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Title: The Relationship of Locus of Control to Career Development in College Engineering Students

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The purpose of this study was to examine the relationship between career development and locus of control as they relate to barriers encountered in career development.

The sample included 144 students in the engineering program at Oregon State University. The Rotter Internal-External Scale and the Career Development Inventory (Form CU) were employed.

Analyses included the use of multiple regression models. Correlations were performed to build a table of relationships between variables. Two-way analyses of variance provided information on the relationships and interactive effects between scale scores and demographic variables.

Based on the results of the study, the following conclusions were reached:

1. Males' scores rose from the pre-professional to the professional level on all scales of the career development measure. Females' scores on attitude scales rose between the levels; however, there were significant decreases in females' performance on scales measuring knowledge about careers and about their chosen career.

2. There were no significant differences in grade-point average among the four subsamples defined by sex and level.

3. Locus of control predicted career development in professional-level males but not among the other groups.

4. Professional-level females showed an inverse relationship between knowledge about their career field and attitude toward careers. They also showed an inverse relationship between grade-point average and knowledge about their career field. This may indicate difficulties related to the women's non-traditional status.

Theoretical implications of the study were discussed and include development of an alternate model for predicting students' subsequent career decisions.

The Relationship of Locus of Control to Career Development in College Engineering Students

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For Doug Flynn, for 15 years of believing, I dedicate this work. TTG

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INTRODUCTION

In 1957, Donald Super proposed that a blockage in an individual's career path - a difficulty in progressing along chosen career lines - can be viewed by that individual as either an insurmountable "barrier" or as a "hurdle" to be overcome (p. 273). Whether it is a barrier or a hurdle depends upon that individual's biases. While some writing and research has been done on the difficulties encountered in career decision making by classes of individuals (LoCascio, 1964, 1967; Manuelle, 1983), little has been said about the source of individual biases that create personal barriers to career development.

Lokan, Boss, & Patsula (1982) noted that career maturity is one aspect of general maturity in which psychological variables play a large part; they state that the paucity of research relating career maturity and psychological variables is therefore surprising. Other researchers, such as Tango & Dzuiban (1984), note that the relationship of psychological variables to career decision issues "has been a major research question for some time

(p. 509)." Locus of control, a generalized belief that events are contingent either on one's own behavior or on luck or other external forces, is one psychological variable that has repeatedly been linked to career maturity and decision making. Cellini & Kantorowski (1984) equate descriptions of persons with high internal locus of control to descriptions of persons strongly decided about career goals and find them quite similar. Both achieve higher grades, both are more dominant and self-confident. Locus of control appears to be closely related to information gathering and its use, which are also aspects of career maturity. Locus of control has also been found to be related to other aspects of general maturity. Therefore, locus of control would appear to be particularly relevant as a point of entry into examinations of relationships between career development and psychological constructs. Lokan, Boss & Patsula's (1982) research supports this view.

The present study attempts to expand upon the body of research examining the relationship of career development and locus of control. It will do that in light of the possibility that locus of control may be one factor determining the biases to which Super referred. If evidence emerges from research showing that locus of control can be affected by interventions of some type,

then it may be possible to more fully assist students who confront career path blockages.

This study will examine locus of control and career development in a sample of students for whom such blockages may present a real and immediate problem. Pre-engineering students at Oregon State University (OSU) face an admissions process at the end of their sophomore year that determines whether or not they may continue to study there in their chosen field. This determination, which will be called the "admissions cut", is based exclusively on the rank of the student's accumulated grade-point average (gpa) relative to his/her peers (Stone, 1984). This sample will allow an examination of the relationship of locus of control (LOC) to career development and a potential way to predict those students who, having failed to surmount the admissions cut, proceed to surmount the blockage that cut imposed. For these students it could be only a hurdle.

CAREER DEVELOPMENT THEORIES

Several types of theories have been advanced to explain career choice processes. Only a very few of these have addressed the way in which career-related concerns are a part of the lifelong development of the individual with which student services professionals are concerned. An early developmental theory was proposed by

Ginzberg, et. al., (1951) for adolescents and young adults. While Ginzberg (1972) has extended his occupational choice theory into later adulthood, it is still primarily concerned with those under 25. Another early developmental theory which has received some measure of attention is Tiedeman and O'Hara's (1963) career decision making theory. It concentrates on the steps a person must take to make a career choice, such as choosing a college or a job. While Tiedeman views career development as a lifelong endeavor, the career decision making steps remain the same and are repeated for each choice.

Tiedeman's theory draws on the work of Ginzberg and that of Donald Super, one of Ginzberg's colleagues. Super (1953) published a critique of Ginzberg's work in which he outlined what was to become the major theory in the career development field. While there have recently been some modifications to his original Theory of Vocational Development based primarily on the results of longitudinal studies, it continues to be validated and elaborated upon by large numbers of researchers in the field.

There appears to be a strong correspondence between Tiedeman's process stages and Super's developmental stages (Phillips & Strohmer, 1983) and evidence that the two theories are compatible and complementary (Gordon, 1981).

Gordon remarks that Super's theory, besides being the best known, is compatible with the major theory of intellectual development (Perry's 1970 theory of intellectual and ethical development) and easily usable for "practical advising, counseling, teaching, programming, and administrative considerations (1981, p. 434)."

CAREER DEVELOPMENT BARRIERS

Entering a professional training program is considered a vocational choice (Super, 1957), one of the many that is made by an individual in the career development process. While it is most often considered to be up to that individual to make this choice, Super has mentioned that sometimes "barriers" to the individual's objectives do exist. The response to a barrier is a function of the individual's own "biases":

> When the barrier seems likely to remain insuperable, the objective must be abandoned and a substitute found.... When it is more likely to be a hurdle, the question appears to be one of the feasibility of overcoming the hurdle, as contrasted with the prospects and costs of substitutes and of retraining.
>
> This is a point at which biases often play a part, for what one client or counselor sees as a barrier, another may see as a hurdle. (Super, 1957, p. 273)

These barriers may be any number of "situational factors", including factors in the environment that create restrictions (Super, 1957, pp. 52-53). Manuelle (1983) cites the special problems encountered by the poor,

minorities, handicapped, and women. Althen & Stott (1983) note that many foreign students and Americans from lower socio-economic groups encounter special problems in our independence-oriented academic and career institutions. LoCascio (1967) mentions the problems encountered by those who do not bring "vocationally relevant" behavior into play in a given situation, although he seems to limit the latter to persons who are disadvantaged or at least not privileged. These persons have not had opportunities to develop the needed skills or have not learned to make use of those skills to resolve the conflicts they encounter. LoCascio's discussions (1964, 1967) point out that neither Ginzberg nor Super clearly address what occurs when a person is not successful in implementing a career choice. Tiedeman & O'Hara (1963) and Super (1957) both imply that any difficulties encountered lead to better self-understanding, which is a positive result. An apparent inconsistency in Super's theory is his discussion of "floundering", a "change which the individual perceives as forced upon him by others or by circumstances (1963, p. 776)." Floundering is characterized by aimlessness and indecision. It therefore appears that the "biases" of which Super writes may be related to perceptions of externally controlled events, in which case the person flounders. The alternate result, a better self-

understanding, would derive from a different perception of events.

LOCUS OF CONTROL

The theory of locus of control was developed by Rotter (1966) from social learning theory. It holds that a person develops an expectation that there is or is not a causal relationship between behavior and rewards. Social learning theory (SLT) states that behavior is determined by goals and reinforcements and by expectations that those goals will be reached. While SLT is based on stimulus - response concepts, it evidences a substantive regard for the self-determination of the individual as well as acknowledging the environmental impacts on that individual (Rotter, Chance, & Phares, 1972). Applied to decision making, SLT emphasizes the individual's control over some factors and alternatives primarily through cognitive mediation and motivational processes (Unruh, 1979).

A person develops the expectancy that his or her behavior will be rewarded based on previous experience of behavior - reinforcement sequences if that person sees the reward as due to personal skills rather than as luck. This attribution is also based on prior behavior - reinforcement experiences. Such an expectation that one's behavior will be rewarded generalizes from one specific situation to others which are similar or related. Rotter

(1966) developed this concept of an individual's attribution of reward to skill or luck because of its importance in understanding the effects of reinforcement on different individuals. Since such an attribution generalizes, the individual eventually develops a predominant belief in whether or not one's behavior will have an effect on what subsequently occurs. This generalized expectancy, locus of control (LOC), is said to be internal (determinant is primarily skill) or external (primarily luck) to varying degrees.

LOCUS OF CONTROL AND CAREER DEVELOPMENT

While theorists have advanced a social learning approach to career choice (Mitchell, Jones, & Krumboltz, 1979), the emphasis is on the actual decisions and the process of decision making. It explains how and why individuals, confronted with similar situations, make different choices based on their current expectations and particular histories. It addresses growth, but it does not account for development.

Career development theory, on the other hand, addresses those processes, consonant with general human development, by which the individual both enlarges ("growth") and also reorganizes the self in increasingly complex ways ("development") (Sanford, 1969, in

Knefelkamp, 1978). Yet, career development theory does not clearly address why some persons, given similar situations such as the "barriers" referred to earlier, will choose differently.

The LOC concept may, by its explication of expectancy, provide one explanation of the source of the biases that cause an individual's response to a barrier.

DEFINITION OF TERMS

career: "The sequence of major positions occupied by a person throughout his preoccupational, occupational, and postoccupational life; includes work-related roles such as those of student, employee, and pensioner, together with complementary avocational, familial, and civic roles. Careers exist only as people pursue them; they are person-centered (Super, 1976, p. 20)." The terms "career" and "vocation" will be used interchangeably.

development: includes change, growth, and "the organization of increasing complexity (Sanford, 1969, in Knefelkamp, 1978, p. 4)." It is "an orderly, ever-increasing, and more complex change in a consistent direction...across the years of the life span (Schell, 1975, pp. 5, 9)."

growth: the "expansion of the personality -- the addition of parts (e.g., habits, needs, or beliefs) and the enlargement of existing parts (e.g., an increase in

the intensity of a need (Sanford, 1969, in Knefelkamp, 1978, p. 4)."

locus of control: Locus of control (LOC) may be either external or internal. "When a reinforcement is perceived by the subject as following some action of his own but not being entirely contingent upon his action, then, in our culture, it is typically perceived as the result of luck, chance, fate, as under the control of powerful others, or as unpredictable because of the great complexity of the forces surrounding him. When the event is interpreted in this way by an individual, we have labeled this a belief in external control. If the person perceives that the event is contingent upon his own behavior or his own relatively permanent characteristics, we have termed this a belief in internal control (Rotter, 1966, p. 1)."

vocational development: "The process of growth and learning which subsumes all instances of vocational behavior. The progressive increase and modification of a person's capacities and dispositions for particular kinds of vocational behavior and of his repertoire of vocational behavior. In this sense, vocational development encompasses all aspects of development which can be identified as related to work (Super, et. al., 1957, pp. 131-132)."

vocational developmental task: "A task encountered at or about a certain period in the life of an individual and deriving from the expectation that the members of a social group manifest a relatively orderly behavioral sequence in preparing for and participating in the activity of work (Super, et. al., 1957, p. 132)."

vocational maturity: "focuses on developmental tasks and is represented by the behavior of the individual in handling the developmental tasks with which he actually is coping (Super, et. al., 1957, p. 132)."

STATEMENT OF THE PROBLEM

The nature of the biases exhibited by persons facing barriers to career development choices is not understood. Several researchers have noted a relationship between career development and locus of control, linking the latter to maturity in the former. These studies will be discussed in detail in the second chapter. While there is reason to believe the two concepts are linked, very little has been done in this area with college students, particularly in this country. Further, the nature of the relationship between these two variables needs exploration. The present study proposes to determine whether LOC is related to career development in college students and to explore the nature of that relationship.

SIGNIFICANCE OF THE STUDY

Locus of control, related as it is to information gathering and use, helps determine the responsiveness of students to advising and guidance activities of many kinds. Foote (1980, in Taylor, 1982) found that college students with external LOC were more indecisive about their major field, less likely to stay in college and less successful academically when they did stay. Taylor (1982) found LOC to be a significant predictor of indecision in high ability students. Phares (1962) and Rotter (1966) noted that high externals had more difficulty coping with potentially threatening situations and were less likely to recognize useful information to improve their situation. Therefore, information about this factor and about its relationship to career development will help educators plan interventions and developmental activities which can assist students in appropriate ways. If LOC is a factor in career maturity, activities designed to augment overall career maturity will also help students to make better use of available resources by lowering passivity in the face of barriers to progress. If LOC is a separate factor in determining how students approach similar stage tasks, then it should be given temporal priority in order to help students develop the skills they will need.

HYPOTHESES

The following questions will be addressed in this study. Each is supported by one or more specific hypotheses, listed after the relevant question. In these hypotheses, "target groups" refers to all of the following:

female pre-engineering level students
male pre-engineering level students
female professional level engineering students
male professional level engineering students

Question One: What is the level of locus of control (LOC) in OSU engineering students?

HO_1: There is no significant difference in mean LOC scores among the target groups.

Question Two: What is the level of career development (as measured by subscales on the Career Development Inventory) in OSU engineering students?

HO_2: There is no significant difference in mean Knowledge of Preferred Occupation (PO) scores among the target groups.

HO_3: There is no significant difference in mean Career Development Attitudes (CDA) scores among the target groups.

HO_4: There is no significant difference in mean Career Development Knowledge (CDK) scores among the target groups.

HO_5: There is no significant difference in mean Career Orientation Total (COT) scores among the target groups.

Question Three: What are the relationships between LOC, career development, and grade-point average among the target groups?

HO_6: There is no significant relationship between LOC and any of the career development scales among the target groups.

HO_7: There is no significant relationship between LOC and gpa among the target groups.

HO_8: There is no significant relationship between any of the career development scales and gpa among the target groups.

Question Four: What is the relationship among LOC, career development, and gpa?

HO_9: Career development is not a function of any subset of locus of control, sex, and grade-point average for pre-engineering students.

HO_{10}: Career development is not a function of any subset of locus of control, sex, and grade-point average for professional engineering students.

REVIEW OF RELATED LITERATURE

A THEORY OF CAREER DEVELOPMENT

In 1953, Super published a set of ten propositions that still form the basis of his theory:

1. People differ in their abilities, interests, and personalities.

2. They are qualified, by virtue of these characteristics, each for a number of occupations.

3. Each of these occupations requires a characteristic pattern of abilities, interests, and personality traits, with tolerances wide enough, however, to allow both some variety of occupations for each individual and some variety of individuals in each occupation.

4. Vocational preferences and competencies, the situations in which people live and work, and hence their self concepts, change with time and experience (although self concepts are generally fairly stable from late adolescence until late maturity), making choice and adjustment a continuous process.

5. This process may be summed up in a series of life stages characterized as those of growth, exploration, establishment, maintenance, and decline, and these stages may in turn be subdivided into (a) the fantasy, tentative, and realistic phases of the exploratory stage, and (b) the trial and stable phases of the establishment stage.

6. The nature of the career pattern (that is, the occupational level attained and the sequence, frequency, and duration of trial and stable jobs) is determined by the individual's parental socioeconomic level, mental ability, and personality characteristics, and by the opportunities to which he is exposed.

7. Development through the life stages can be guided, partly by facilitating the process of

> maturation of abilities and interests and partly by aiding in reality testing and in the development of the self concept.
>
> 8. The process of vocational development is essentially that of developing and implementing a self concept: it is a compromise process in which the self concept is a product of the interaction of inherited aptitudes, neural and endocrine make-up, opportunity to play various roles, and evaluations of the extent to which the results of role playing meet with the approval of superiors and fellows.
>
> 9. The process of compromise between individual and social factors, between self concept and reality, is one of role playing, whether the role is played in fantasy, in the counseling interview, or in real life activities, such as school classes, clubs, part-time work, and entry jobs.
>
> 10. Work satisfactions and life satisfactions depend upon the extent to which the individual finds adequate outlets for his abilities, interests, personality traits, and values; they depend upon his establishment in a type of work, a work situation, and a way of life in which he can play the kind of role which his growth and exploratory experiences have led him to consider congenial and appropriate. (pp. 189-190)

Weinrach reported in 1979 that this classic, yet still appropriate, list of propositions had not undergone major revision up to that time. There does not seem to have been substantial revision to date, although Super's and his colleagues' many articles and volumes continue to elaborate on the theory.

Proposition 5 sets forth the stages of development. Exploration and establishment are the stages generally encountered by 18 to 25 year olds (Super, 1957, 1963; Super, et.al., 1957), involving four major tasks, each of

which may be seen as a career choice (Super, 1957):

1. choice of college or work
2. choice of college curriculum
3. choice of a suitable job
4. development of skills on the job (Super, et. al., 1957.)

In a later attempt to clarify the tasks of this period and put them into researchable terms, Super and others (1963) outlined the following developmental tasks for completing the exploration and establishment stages:

1. crystallizing a vocational preference
2. specifying a vocational preference
3. implementing a vocational preference
4. stabilizing in a vocation
5. consolidating status and advancing in a vocation.

These span a broader age range than his 1957 conception. Crystallization is encountered during the 14 to 18 year old's tentative substage. Stabilization is typically the task for ages 21 to 30 and consolidation for those in their early thirties. These "typical" age ranges do not, however, take into account prolonged schooling nor other nontraditional career preparation patterns (Phillips, 1982). Super did mention in 1983 that the "facts of recycling through the career processes [stages] (p. 557)"

for adults had to be accommodated by updating the theory in the area of career maturity. The stages are still seen as primarily age-dependent for adolescents, although researchers (Crites, 1965; Hawkins, et. al., 1977) have found that it is grade level, more so than age, that is important in measured changes in vocational maturity.

During the 18- to 25-year-old range, persons in the exploratory and establishment stages have five types of coping behaviors to deal with the tasks outlined above. These are: floundering, trial, stagnation, instrumentation, and establishment. (Super, 1963) Floundering and trial behaviors "are actually the two poles of one continuum...the two extremes (p. 776)." While floundering involves an aimless casting about, trial behavior is a progressive narrowing down of options to find the most appropriate, although both involve frequent job changes. Stagnation involves staying in an employment situation which can not lead to normal adult security, pay, or status, and which can not satisfy the jobholder's abilities and interests. Instrumental behavior, on the other hand, enables a person to prepare for a "regular adult occupation." Trial and instrumentation can become negative if taken to extremes, as when a person continues in entry-level positions past the necessary preparation period. Finally, establishment "is the achievement of

stability in an occupation which does not involve stagnation (p. 779)."

The subtasks which assist persons in the exploratory and establishment stages to trial and instrumentation behaviors are: exploration, information, decision making, planfulness, and reality orientation (Super, 1974). Reality orientation, also called "wisdom of vocational preference", does not appear to be subject to the same developmental process as the other aspects of career maturity (Jordaan & Heyde, 1979). It is not a single factor and attempts to measure it directly have not been found adequate (Super, 1974; Super & Thompson, 1979). The four subtasks which remain (exploration, information, decision making, planfulness) form the structural model for the measurement of career maturity which Super (1974, Super, et. al., 1981) has proposed.

Gender. The preceding descriptions, derived from the results of the Career Pattern Studies, are based on the longitudinal study of 142 males (Super, et.al., 1957; Super, Kowalski, & Gotkin, 1967; Super, 1963). Moreland and others (1979), in a review of studies on the career decision-making process, found no difference between women and men in decision-making style, progress through career decision-making stages, vocational self concept crystallization, and vocational decisiveness. Decidedness about a college major also appears unrelated to sex,

though a 1966 study disagreed (Moreland, et. al, 1979). There may, however, be indirect gender influences, related to sex role (Moreland, et. al., 1979; Harren, et. al., 1978), but the differences found have been small and account for only a tiny portion of the variance.

Social class. Unstable and trial career patterns, characterized by floundering or relatively permanent trial behaviors, are accommodated by Super's theory (1969) as lower-class patterns. LoCascio (1964) pointed out that discontinuous patterns do exist. Later, he attributed these patterns to the less advantaged and questioned the applicability of current vocational theory to anyone not part of the privileged class (1967). Emphasis on the "continuous, uninterrupted, and progressive aspects of career development" (Manuelle, 1983, p.46) appears to disqualify all but the male middle-class from the theory's tenets (Manuelle, 1983; Resnikoff, 1969). This problem is related to the availability of opportunities and resources (Bingham, 1969; Resnikoff, 1969) traditionally not offered to the lower socioeconomic classes, minorities, the handicapped, and women (Manuelle, 1983).

RESEARCH RELATING LOCUS OF CONTROL TO CAREER DEVELOPMENT

While a few researchers have noted a link between locus of control and career development, more work is

needed using statistically validated instruments. There are very few studies of college students, particularly in the United States. Of the research studies identified, two were conducted on Canadian youth (Lokan, Boss & Patsula, 1982; Breton, 1972), and one on Australian high school students (Lokan & Biggs, 1982). Breton (1972) did not use a validated instrument to assess locus of control and did not address the construction of his 3-item scale in the report. Similarly, Minnich & Gastright (1974) did not demonstrate the validity of their 4-item scale. Thomas (1974) and Gable, Thompson & Glanstein (1976), while using validated instruments, restricted their samples to such a degree that developmental variables cannot be assessed. Utz's (1983) comparisons were between seekers of counseling, non-seekers, and career development class-takers in the United States. Those distinctions confound the relationship between the variables under inspection in the present study due to the unknown causes and effects of the self-selection criterion. Thus, while no one of the aforementioned studies individually yields strong evidence for a link between locus of control and career development in American college students, taken together they give reason for assuming such a relationship exists.

In a sophisticated study designed specifically to broaden the research base on the connection between locus

of control and vocational maturity, Lokan, Boss & Patsula (1982) compared internals and externals (based on a buffer-zone approach to scores on the Nowicki-Strickland LOC Scale for Children) to Career Development Inventory (CDI, Form I) scale scores. They found significance levels of $p < .001$ to $p < .0001$ between the two tests by grade level, with Knowledge of Preferred Occupations (CDI scale "PO") being the most significant. An important part of their conclusions was that locus of control was believed to be the mediating factor in vocational maturity. While the multivariate analysis cannot address cause and effect, they pointed out the belief that locus of control is fairly well-established by grade 6 as reason for that conclusion. Hazler and Roberts (1984) and Husa (1982) present information and evidence that, while well-established at an early age, locus of control orientation can be altered by training. Cellini & Kantorowski (1982) discussed locus of control as both a dependent and an independent variable, supporting the view that locus of control may change over the course of a lifetime yet is sufficiently stable for predicting behavior. It is sufficient particularly for behavior related to achieving career goals (Cellini & Kantorowski, 1984). Tango & Dzuiban's (1984) investigations also support Lokan, Boss & Patsula's (1982) conclusion that locus of control is a

mediating factor in vocational maturity. Tango & Dzuiban advise that "further inquiry into the latent relationships between career indecision and personality is warranted (1984, p. 512)" and should prove useful to counselors designing client interventions.

Lokan and Biggs (1982), also using the CDI, found that bright high school students with long-term career plans were more internal; vocationally immature students lacking decision-making confidence were more external. Their locus of control measure was a 7-item scale embedded in the General Information Questionnaire - a demographic information-collection tool designed specifically for their study. Breton (1972) used a brief (3-item) measure to assess "sense of control over events" and found a relationship between it and vocational level. No levels of significance are available. Thomas (1974) developed his own locus of control measure, although he did report its adequacy, and compared results to scores on the Career Maturity Inventory (CMI) for a single grade level. Thomas found that those scoring in the middle to high range of internality tended to be higher on the CMI measures of career maturity. Gable, Thompson & Glanstein (1976), also using the CMI (and the MacDonald-Tseng I-E Scale), found similar results for female university student volunteers.

Taylor (1982) chose a sample of vocationally-decided and vocationally-undecided students based on scores on the

Career Decision Scale. She found higher externality (on the Rotter I-E Scale) was related to greater indecision to a significant degree in high ability students for both men and women. Like Lokan, Boss & Patsula (1982), Taylor suggested that locus of control plays a moderating role in career decision making and development.

In a longitudinal study, Richards (1983) followed a sample of high school graduates for four years. Using both a 4-item locus of control scale and a 4-item self esteem scale, Richards found both internal locus of control and self esteem increased during the period studied and were significantly directly correlated with educational goal attainment. Self concept theory, according to Richards, "views self esteem as a generalized expectancy much like locus of control with positive self esteem functioning in much the same way as internal locus of control (1983, p. 898)." Investigations of the relationship between other personality variables besides locus of control are beyond the scope of the present study. However, the literature in these areas might prove fruitful for broader study of variables affecting career development. Attention might also be paid to study of the similarities among such variables.

ENROLLMENT LIMITATIONS IN ENGINEERING COLLEGES

Record numbers of undergraduates enrolled in engineering programs in 1982. Their numbers have been rising each year since at least 1972 (Doigan, 1983). The increasingly large demand, coupled with limited resources, has resulted in a restricted supply of openings for students seeking to enroll in those curricula (Dixon, 1983; Culver, 1984; Ryback, 1984; Stone, 1984; Forgey, 1985). The result has been limitations on enrollments, particularly upon entrance to the upper-division curriculum (Stone, 1984). In a special issue of Engineering Education, Culver (1984) bemoaned the wastefulness of attrition and cited the need to be more aware of the specific needs of freshmen engineering students. In that same issue, Woods & Crowe (1984) described the anxieties of freshman students faced with the demands of the pre-professional engineering program. These pressures block opportunities for numbers of students, many of whom may be minorities and women (Dixon, 1983), and seriously limit the numbers of graduates in a growing, economically important field (Blumfield, 1983; Dixon, 1983).

In Oregon, in spite of pressure for increased retention efforts, qualified students are being dismissed due to such enrollment limits. Numerous reports cite the

same reasons for enrollment limits at Oregon State University (OSU) as elsewhere: too few resources and too high a demand (Fowler, 1984; Anderson, 1984; Manzano, 1984; Engineering education found..., 1984; Blumfield, 1983). Reporting on a subcommittee's findings for the State Board of Higher Education in July, 1984, Anderson said that 206 students, some with grade point averages of 3.18, were turned away. In the fall of 1983, 92 out of 192 students applying for the upper division in electrical engineering at OSU were denied admission (Anderson, 1984).

There are no data on these students once they are denied admission to the upper division. Some stay at OSU and continue to try for admission to the professional program. Some find places in other programs; some leave altogether. Of those who leave, it is not known how many attend college elsewhere, nor in what types of programs they enroll. (Stone, 1984). OSU is losing some unknown number of students who have been dropped because their grade point averages, satisfactory to the University, were not high enough to rank them in the very top of a demanding program. That poses an important issue for retention efforts at the University. It also suggests an effect on the students enrolled in pre-professional engineering programs as they face such a ranking at the end of two or three years' college work.

The National Engineering Career Development Study (Shell & LeBold, 1983) found that "nearly all" freshman and sophomore engineering students "had made their final decisions to major in engineering by the twelfth grade" (p. 166). They then take two or three years' coursework specifically tailored to professional engineering preparation. These processes of choice and implementation are major mileposts in career development leading to selecting and developing specific job skills and stabilizing in the occupation (Super, et al, 1957).

METHODOLOGY

SAMPLE

Two samples, stratified by gender, were drawn from lists of students registered in the Oregon State University College of Engineering during Fall term, 1985. Sample A (PRE) consisted of those students who were in the second year of the pre-engineering program Fall term 1985 and eligible to apply at the end of that year for the professional engineering program. Sample B (PRO) consisted of students in their first term of professional engineering study during Fall 1985. Since 10% (90) of the students in the two samples were female, all females and a random sample of 310 males were selected.

Table 1: Original sample by sex and class level

	Sample A (PRE) pre-engnr. students	Sample B (PRO) profess. engnr. students
Women	N = 51	N = 39
Men	n =149	n =161
Total	n =200	n =200

("N" denotes a population size; "n" denotes a sample taken from a larger population.)

Those selected were mailed an invitation to participate and a response card suitable for return

through campus mail. After the initial testing dates, a followup mailing was sent and additional testing sessions occurred. (See Appendix A for copies of letters and response materials.) Of the 194 students who replied, 145 completed testing. Of those, 144 sets of responses were usable. That 144 represents 74% of respondents, 36% of the initial number selected. They are described in table 2.

Table 2: Research subjects by sex and class level

	Pre-professional (PRE)	Professional-level (PRO)	Total
Women	12	17	29
Men	46	69	115
	58	86	144

TEST INSTRUMENTS

Rotter Internal-External Scale (Rotter, 1966). This self-report inventory measures the single general factor of locus of control. Attempts to discover subfactors (such as achievement and social desirability) have not had statistically significant results. Responses are forced-choice between two options on 29 items, 6 of which are fillers designed to obscure the test's purpose. Raw

scores, which theoretically may range from 0 to 23, are used and are generated by counting the number of external choices. Therefore, the higher the score, the more external that subject's locus of control. An inspection of scale results given in Rotter's monograph reveals apparently normally distributed scores, with a median of 8 for both males and females. Females' mean score is 8.42 (s.d. = 4.06); males' mean score is 8.15 (s.d. = 3.88) for a large group of college students (N = 1180). Later investigations (Rotter, 1975; Cellini & Kantorowski, 1984) indicate that the mean score among college students may be rising. While limited normative data are available and comparisons with locus of control scores from other college studies could be used, it is the relative score that is needed for the present study.

Reliability and Validity. Test-retest reliabilities of r = .72 (females) and r = .78 (males) for a one-month period and r = .55 for longer periods is satisfactory and consistent with theoretical assumptions. Change in scores was in the predicted (toward internal) direction upon retest. Factor analyses, as mentioned previously, show internal consistency, a second component of reliability. Rotter (1975) has cautioned that the test measures a generalized expectancy. Therefore use of this measure in highly specific circumstances, or as a selection tool, is not recommended. Correlations with

intelligence measures and social desirability scales are extremely low, suggesting strong discriminant validity. Content validity has been assured in the construction of the instrument by elimination of items correlated strongly with social desireability, elimination of those items not correlated with validation criteria (interview and questionnaire results), and by several "purification" iterations. Rotter cites predicted differences in behavior as the most significant evidence of the construct validity of this scale (1966, p.25). A copy of the Rotter I-E instrument used in the present study is contained in Appendix B. Note that item 30 is not a part of the original instrument and is not used here.

Career Development Inventory: College and University Form (CDI) (Super, et. al., 1981). This instrument was designed to assess career development and maturity, based on the research and theory of Donald Super. The instrument is recommended for determining career maturity differences among groups of students, including those in different class levels (Thompson & Lindeman, 1981). The CDI has eight scales, three of which are combinations of four of the five basic scales:

CP: Career planning

CE: Career exploration

DM: Decision making

WW: World of work information

PO: Knowledge of preferred occupation (not included in the combined scales)

CDA: Career development attitudes (CP + CD)

CDK: Career development knowledge (DM + WW)

COT: Career orientation total (CDA + CDK)

The Career Development Inventory does not address reality orientation, another component of career maturity in Super's model. Reality orientation, however, is not assumed (in the theory) to be developmental.

Reliability and Validity. The items are derived directly from the career development theory of Donald Super, one of the test authors, then tested and refined to make them consistent with the theoretical concepts. Recent work continues to support assertions of consistency (Punch & Sheridan, 1985; Hansen, 1985; Savikas, 1984). Thus, the content validity of the CDI is strong. Factor analyses reveal two major factors, attitudes and knowledge, consistent with the design and scoring of the instrument(Hansen, 1985; Super, et. al., 1981). This factor structure holds for all five scales for both sexes and each class level.

Since the CDI measures a developmental variable, mean scores would be expected to generally increase from the freshman through senior years. An inspection of scale

scores split by class year and sex shows that, with one major exception, that trend holds true. The exception, career exploration (CE), increases steadily from the sophomore through senior years, but is highest for freshmen. Thompson & Lindeman (1982) explain that freshmen are more apt to be involved in career exploratory activities than the other groups. Since exploration is a major aspect of the stage predicted for the younger members of the age group under study, this otherwise contrary result seems fully compatible with theoretical predictions of movement from the exploratory stage into the crystallization stage of career development.

Interitem consistency, measured by use of the coefficient alpha, a generalized form of the Kuder-Richardson reliability coefficient, achieves a high level (.90) for the combined norm group. Since alpha is affected by the heterogeneity of the instrument's content (see Anastasi, 1976), this result is surprisingly strong. While the individual knowledge and skills scales do not achieve similarly high levels, they are high enough (.50 to .69) for group measures. The alpha for the combined knowledge and skills scales (CDK) achieves a satisfactory .75. Interitem consistency for the individual attitude scales is very good and in combination achieves an alpha of .86. Thus internal consistency, the

appropriate test of reliability for an instrument measuring a developmental variable, is satisfactory for the present study. Information regarding test-retest reliability data is somewhat scarce, causing a need for caution in individual interpretations (Hansen, 1985).

METHOD

At the designated group testing times, subjects arrived at the on-campus testing site and, upon giving their name or assigned number to the proctor, were provided with a set of materials. Each set included a pencil, instruction sheet, CDI test booklet, CDI answer sheet, and Rotter I-E test form. (Copies of testing materials developed for the present study are contained in Appendix B.) Subjects worked on their own and were given sufficient time to complete all items. Each testing session lasted approximately one hour. Proctors remained on-site to answer questions and collect materials as individuals left the room.

ANALYSIS

Frequency distributions were generated for both LOC and CDI scale scores for each of the target groups. These data were also subjected to two-way analyses of variance (ANOVA) to examine LOC, grade-point average (GPA), and CDI scores by class level and gender. Fischer's protected t

tests were used to determine the location of differences. Subsequently, series of correlations were computed between LOC, each CDI scale, and GPA for each target group. After significance testing was completed for these correlations, these results were also used to build eight (8) regression models using the following equation:

$$y = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_1x_2$$

where: y = CDI scale (PO, CDA, CDK or COT)

b = beta, the strength of relationship

x = scores on the LOC scale, GPA, sex, and the interactive effect of sex by LOC.

For this model, cumulative grade-point averages (GPA) taken from official University records were used.

RESULTS

This study was designed around four questions, each with derived hypotheses, outlined in Chapter One. Following are the results of the statistical analyses as they relate to each question and hypothesis.

Question One: What is the level of locus of control (LOC) in OSU engineering students?

HO_1: There is no significant difference in mean LOC scores among the target groups.

Frequency distributions, t-tests, and analyses of variance were run to determine the score levels and compare them for the four sex-by-class level groups.

Table 3: LOC summary statistics

	Male Pre	Male Pro	Female Pre	Female Pro	Total
LOC					
x	9.13	8.87	9.50	10.06	9.15
sd	4.13	4.04	3.12	2.97	3.87

Inspection of these means reveals small differences between males and females at the two levels. These differences are in opposite directions. Males are more internal (lower scores) at the professional level, where

females are more external at that level. T-tests did not find these differences to be significant.

Subsequent two-way analysis of variance produced non-significant F statistics for sex, professional level, and sex-by-level interaction effects. The null hypothesis (HO_1) is supported.

Question Two: What is the level of career development (as measured by subscales on the Career Development Inventory) in OSU engineering students?

Frequency distributions and two-way analyses of variance were performed for scores on four scales of the Career Development Inventory:

PO : Knowledge of Preferred Occupation

CDA: Career Development Attitudes

CDK: Career Development Knowledge

COT: Career Development Total

HO_2: There is no significant difference in mean Knowledge of Preferred Occupation scores among the target groups.

Table 4: Knowledge of Preferred Occupation summary statistics

	Male Pre	Male Pro	Female Pre	Female Pro	Total
PO					
x	122.28	124.08	126.82	118.62	123.17
sd	13.03	11.57	9.60	9.41	11.75

Analysis of variance for sex-by-professional level resulted in F = 3.47, which approaches significance ($p < .0651$). Other terms in the analysis did not approach that level. Fisher's protected t of 1.7091 between the two female groups was significant at $p < .05$; however, since the F did not achieve the designated alpha = .05 level, HO_2 must be retained.

HO_3: There is no significant difference in mean Career Development Attitude scores among the target groups.

Table 5: Career Development Attitude summary statistics

	Male Pre	Male Pro	Female Pre	Female Pro	Total
CDA					
x	113.63	116.99	106.75	117.82	115.16
sd	17.83	18.11	13.92	12.81	17.28

Analysis of variance for professional level resulted in an $F = 3.95$, significant at $p < .0488$. Fisher's protected t revealed that the difference was significant between the female groups only. No other terms in the analysis achieved significance. The null hypothesis HO_3 was not supported.

HO_4: There is no significant difference in mean Career Development Knowledge scores among the target groups.

Table 6: Career Development Knowledge summary statistics

	Male Pre	Male Pro	Female Pre	Female Pro	Total
CDK					
x	112.82	114.70	121.67	117.94	115.09
sd	10.66	11.23	5.23	6.84	10.44

Analysis of variance for professional level and sex-by-level did not achieve significance. However, the F for sex, at 7.77, is significant at $p < .0061$. Fisher's protected t's between opposite sex groups at the two levels confirmed the ANOVA; however, only the male preprofessionals by female preprofessionals comparison achieved significance ($p < .005$). The professional level comparison was slightly higher than $p < .10$. Due to the F-statistic, HO_4 is rejected.

HO_5: There is no significant difference in mean Career Orientation Total scores among the target groups.

Table 7: Career Orientation Total summary statistics

	Male Pre	Male Pro	Female Pre	Female Pro	Total
COT					
x	116.78	118.99	117.83	121.77	118.52
sd	11.77	12.95	9.90	8.52	11.88

Analyses of variance revealed no significant differences between any of the groups; therefore, HO_5 is retained.

Grade-point average was also subjected to analysis of variance and t-testing for differences between means. While the more conservative F-statistic did not approach significance, the t-tests showed significant differences at $p < .001$ between the two groups of males (but not between females), between male and female preprofessional students, between male and female professional students, and between male preprofessionals and female professional students.

Question Three: What are the relationships between LOC, career development, and grade-point average among the target groups?

A series of Pearson product-moment correlations (r) was run to test the hypotheses for Question Three.

Table 8: Correlations between LOC, GPA, and CDI scores

	Male Pre	Male Pro	Female Pre	Female Pro
PO x CDA	-.01	-.06	.04	-.77*
PO x CDK	.38*	.24*	-.56*	.15
PO x COT	.22	.07	-.19	-.66*
PO x GPA	.32*	.07	-.06	.45
PO x LOC	-.10	.05	-.18	.17
CDA x CDK	-.09	-.01	.21	-.13
CDA x COT	.80*	.82*	.94*	.86*
CDA x GPA	.16	.04	.00	-.42*
CDA x LOC	-.13	-.25*	-.43	-.11
CDK x COT	.52*	.56*	.53*	.39
CDK x GPA	.15	-.13	.56*	.43*
CDK x LOC	-.06	-.21*	-.25	-.30
COT x GPA	.23	-.11	.19	-.17
COT x LOC	-.03	-.28*	-.45	-.24
GPA x LOC	.05	-.18	-.11	.14

*significant at or above $p < .05$.

HO_6: There is no significant relationship between LOC and any of the career development scales among the target groups.

From Table 8 it can be seen that the correlations for all groups on PO are low; none are significant. CDA and LOC are inversely related for male professional-level students (as CDA rises, LOC drops toward greater internality). For female pre-professionals, the relationship between CDA and LOC is strong, but for this small group ($n = 12$) does not achieve significance ($p < .080$). CDK by LOC results are similar. In male professionals the relationship achieves $p < .047$; for females, the correlations do not achieve the critical alpha = .05 level. For COT, correlations with LOC do not reach significance except in the large group of male professional students, although the relationship is strong in both female groups. This COT x LOC result mirrors the CDA x LOC and CDK x LOC results as expected, since COT is a combination of the CDA and CDK scales. They are not, however, interrelated to any significant degree, as can be seen in the table. PO, which is not included in COT (Career Orientation Total), is not correlated with it except in female professional-level students. Similarly, PO is significantly correlated to CDA only in female professional-level students. The situation is reversed with respect to PO x CDK. There, the relationship between

these two separate knowledge scales is not significant only when applied to female professional-level students. HO_6 is therefore rejected.

HO_7: There is no significant relationship between LOC and GPA among the target groups.

As shown in the last row of Table 8, the Pearson r's range from -.18 to +.14, none of which are significant. A scatterplot of scores revealed no indication of curvilinear relationship. Therefore, HO_7 is retained.

HO_8: There is no significant relationship between any of the career development scales and grade-point average among the target groups.

COT, the career development summary scale, and GPA do not yield a significant r, although in preprofessional males the relationship approaches it at $p < .059$. The two COT subscales, CDA and CDK, are related to GPA for females, but not males. CDA by GPA is significant for female professional students; CDK by GPA is significant for both female groups. PO by GPA is significantly related only for male preprofessional students, although the $r = .45$ nears significance at $p < .057$ for female professional-level students. HO_8 is rejected.

Question Four: What is the relationship among LOC, career development, and grade-point average?

HO_9: Career development is not a function of any subset of LOC, sex, and GPA for preprofessional students.

Regression analyses were run for each of the four career development scales as dependent variable, serially adding LOC, sex, GPA, and the interaction between sex and LOC as the analyses progressed. In this procedure, independent variables are sorted into decreasing order of degree of predictive relationship to the dependant variable, added one at a time into the equation and analyzed for effect on the regression line. The following table (Table 9) lists the order in which independent variables were added for each dependant variable.

Table 9: Order of entry for independant variables into regression equation: Preprofessional students

	X_1	X_2	X_3	X_4
Y = PO	GPA	LOC/SEX	LOC	SEX
Y = CDA	LOC	LOC/SEX	GPA	SEX
Y = CDK	SEX	GPA	LOC	LOC/SEX
Y = COT	GPA	LOC	LOC/SEX	SEX

Only the analysis for Y = CDK maintained significance throughout the addition of all variables. Sex was significant at $p < .008$. The entry of GPA, while adding to the percentage of variance explained, dropped the level to $p < .01$; with LOC, $p < .02$; with LOC/SEX, $p < .05$. This regression analysis overall explained 16.2% of the variance.

Where Y = PO, GPA achieved a .055 level of significance (not sufficient at alpha = .05). Further additions lowered overall significance of F to $p < .271$. The equation explained 10.6% of variance.

The equation for Y = CDA explained 8% of the variance and did not approach significance. For Y = COT, 8.1% was explained, and it was also not significant.

HO_{10}: Career Development is not a function of any subset of LOC, sex, and GPA for professional engineering students.

Table 10: Order of entry for independent variables into regression equation: Professional-level students

	X_1	X_2	X_3	X_4
Y = PO	SEX	GPA	LOC	LOC/SEX
Y = CDA	LOC	LOC/SEX	GPA	SEX
Y = CDK	LOC	SEX	GPA	LOC/SEX
Y = COT	LOC	GPA	LOC/SEX	SEX

Although sex was the strongest predictor of CDK for preprofessional students, for the professional group LOC played that role, approaching significance at $p < .070$. With the addition of sex, the overall significance became $p < .078$. Only 6.7% of the variance was explained.

LOC was also the strongest predictor for CDA and COT, significant at the stipulated alpha = .05 level. Where Y = CDA, only LOC was significant, $p < .034$. For Y = COT, the overall regression achieved $p < .029$, explaining 10.6% of the variance without the sex variable (which was below minimum for computation into Y = COT). For Y = PO, there was no significant result.

Reference to table 8 supports the regression findings. The relationship between CDK and GPA is strongest for females, particularly the preprofessional sample. COT by LOC is significant for male professionals and nearly so for female preprofessionals, supporting both the GPA effect in Y = COT and the LOC/SEX interactive effect. CDK by LOC is strong for females and professional males, significant at $p < .047$ for those males.

Thus, while some groups of variables do combine to predict career development scores and therefore HO_9 and HO_{10} must not be retained, it seems clear that the major result is that career development is not generally better predicted from a combination of these variables than from individual ones.

DISCUSSION AND CONCLUSIONS

In this chapter, the results of the statistical analyses are examined for their possible meanings in light of the theory explored earlier. This discussion is based on the four questions proposed in Chapter One and used to present the statistical results in the previous chapter. Following the discussion and the conclusions are recommendations for further study.

DISCUSSION

Question One: What is the level of locus of control (LOC) in OSU engineering students?

Dudley (1980) reported LOC scores for 108 Fall, 1979, seniors who had attended OSU for four consecutive years. Their mean score, 13.3 (s.d. = 4.2) was significantly more external than that of the students in the present study (mean = 9.15, s.d. = 3.87). The present sample, unlike Dudley's, is similar to Taylor's (1982) college group and Rotter's (1966) one group of college students in which he included all college grade levels. While females and males scored somewhat higher, respectively, in the present study than Rotter's (1966) overall female and male groups (mean, females = 8.42, mean, males = 8.15) for the norming population, the scores from the present study do not significantly differ statistically from that overall norm

group. Dudley's (1980) sample of OSU senior volunteers, significantly more external than the present group, does not seem comparable for the purpose of the present analysis. The present group of engineering students, in the middle of their formal program, score close to the published national test averages.

However, Rotter (1975) and Cellini & Kantorowski (1984) have noted that the mean for college students appears to be rising toward external LOC. Rotter placed the new national mean at somewhere between 10 and 12. Cellini & Kantorowski (1984), using similar data, performed a median split to create a typology of internals versus externals, where internals score between 1 and 11 on the Rotter I-E. Rotter (1975) argued against the use of such a typology, citing a lack of evidence.

Even with the drift toward more external scores, the present samples' test results appear more similar to the published norms. It is possible, therefore, that the present Oregon State University engineering cohort is slightly more internal than current college students in general. Sufficient data has not been reported to statistically validate that conclusion, however.

Question Two: What is the level of career development (as measured by subscales on the Career Development Inventory) in OSU engineering students?

The several CDI scores are reported as standard score units with a mean of 100 and a standard deviation of 20. On all scales, members of the present sample performed above the national norms for their class levels and major field. These scales reflect developmental variables and are expected to rise as a person gains maturity. Thus the real difference between female professional and pre-professional students on PO (Knowledge of Preferred Occupation) is an unexpected result. Females' "knowledge of preferred occupation" appears to drop from the pre- to the professional level. There is also a slight drop between these groups on the other knowledge scale (CDK), although it does not approach significance.

Also between the female groups, there is a significant increase in CDA (attitude) scores from the pre- to professional level. For overall scores (COT), the differences, while in the expected direction, are not significant.

For females, there appears to be a mixed pattern. While attitude-toward-career scores rise, knowledge about careers and about engineering as a career appear to drop.

Males' patterns are less distinct. There were no significant differences between male pre- and professional students on any of the four scales, although the small observed differences were in the predicted direction of increased career development.

Males and females did not differ significantly from one another except on the CDK scale. On this knowledge scale, female preprofessional students, the highest scoring group, were nearly one-half of one standard deviation higher than male preprofessionals. The difference for professional level students was less pronounced, achieving a $p < .10$.

Question Three: What are the relationships between LOC, career development, and grade-point average among the target groups?

Grade-point average (gpa) is the variable used to select those preprofessional students who will be admitted to the professional program. While there were no significant differences in gpa among the four groups, the professional students' scores were slightly higher; the females' scores were slightly higher overall than the males.

Table 11: Grade-Point Averages

	Male Pre	Male Pro	Female Pre	Female Pro
GPA				
x	2.92	3.16	3.16	3.21
sd	.445	.434	.483	.426

The lack of a significant difference between the selected group (professional level) and the pre-selection applicant pool (preprofessionals) poses a question as to the usefulness of gpa as a screening device.

For females, gpa is related to the two summary scales, CDA and CDK, although in opposite directions. It is directly related to CDK. That is, as gpa rises, career development knowledge scores rise. However, for professional-level females, as gpa rises, career development attitude scores drop. No such relationships are observed for males.

In the above (Question Two) discussion of the level of career development among these students, it was noted that females' knowledge of preferred occupation (PO) appears to drop from the pre- to the professional level. Here it is also seen that this drop is significantly related to attitude scores for professional females ($r = -.77$). As their attitude scores rise, their PO scores

(and gpa) drop significantly. Similarly, as COT (total) rises, PO drops significantly. General knowledge of careers (CDK) rises with gpa. General knowledge is not related to gpa for men, but is related for both female groups. There appears, in this one group (professional-level females) to be some difficulty with specific career-related concerns and general career attitudes as the women progress. These results may be due to factors reflected by Manuelle's (1983) criticism (see p. 17) of opportunities and resources available to women and other nontraditional groups or may reflect the expectations of these women regarding such opportunities and resources.

For male professional-level students, LOC appears to predict career maturity. As LOC scores change toward greater internality, the predicted direction for mature development, the summary (CDA, CDK) and total (COT) scores rise in the direction of greater career maturity. These results follow the general trend found in the literature explored in Chapter Two. No such similar relationships exist for the other three groups in the present study.

No relationship was found between LOC and gpa.

Queston Four: What are the relationships among LOC, career development, and grade-point average?

Question Four is an attempt to recombine the variables examined in Question Three to determine if relationships among the variables, taken all together, differ from when they are taken one to one. Some support was found for an additive effect, particularly for sex and gpa when predicting CDK in preprofessional students and for LOC and gpa when predicting COT for professional students. These effects are not strong, however. While there are some relationships among the variables, they are not primarily additive.

CONCLUSIONS

There is a relationship between greater internality of locus of control and increased career maturity in male professional-level students, the largest of the four groups under study. That relationship does not hold for the other groups and does not appear related to grade-point average.

Mixed results for females, especially the professional-level females, poses a difficult problem. Caution must be used in interpreting and applying these results due to the small sample sizes, particularly in the female subsamples. Results, where significant, are often

in the direction opposite that proposed by the theory and confirmed by other research results. Unfortunately, much of the research previously cited relies more heavily on male subjects and on theories based primarily on males. Thus, LoCascio's (1964, 1967) and Manuelle's (1983) reservations about the applicability of career development theory to women and other non-male-middle-class groups are given added weight. Recent discussion of the different developmental paths taken by women, such as Gilligan's (1982), also supports that view. Separate theories of women's career development have not yet been explored.

Returning to the two groups of males, the pre-professional sample potentially includes both those who will be selected for the professional program and those who will not. Distinguishing between the two is not possible prior to the selection point, particularly since the difference in grade-point average, which will determine selection, is not significant between persons before and after selection. For the professional-level males, the relationships among the variables, predicted theoretically and borne out in previous studies, hold true. They are slightly more internal and their career maturity in all measured areas is slightly higher, as befits developmental variables. There is a significant, although low, relationship between locus of control and career development, as expected. These students appear to

be proceeding along ordinary, orderly career paths. Their grade-point averages were sufficient for acceptance into the professional program; they faced no barrier to entrance.

What is missing, however, is data on their peers - former engineering students who did face a barrier, did not get accepted into the professional-level program, and went elsewhere or left school entirely. Those persons do not fit the ordinary assumptions of continuous, orderly, and uninterrupted progress (LoCascio, 1967; Bingham, 1969; Resnikoff, 1969; Manuelle, 1983). The barrier they faced was not internal, since the division according to grades does not appear significant. Rather, the barrier they faced, and which some of the present preprofessional engineering students may face, is external to them, related instead to the availability of opportunities in this engineering college. In that respect they resemble the disadvantaged persons pointed out by LoCascio (1964, 1967) and others. As such, Super's theory (1969) describes their expected career patterns as unstable and characterized by floundering or relatively permanent trial behaviors, discussed here in Chapter Two.

There are two major differences apparent between the two groups of males in the present study. First, they are one year apart in their academic program, a span of time

not particularly long for developmental growth and change. Second, one group includes a subset of persons who may have reason to question whether or not they will succeed on their present course; the other group does not. The group with no reason to question (professional-level) appears to be proceeding on course. The other group (pre-professionals), as a whole group, does not show the predicted relationships. It is possible that the subset of persons believing orderly progression will not be permitted has confounded the results.

It is at this point that a consideration of barriers to career development becomes important. Perhaps those students who do not gain admission, and therefore face a barrier, will react as Super predicted in 1957. Some will confront it as only a hurdle and will find a way to meet their goals. Others will flounder. "Barriers", it may be recalled, are factors in the environment which create restrictions. Those who are admitted to the professional-level program can be expected to perform similarly to those there now. It is those who do not gain acceptance for whom their own behavior ("biases", see p. 4) relative to seeking out alternatives and information about those alternatives will determine their success or its lack. Tango & Dzuiban (1984) have suggested a "latent relationship" between career-related behavior and locus of control in college students. Therefore, it is those

students for whom a clear tendency toward internal locus of control becomes most relevant. If that is the case, then former students who surmount the barrier by seeking and securing comparable education elsewhere would evidence greater internal locus of control and higher career maturity. Other students, found to be floundering, would evidence a more external locus. Such an explanation would account for the undistinguished relationship of these variables to one another in the present preprofessional group. The differences could be cancelled out by inclusion of both subsets in one sample group.

The present study did not find a means to predict, in advance, those students who may not surmount an impending admissions cut. However, it has been shown that LOC and career development are not generally correlated among the preprofessional-level students, yet the concepts appear to be linked. Therefore the regression model may yet provide a predictor of "success" if success is defined as a measure of subsequent goal-seeking behavior. Instead of predicting career development from GPA and LOC, the model should be revised to predict success from LOC and career development.

RECOMMENDATIONS FOR FURTHER STUDY

1. The possibility of distinct career development tasks and patterns for females should be explored.

2. In the absence of identifiably different patterns for females, the possibility of a differential impact on males and females of the present engineering program should be examined.

3. Followup research of the pre-engineering students from the present study should be conducted. Subsequent decisions to enter other educational or training programs should be analyzed and compared to locus of control and career development scale scores to discover if LOC does constitute a personal "bias" determining response to a career barrier.

4. Follow-up research should be conducted to test the possibility that career development and locus of control are related through a third variable, "success", where success is defined as goal-seeking or attainment. The regression model used in the present study could be changed to predict success (dependent) from LOC, COT, and other variables such as sex and grade-point average (independent).

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APPENDICES

Appendix A: Letters and Response Materials

September 3, 1985

Dear Faculty Member:

The College of Engineering has agreed to participate in a study of the career decisionmaking and academic success of our students. The primary researcher is Cynthia Flynn, Director of Special Programs in the Office of Student Services, and a doctoral student in College Student Services Administration here at Oregon State. Cindy has provided me with a copy of her proposal, and I am convinced the information she will collect should be of use to us and to our students.

A sample of 400 pre- and professional-engineering students will be selected and asked to participate in mid-October. Participation will consist of attending a choice of one of several one-hour sessions and completing two "tests." These instruments measure several aspects of career choice, decisionmaking, and opinions about making choices. No student will be asked to miss class in order to participate. Responses will be confidential. Once the data is collected, no particular student's answers will be identifiable.

Cindy has asked me to provide you with this information so that you are aware of the study in advance. Students will be asked to return a reply card to my office stating their intention to participate and confirming their choice of test session. If they have any questions about any aspect of this study, they are welcome to contact me or Cindy Flynn (754-3661). Results of this study will be provided to us upon completion of the project, planned for March, 1986.

Thank you for your cooperation.

Sincerely,

Solon A. Stone
Assoc. Dean for Academic Affairs

SAS:CAF:f

October 4, 1985

Dear Engineering Student:

The College of Engineering is participating in a research project designed to help students make career decisions. You have been selected for inclusion in this study, and I strongly encourage you to participate. Your opinions and ideas are needed.

Please choose ONE of the one-hour sessions listed below. Mark your choice on this letter AND on the enclosed reply card. Send the reply card to me via CAMPUS MAIL or bring it to my office in Covell Hall 201. Bring this letter with you to the session you choose. Please also bring a #2 or soft-lead pencil.

When you arrive you will be asked to complete two questionnaires, one about careers and one about your opinions. Your answers will be kept strictly confidential by Cynthia Flynn, the person conducting this research. Once the data is collected, there will be no way to identify any particular student's answers.

Your participation is very important. Please return the reply card right away and mark your chosen appointment on your calendar.

Sincerely,

Solon A. Stone
Assoc. Dean for Academic Affairs

SAS/CAF/

Select <u>one</u> option; mark it here and on the reply card:

_____ Tuesday, Oct. 15, 4:30pm, Covell Hall 319

_____ Wednesday, Oct. 16, 4:30pm, Covell Hall 319

_____ Thursday, Oct. 17, 4:30pm, Covell Hall 319

Reply card, side one:

COLLEGE OF ENGINEERING
Covell Hall 201

attn: Engin Career Research

Reply card, side two:

I will attend the one session marked:

____ Tuesday, Oct. 15, 4:30pm, Covell 319

____ Wednesday, Oct. 16, 4:30pm, Covell 319

____ Thursday, Cot. 17, 4:30pm, Covell 319

____ Please call me at (phone)_____
(best times)_____
for clarification.

NAME: (please print)_____

Follow-up reply card, side two:

PLEASE SELECT ONE OPTION; MARK IT BY CIRCLING THE TIME:

__Mon., Nov. 4: 8:30am 10:00am 11:30am 1:00pm 3:30pm

__Tues., Nov. 5: 8:30am 10:00am 11:30am 1:00pm 3:30pm

__Please call me at _____(best times)_____
to set up an alternate time.

__I am unable to participate.

PLEASE RETURN THIS CARD TO THE ADDRESS ON THE REVERSE SIDE.

Thanks!!!

Appendix B: Test Materials

Rotter I-E Scale

Scoring Instructions

The score is the total number of the following answer choices:

2.	a	16.	a
3.	b	17.	a
4.	b	18.	a
5.	b	20.	a
6.	a	21.	a
7.	a	22.	b
9.	a	23.	a
10.	b	25.	a
11.	b	26.	b
12.	b	28.	b
13.	b	29.	a
15.	b		

NOTE: Items 1, 8, 14, 19, 24, and 27 are not scored. Item 30 is not part of the Rotter I-E. It has been inserted and should not be scored.

Engineering Students Career Study

I N S T R U C T I O N S

You should have a folded sheet titled "Rotter I-E", a Career Development Inventory test booklet and separate answer sheet, and your letter requesting your participation. If any of these three items is missing, please see the proctor. Please use only a number 2 pencil. The proctor has extras.

Where you are asked to give your name, please list your first name only, or any first name of your choice. Please be consistent and use the same name each time.

FIRST: Complete the Rotter I-E by marking out the letter of your preferred item for each choice. There are 29 choices of "a" or "b". Please mark these ✗ or ✗ .

The last item asks for a number to be placed in the spaces provided.

PLEASE WORK RAPIDLY.

SECOND: On the Career Development Inventory Answer Sheet, please complete the following items:

1. Name: print the same first name you used for the Rotter I-E and darken the corresponding spaces.
2. Darken M or F for your sex.
3. Answer the year item by blackening the appropriate space.
4. MAJOR: DO NOT ANSWER THIS ITEM.
5. I.D.: DO NOT ANSWER THIS ITEM.

THIRD: Read the instructions on the Career Development Inventory Test Booklet cover and follow them in completing both parts.

PLEASE WORK RAPIDLY.

Do not make any marks on the test booklet.

LAST: Please put your letter of participation, your answer sheet, your test booklet, and this instruction sheet inside the Rotter I-E form and turn it in to the proctor.

THANK YOU VERY MUCH!!!!!

caf 100185

NAME: _____

DO NOT WRITE IN THIS AREA

ROTTER I-E

Instructions: This is a questionnaire to find out the way in which certain important events in our society affect different people. Each item consists of a pair of alternatives lettered a or b. Please select the one statement of each pair (and only one) which you more strongly believe to be the case as far as you're concerned. Be sure to select the one you actually believe to be more true rather than the one you think you should choose or the one you would like to be true. This is a measure of personal belief; obviously there are no right or wrong answers.

Please answer these items carefully, but do not spend too much time on any one item. Be sure to find an answer for every choice. Find the number of the item in the answer column and carefully circle the letter a or b which you choose as the statement more true.

In some instances you may discover that you believe both statements or neither one. In such cases, be sure to select the one you more strongly believe to be the case as far as you're concerned. Also try to respond to each item independently when making your choice; do not be influenced by your previous choices.

1. a Children get into trouble because their parents punish them too much.
   b The trouble with most children nowadays is that their parents are too easy with them.

2. a Many of the unhappy things in people's lives are partly due to bad luck.
   b People's misfortunes result from the mistakes they make.

3. a One of the major reasons why we have wars is because people don't take enough interest in politics.
   b There will always be wars, no matter how hard people try to prevent them.

4. a In the long run people get the respect they deserve in this world.
   b Unfortunately, an individual's worth often passes unrecognized no matter how hard he tries.

5. a The idea that teachers are unfair to students is nonsense.
   b Most students don't realize the extent to which their grades are influenced by accidental happenings.

6. a Without the right breaks one cannot be an effective leader.
   b Capable people who fail to become leaders have not taken advantage of their opportunities.

7. a No matter how hard you try some people just don't like you.
   b People who can't get others to like them don't understand how to get along with others.

8. a Heredity plays the major role in determining one's personality.
   b It is one's experiences in life which determine what they're like.

9. a I have often found that what is going to happen will happen.
   b Trusting to fate has never turned out as well for me as making a decision to take a definite course of action.

10. a In the case of the well prepared student there is rarely if ever such a thing as an unfair test.
    b Many times exam questions tend to be so unrelated to course work that studying is really useless.

11. a Becoming a success is a matter of hard work, luck has little or nothing to do with it.
    b Getting a good job depends mainly on being in the right place at the right time.

12. a The average citizen can have an influence in government decisions.
    b This world is run by the few people in power, and there is not much the little guy can do about it.

13. a When I make plans, I am almost certain that I can make them work.
    b It is not always wise to plan too far ahead because many things turn out to be a matter of good or bad fortune anyhow.

14. a There are certain people who are just no good.
    b There is some good in everybody.

15. a In my case getting what I want has little or nothing to do with luck.
    b Many times we might just as well decide what to do by flipping a coin.

16. a Who gets to be the boss often depends on who was lucky enough to be in the right place first.
    b Getting people to do the right thing depends upon ability, luck has little or nothing to do with it.

17. a As far as world affairs are concerned, most of us are the victims of forces we can neither understand nor control.
    b By taking an active part in political and social affairs the people can control world events.

18. a Most people don't realize the extent to which their lives are controlled by accidental happenings.
    b There really is no such thing as "luck."

19. a One should always be willing to admit mistakes.
    b It is usually best to cover up one's mistakes.

20. a It is hard to know whether or not a person really likes you.
    b How many friends you have depends upon how nice a person you are.

21. a In the long run the bad things that happen to us are balanced by the good ones.
    b Most misfortunes are the result of lack of ability, ignorance, laziness, or all three.

22. a With enough effort we can wipe out political corruption.
    b It is difficult for people to have much control over the things politicians do in office.

23. a Sometimes I can't understand how teachers arrive at the grades they give.
    b There is a direct connection between how hard I study and the grades I get.

24. a A good leader expects people to decide for themselves what they should do.
    b A good leader makes it clear to everybody what their jobs are.

25. a Many times I feel that I have little influence over the things that happen to me.
    b It is impossible for me to believe that chance or luck plays an important role in my life.

26. a People are lonely because they don't try to be friendly.
    b There's not much use in trying too hard to please people, if they like you, they like you.

27. a There is too much emphasis on athletics in high school.
    b Team sports are an excellent way to build character.

28. a What happens to me is my own doing.
    b Sometimes I feel that I don't have enough control over the direction my life is taking.

29. a Most of the time I can't understand why politicians behave the way they do.
    b In the long run the people are responsible for bad government on a national as well as on a local level.