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ABSTRACT

A causal model of faculty research productivity was developed through a survey of the literature. Models of organizational behavior, organizational effectiveness, and motivation were synthesized into a causal model of productivity. Two general types of variables were assumed to affect individual research productivity: institutional variables and individual variables. Twenty propositions concerning individual research productivity were examined for both types of variables. Institutional variables are as follows: level of research emphasis at the institution, granting of advanced degrees at the institution, institutional reputation, size, degree of affluence, degree of centralization, and degree of autonomy of the institution. Individual variables are as follows: level of research goals, number of research colleagues, degree of undergraduate teaching responsibilities, level of research resources, level of perceived equity of rewards, level of alienation, perceived level of legitimacy in one's research, level of expectancies, level of need for personal growth, level of publication in graduate school, period of time as a faculty member after beginning as productive in research, academic rank at an institution with a research emphasis, and level of individual autonomy for individuals with high levels of research goals. Several variables that have received mixed support in empirical research, and which are not included in the model are ability, sex, field, career stage, and prestige. A bibliography, summary information on empirical studies of faculty research productivity, and a diagram of the causal model of faculty research productivity are appended. (SW)

A CAUSAL MODEL OF FACULTY RESEARCH PRODUCTIVITY

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ABSTRACT

A causal model of faculty research productivity was developed through an survey of the literature. Models of organizational behavior, organizational effectiveness, and motivation were synthesized into a causal model of productivity. Determinants of research productivity were placed in the model based on empirical studies. Two general types of variables were assumed to affect individual research productivity: institutional variables and individual variables. The model indicates the pathways through which these variables are expected to produce variations in the dependent variables.

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Introduction

The mobility of the professoriate is expected to decline in the decade of the 1980's for three main reasons: decreased enrollments; decreased income from tuition, state and federal sources; and increased relocation costs--especially due to high mortgage rates. Accompanying decreased enrollments and decreased income, the number of new faculty positions is expected to be small, and faculty mobility, although still possible, is likely to be at a low rate (Bowen, 1980). One challenge for higher education generally is to maintain vitality in the professoriate while the amount of "new blood" coming into the system declines (Reskin, 1979). Attempts to meet this challenge are coming from faculty development programs (Gaff, 1975; Centra, 1976). Faculty development is a means to the end of faculty productivity, and the better faculty productivity is understood, the more likely faculty development programs are to be effective.

It is on the issue of faculty productivity that this paper focuses. The paper is limited to an examination of research productivity because other types of faculty productivity (e.g., teaching and service) are probably influenced by factors other than those which affect research productivity. It is the purpose of this paper to develop a causal model of faculty research productivity. The model orders and identifies the determinants thought to explain differing levels of individual research productivity.

Three important goals for higher education are teaching, research and service. Organizational effectiveness is the extent to which the organization is successful in achieving its stated goals. To the extent that the organization is effective, it is directly or indirectly through human performance. One element of performance is productivity, and in higher education, one type of productivity is research productivity. Thus, an increase in research productivity should be directly related to increased organizational effectiveness. Because productivity is an efficiency criterian, indicating the cost of a unit of output, it might be better to speak of research performance. The tradition of research in the field has been to use the term "research productivity," and that is the term that will be used in this paper.

Research productivity, for the purpose of this paper, is defined as tangible evidence of research or scholarly activities. Research is viewed as the process by which new facts, relationships and understandings of the human and natural world are discovered, identified, explained, or derived. Although a generic definition may be satisfactory, operational definitions are difficult for three primary reasons. The first reason is that different disciplines produce different types of research output (e.g., books vs. articles) at different rates (Creswell and Bean, 1980). Second, because there are multiple kinds of products, to get an overall sense of a faculty members research productivity, articles must be added to books and monographs to get a sum of publications. How each should be weighted, especially if books are considered as teaching materials (texts) and not as original research, is not apparent. Finally, quality

of research is not included in quantitative measures. Some control for quality can be assumed to come from citation counts but such indicies are not available for all disciplines. It is suggested, therefore, that in an estimation of research productivity, multiple indicators of productivity be used (Blackburn, Behymer and Hall, 1978). Furthermore, these should be used singly and then combined according to the importance assigned normatively to each by the faculty members representing the different disciplines (e.g., counting a book as 5 and an article as 1 as done by Blau (1973)). Also, only single fields should be studied initially, such as English or chemistry. Finally, if citation counts are available; these may be combined multiplicatively to get a measure not only of quantity but also importance to the field (quality).

Causal Models

The term "causal model" is not intended to imply a high degree of theoretical sophistication. The model developed here represents a plausable althought tentative synthesis of other models, theories, and empirical studies of those factors which are expected to produce variations in individual research productivity. As Glaser and Strauss argue in Blalock (1969), theory must be grounded in empirical data. Thus, empirical estimations of this model, and subsequent revision, reconceptualization, and re-estimation is a natural part of the model development process.

The notion of causality is not always popular in social science research, especially for those who assume that if you cant't prove a one-to-one relationship between variables, causality should be stricken from our vocabulary. There is a restrictive set of conditions under which one can conclude that a causal relationship exists. First, X and Y must be shown to covary. Second, X must be shown to occur before Y (temporal assymetry). Finally, it must be demonstrated that no other causal factor exists in the system, e.g., no Z causes both X and Y (spuriousness) (Sellitz, et. al., 1959). The first two conditions can often be met, but the third probably cannot be met in the social sciences. One proceeds with the best theoretical and empirical information available with full knowledge that one can only estimate the model on an "as if" basis--as if confounding variables which produce spurious relationships did not exist (Asher, 1976).

Despite these limitations, there appear to be three reasons why causal models are valuable. First, bad models can be eliminated by empirical study. If X can be shown <u>not</u> to have a causal influence on Y, our knowledge of the situation is improved. Second, there is a heuristic value in causal modeling (Asher, 1976). This value lies in separating correlates from determinants (discussed below), requiring a clear statement of the relationships among the variables (exogenout, endogenous, and dependent), and generating additional insights into the matter at hand. Third, practical applications of research findings make implicitly causal assumptions about the relationships among variables. For example, if an institution provides additional research resources, they do this implicitly because they think

that these resources will have a positive influence on research productivity. Hence, research which provides improved insights into causal relationships should be of greater practical value than research which does not. This is not to say that causal modeling is the only way, or in extremely complex or little studied situations, even the best way of improving our understanding of these relationships. It is believed, however, that in certain circumstances it can be a valuable asset for reaching such understandings, especially when a model is estimated and revised.

The development of a causal model of research productivity is difficult for a variety of reasons. In past studies, correlates have been mixed with determinants, operational definitions of research productivity have varied widely, the independent variables used have not been inclusive, the populations sampled have varied widely, and results (not surprisingly) have generally been inconclusive. Blau (1973), using organizational characteristics to predict productivity with institutions as the unit of analysis, and Blackburn, Behymer and Hall (1978), using individuals as the unit of analysis, have been most successful in identifying the correlates of faculty productivity. Besides the use of mentors, there has been little use of theory in the empirical studies, and mentorship has produced mixed results.

There are also general problems associated with developing causal models. The basic dilemma is to develop a model complex enough to represent the real world but not so complex as to be impossible to estimate. Blalock writes:

> The need for deductive theories, when combined with the need for testable theories that are sufficiently complex to give really new insights, poses a major dilemma for the theory builder. In order to develop deductive theories, one must ordinarily begin with very simple models that are totally inadequate to mirror the real world. By adding new variables and complications a few at a time, one can then construct more realistic theories by what amounts to an inductive process . . .. The methodological task is to suggest procedures for constructing reasonably simple deductive theories that also allow for relatively large numbers of variables. (1969, pp. 3-4)

One must attempt to reach a happy medium between the very abstract and general models and those so complex and filled with variables as to be intractable.

The Model

The causal model for faculty research productivity is presented in Table 1. Definitions of the variables follow the propositions presented below. The most obvious characteristic of the model is that it has two classes of variables. The first level of influence comes from the organizational variables. These variables act through a set of individual variables in influencing individual productivity, which is the dependent variable. In addition, several individual characteristics are expected to have a direct influence on individual research productivity, and three variables are expected to have multiplicative (e.g., interactive) effects on the dependent variable.

The two levels of the model represent not temporal but influential assymetry. That is, the organizational variables are thought to influence the levels of individual variables rather than vice versa. Influence assymetry is viewed as the way in which organizational policies and characteristics influence the individual members. It is posited that the total influence of institutional policies and characteristics on an individual at the operational level (e.g., a faculty member) is greater than the influence of a single individual on the total set of institutional policies and characteristics. It is, of course, individual members who make up policies which result in such things as offering a Ph.D. degree, or centralization. Once the policy, practice, or characteristic is in place, however, it constitutes an existing condition of potential consequence to individual behavior. Thus, offering a Ph.D. degree probably attracts and keeps faculty members interested in research, and thus affects the level of the research goals for individual members of that organization. An individual, however, can have no personal goals for research without affecting the fact that the organization offers the degree. An individual can leave an organization without affecting its policies, but if a policy is terminated, it is of potential consequence to all members of the organization. Thus, it is assumed that the influence of the organizational variables on the individual variables is asymmetrical rather than reciprocal. The relationship between the individual variables can be unequivocably prior to individual research productivity when measures of the individual variables precede (temporal assymetry) the measurement of the dependent variable.

The model indicates that organizational factors affect individual behavior which result in a faculty member being more or less productive in the area of research. A heirarchical structure developed by Payne and Pugh (in Payne and Astin, 1976) was initially included so that organizational characteristics would influence deparmental characteristics, then work group characteristics, then individual factors which would eventually influence the levels of individual research productivity. The model became hopelessly filled with reciprocal relationships. It was then reduced to include only organizational and individual factors expected to influence the criterion. These relationships are discussed in the propositions below.

The Propositions

Causal models should contain determinants of a dependent variable, and not correlates. Determinants are analytical variables which are believed to produce variations in a dependent variable. (The discussion in this paragraph follows Price, 1977.) Correlates vary with a dependent variable but do not indicate the means by why they produce these variations. For example, at a research university men may produce more research articles than women. Gender, however, is not an explanation of why this occurs. When one finds that women have heavier teaching loads in undergraduate courses, and that the vast majority of full professors are men, then some of the reasons why men produce more research articles than women become apparent. Correlates do not provide explanation, although they may increase prediction. It is primarily exlanation and not prediction which is the

purpose of causal models.

The statements used to form a causal model are propositions. Propositions contain a determinant and the dependent variable, and indicate the direction (positive or negative) of the presumed effect. For example, "successively higher levels of research emphasis will likely produce sucessively higher levels of individual research productivity." These propositions are probalistic rather than deterministic (e.g., "likely"). The effects of the determinants are assumed to be additive and linear, except where noted. In the discussions of each proposition, the rationale for the effect of the determinant is supposed to affect productivity. It is a customary assumption that each proposition is qualified by the phrase "other things being equal" (Price, 1977). This condition is assumed but not stated for the propositions presented here.

1. Institutions which have successively higher levels of research emphasis are likely to have successively higher levels of individual research productivity. Research emphasis is defined as the use of research criteria in promotion and tenure. Research emphasis was found to be an important predictor of institutional research productivity in Blau (1973) and Fulton and Trow (1974). This factor could be expected to attract researchers to an institution, and eliminate faculty members who failed to produce research, increasing the likelihood that those who remain are productive researchers. The factor is expected to work primarily through increasing an individual's research goals.

2. Institutions which have successively higher levels of reputation are likely to have successively higher levels of individual research productivity. Again, chief support for this proposition comes from Blau (1973), with further support from Blackburn, et. al. (1978), and Long (1978). Blau found that the higher the number of received college choices by semifinalists and recipients of letters of commendation from the National Merit Scholarship program divided by the number of freshmen admitted, the higher the level of research productivity for the institution. It is assumed that much of an institutions reputation is because of the past research productivity of the faculty. To the extent that past behavior influences future behavior, institutions with high reputations should have individual faculty members who will continue to be productive. The variable may also work to attract individuals with high levels of research goals. By drawing large numbers of people with research interests together, the variable might also be expected to influence the number of research colleagues one had.

3. Institutions which offer successfully higher degrees will likely have successfully higher levels of individual research productivity. This proposition is based on the common finding that universities (e.g., Ph.D. granting institutions) consistently have higher levels of research output than other types of institutions (see Table 1). It may be deduced, then, that an individual faculty member will be more likely to be a productive researcher at this type of institution. It is expected that this variable acts through three intervening variables. First, Ph.D. granting institutions are more likely to attract and keep faculty members with

high levels of research goals than other institutions. Second, due to the research interests of the faculty attracted and kept in Ph.D. granting institutions, individual faculty members are more likely to have research colleagues (as opposed to simply colleagues). Finally, degree level is expected to influence individual research productivity by reducing undergraduate teaching loads. This reduction occurs because graduate students teach some undergraduate courses, because graduate courses are taught in place of undergraduate courses, and because there are generally lighter teaching loads in research universities than in other four- or two-year colleges.

4. Successively larger institutions are likely to have individuals with successively higher levels of research productivity. Size is defined as the number of full and part time faculty employed at the institution. Although Blau (1973) found size correlated fairly highly with average faculty research productivity (.57), size was not a significant predictor of productivity when controlling for such things as institutional type and research emphasis. Price (1968) cited studies which indicated that size reduced effectiveness in professional organizations with the exception of large public universities. Although size is not expected to have direct effects on individual research productivity, size would be expected to have a direct positive effect on the number of research colleagues one has at an intitution. Also size would be expected to influence the research resources available to the researcher. This is both because there are likely to be more books and periodicals in the libraries of large institutions, and also because other members of a research group could be expected to have research materials

and techniques which the individual could use in research.

5. Institutions with successively higher levels of affluence will likely have individual faculty members with successively higher levels of research productivity. Affluence, is defined as the total institutional budget divided by the total, headcount of the students enrolled. Again, Blau (1973) did not find affluence significantly affected average faculty research productivity while controlling for other factors, despite the high zero-order correlation. It is expected that affluence would have two indirect effects on individual research productivity. The first would be through research resources, where the more affluent the institution, the more resources could be allocated to research functions. This should in turn increase the level of individual research productivity. Second, affluence would be expected to increase the perception that rewards are distributed equitably in the institution. To the extent that equity of rewards motivates individuals to produce, individuals have been found to have a greater tolerance for over-reward then under-reward (Adams, 1963). Hence, affluence would be expected to reduce feelings of inequity.

6. Institutions which have sucessively higher levels of centralization would likely have successively lower levels of individual research productivity. Centralization is defined as the degree to which decision making is concentrated in a social system (Price, 1977). Where there is a high degree of centralization in an organization, most individuals have less power to direct their activities. Perceived loss of power to direct one's activities constitutes a state of alienation. The

more centralized the organization, the more likely its members are to be alienated. Although centralization is viewed as increasing effectiveness for most organizations, its effect is opposite in professional organizations (Price, 1968). It is believed that the loss of control over one's activities reduces the probability that an individual researcher will be productive. Centralization is seen to reduce productivity by increasing alienation. Centralization may also be expected to reduce the perceived equity of rewards. This would likely occur because "collegial decision making" is inversely proportional to administrative decision making. It is assumed that faculty members would feel more equity if peers instead of administrators made decisions about such things as faculty evaluations which result in promotion, salary increases, and tenure. Blau (1973) reported that administrative decision making was negatively related to research productivity.

7. Institutions with a high degree of autonomy are more likely to have higher levels of individual research productivity than institutions with a low degree of autonomy. Autonomy is defined as the degree to which a social system has freedom to make decisions with respect to its environment (Selznick, 1953). In the case of academic institutions, a campus which is relatively free from board, system, or legislative control would be considered as autonomous. Support for this proposition in higher education comes from Clark (1960). Control in this instance relates to decisions about budgetary priorities and the recruitment, selection and promotion of faculty. Autonomy is expected to operate through two intervening variables in influencing individual research productivity. First, in an

autonomous organization faculty are less likely to feel alienated than in an organization lacking autonomy. The potential for influencing decisions is low where policies are set outside of the institution. Second, it is suspected that the legitimacy of research is highest at institutions which have the highest degree of autonomy. This situation is expected partly because research benefits tend to be unpredictable and/or long term, and thus are of less use than, for instance, student credit hour production, in a politically charged environment which demands accountability for the use of resources.

8. Successively higher levels of research goals are likely to lead to successively higher levels of research productivity. Research goals are defined as the perceived desirability of engaging in research. This variable differs from intent to do research which, according to other studies of intentions (Ajzen and Fishbein, 1980) would probably increase the predictive power of the model, but would not explain why people intended to engage in research. Blackburn, et. al. (1978) found that a "preference for research" was one of the three best predictors of faculty research productivity. It is assumed that preference for research and research goals are similar to one another. The underlying assumption is that people are more likely to pursue goals they set for themselves than other goals.

9. Successively higher numbers of research colleagues will likely lead to sucessively higher levels of individual research productivity. Research colleagues are those people with whom one collaborates on research projects or with whom one discusses their research. The variable is similar to the Blackburn, et.

al. (1978) variable of "communication with scholars at other institutions" which correlated highly with research productivity. The assumption here is that if one is able to communicate with scholars "in house" that this would be even more valuable in influencing research. Also, it is from research colleagues that mentors for young researchers would be drawn. Research colleagues are assumed to form the "work group" which Aston and Pugh (in Payne and Aston, 1976) have identified as being highly influential on individual behavior. This variable may not have important effects beyond a certain level when a "critical mass" is achieved (Gallant and Prother, 1972). If one, however, has no or only one colleague, the negative effects may be more dramatic. This variable may also depend on a persons field of study. In fields where collaboration is common (e.g., astronomy) the variable may be more important than in history where collaboration is less common. Finally, it is research colleagues who may be considered one of the most important factors in creating the work environment for faculty. Work environments clearly affect productivity levels (Blackburn, et. al., 1978).

10. Successively higher levels of undergradute teaching responsibilities will likely lead to successively lower levels of individual research productivity. Undergraduate teaching responsibilities are a function both of the number of preparations required of a faculty member, and the number of students enrolled in his or here classes. The negative influence of undergraduate teaching responsibilities on research productivity is based on a hydraulic model of time. If one is devoting more time to undergraduate teaching, they will have less

time to spend on research. The studies by Blackburn, et. al. (1978) and Astin (1978) both support this proposition.

11. Successively higher levels of research resources will likely lead to successively higher levels of individual research productivity. Research resources are defined as those resources which the individual perceives as being necessary to carry out his or her research program. This proposition is supported by Payne and Pugh (in Pugh and Aston, 1976) for organizations in general and by Allison and Stewart (1974) and Crane (1965) for faculty members. One may also deduce that if faculty members need (or believe that they need) a piece of equipment or set of books in order to do research, they are more likely to produce this research if they have these resources than if they do not.

12. Successively higher levels of perceived equity of rewards will likely lead to successively higher levels of individual research productivity. Equity is defined as an individuals perception of the ratio of their organizational inputs to outcomes as compared with others (Adams, 1963). In this instance, only conditions of perceived negative inequities (e.g. underpayment) would be considered as inequitable. When one perceives that their outcomes (e.g., salary, rank, perquisites) are too low for their inputs (abilities, education, effort) compared to others, they feel frustrated, and would be expected to lower their productivity. Perceptions of inequity affect productivity by decreasing one's motivation to work (Szilagyi and Wallace, 1980) and in this fashion reduce productivity. This variable has not previously been studied in relation to faculty research productivity.

13. Successively higher levels of alienation will likely lead to successively lower levels of individual research productivity. Alienation is viewed as the loss of control over one's immediate work area, and increasing one's dependence and submissiveness (Argyris, 1973). Thus alienation can be considered as powerlessness in one's organizational context. One study of productivity among professionals supports this proposition (Meltzer, 1956). It is the nature of research, its unpredictability, and the new research problems on-going research generates that make the autonomy of the researcher almost manditory. With an increase in alienation, and the implicit loss of power to direct one's work, it is expected that research productivity would suffer.

14. Individuals who perceive a high degree of legitimacy in their research are more likely to be productive researchers than individuals who perceive a low level of legitimacy in their research. Legitimacy is the degree to which behavior is socially approved (Lipset, 1960). Illegitimate research is identified regularly by Senator Proxmire of Wisconsin who gives "Golden Fleece" awards to research which he deems illegitimate. It is expected that public pressure intimidates some researchers reducing their productivity. Legitimacy may also influence research productivity by increasing the level of resources available for pursuing certain types of research (e.g., research on cancer). In this case, however, it is actual as opposed to perceived legitimacy which is influencing research productivity.

15. Successively higher levels of expectancies will likely lead to successively higher levels of individual research

productivity. Two types of expectancies are thought to operate here. The first is the expectancy that one's effort (e.g., energy expended on research) will lead to a particular performance (e.g., writing a publishable article). The second expectancy is that performance (e.g., writing a publishable article) will lead to some outcome (e.g., increased salary, promotion, etc.). Szilagyi and Wallace (1980) report that research studies consistently report a positive relationship between these expectancies and productivity. It is assumed that faculty who perceive that they are able to conduct publishable research, and who believe that their research positively influences the level of outcomes from their work, are more likely to be productive reearchers than if this were not the case.

16. Successively higher levels of need for personal growth will likely lead to successively higher levels of individual research productivity. Personal growth is defined as the development of new skills, understandings or knowledge. This definition is consistent with Maslow's (1954) defirition of self-actualization and Alderfer's (1972) definition of growth. The need for growth is part of an individual's motivation system. It is assumed that being a productive researcher would in part satisfy that need. Thus, the higher the need, the greater the probability that the individual will be a productive researcher.

17. Successively higher levels of publication in graduate school will likely lead to successively higher levels of individual research productivity. Publication in graduate school here is considered publishing, either singly or in collaboration

with others, research articles before completing one's terminal degree. This is the beginning of what many researchers (Allison and Stewart, 1974; Long, Allison and McGinnis, 1979; Clemente, 1973; Blackburn, et. al., 1978) have identified as a dichotomy among the faculty between producers or non-producers. Producers begin early, even in graduate school, and continue to produce at a high level throughout their careers. Non-producers remain non-productive--they do not improve with age.

18. Under the condition that an individual is initially productive, successively longer periods of time as a faculty member will lead to successively higher levels of research productivity. The rationale for this proposition is similar to the last. The underlying basis for this proposition is that past behavior is an indicator of future behavior (Bentler and Speckart, 1977). Thus, if an individual is productive initially, they will continue to be productive. Productivity does not have a linear relationship with age (Blackburn, et. al., 1978) but appears to increase steadily during the first fifteen years of a career (e.g., 29 to 45) after which period the trend flattens out. Productive people, however, continue to be productive--neither tenure nor age sharply reduces their output.

19. At an institution with a research emphasis, successively higher ranks lead to sucessively higher levels of individual research productivity. Ranks are considered lecturer, instructor, and assistant, associate and full professors. This proposition is supported by studies by Blackburn, et. al. (1978), Fulton and Trow (1974), and Astin (1978). It is believed that rank may affect productivity little at institutions where

research is not an important criteria for promotion or tenure. Thus, the proposition reflects an assumed interaction between institutional type and rank. Rank at institutions with a research emphasis indicates past research productivity which can be expected to influence future levels of research productivity. The influence on productivity of rank increased due to longevity, or teaching, or service would be eliminated.

20. For individuals with higher levels of research goals, successively higher levels of individual autonomy are likely to have successively higher levels of individual research productivity. Individual autonomy here is considered the inverse of alienation. Where individual autonomy exists, individuals control their immediate work area, are independent, and are not submissive. Individual autonomy is assumed to influence individual research productivity only when one's research goals are high. Thus, given the opportunity, individuals with high levels of research goals will pursue those goals, increasing their research productivity.

Excluded Variables

Specification error, that is, including variables which do not affect the criterion and excluding those that do, is an on-going problem in developing causal models. Several variables have received mixed support in empirical studies, and are not included in the model developed here.

Ability. There is little doubt that researchers of high ability produce more than researchers of little or no ability.

(They may not produce the most, however, a position reserved for those who place quantity about quality.) Ability was not included in the model for several reasons. First, if one is talking about general ability (e.g., intelligence) one would not expect too wide a variance when drawing a sample from a single occupational group. Second, I.Q. tests may not be apropriate for testing "creative" thinking required in much research. Third, general ability might not reflect research ability, but if research ability (as indicated by past research) is taken as a measure of ability, the independent and dependent variables begin to coincide. It is due to the difficulties of measurement that ability was excluded.

Sex. It is apparent that men, in the aggregate, produce more research than women. Sex, however, is a correlate of research and not included in the model. The reasons why men produce more have more to with the positions men hold and the types of tasks expected of them rather than their gender. To quote Blackburn, et. al.:

> It was found that women are less interested in research, generally graduate from less prestigious institutions, work in less prestigious schools (especially in four-year colleges in contrast to research oriented universities), more often are untenured, hold lower rank, teach undergraduate courses, and are more often found in the humanities and less often in the natural sciences. In constrast, exactly the opposite characteristics most often correlate with high productivity. (1978, p. 138)

They go on to say that the reasons for this situation seem to be one or more types of discrimination.

Mentors. Several studies (e.g., Long, 1978; Long, et. al., 1979) have indicated that research mentors influence an individual's later research productivity. The findings are inconclusive, although they tend to be positive. One reason for excluding mentor influences is that outside of the sciences, there is no reliable way to get information on how productive a mentor was without prohibitive cost. Also, it is assumed that a researcher's current environment (e.g., institutional prestige and number of research colleagues) plays a more important role in determining research productivity then does mentor productivity.

Field. It has been well demonstrated (see Table 1) that researchers in different disciplines publish at different rates, and also use different formats to present their findings (Creswell and Bean, 1980). Since combining different fields raises questions about the validity of the criterion variable, it is suggeted that initial studies concentrate on single fields. Thus, the variable is held constant, reducing possible confounding elements (Kerlinger, 1973) as well as simplifying the interpretation of the findings.

Career Stage. Individuals undoubtedly change as they progress through their careers. For some, a typical career might be divided into an initial flurry of activity as one carves out a niche in the field. After feeling that one is established, the person may explore new research or teaching areas or take a foray into adminstration or consulting, and on top of this pass through a midlife crisis. Towards the end of one's career, they may become more reflective, writing fewer but more thoughtful pieces. Researchers interested in productivity should beware of the

confounding influence of career (or even life) stage in identifying those factors which are thought to influence research productivity. Factors important at one career stage may be of little importance at another.

Prestige. Two types of prestige, that of the department from which the individual comes, and the department to which the individual is currently attached, were not included as determinants. It is assumed that the prestige of the department from which an individual comes is less important than the department in which the individual is currently working. Departmental prestige, it is assumed, is a function of institutional prestige and vice versa. Due to this reciprocal relationship, departmental prestige was not included in the model. Another problem with prestige is its measure. The obvious measure is the level of research productivity of the department. Individual research productivity and departmental research productivity are inextricably linked. For these reasons, only institutional reputation among students was used as a measure of prestige.

Conclusion

It is not expected that this paper will solve the many riddles of faculty research productivity. It is hoped that it may have clarified some of the relationships among the various factors believed to influence the various levels of individual research productivity. The problem of finding a satisfactory measure of research productivity remains, however, and until such

an indicator is found, empirical studies may not meet with widespread acceptance.

The model stands in need of revision based on empirical studies. Through such research the model can undoubtedly be improved. In considering the difficulty involved in modeling any phenomena, a quote from Blalock seems appropriate:

> Tests of the theories in these instance will involve empirical tests of the derived theorems. Clearly, if the theorems prove false the theory must be modified or the axioms of the theory even abandoned. But if they are true, one cannot claim that the theory has been "verified" unless all possible competing alternatives can be rejected. In the case of causal theories, it will always be possible to state alternative explanations by the simple device of introducing additional variables. Where one allows for meauremnt error, a second kind of alternative explanation can always involve the possibility that results might have been different had there been no such measurement error. Therefore, we shall be in the unfortunate situation of having to proceed by eliminating inadequate theories, rather than ever really establishing any of them. (1969, pp. 11-12).

Thus, it is primarily as a hueristic device useful in guiding future research that the model developed in this paper is potentially of value.

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TABLE 1. EMPIRICAL STUDIES OF FACULTY RESEARCH PRODUCTIVITY

AUTHOR(S)	DATE	SUBJECTS	DEPENDENT VARIABLE	VARIABLES INFLUENCING RESEARCH PRODUCTIVITY*
Allison, Stewart	1974	1947 biologists, math.	5 yr pub all citations	Yrs in hi. ed. x initial prod., research resources
Astin	1969	1547 women PhDs at 108 insts.	3 or more publications	Field, quality of PhD granting inst.
Astin	1978	1800 women and 2041 men PhDs at at 301 insts.	Published books and articles (3 levels)	Field, rank, men, undergraduate teaching(-)
Blackburn Behymer, Hall	1978	7484 faculty national sample 4 yr institutions	Fac self-rept. total articles and books	Degree level, prestige, research goals communication with other scholars, early career pubs., rank, undergrad. teaching(-), field, research colleagues, size
Blackburn Havighurst	1979	74 social scientists	Publications	Degree level, research colleagues, PhD at an early age, yrs in hi. ed. x initial prod., centralization
Blau	1973	2577 faculty at 115 four-year insts.	Average pubs. of faculty per inst. (books=5, articles=1)	Degree level, reputation, research emphasis, centralization(-), size, affluence
Cameron, Blackburn	1981	95 Eng, psych or soc PhDs at 9 midwest insts	3 yr pub rate-Degree level Grants rec'd--Degree level Collaboration-Early collaboration Prof. network-Men	

TABLE 1, CONT'D

AUTHOR(S)	DATE	SUBJECTS	DEPENDENT VARIABLE	VARIABLES INFLUENCING RESEARCH PRODUCTIVITY*
Clemente	1973	2205 PhDs in sociology	Weighted books, articles	Yrs in hi. ed. x initial res. prod., early res. interest
Cole, Cole	1973	120 physicists	3 or more articles	Yrs in hi. ed. x initial prod.
Crane	1965	150 bio., poly sci., psych	Weighted publications	Field, resources, quality of PhD granting inst., degree level
Folger, Astin, Bayer	1970	20,935 PhDs in science, math, psych.	Bibliographic counts, citations, peer ratings	Field, degree level quality of PhD granting inst.
Fulton, Trow	1974	60,028 faculty at 303 institutions	Professional writings for past 2 years plus current projects	Rank, degree level, field, research emphasis
Long	1978	181 male biochemists	Publications citations	Prestige
Long, Allison, McGinnis	1979	239 male PhD biochemists	Publications, citations	Pre-PhD publications PhD origins, dept. size, prestige

* Influence is positive unless indicated by (-).

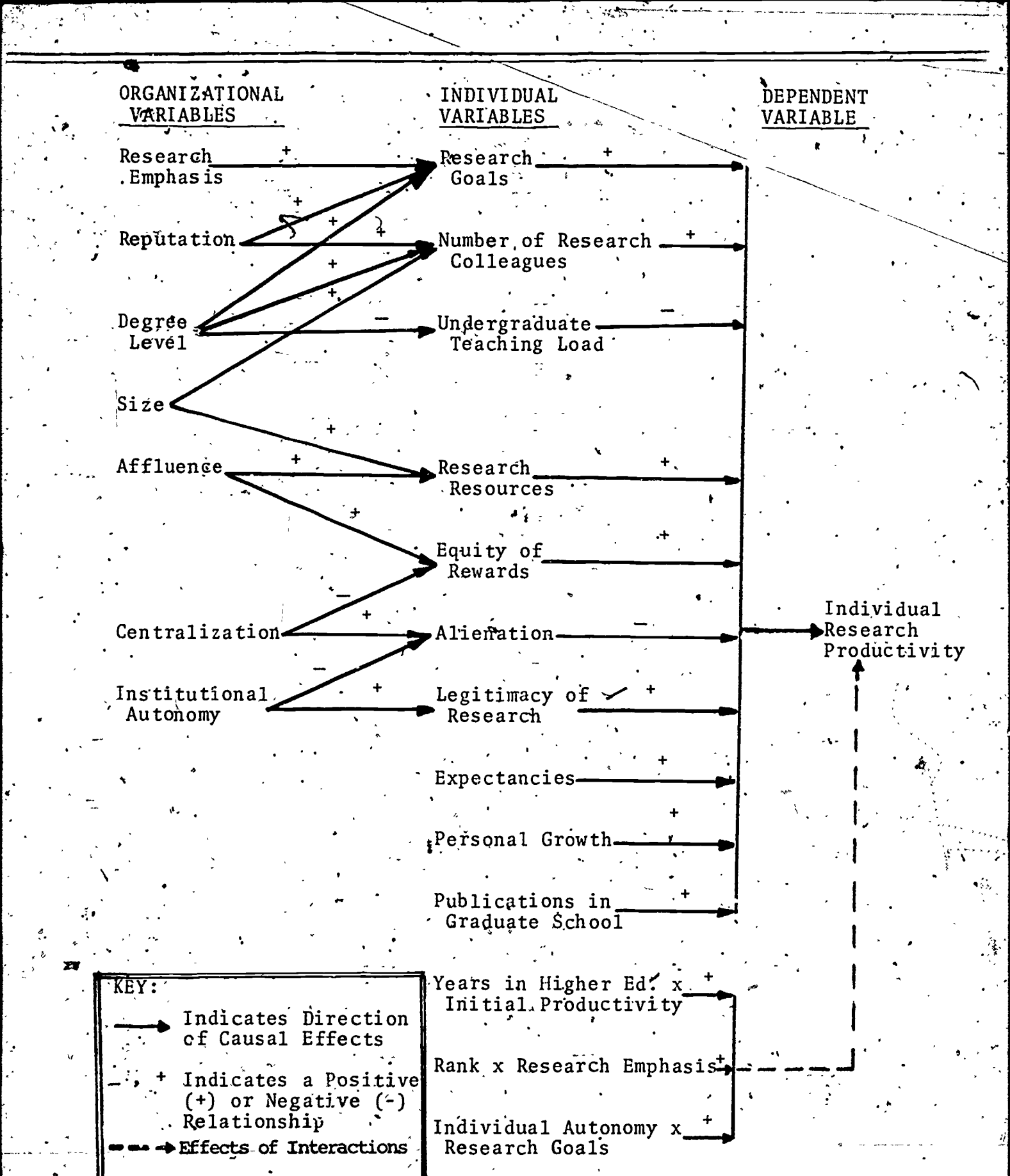

Figure 1. A Causal Model of Faculty Research Productivity