining differences or gains. As Lord (1956, 1958) points out, in most cases the result of such subtraction is only an *estimate* of "true" change and not a particularly good one at that.

The partial (artifactual) dependency of change-score on initial score is generally discussed within the domain of "regression effects" (sometimes supplemented by analyses of "ceiling" and "floor" effects). The literature on regression effects is not without its confusions. The term is used to refer to either of two similar but not totally identical phenomenon. In the first case, based on Galton's observations on heredity (1879), regression refers to the tendency for offspring of persons at the extremes of the distribution of a trait such as height to be closer to the mean than their parents. Galton generalized this tendency to apply to regression toward the mean of scores on all reported measures of human attributes and characteristics. In the second case, the discussion revolves around considerations

of the nature of the regression of observed gains upon observed initial scores; in this case, regression refers to the spurious negative element in the correlation of initial score on a test with gain on the same test—first noted by Thorndike (1924) and Thomson (1924, 1925). The even earlier observation by Yule (1895) of the tendency for a variable correlated with position on wave one to be negatively correlated with change in position between wave one and wave two can be seen as a consequence of the operation of this second kind of regression effect.

Reasons for one or the other type of regression focus either on *(a)* unreliability of measurement or measurement error, including in some cases an analysis of the inverse relationship between errors in the observed initial and gain score (Bereiter, 1963; Garside, 1956; Lord, 1956, 1958, 1963; Maccoby, 1956; Maccoby & Hyman, 1959; Thomson, 1924, 1925; and Thorndike, 1924), or on *(b)* lack of a perfect correlation between variables, an imperfect test-retest correlation being one instance (Campbell & Clayton, 1961; Campbell & Stanley, 1963). Bohrnstedt (1969) has incorporated both kinds of explanations into a unified framework. There have been a number of suggestions for controlling or adjusting for initial position, i.e., obtaining a corrected change score by correcting for the artifactual element in the regression of gains on initial scores (Bereiter, 1963; Bohrnstedt, 1969; Cronbach & Furby, forthcoming; Lord, 1956, 1958, 1963; McNemar, 1958; Thomson, 1924, 1925; Tucker, Damarin, & Messick, 1966; Webster, 1963, 1968; Wiseman & Wrigley, 1953; and Zieve, 1940; also, see Werts & Linn, 1970, forthcoming [b]). However, none of these at the moment can be considered the definitive method.

Although the great bulk of college studies compare average scores of groups of students at different college-class levels, it should be remembered that the use of average differences is only one way of comparing two or more college classes and is best regarded only as an initial step. Using mean differences, while showing *net* change in a particular direction, does have the disadvantage of not revealing the amount and the nature of individual changes: *(a)* A mean score obscures the fact that change may be in at least two directions. *(b)* From average change, one is not able to determine either the *extensity* of change (the number or proportion of individuals changing in a given direction) or the *intensity* of change (the degree to which individuals change in the given direction). Moreover, quite apart from such disadvantages, an average is only *one* useful statistic describing scores of a group. Useful information can be obtained by comparing other characteristics of groups, such as dispersion of scores or the shape of the distribution of scores (see Barton, 1960; Chickering, 1968, 1969; Chickering, et al., 1968; Feldman & Newcomb, 1969; and Jacob, 1957).

Impact as Stability

Defining impact exclusively in terms of change is too restrictive. Under certain conditions *nonchange* or *stability* may also indicate impact. Suppose, for instance, that a large proportion of persons of college age not attending college are changing intensively on some dimension compared with college students. A lack of change on the part of college students could be an impact of college. It is also possible that there may be a change for the student but not exactly on the specific variable under consideration. For example, a student may as a senior be as favorable (or unfavorable) to some object or issue as he was as a freshman. But the object or issues may be more (or less) salient to the senior; it may be more (less) strongly related to other attitudes and more (less) firmly embedded in other processes of his personality system; he may have more (less) knowledge about it, with increasingly (decreasingly) explicit reasons for his attitude. Thus there is both stability of sorts *and* change.

Impact as Outcome

Attempts have been made to determine the impact of colleges generally, as well as the effects of specific colleges, without *directly* measuring change or stability, at least in the sense of actually calculating a freshman-senior difference score. This is the case, for instance, in the "input-output" model developed by Astin and his associates (see, for example, Astin & Panos, 1966), which explains variation in outcome using a variety of student input characteristics and characteristics of colleges. In this model, the background of students entering college and their values, orientations, and personality characteristics are considered as input. An "expected output" is computed (usually when students are seniors but theoretically at any time after students enter college) based on these input characteristics. The expected output is then statistically removed (or subtracted) from students' "observed output" (their actual scores as seniors on the variable under investigation), producing a "residual output" now statistically independent of input characteristics. Measures of the characteristics of institutions are then related to this residual output to determine the extent to which they explain variation in the output beyond that explained by the input characteristics, thus determining the nature and strength of college influences. (For some studies using this method, see Astin, 1963a, 1963c, 1964, 1965b, 1968b, 1968c; Astin & Panos, 1969; Nichols, 1964, 1965, 1967; Thistlethwaite, 1965; and Thistlethwaite & Wheeler, 1966.)

Usually included in the input variables are the initial scores of entering students on the particular (output) variable under consideration in the study. This input variable will generally be the one best predictor of the output variable. Hence the career choice of entering freshmen explains more variation in seniors' career choices than any one other input variable (Astin, 1965b). Although the input variables generally include entering or initial scores on the output variable, this is not and need not always be the case. That is, the set of input variables may not include exactly the same variables, being measured as output, although there may be closely related variables among the input variables. Thus in a recent study of personal and college determinants of activism, the input variable presumed closest to each of the three associated output variables—participation during college *(a)* in a demonstration against racial discrimination, *(b)* in a demonstration against the war in Vietnam, and *(c)* in a demonstration against some administrative policy of the college—was participation in an organized demonstration in high school (Astin, 1968b). Sometimes it is not possible to have the same or even a closely related input variable. What, for example, is the same or most closely related variable to the output variable of dropping out of college (Astin, 1964)? Dropping out of high school is logically similar but, practically speaking, not feasible; those who have had the opportunity to drop out of college are not likely to have been high school dropouts. This should not be taken as a negative comment. In a real sense, focusing on outcome does have the benefit of being able to assess college impacts on variables (such as dropping out) that do not lend themselves to calculation of a full-fledged change score.

Approaches to the Study of Impact

Studies show wide variation both in the specification of attributes thought to be affected by college and in the theoretical stance taken on the direction of college impacts. Many college studies, at least as formally presented in published reports or articles, do not have an explicit theory concerning which dimensions of students are most likely to be affected by colleges in what ways. In effect, they say the following: "Here are some interesting dimensions that may (or may not) be affected by the college experience. Let's compare college-class levels to find out." Often, in this approach, the dimensions are measured by using existing, relatively well-validated psychological and attitudinal instruments and scales. Lehmann (1963) and Stewart (1964) furnish two examples of this approach. In these particular two studies, as is typical of this approach, predictions about the nature of change (including the direction of net or average change) are *not* made.

Actuarial Predictions

There are other studies, of course, that do make predictions about the nature and amount of impacts. One means of doing so is essentially actuarial. Prediction is based upon the trends of results of other research past and concurrent. The expectations of results are usually not grounded in a theoretical orientation or nomological network. Examples are Beach (1966), Bugelski and Lester (1940), and Tyler (1963).

Predictions from Goals and Functions of Higher Education

Anticipation of results, or outright predictions, can also be derived from the presumed goals of higher education. That is, given the goals of higher education—as specified by the investigator—students are expected to change in certain ways. The nature of this expected change may be viewed as obvious and not in need of defense, either theoretically or functionally. Or assertions about change may be more polemically toned, perhaps couched in normative terms of "ought to": the goals of higher education *must* be such and such, and students *ought to* change in these and these ways. The goals posited vary in the degree of consensuality of general acceptance. In the following two examples, the first set of presumed goals is quite widely accepted whereas some of the goals of the second set are more debatable:

> Few people would quarrel with the notion that, among other objectives, students should demonstrate a greater knowledge of subject matter, more skill in use of language, and increased reading

ability—to read with comprehension, to apply their readings to new situations, and to recognize writers' styles and biases. Further, they should be able to analyze and solve problems, to make inferences, and to think critically (Lenning, Munday, & Maxey, 1969, p. 145).

Each one of these major goals recognizes to some degree the importance of an affective domain among educational objectives. Thus, students are expected to develop a code of behavior based on ethical *principles.* They are to *participate* as responsible citizens. They should recognize *personal responsibility* for fostering international understanding. In addition to learning facts about their physical environment, they should *appreciate* the implications of scientific discovery for human welfare. They should attain a *satisfactory emotional* and *social adjustment.* They are to *enjoy* literature, art, and music, and should acquire *attitudes* basic to a satisfying family life. Their selection of a vocation should be socially useful and *personally satisfying,* and should allow an individual to make full use of his *interests* (Dressel & Mayhew, 1954, p. 209, emphasis in the original).

Personality Development

Predictions about, and interpretations of, changes during college are placed by some investigators into a framework of personality development. Freshman-senior differences are seen as more than neutral differences; they are viewed in terms of "progress" (or lack of it) toward increased maturity. This approach works well if a certain kind of personality and/or attitudinal change *unambiguously* represents a certain kind of change in terms of development and maturity. Thus if increases in "x" always represent increases in maturity, and if such increases occur for most college students, and finally if these increases can legitimately be attributed to the college, then the school has been responsible for increasing maturity and the development of the student. However, it would then follow that if the college causes decreases in "x," it is responsible for arresting development. Clearly, personality and attitudinal change are often not easily and unambiguously interpreted in terms of development and maturity. As illustrated in Table I, specified personality and attitude change of some kinds can as plausibly be argued to be indicative of decreasing maturity or arrested development as increasing maturity. Therefore, it is not always clear whether the decrease in "x" should be seen as decreasing maturity and blamed on the college or interpreted as increasing maturity and credited to the college.

Efforts are often made to resolve such confusions by working within a theoretical framework—such as Sanford's (1956) "growth trends"; Chickering's (1969) "vectors of development"; or Heath's (1965, 1968) "model of a maturing person"—in which the investigator specifies *beforehand* what sorts of changes are to represent increasing maturity and which ones are not. Even with such theoretical frameworks, there still is a tendency to reinterpret unexpected results (ostensibly indicating decreasing maturity) as showing increasing maturity after all. The "progress" aspect of the personality-development framework appears to be so compelling that increasing maturity is posited even in the face of what might seem to be evidence to the contrary. As an example, Sanford (1956) writes the following in discussing the fact that, as a group, senior women at Vassar when compared to freshmen showed more disturbance with respect to ego identity, more dissatisfaction with themselves, more apparent vacillation between different patterns, and more conscious conflict about what to be:

> There is more to the matter of sound ego identity than that the individual have a satisfying self-conception and remain more or less unchanging in this respect. The seniors, in our view, are striving to include more in—they are on the road to becoming richer and more complex personalities; they are striving for stabilization on a higher level. What distinguishes seniors from freshmen is not just the latter's relative freedom from conflict and uncertainty, but their greater narrowness, perhaps rigidity, of identity, and their greater dependence upon external definition and support. These are the very supports which seniors have had to give up, without having as yet found adequate replacement (p. 76).
>
> Seniors show more self-insight, more inner life and—let's face it—they show more "neuroticism" of a certain kind. At least they show a greater willingness to admit, or perhaps to take a certain satisfaction in admitting, conflict, worries, doubts, fears, faults, psychosomatic symptoms. Perhaps we are dealing here with responses to the situation of being a senior—with that identity crisis mentioned earlier. Perhaps for college students, the usual neuroticism scales are not so much measures of durable neurotic structures as they are measures of growing pains. But at least, it seems, seniors show fewer repressive mechanisms of defense (p. 78).

Most investigators find that seniors typically have increased awareness of their emotions and increased

TABLE 1

Some examples of possible interpretations of personality change in terms of change of level of maturity. (This table is based in part, on materials in Chickering, 1969; Heath, 1965, 1968; Izard, 1962; Sanford, 1962a; Webster, 1956; and White, 1952.)

Scale or Index	Direction of Change	Interpretation	
		Increase in Maturity	Decrease in Maturity
need for "deference"	decrease	1a) increase in emancipation from authority figures, conformity pressures, and "other-directed" behavior	1b) increase in irrational rebellion and lack of consideration for others
	increase	1c) obverse of 1b	1d) obverse of 1a
need for "abasement"	decrease	2a) increase in feeling of adequacy; decrease in susceptibility to feelings of guilt and inferiority	2b) increase in self-centeredness and loss of superego controls
	increase	2c) obverse of 2b	2d) obverse of 2a
need for "autonomy"	increase	3a) increase in capacity to find rewards and satisfactions from one's own comings and goings; increase in ability to make one's own decisions independent of external pressures	3b) increase in social irresponsibility; decrease in awareness of interdependence with others
	decrease	3c) obverse of 3b	3d) obverse of 3a
readiness to "express impulses" rather than "excercise restraint"	increase	4a) decrease in repressive and rigid self-control; increase in openness to experiences and awareness of one's range of feelings; increase in "genuine" freedom of emotions, with flexible control	4b) increase in organization of personality around personal need-dominated (autocentric) forms rather than internalized reality-given (allocentric) forms; increase in drive-determined behavior rather than behavior controlled by cognitive types of structures
	decrease	4c) obverse of 4b	4d) obverse of 4a
"sociability" and "gregariousness"	increase	5a) decrease in interpersonal defensiveness; increase in freeing of personal relationships—with movement in the direction of relationships that are less anxious and more friendly, spontaneous, warm and respectful	5b) decrease in independence from the "tyranny" of the peer group; increase in the superficiality of relationships with many persons rather than increase in the intimacy and depth of relationships within a delimited range of friends
	decrease	5c) obverse of 5b	5d) obverse of 5a

freedom of expression in words or behavior as indicated by higher scores on such measures as the Impulse Expression Scale of the Omnibus Personality Inventory. This finding can be interpreted as indicative of increasing maturity and development (see, for example, Chickering, 1969). Unexpectedly finding that students at Goddard, if anything, *decreased* on the Impulse Expression Scale, Chickering writes:

> The higher entering scores for the Goddard students suggested that they were . . . already awakened and open to experience. For them the principal developmental task was to achieve increased self-control, increased integration of emotions and other elements of personality (p. 43).

As a final example, consider the following analysis by Heath (1968) in interpreting certain changes made by students at Haverford:

> The assessment of the "maturity" of development on a dimension depends upon the stage in the adaptive sequence or the level of equilibrium at which it is observed. For example, the entering freshmen seem to have been more "autonomous" and emotionally self-sufficient in their relationships than they were seven months later. But within the context of their maturing generally, the apparent "regression" in autonomy was necessary to become more autonomous. Similarly, the apparent "integration" of the entering freshmen's talents, values, and interests may have been a less mature form of integration than the "disintegration" the same men experienced later in the year. To continue their development the men had to form an even more mature integration that assimilated their emotional and social needs into their images of themselves as cool professionals. Their "disintegration" was more "mature" than their earlier integration (p. 253).

These interpretations by Sanford, Chickering, and Heath are quite plausible and may be correct, but they still have a *post hoc* quality. These and other similar interpretations need further research verification—particularly by specifying prior to data analysis the conditions under which certain sorts of changes in personality indicators will be taken to signal certain changes in maturity and development. It should be kept in mind that there may be many kinds of changes that cannot be placed neatly within a developmental framework and that are best studied outside of such a schema.

Life-Cycle Movement within the General Social System

Another kind of theoretical orientation usually made by certain sociologists and social anthropologists employs a social-structural or systems approach. These theorists—emphasizing the societal and social-systems functions of higher education (which are not necessarily coterminous with the expressed goals of colleges)—focus on the distinctive life-cycle and social-system context of college students (see, for example, Baur, 1965; Becker, 1964; Becker, Geer, & Hughes, 1968; Coleman, 1966; Jencks & Riesman, 1968; Meyer, 1968; Meyer & Bowers, 1965; Riesman & Jencks, 1962; Thielens, 1966; Trow, 1959; and Wallace, 1964, 1965, 1966). The impact of college is analyzed in terms of the movement of students within a general, national social system in which college is a subsystem in interaction with other subsystems. This approach argues that college prepares and certifies students for certain social positions in the middle and upper-middle adult occupational system and general social system, channels them in those directions, and to some extent ensures them of entrance to such positions. In the words of Riesman and Jencks (1962), the "college is an initiation rite for separating the upper-middle from the lower-middle class, and for changing the semi-amorphous adolescent into a semi-identified adult. . . . [Colleges stand] as the watchdogs of the upper-middle class . . ." (p. 78). Investigators of this persuasion discuss changes in college students in terms of what they learn in preparation for their new adult roles. As Wallace (1964) puts it, the aim of college "is to shape students toward statuses and roles for which they have never before been eligible" (p. 303).

The social preparation or shaping discussed in this approach includes assistance in making the break from family and local community and in developing an independence of spirit that is useful in our highly mobile society. Also, although it is not part of the formal curriculum, college students learn the kind of manners, poise, social skills, cultural sophistication, and values that will be of use to them in their adult roles in the middle and upper-middle social system. Moreover, they usually extend their heterosexual interests and feelings in preparation for courtship and marital decisions. College helps young men and women to acquire the necessary skills, information, attitudes, and motivations to be (as well as to choose) "culturally adequate" marriage partners for the social and occupational positions they will occupy. Students also learn a number of organizational skills, attitudes, and motivations that are necessary for success in the typical middle class and upper-middle class occupational world—including the general abilities and motivations needed to meet deadlines, start and finish tasks, juggle several things at once and keep

them straight, and budget one's time and energy. Becker (1964) makes the further intriguing suggestion that the college student, as a recruit into the middle-class world, must even learn to attach his own desires to the requirements of the organization in which he becomes involved. He must learn, in short, "institutional motivation"—wanting things simply and only because the institution in which he participates says these are the things to want. Becker contends that the college experience provides much practice in this linking of personal and institutional desires.

There is considerable evidence that the higher the socioeconomic status of the family of a young person, the more likely he is to attend and finish college (among the many studies, see Astin, 1964; Eckland, 1964a, 1964b, 1965; Educational Testing Service, 1957; Feldman & Newcomb, 1969; Medsker & Trent, 1965; Nam & Cowhig, 1962; Schoenfeldt, 1966; Sewell, Haller, & Strauss, 1957; Sewell & Shaw, 1967; Spady, 1967; Trent & Medsker, 1968; and Wolfle, 1954). Data in these studies empirically support the contention that college, in its sorting and sifting activities, acts as a "social sieve" to help guard the gates to higher status level within the social system (see Jencks & Riesman, 1968). The proposed preparation and shaping of students for these positions—and the resultant changes in personality and characteristics—are not nearly so well documented. Investigators in this area have relied heavily upon general, informed anthropological and sociological observations and are only in the beginning stages of collecting "hard" data gathered through survey research methods, systematic participant observation, and/or sophisticated psychological measurement. The insights generated by these observers—which, incidentally, often have an "inside dopester" flavor (witness the title of one of Becker's pieces: "What Do They Really Learn at College?")—will become even more useful as they are refined by further empirical testing.

Social Organizational Approach

In the approaches described so far for predicting and interpreting freshman-senior change and stability—the avowed goals and functions of higher education; personality development; and life-cycle movement within a social system—the multidimensionality and complexities of colleges tend to be a secondary (although not necessarily an unimportant) consideration. To put this matter a bit too simply, the analysis of characteristics of colleges is contingent upon interest in their correlation with degree of success, effectiveness, or efficiency in *(a)* inculcating the presumed or desired goals of higher education, *(b)* facilitating rather than impeding increased maturity and personality development, or *(c)* channeling, ensuring, and preparing persons for certain occupational and social roles in the largersocial system.

There is an approach that more or less reverses the general tack just described. This approach, which is social organizational in nature, concentrates initially and primarily on the variation among colleges. The emphasis is on describing, analyzing, and measuring differences in organizational arrangements; the interrelationships among college subsystems; the content of, and degree of consensus about, goals; the consistency of normative pressures; and such. Differential impacts are then inferred *directly* in terms of the differences among colleges, rather than in terms of the "preconceived" notions of the three approaches described above. To some extent, the work of Astin and his associates (cited earlier), of Pace (1964), Pace and Baird (1966), and of Stern (1962a, 1962b, 1966, 1967) fit this approach. Also, consider Bidwell and Vreeland's (1963) and Vreeland's (1963) typology of colleges in terms of variability in the scope of the client-member (i.e., student) role and the variability of goals ("moral" or "technical"), from which predictions are made about the direction, intensity, and homogeneity of students' value and attitude shifts. The social organizational approach has the important value of focusing on just how college environments vary and of conceiving and predicting differential impacts directly in terms of this variation.

Conventional Classifications

When referring to variations among colleges, it is commonplace to divide them into certain conventional classifications in terms of type of curricular organization (technical school, liberal arts colleges, teachers colleges, etc.), types of control (public, private-nonsectarian, etc.), gender of students (men's colleges, etc.), geographical location of school, highest degree conferred by the school, and the like. When interest lies in discovering the impacts of colleges on students, such classification is not totally satisfactory since the categories of classification are not directly interpretable in terms of dimensions relevant to impact. Thus if public and private institutions are found to have differential effects on students, the "publicness" or "privateness" of the school offers little in the way of explanation. Moreover, it is possible that colleges *within* these familiar classifications are quite diverse with respect to impact factors. If so, these classifications conceal the environmental differences that are causing differential impacts.

Demographic and Related Institutional Characteristics

As one remedy to the problems involved in using conventional classifications, investigators have found it helpful to measure colleges on demographic and related dimensions that might bear on impact. Colleges can be ranked with reference to having a larger or smaller quantity of some characteristic or trait: size of enrollment, operating budget of the school, library resources, average level of training of the faculty, faculty-student ratio, proportion of students at the school with a specified characteristic, etc. (see, for example, Astin, 1962a, 1963b, 1965d; Astin & Holland, 1961).

Institutional "Climates"

Still, correlations between variations in demographic or related institutional features and variations in student change and stability may not be directly interpretable. It may be found that colleges with large libraries have one kind of impact while colleges with small libraries have another. Most people would not want to argue that it is the size of the library, *per se,* that is producing differential effects at the two colleges. Rather, the differential effects are probably due to other differences in the environmental features that happen to be correlated with library size. Moreover, the demographic characteristics of a school may not be as important in and of themselves in affecting students as they are in creating conditions which in turn have impacts. That is, the demographic characteristics of the school—for example, size and affluence—become important because of the interpersonal conditions they foster and the environmental pressures, demands, and opportunities they create.

It makes sense, then, to try to measure these environmental "climates" directly, by using such instruments as the College Characteristics Index (CCI) and the College and University Environment Scales (CUES). These instruments consist of statements indicating features and characteristics of college environments (events, conditions, practices, opportunities, or pressures) to which students respond either "true" or "false" (see Pace, 1963, 1969; and Stern, 1963). CCI and CUES clearly have advanced the measurement of college environments, although they are not without problems and limitations.

A student's responses to CCI and CUES are determined in part by his gender and by his "location" in the college environment, such as his college-class level, major field, and residence. The student's own values, attitudes, and personality characteristics may on occasion also come into play to the instruments, although the operation of this set of variables seems to be much less consistent and less important in determining responses than do the variables of structure or location. (For recent data on the correlates of responses to CCI and CUES, see Berdie, 1968; Centra, 1968a; Conner, 1968; Duling, 1969; Gelso & Sims, 1968; Grande & Loveless, 1969; Jansen & Winborn, 1968; Marks, 1968; Pemberton, n.d.; Schoemer, 1968; Schoemer & McConnell, 1968; Walsh & McKinnon, 1969; and Yonge & Regan, n.d.; for a review of earlier research, see Feldman & Newcomb, 1969.)

At any rate, it is important that those using these instruments obtain a representative sample of students at a college, especially if intercollege comparisons are intended. This consideration has not always been sufficiently stressed by the originators of these instruments, although most recently Pace (1969) did advocate the selection of a "reasonable cross-section or sample" of students when

using the revised edition of CUES. Even a perfect sample will not suffice if various substructures in a college vary greatly in "climate" and if "local" environments strongly influence the perception of the overall environment. In this case the average of student responses about the overall environment will in effect be an artificial construct with little correspondence to any actuality. (This consideration applies primarily to CCI, not CUES, whose scoring procedure largely circumvents this problem.)

The interpretation of scores on CCI and CUES is somewhat ambiguous because the scores reflect amount of consensus in the environment as well as intensity of environmental emphasis (Selvin & Hagstrom, 1963). Moreover, scoring procedures do not take into account the possibility that students may vary in knowledgeability about various aspects of the environment, a fact which may mean that scores should be differentially weighted.

Another problem is that many of the items of these instruments ask for the students' perceptions of aggregative characteristics of the student body rather than about each student's own feelings and activities which could then be aggregated to produce a picture of the environment. Thus it is possible that for some characteristics, students merely are reporting rumors, engaging in wish-fulfillment, or stereotyping (cf. Barton, 1961; Coleman, 1966; Pate, 1964; and Wilson, 1964). There is evidence that aggregation across individual student behavior does not produce exactly the same results as perceptions or images that students have of their schools (Astin, 1968a; Davis, 1963; and Pervin, 1967). Of course, an investigator may be interested in the ideologies and traditions of the institution as perceived by the students, whether or not they are perfectly accurate; and it is possible, furthermore, that even pure fictions based on pluralistic ignorance nevertheless are social facts that can influence individual behavior and attitudes. The important point here, however, is that from scores on the CCI and CUES alone one is not able to differentiate fictions from nonfictions, nor is one able to discern the extent to which public belief and private behavior are discrepant.

Finally, the "assumption that the aggregate awareness of students about their college environment constitutes a press in the sense of exerting a directive influence on their behavior" (Pace, n.d., pp. 2-3) may not always be a good one. It is not really clear to what extent the features and characteristics of the environment, as garnered by the use of the CCI or CUES, represent either social or normative pressures on students. Many items are phrased in the way that a student might report behavior he sees or attitudes he infers without making a personal or moral evaluation of it. Thus, scores on this instrument represent, in part, what "is" and are not necessarily descriptions by students of what they "ought" to do or what is "expected" of them. Although the "is" and the "ought" often are associated, the correlation is not perfect. Widely held sentiments are not necessarily group norms. To know whether the "is" of the environment represents pressures on students, one needs to know such things as the degree to which there is shared awareness about the desirability of certain attitudes and behaviors, the structural arrangements and systems of rewards and punishments that implement and ensure conformity to norms, and the degree to which individuals accept these norms.

Other Ways of Measuring Environments

Other means to describe, classify, or measure college environments have been proposed and used: *(a)* anthropological vignettes (Boroff, 1961; Bushnell, 1962; and Riesman & Jencks, 1962); *(b)* actual behavior patterns of students, based on their reports of the nature and frequency of a variety of activities and interpersonal interactions (Astin, 1965c, 1966, 1968a); *(c)* homogeneity of students' interests (Astin, 1962; Holland, 1963, 1968); *(d)* scope of student involvement in the college (Bidwell & Vreeland, 1963); *(e)* institutional vitality (institutional functions and emphases), based primarily on responses by the faculty but in some cases also by administrators and students (Peterson & Loye, 1967; Peterson, n.d.); and *(f)* faculty/administrators' descriptions of either the "ideal" or the "actual" institutional objectives (Chickering, et al., 1968; Chickering, McDowell, & Campagna, 1969; Gross, 1968).

Because the thirty scales of the CCI were conceived and constructed as parallel to the thirty "need" scales of the Activities Index (AI), the instrument has been criticized as too narrowly psychological to be used as an adequate measure of social structure. CUES, and certain other ways of measuring college environments that are being developed (for example, those just listed), are less vulnerable to this type of criticism. Still, all of them are only first steps in the direction of systematic construction and instruments relating to general theories of social structure and process. Such instruments, when properly constructed, should directly measure such features of college environments as the following: content and structure of the status system; the college's type of control structure (distribution of control among the various categories of its membership); avowed and actual institutional objectives; nature and range of social organizations within the college; scope, clarity, intensity, and pervasiveness of group norms; nature and form of punishments and rewards; relationship of leaders to followers; nature of the structure of competition and cooperation; degree to which the environment is monolithic

rather than pluralistic; type of communication patterns; density of social relations and closeness of personal ties; and degree of cohesiveness and solidarity of the social structure as a whole as well as its various substructures. It would be worthwhile for future investigations to conceive and to study these social structural phenomena as independent variables. Such an approach would help to determine the sequentially linked variables of actual and perceived "climates" which influence student change and stability.

Subenvironments

It can be useful to think of the college environment as homogeneous, particularly when interest resides in the overall ambiance or the dominant pattern of values, attitudes, pressures, opportunities, and structural constraints in the environment. More realistically, however, every college is in one degree or another a plurality of different subenvironments, each valuing different interests and rewarding different activities. Hence each student confronts a somewhat different environment depending on his particular location in the college social structure (cf. Bowers, 1965).

As one step in the study of locational experiences within colleges, certain conventional classifications are often used to circumscribe subenvironments—for example, residence (dormitory, fraternity, etc.) or major field (natural sciences, humanities, etc.). Such classifications involve the same difficulties as when colleges as a whole are classified into conventional categories: the category name cannot *in itself* be interpreted in impact terms, and there may be relatively wide variation in environmental pressures of substructures classified as being in the same conventional category (for this latter, see Selvin & Hagstrom, 1963,1966; Standing, 1968; Thistlethwaite, 1962; and Vreeland & Bidwell, 1966). As with the study of total college environments, there have been efforts to move past conventional classification to the measurement of demographic features, structural arrangements, and environmental "climates." For instance, see the just-mentioned studies along with Astin, 1965a; Centra, 1965, 1967, 1968b; Kirk, 1965; Olson, 1966; Pace, 1964; and Thistlethwaite, 1968, 1969. However, much remains to be done.

Conceiving the student body in terms of a variety of types of student subcultures is also a useful procedure (see Clark & Trow, 1966); but too often the presumed subcultures have been measured and discussed in terms of individual traits—for example, role orientations or social types—rather than in terms of interacting students who share a common orientation (see Bolton & Kammeyer, 1967; Feldman & Newcomb, 1969; and Frantz, 1969; for elaboration).

Methodologies in College Impact Studies

There are numerous nonlongitudinal (one-shot) studies showing variations in student bodies at different colleges or differences among student groups across substructures within a college (major field, residence, etc.). Such "static" differences in and of themselves tell little about the impacts of college environments or their subenvironments. Students about to enter different colleges or substructures within a college often show distinctive differences in ways similar to those exhibited by students currently in the colleges or substructures (Feldman & Newcomb, 1969). In short, there is some degree of selection into a particular environment. Initial, differential selection may indicate a type of impact of a college or subenvironment in the sense of differential attraction of students—due to differences in direct recruitment procedures, as well as differences in indirect "recruitment" and self-selection associated with varying public images and differential attractiveness of the organizations and environments. But these are not differences in the *ongoing* impacts of the social structures on students already in them. Interest thus shifts to the question of whether these structures have impacts on students over and above any influence they may have with respect to initial recruitment or selection.

Relating Student Changes to the College Environment

To show the impacts of college environment on students, something about the individual in impact terms (change, stability, outcome) must be connected with something about the environment (conventional type, demographic and related institutional features, pressures, "climate"). One common way of showing impact has been to associate differential change (differences scores, net change, etc.) with different environments (however classified or measured). Examples are particularly numerous; a few are the following: Brown and Bystryn, 1956; Chickering, McDowell, and Campagna, 1969; Dressel and Mayhew, 1954; Huntley, 1965; Katz, et al.,1968; Nelson, 1938, 1940; Scott, 1965; and Siegel and Siegel, 1957.

Most studies relating test-retest differences or net change to environment, including those just cited, have *not* adjusted for initial position of students on the variable under consideration. In such cases, the possibility of the operation of regression (and related) effects as a minimum limitation should be kept in mind when interpreting results.

A finding from a study by Trent and Medsker (1968) will serve as an example. Using the Social Maturity Scale of the Omnibus Personality Inventory to measure change in level of nonauthoritarianism (and a need for independence), these researchers divided college students into the following three categories, based on the direction and amount of change between their freshman year (1959) and their senior year (1963):

(a) "exceptional" changers—those who changed by at least plus ¾ of a standard deviation of the scores from the average change score; using this procedure, exceptional changers were those who gained nine points or more;
(b) "negative" changers—those who changed by ¾ of a standard deviation of the scores from the average change score (which turned out to be a minimum loss of one point);
(c) "average" changers (more than -1 point but less than +9 points).

One of the findings was that the percentage of students majoring either in social science or the humanities/fine arts who were in the exceptional change category (44% in each case, coincidentally) was larger than the percentage of students from education, engineering, or natural science who were in this category (33%, 34%, and 34%, respectively). Presumably expecting evidence of a greater differential impact of major field, the authors express surprise at finding differences in the range of only 10 percent.

Assuming only the operation of regression effects, it would be expected that students initially scoring relatively low on the Social Maturity Scale (in 1959) would be disproportionately numerous in the exceptional change category (and "underrepresented" in the negative change category). Data that can be interpreted as consistent with the operation of regression effects appear in Table 65 (pp. 202-203 of Trent & Medsker's work) although the authors do not point this out, using the data therein for other purposes. In this table the initial, 1959 average was 48.53 for "exceptional" males, 51.99 for "average" males, and 57.46 for "negative" changers; thus those who were to make the largest positive gains were, as a group, initially lowest. From Trent and Medsker's study, we do not know average levels of nonauthoritarianism of students in the several major fields; but generalizing from findings in other studies (Feldman & Newcomb, 1969, Ch. 6), it can be assumed that students in their sample who entered the major fields of engineering, education, and natural science already were less nonauthoritarian than entrants to the humanities/fine arts and social science fields. If this assumption were true and if only regression effects were in operation (perhaps boosted by "ceiling" effects), the engineering, education, and natural science entrants, initially lower, would have been more likely to make larger gains than the humanists and social scientists. Hence, under these conditions the first group of students would have a larger percentage in the "exceptional change" category. But they did not. Presumably, the effects of the major-field environment "overrode" the regression and ceiling effects. Results, in a word, were contra-regressive. The observed 10 percent advantage of students in humanities and social science probably not only represents a "true" difference of a larger magnitude but also indicates an accentuation of initial major-field differences. If so, this particular finding has more substantive significance than Trent and Medsker would have their readers believe.

Initial scores on the variable under consideration and their possible effects may be noted informally and somewhat unsystematically—as in Rose (1964) and Chickering, McDowell, and Campagna (1969). Other studies have either controlled for initial level or corrected for its artifactual effect in more systematic ways. Thus Hites (1965) obtained "corrected" change scores, using a formula suggested by Zieve (1940). In their longitudinal study of institutional effects on changes in black students' occupational aspirations, Gurin and Katz (1966) adjusted for initial differences among students at different colleges on this variable by using analysis of covariance. In investigating changes in self-ratings and in goals of students (as potentially related to a variety of institutional characteristics), Skager, Holland, and Braskamp (1966) controlled for initial position on these variables in still another way. They calculated rank-order correlation coefficients between the rank of each college's score (on each of the several

environmental variables) and the rank of the average change scores (on each of the variables of self-ratings and goals)—but *within* each of the four levels of *initial* scores on the self-rating and goal variables. Then, for each of these change variables, an *average* rank-order correlation was calculated *across* the rank-order correlations of each of the four levels.

What promises to be an increasingly popular and important method for adjusting not only for initial scores but also for other personality and background characteristics of students has been mentioned earlier: the input-output model used in the work of Astin and his associates. Technically speaking, this model involves a two-step procedure for calculating a *part correlation* (not a partial correlation), wherein the input variation is used to residualize the dependent (output) variable(s) but not the "treatment" (college environment) variables (see Creager, 1969a; and Werts & Watley, 1968). The residualized student output variable is correlated with the college environment variable(s).

There is no doubt that Astin's efforts over the years have pushed the analysis of college impacts to new and needed methodological levels. Because of this fact, and also because of the potential usefulness and popularity of his procedures, there must be careful consideration of the fairly intense critical scrutiny that his input-output model is currently receiving. One difficulty with the model, which it shares with any analysis attempting to isolate causal factors under conditions where "subjects" have not been randomly assigned to "treatments," is that logically one must find all relevant antecedent factors on which students differ on entrance to the several environments under study and adjust or control for the influence of these variables. This control may not prove possible. Although the difficulties in this connection may, in principle, be well-nigh insurmountable, in practice they may be much less worrisome; Skager, Holland, and Braskamp (1966), and Stanley (1966, 1967) have suggested feasible procedures.

The two-step, part-correlation procedure advocated by Astin is most useful when the input and environmental variables are independent of one another. If, on the other hand, these two sets of variables are correlated, which is usually the case, the use of this particular input-output model can create certain problems. In the case of interrelationships among input and environmental variables (technically, when there is multicollinearity), some proportion of the student outcome is due to the joint variation of student input characteristics and the college (environment) characteristics. The shared portion of variance in student outcome that could be accounted for by either set of variables is attributed to that set that is controlled initially (or which enters the initial regression analysis). Thus the input-output model results in attributing *both* the joint effect and the independent effect of input characteristics to the input characteristics; the college (environment) characteristics can only explain some proportion of the residual variance that is left. (For elaboration, see Treiman & Werts, n.d.; Werts, 1968b; and Werts & Watley, 1968.) Therefore, this particular input-output model, by first adjusting outcome by student inputs, overestimates the magnitude of the influence of inputs and underestimates the magnitude of the effect of college environments.

Parenthetically, it may be noted that a parallel criticism has been levied against that part of the study by Coleman et al. (1966), which compared the influence of student background (of primary and secondary school students) with the influence of school environment (school resources) on student achievement levels (Bowles & Levin, 1968a, 1968b; but see Cain & Watts, 1968; Coleman, 1968; and Smith, 1968). An essentially similar point has also been raised by Boyle (1966), Michael (1966), and Turner (1966) about Sewell and Armer's (1966a) analysis of the effects of neighborhood context on high school students' plans for college as compared with the influence of gender, intelligence, and socioeconomic status (but see Sewell & Armer, 1966b).

Path Analysis

There are a number of ways of taking into consideration the correlations between input and environmental variables and the possible underestimation of college effects. One way is to work within an explicit, causal framework—using path analysis (see Duncan, 1966; Duncan, Featherman, & Duncan, 1968; Heise, 1968; Land, 1968; and Wright, 1934,1954,1960). Path analysis provides a convenient and efficient method for determining the direct and indirect effects of each of the independent variables in a causal chain composed of standardized variables in a closed system. These effects are expressed in terms of path coefficients. In any system under consideration, one or more of the variables—referred to as exogenous—are assumed to be predetermined. The total variation of these variables is further assumed to be caused by variables outside the set under consideration. The exogenous variables in a particular set may be correlated among themselves, but the explanation of their intercorrelation is not a problem for the system. The remaining subset of variables is taken as dependent, and is termed endogenous. Each of these dependent (endogenous) variables is regarded as completely determined by some linear combination of the preceding endogenous variables in the system.

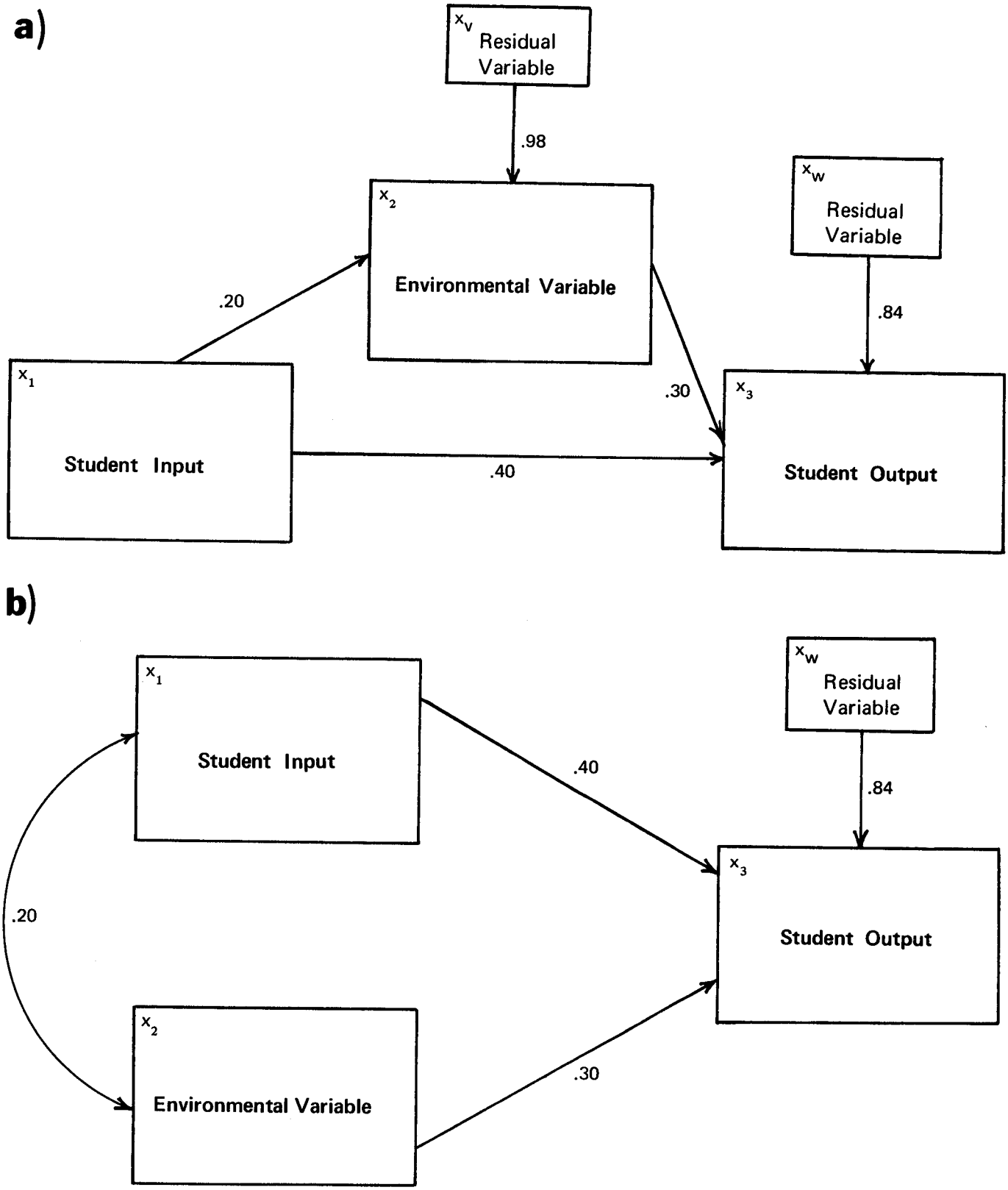

Figure 1. Two examples of path diagrams.

When it is not possible to explain all the variation in a dependent variable, a residual variable is introduced to account for the variance not explained by the measured variables. Typically, as is the case in the simple path diagrams presented in Figures 1a and 1b, each residual is assumed to be uncorrelated with any of the immediate determinants of the dependent variable to which it pertains; also, each residual is presumed to be uncorrelated with any other residual in the system. There are models, however, in which some residuals are intercorrelated, or in which a residual is correlated with variables antecedent to, but not immediate determinants of, the particular endogenous variable to which it is attached. Path analysis amounts to a *sequence* of conventional regression analyses in the case where there are no unmeasured variables other than the residuals, the residuals are uncorrelated, and each of the dependent variables is directly related to all the variables preceding it in the assumed causal sequence. In this case, the path coefficients are equal to the beta coefficients of these regression analyses. Examples of the use of path analysis in analyzing student outcomes can be found in Bidwell (1968, n.d.), Bidwell and Vreeland (forthcoming), Werts (1967, 1968a), and Werts and Watley (1969). This kind of analysis generally assumes interval scaled data, although the method and its logic have been adapted in various ways for use with ordinal and even nominal data (see Boyle, 1970; Braungart, 1969a, 1969b; Sewell & Shaw, 1968; Smith, 1969; Werts & Linn, 1969b, forthcoming [b]).

To employ path analysis, one must specify the causal ordering of the variables under consideration. For the case at hand—even when simplifying by assuming only one input variable, one environmental variable, and one output variable—a number of causal models are logically possible (see Werts & Watley, 1968). Figure 1a represents one such causal model. There is a "causal arrow" from the input variable and one from the environmental variable to the output variable. Also, there is a "causal arrow" from the input to the environment variable (signifying that a certain kind of student tends to select and to attend a certain kind of college).

The coefficient on the path from the input variable to the output variable in this particular case (.40) indicates the "direct" influence of input on output, in the sense of measuring the influence of input on output that remains when the college environmental variable is controlled. Similarly, the coefficient on the path from the environment to the output (.30) measures the influence of environment on output controlled for input. The zero-order correlation (.46) between the input and output variables is accounted for by *(a)* the direct influence of input on output (.40) and *(b)* the indirect or mediated influence of the input on output via the environmental variable (.06). The magnitude of the second component is obtained by multiplying the input-to-environment path coefficient by the environment-to-output path coefficient. The zero-order correlation between the environmental variable and output (.38) also is made up of two parts: *(a)* the direct influence of environment on output (.30) and *(b)* a spurious component representing the association between environment and output due to the common (antecedent) input variable (.08). Thus the relative weight or influence of these various influences can be determined by comparing appropriate path coefficients (and their combinations).

It should be remembered that assumptions about causal ordering other than the one just presented can be made. For example, perhaps a more realistic causal diagram would show a curved double-headed arrow between the input variable and the environmental variable, as in Figure 1b. The numerical value entered on the diagram for this bidirectional correlation is the simple correlation coefficient. It indicates that the input and environmental variables are correlated but that one is unable or unwilling to indicate a particular, one-way causal direction between the two.

Procedures for Partitioning Explained Variance

Path analysis is not the only alternative to Astin's two-step, part-correlation procedure. Werts (1968b) has suggested the use of a method that he considers heuristically superior to Astin's procedure. The "predictable" or "explained" variance (R^2) in the outcome variable is partitioned into components in order to examine the relative magnitudes of both the "independent" effects of the various predictor variables and their "joint" effects. Both student input and environment variables enter into a *single regression equation,* from which the various components of the predictable variance can then be calculated. The squared standard regression weights (i.e., the squared betas) are interpreted as the independent contribution of the associated predictor variables; and the covariance terms of the formula are interpreted as their joint effects. Thus in the case of multiple input and school environment variables, the total predictable variance can be divided into three parts: the variance due to input independent of environment (which includes the independent and joint variances for all input variables); the variance due to school environment independent of input (which includes the independent and joint variances for all environment variables); and the variance due to input and environment jointly (which includes the joint variance of any input with any environment variable).

Creager (1969a), while agreeing that Astin's input-output procedure may underestimate the magnitude of

environmental variables, criticizes the solution offered by Werts. He, along with others (Darlington, 1968; Pugh, 1968; Ward, 1969), has questioned both the meaningfulness and the usefulness of interpreting the squared betas (in a nonorthogonal system) in terms of "contribution to variance," and of taking these squared betas to be indicative of the "importance" of the various predictor variables. (For a more general discussion of problems in interpreting regression coefficients in a multiple regression, see Gordon, 1968.)

Creager (1969a) has advocated, therefore, a different method of partitioning the predictable variance of an output variable, one which involves determining the "unique contribution" of each variable or subset of variables as well as the net, joint contribution, or "commonality," of all variables or all subsets of variables (also see Bottenberg & Ward, 1963; Creager & Valentine, 1962; Mayeske, 1967; and Wisler, 1968). What is called the "unique contribution" in this model is termed by Darlington (1968) the "usefulness" of a predictor variable—that is, the amount that the squared multiple correlation would drop if the variable, or subset of variables, under consideration were removed. In other words, the "usefulness" of a variable is the amount of variance it adds to prediction after all the other variables under consideration have entered into a stepwise regression (see Werts & Linn, 1969a). This amount, incidentally, is equal to the squared part correlation between the residualized predictor (i.e, the particular predictor variable partialed by the other predictor variables) and the original (unresidualized) criterion or output variable (Astin, 1969; Creager, 1969a; Darlington, 1968; Pugh, 1968; and Werts & Linn, 1969a).

For purposes of simplicity, again consider the case of a simple input variable, an environmental variable, and an output variable. The "unique contribution" of the environmental variable is the squared part correlation between the environmental variable and the output variable, with the input variable partialed out of the environment variable. Likewise, the "unique contribution" of the input variable is the squared part correlation between it and the output variable, with the environmental variable partialed out of the input variable. In a nonorthogonal system, these two unique contributions will *not* add up to the squared multiple correlation of input and environment with output. The amount missing is the contribution to variance due to the commonality between input and environment.

Recently Creager (1969b; Creager & Boruch, 1969) stated that he was not altogether satisfied with this uniqueness-commonality model. Since the part correlations are not independent of (or orthogonal to) each other, they cannot be interpreted as independent, orthogonal contributions to criterion variance. That is, each of the various unique contributions is orthogonal to the rest of the prediction system, but these various contributions are not necessarily orthogonal to each other (see Creager, 1969a). Therefore, it may be somewhat misleading to refer to them as unique contributions and, likewise, to interpret what is left in the squared multiple after the squared part correlations are subtracted out as the common contribution to criterion variance. Consequently, he proposes a different model, involving an orthogonal decomposition of the regression system (based on "a proper form of complete orthogonal factor analysis," Creager, 1969b, p. 709). In this approach the direct, independent, orthogonal, and unique contribution of the input variable is given by the square of the loading on the factor unique to this input variable (and parallel procedures are used to determine the contribution of the environmental variable). The contribution shared by the two variables is given by the squared loading on the "common factor" generated by the factor analysis.

Stochastic Models

It is important at this point to note some of Richards' criticisms (1966, 1968) of the two-step, input-output procedure used by Astin, since at least one of them also applies to all of the procedures discussed so far. Richards criticizes Astin's procedure for the following reasons:

(a) It relies on residual scores with respect to the dependent (or outcome) variable(s); such scores are unreliable and subject to errors of various sorts. (This criticism cannot be made of the other procedures discussed, since they do not use residualized output scores.)

(b) It essentially weighs change by input in complex and ambiguous ways.

(c) It does not really deal with change directly—the variable of real interest, Richards maintains—but focuses instead on a variable that only indirectly reflects the main concern. (This criticism applies to all the procedures discussed so far, since they direct their attention to outcome and do not consider change *per se.* Cronbach and Furby (forthcoming), incidentally, would probably disagree with Richards on this point. They argue that focusing on outcome rather than on change itself is desirable.)

Richards suggests an alternative that he calls an "analytic model of college effects." It is essentially a stochastic

model for change that "treats change as moving from one discrete state to another instead of standing on a latent change variable, or trait, only inferentially related to observed change" (Richards, 1968, pp. 412-413). The "output" of a college is algebraically calculated and theoretically analyzed as a function both of the initial probability of being in one or another "state" (say, when entering college) and the probability of changing from any one of these initial "states" to one or another of the final "states." Creager (1970) has explored the use of stochastic models to study college effects in terms of the analysis of empirical transition probability matrices. These stochastic models seem promising and deserve further attention. Gauging their usefulness will be easier once they have been employed in the analysis of actual college data.

Comparing Methods of Assessing College Impacts

It is not a simple matter to pick one of these methods as the best way of analyzing any set of data.[3] The various procedures ask somewhat different questions and make different assumptions about the nature of the underlying phenomena. The optimal method, assuming there is one, is in part determined by the hypotheses one wishes to support and the pattern of the obtained zero-order correlations among all the variables in the given analysis. Moreover, a good choice depends on an understanding of the phenomena being studied and of the relationship of the phenomena to the mathematical model underlying the statistics. (For elaboration of these contingencies, see Duncan, Featherman, & Duncan, 1968; Linn & Werts, 1969; and Werts & Linn, 1969a, forthcoming [a].)

When the focus of the research is on the prediction of one or more dependent variables rather than causal analysis, procedures (such as those sponsored by Astin, Werts, and Creager) that attempt to account for explained variance may be appropriate (Darlington, 1968; Werts & Watley, n.d.). In this respect, Astin's two-step, part-correlation procedure may or may not be the best choice. It may be contended that since the sets of input and environmental variables are asymmetric temporally (the student has his input characteristics before he arrives at college), the use of a two-step, part-correlation procedure is justifiable. Indeed, the fact of temporal asymmetry—when coupled with the assumption that student input influences the type of college one attends or even that it actually "causes" the environmental characteristics (or both)—makes it plausible to include the so-called "joint" or "common" student-college contribution with the contribution ascribable to student input alone. However, even here it may be suggested that a procedure separating out this joint or common effect, while not mandatory, is still desirable because it gives more information and permits detailed examination of the components of predictable variance (Werts, 1968b).

A more essential consideration is that an investigator may *not* be justified in interpreting the zero-order correlation between input and college characteristics as due solely to a one-way causal influence of input on college. The input-college correlation may be due to other reasons. Thus the college and its environment may influence or determine the types of students who enroll (due to the appeal of its particular image, its recruitment procedures, its criteria for accepting students, etc.); or the type of student and environment may reciprocally influence each other, or the two may share some common, antecedent cause which gives rise to the correlation between them (see Duncan, Featherman, & Duncan, 1968; Werts, 1968b; and Werts & Watley, 1968). (In a path analysis, incidentally, the variables involved would be connected by double-headed arrows and treated as "unanalyzed" correlations.) In these cases, where the investigator is unwilling or unable to assert a given one-way influence between correlated predictor variables (such as sets of input and environmental variables), an analytic procedure that separates out the joint contribution of input and environment to outcome variance is preferable. Either Creager's uniqueness-commonality model or his orthogonal decomposition model can be recommended.

Compared to prediction models, path analysis is particularly appropriate when the intent is to test logically derived hypotheses or to work within a hypothetical-deductive causal framework (Werts & Watley, n.d.). As Darlington (1968) puts it, this procedure "provides a technique for rationally inferring causal relationships in complex situations even though experimental manipulation of the independent variables is impossible" (p. 167).

These remarks are not meant to imply that path analysis and analytic methods aimed at explaining variance

[3]The present listing of statistical procedures for studying college impacts is by no means exhaustive. To mention only two others, methods of partial correlation and analysis of covariance are available to adjust for input variables. The use of either of these may also present difficulties. For example, using partial correlations to adjust for the effects of input under certain circumstances may partial out some or all of the college effects (see Astin, 1963a, and Gordon, 1968). Analysis of covariance is most suitable to cases in which there has been random assignment of individuals to "experimental treatment"; in naturalistic studies of college effects, where the "treatment" (environment) and inputs are correlated due to lack of random assignments of students to colleges, the use of this technique can be inappropriate and misleading (see Elashoff, 1969; Evans & Anastasio, 1969; and Werts & Linn, 1969a, forthcoming [a]).

are totally distinct, unrelated procedures. The numerical coefficients that are part of path diagrams can be used directly in the calculation of "contributions" in certain of the prediction models—in particular, the partitioning components of the independent-joint effects model (Werts) and the uniqueness-commonality model (Creager). The analyst may be interested in the values of path coefficients themselves, which represent the relative weights of the variables in the system of variables with respect to indicating how much change in the dependent variable is produced by a standardized change in any one of the independent variables when the others are controlled. Or the analyst may be interested in the partitioning of variance, which produces estimates of the relative importance of the variables in an account of the sources of explained variance. Thus path analysis and partitioning of variance are often interchangeable; or, at the very least, they are usually compatible (see Duncan, Featherman, & Duncan, 1968).

More importantly, an analyst who wishes to use a prediction model in order to analyze contribution to variance is not necessarily freed on that account from causal considerations such as those underlying the use of path analysis. The analyst in fact will have assumed one or another causal ordering of variables in calculating and interpreting contributions to variance—even if he does not make this implicit to the reader or to himself. From this, Duncan, Featherman, and Duncan (1968) argue that achieving an algebraically consistent partitioning is essentially secondary in importance to setting up an appropriate representational or causal model of the structure of the problem. Thus they write:

> The general lesson . . . is that *no* interpretation whatever is possible, except on a definite assumption as to the anatomy of the system [of variables]. While it is possible to make all the calculations reviewed, not to mention a number of others, from the same statistics, only a particular subset of such calculations (partitions or partials) will actually provide consistently interpretable results; and the choice among possible subsets will not be a free one, once a commitment as to the system's causal structure has been made (p. 38).

> The contribution of path analysis . . . lies not so much in rationalizing calculations of explained variance, but in making explicit the formulation of assumptions that must precede such a calculation, if it is to yield intelligible results. Moreover, the power of path analysis consists in the deductions it permits concerning systems more complicated than those of a straight forward recursive regression setup. In problems where systems of this kind afford an appropriate model, the calculation of explained variances is often an irrelevant or at best a secondary objective (p. 43).

Specifying Conditions and Dynamics

Even assuming that one accepts the importance of making explicit the causal assumptions underlying a particular analysis of college impacts (whether or not path analysis is being used), there is still much work to be done and new directions to be taken in the specification and elaboration of causal schemata. For example, it is becoming increasingly apparent that the impact of any particular college environment depends not only on the characteristics internal to the environment (that is, the internal structure) but also on features of the larger social-system context in which the college unit under analysis resides (cf. Meyer, 1968). This realization is hardly news to behavioral scientists in general, but educational researchers are just beginning to take it seriously. Thus Kamens (n.d.) uses characteristics inherent in a given kind of college *together with* the particular relation of that college to the wider social order to explain differential dropout rates for different colleges. Likewise, the impact of social organiza-

tion *within* a college depends in part on the social structure of the college itself. Zelda Gamson (1967) has suggested a typology of relationships that student organizations have with the college based on the degree to which the student subgroup accepts the values and goals of the university (high or low interaction). If the subgroup has high acceptance of university values (say, academic and intellectual values) and has high interaction with the college, the relationship is one of "cooperation." If there is high acceptance but low interaction, the relationship is one of "conformity." Low acceptance with high interaction is a relationship of "rebellion," while low acceptance and low interaction is a relationship of "withdrawal." For these four types of student groups, Gamson predicts different kinds of individual outcomes as well as differences among the group's functions within the university, susceptibility to university influence, degree of recruitment selectivity, and degree of solidarity.

A consideration of the influence of the broader social-system context within which subunits exert influence should be encouraged in the study of college impacts. Also to be encouraged is the movement away from analyses of change merely in terms of social-structural correlates (resulting, say, in such conclusions as students residing in fraternities are less likely to improve their grades than are dormitory residents) to the search for underlying conditions and processes that are producing the correlations. Indeed, this search is the implication and consequence of working within a causal framework such as that used in path analysis.

As an example of the need to probe past correlations, consider the generalization made earlier that the initial differences of students either entering different colleges or entering different environments within a college (major field in particular) tend to be *accentuated* during the students' stay at college (shown in Feldman & Newcomb, 1969, by a type of correlational analysis). At the moment, the exact determinants and underlying processes of the accentuation phenomenon are not known. They probably include any or all of the following environmental pressures: influence of students on one another; the impact of distinctive structural arrangement of the environment; organizational goals and other environmental pressures (e.g., curricular-based influences for major fields); and influences of socialization and social control agents (teachers, administrators, etc.). Accentuation may also be a result of the operation of personality dynamics. For example, persons already high or distinctive on some characteristic may be the very ones who tend to make the greatest (nonartifactual) change on that characteristic. If students differing on this characteristic are not uniformly distributed among different social systems (at entrance), these structures will show accentuation of initial differences, as determined by this personality dynamic alone. Or it may be that other personality attributes, associated with the one under consideration, may be causing differential change. (This line of reasoning about the possible influence of personality dynamics is essentially equivalent to what Campbell, 1967, has called the "fan-spread trajectory hypothesis" based on postulated differences in "rates of development.") Quite probably, both sets of influences—environmental pressures *and* personality dynamics—contribute to accentuation. Moreover, there may well be an interplay or interaction between these mechanisms. To establish these and other suggested processes requires future research.

To unearth a correlation is usually to *raise* questions about conditions, mechanisms, dynamics, and social-psychological linkages, not to *answer* them. For example, it has been shown repeatedly that friends in college tend to be similar in values and attitudes (Feldman & Newcomb, 1969). But much research remains to be done in specifying and elaborating this correlation, in showing the exact place of these similarities in the formation and maintenance of friendship. To discover that college friends are similar, say, in political matters, raises a whole series of research questions, such as the following:

(a) Are political similarities among friends merely coincidental, stemming from similarities along other dimensions?

(b) Are political similarities among friends due primarily to the fact that people with similar political orientations pick each other out to be friends or primarily to the fact that friends have reciprocal influence on one another? Might the processes of selection and reciprocal influence be interdependent?

(c) In general, of what importance are political similarities in the formation and maintenance of friendships as compared with similarities along other dimensions (religious, economic, aesthetic, personality needs, and so forth)? Under what conditions does the importance of political similarity relative to that of other kinds of similarities become more important as a college friendship progresses? Under what conditions does it become less?

(d) Is the extent of political similarity more important for certain types of persons than for others? For example, do highly authoritarian students demand more political similarity in their friendships than do low-authority person-

alities? Or, are students for whom politics *in general* is an especially salient consideration and an important life-value more likely than others to want their friends to be similar in *specific* political attitudes and orientations?

(e) Are there some structural circumstances in which political similarity among friends is more important than in others? For example, is it more important for roommates (or for members of the same extracurricular political organization, etc.) to be alike in political attitudes?

(f) Under what conditions and for what kinds of students may political dissimilarity (complementary or otherwise) promote friendships?

(g) Are friendship patterns in relation to political values influenced by the dominant political tone of the school? For instance, does having conservative political views play a more important role in friendship formation and maintenance in politically conservative or politically liberal schools?

Research on the impacts of colleges on students has accumulated a multitude of correlations and associations; but its storehouse of knowledge about conditions, processes, dynamics, and mechanisms is small. In this respect, as we mentioned at the beginning, the field knows more than is often believed but less than it might.

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