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Theory Testing in Organizational Behavior: The Varient Approach

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PREFACE

In this book we present and illustrate a framework or paradigm for use in attempting to investigate why and how human beings function in organizations. The paradigm provides a way to (1) formulate theories, (2) analyze data, and (3) align theory and data so as to (4) encourage theory testing by a comparison of competing alternative hypotheses. Standard approaches to testing theories (such as tests of statistical significance) are integrated and used in the paradigm. Additional tests are developed that permit empirical assessments of theoretical assertions about (1) networks of variables (performance, satisfaction, and climate) and (2) multiple entities and levels of analysis such as persons, dyads, groups, and collectivities. Because ***variables*** and ***entities*** are integral components of the framework, a new term—***varient***—is used to characterize the paradigm.

The varient paradigm can be employed with variables and levels of analysis that are typically of interest in organizational behavior and the social sciences. Specifically, the levels of analysis discussed in this book are often of interest in psychological, social psychological, and sociological approaches to organizational analysis. When the paradigm is used, the theoretical and empirical significance of all or some of these levels of analysis can be evaluated. In addition, theoretical and empirical distinctions can be made between the different types of contingent and noncontingent formulations of variables that are often of interest in disciplinary and interdisciplinary work.

Individuals who are interested in theoretical work will find a framework for organizing, comparing, contrasting, and generating theories that specify variables and entities. The illustrations of how to formulate theories have implications for theories of personality, leadership, dyads, informal work groups, and professional and organizational subsystems, as well as for the theoretical constructs of roles and exchanges. When theories are formulated with the use of the paradigm, they are automatically testable with data.

The book addresses empirical work through within and between analysis (WABA). This analytical procedure is based on mathematical theory and provides a way to reduce data to a set of key empirical indicators compatible with widely used contemporary approaches to data analysis, such as univariate and multivariate analyses of variance and correlational analysis. An advantage of the varient paradigm is that it permits inferences to be drawn about the entities and levels of analysis which may underlie obtained empirical relationships between variables. Moreover, when within and between analysis is used as specified in the paradigm, data are automatically aligned with theory-based hypotheses.

Individuals who carry out both theoretical and empirical work are offered a method for choosing among multiple hypotheses about one set of variables and entities; thus, a complete inferential system for drawing conclusions about theory and data is presented.

Essentially, this book provides an explication of how theories are formulated (Part II), how data are analyzed (Part III), and how conclusions are drawn about theory and data (Parts IV and V), based on the basic "varient" concepts presented in the first part of the book. For readers with limited exposure to this type of work, a detailed theoretical and data analytic inferential system is presented and illustrated. For more experienced readers, the varient paradigm, building on traditional approaches, provides an alternative means for the consideration of multiple variables and levels of analysis in theory formulation and data examination. The book is not, however, intended to be all things to all people. Rather, by extending the usefulness of specific and widely used contemporary approaches, it presents the integrated varient method for engaging in the research process.

Individuals who wish to draw conclusions about theory and data in this way will be interested in the FORTRAN and SPSS computer programs described in the appendix to the book. In addition, the computer program and user's manual we employ in this work can be obtained by writing to Fred Dansereau, SUNY at Buffalo, 212 Crosby Hall, Buffalo, New York 14214. Individuals who teach others about theory testing can obtain an instructor's manual from Prentice-Hall.

Throughout this book, various applications of the paradigm are illustrated with data collected from employees of a metal extraction company. We wish to express our appreciation to these individuals for their willingness to respond to in-depth interviews and lengthy questionnaires and hope they found our feedback sessions about multiple levels of analysis in their setting useful in building a better organization.

A number of colleagues have made intellectual contributions to the development of the varient paradigm since we began this work in 1976. Specifically, Steven Markham at Virginia Polytechnic Institute and State University, Thomas Naughton at Wayne State University, and Sidney Nachman at New York University provided insights at various stages in the development of the paradigm. G. Chandrasekaran at the State University of New York at Buffalo was particularly important in the development of a FORTRAN program for within and between analysis, as well as for assisting in the development of a proof for linking the analysis of variance with bivariate correlations.

In addition, portions of the paradigm have been presented at professional meetings and in books, journals, and doctoral dissertations. The responses of the participants in these meetings and of reviewers, as well as those of our colleagues at Buffalo, served to focus our thoughts and reinforce the view that our approach is very compatible with contemporary and traditional work. We are grateful to those colleagues at the State University of New York at Buffalo School of Management who have helped create a climate in which the free exchange and challenge of ideas is commonplace. We would also like to thank various individuals who read versions of the manuscript at different points in its development for their insights and criticisms, as well as the reviewers of our manuscript. These include Professors Nealia Bruning (Kent State University), G. Chandrasekaran (SUNY at Buffalo), Peter Dubno (New York University), Janet Dukerich (University of Minnesota), Robert House (University of Toronto), Jerry Hunt (Texas Tech), Frank Krzystofiak (SUNY at Buffalo), Steven Markham (Virginia Polytechnic Institute and State University), George Milkovich (Cornell University), Ian Miners (University of Toledo), Michael Moore (Michigan State University), Thomas Naughton (Wayne State University), Eric Nielsen (Case Western University), Jerry Newman (SUNY at Buffalo), Saroj Parasuraman (Drexel University), Denise Rosseau (Northwestern University), John Slocum (Southern Methodist University), William Snavely (Miami University), Barry Staw (University of California, Berkeley), Donald Vredenburgh (Baruch College, City University of New York).

We owe a special debt to Sabina Schneider, who was able to quickly transform numerous handwritten (scribbled) versions of text and tables into clear, typewritten manuscript. After all these years, Sabina could probably retype this book from memory. Irene Forster's and Debra Kiel's expert typing and supervisory skills and the outstanding editing ability of Nola Healy Lynch greatly facilitated the completion of this project. In the final stages of the project James Bergantz, Daniel Coleman, Sanford Ehrlich, and Mark Lawton helped with various tasks. In addition, a number of typists worked diligently to help us complete the manuscript in a timely fashion. These include Elaine Csont, Linda Lucas, Mary Guadagna and Joan Mahoney.

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Fred Dansereau
Joseph A. Alutto
Francis J. Yammarino

CONTENTS

INTRODUCTION

This book can be used in formulating and testing theoretical assertions about variables (performance, satisfaction, and climate) and entities at any level of analysis (persons, dyads, groups, collectivities). For example, a theorist may have a hunch and therefore hypothesize that a particular variable (such as leadership) refers to entities at one level of analysis (such as persons). The *varient* approach to variables and entities presented in this book allows an individual to test such an assertion with data. Empirical results may be in line with a theorist's hunch, or the variable may be associated with a different level of analysis (such as leader-follower dyads) than originally hypothesized. The idea that one should allow for the disproof of hypotheses is compatible with approaches in the physical sciences and is, of course, the key to theory testing —unless a theory can fail by being replaced by another theory, it is untestable. To incorporate into our field the excitement and fun of not knowing before data analysis which of several theories (if any) will be supported, we created a paradigm.

As suggested by Masterman (1970) the term paradigm has been defined in a number of ways. We define a **paradigm** as a cognitive framework that can serve to initiate and guide scientific investigation (Barrett, 1972; Behling, 1978; Roberts, Hulin, and Rosseau, 1978) through multiple-hypothesis generation and testing (McGuire, 1973). To call an approach a paradigm, we require that a cognitive framework must be specified; it must be possible to use the framework to formulate theories and analyze data in such a way that theoretical formulations and data analytic techniques are aligned and an inferential system for drawing conclusions about theory and data must be specified. In addition, we require the inferential system specified in a paradigm to be compatible with the approach used in the physical sciences to test hypotheses. Specifically, a hypothesis of interest should be viewed as passing a critical test when it is not replaced by an alternative hypothesis, and as failing when it can justifiably be replaced by a competing hypothesis. A classic example of this testing process can be found in physics, where Newton's theories were replaced by Einstein's.

We believe the varient approach satisfies the requirements of a paradigm because: A basic cognitive (varient) framework is presented in Chapters 1 and 2; the way in which theories are formulated when the paradigm is used is presented in Chapters 3 and 4; data analytic techniques and theoretical formulations are aligned as presented in Chapters 5 to 7; and an inferential system is summarized and illustrated in Chapters 8 to 15. The varient approach also incorporates the physical science approach to theory or hypothesis testing. As an illustration, consider two substantive hypotheses about three variables and two levels of analysis. One hypothesis may include an assertion that two of the variables are related, independent of a third variable, and applicable to groups but not collectivities. An alternative hypothesis may include an assertion that these three variables are all related and that they are applicable only to collectivities. The first, or group, hypothesis suggests that multiple interpersonal processes underlie the three variables and their relationship. The second, or collectivity, hypothesis suggests that collectivized or large-scale social movements, rather than small-group processes, may underlie variables and relationships. The varient paradigm can be used to formulate these two theories in such a way that an empirical analysis can be performed to test the probable validity of each competing hypothesis.

The following four analytical procedures comprise the varient paradigm:

1. Single-level analysis
2. Multiple-level analysis
3. Multiple-variable analysis
4. Multiple-relationship analysis

Single- and multiple-level analyses are used to specify and test assertions about entities. Multiple-variable and multiple-relationship analyses are used to identify and test assertions about variables. These four analytical perspectives on variables and levels of analysis are considered in every chapter of this book. Thus the entire book has been used as a vehicle for presenting and illustrating the varient paradigm. Our point of departure in Chapter 1 is, of course, traditional and contemporary approaches to theory testing, since these approaches are the basis of the varient paradigm.

1

TRADITIONAL APPROACHES AND THE VARIENT PARADIGM

Most contemporary theories in organizational behavior and the social sciences either implicitly or explicitly include an assertion of (1) the relationships among variables and (2) the entities, and therefore levels of analysis, to which the variables apply. Whether about personal feelings, group level phenomena such as leadership, or organizational attributes such as climate or technology, **theories** and **hypotheses** include assertions about both variables and types of entities. This characteristic of theories is usually mentioned in writings that attempt to define theory-building processes (Blalock, 1969; Dubin, 1976; Miller, 1978). However, problems do remain in contemporary approaches designed to test theoretical assertions about variables, their relationships, and entities, and this chapter will demonstrate how the varient paradigm addresses many of these problems.

It has been suggested that current investigatory work might be viewed as using a complex set of assumptions and beliefs which are adopted during the research process (Bass, 1974; Bronfenbrenner, 1971; Cartwright, 1973; Myrdal, 1973). The ad hoc character of much research hardly ensures that assertions have been adequately tested in relation to alternative explanations. Indeed, some writers have gone as far as to suggest that there are no articulated paradigms in organizational behavior or in the social sciences in general (Barrett, 1972; Bass, 1974; Behling, 1978; Eckberg and Hill, 1979; Lindzey, 1978; McGuire, 1973; Meehl, 1967; Roberts et al., 1978; Van den Berghe, 1978; Watson, 1982; Ziman, 1978). For example, Watson (1982, p. 448) states: "Work done in the social and behavioral sciences is piecemeal, unsystematic, and lacking in consensuality. . . . The result is that social behavioral scientists work in small, disjointed areas employing idiosyncratic concepts and methods."

We believe, however, that at least one approach to theory testing is widely used. It is based on the multiple hypothesis testing approach used in the physical sciences (see Behling, 1980; Braithwaite, 1973; Chamberlin, 1890; Cohen and Nagel, 1934; Diesing, 1971; Dunnette, 1966; Fisher, 1973; Graen, 1976; Kaplan, 1964; Kuhn, 1970; Lerner, 1959; MacKenzie and House, 1978;

Meehl, 1967; Nagel, 1961; Platt, 1964, 1966; Popper, 1959; Staw, 1974; Staw and Ross, 1978). In **multiple hypothesis testing** at least two hypotheses are compared, and the hypothesis that is viewed as the more likely explanation for an outcome is adopted. The version of multiple hypothesis testing currently used in the social sciences and studies of organizational behavior involves tests of statistical significance. In these tests, a **substantive hypothesis** based on a theory of interest is evaluated by comparison against a statistically based **null hypothesis.** If a substantive hypothesis seems more likely than a null hypothesis, the substantive hypothesis passes the test and the results are viewed as **statistically significant.** When results of a study do not pass the test, and thus do not allow for the rejection of a statistical or null hypothesis, the inference is that the study has produced random results. The failure could be due to poor (for example, random) data, a poor theory, or both. In essence, these statistical procedures place a theory in only limited jeopardy. Consequently, for example, the American Psychological Association suggests in its guide to authors that results which allow for the rejection of statistical hypotheses are appropriate for publication, although substantive theories cannot be publicly rejected when only standard statistical procedures are used.

Because the statistical approach is widely used and seems to be based on multiple hypothesis testing, it is a starting point for evaluating theoretical assertions about variables and entities. A complementary approach is necessary, however, if there is interest in testing theories in such a way that a hypothesis can visibly fail through replacement by another substantive, rather than simply statistical, hypothesis. From this perspective, our objective is to develop an approach that permits preferred substantive hypotheses to be compared to competing substantive hypotheses — that is, the varient paradigm. Before we illustrate how this conceptualization can be first derived from traditional and contemporary work involving variables and entities and then integrated into a paradigm, the following review of the statistical approach to multiple hypothesis testing will demonstrate the need for an additional investigative paradigm.

A VARIENT APPROACH TO STATISTICS

Statement of the Problem

Tests of statistical significance are known to have limited usefulness. For example, Bolles (1962), Meehl (1967), and Rozeboom (1960) have attempted to draw attention to a distinction made by Fisher, a biologist and one of the pioneers in developing statistical theory, between the process of statistical hypothesis testing based on numbers and the testing of scientific hypotheses about variables and relationships. According to Fisher (1973), the statistical testing procedures were not designed to provide a basis for acceptance of theoretical or scientific hypotheses about variables and relationships; rather, they were designed to be used as a basis for rejection of statistical hypotheses about numbers. In a similar vein, as pointed out by Hays (1973, p. 415), "Any study can be made to show *significant* ($p \le 0.05$) *results if* one uses enough subjects, regardless of how nonsensical the content may be."[1]

A Varient Approach to the Problem

Our approach to these problems was to develop a set of tests of **practical significance** (see Part III) that parallel the traditional statistical tests but are not sensitive to increases in the number of subjects in a study. Although we use tests of statistical significance, we view these tests as inherently limited. To illustrate these limitations, it is helpful to view the statistical approach as a paradigm. If the approach is a paradigm, we should be able to identify the cognitive framework that underlies the approach and to show how it is used to formulate theories and analyze data in such a way that theoretical formulations and data analytic techniques are aligned into an inferential system.

Basis of the Cognitive Framework

The statistical paradigm can be found in virtually any basic statistics book. Although the paradigm was first used in biology (Fisher, 1925), its underlying cognitive framework is statistical in nature and is based on a general conceptualization of randomness commonly called a **normal distribution**. This conceptualization permits a large number of distributions to be generated from a general equation for a normal curve.

F, Z, t Distributions Specifically, various theoretical distributions, such as the $\hat{F}$, $\hat{Z}$, and $\hat{t}$, are deduced from the general normal conceptualization and a probability is associated with each value of the distributions, in this case $\hat{F}$, $\hat{Z}$, or $\hat{t}$. (The use of hats [^] indicates that these distributions are purely theoretical in nature and involve predicted values.) It is well known that the $\hat{F}$, $\hat{Z}$, and $\hat{t}$ distributions are similar. Although these indicators will be described in more detail in later chapters, a brief statement of their relationship may be helpful. $\hat{F} = \hat{t}^2$, and $\hat{Z}$ has been shown by Fisher to underlie the $\hat{F}$ distribution — indeed, Fisher labeled values for $\hat{F}$ as $\hat{Z}$ values. From a theoretical perspective, the paradigm aligns a variety of well-known mathematical indicators (such as correlations) with $\hat{F}$, $\hat{Z}$, and $\hat{t}$ values. By means of this alignment, a probability is then associated with all values that can be taken on by mathematical indicators.

In the paradigm, theoretical formulations (the $\hat{F}$, $\hat{Z}$, and $\hat{t}$ distributions) and data analytic indicators (expressed as F, Z, and t scores) are aligned so that any value for a particular mathematical indicator can be assigned a probability. For making inferences, these probabilities can be viewed as indicating the degree to which a statistical hypothesis is a likely explanation for an obtained value. If the probability is low in value (such as $p \le 0.05$), a statistical explanation is rejected. An illustration of a correlational problem the statistical paradigm attempts to solve may be helpful at this point.

[1] From *Statistics for the Social Sciences*, 2d ed., by William L. Hays. Copyright © 1973 by Holt, Rinehart and Winston, Inc. Reprinted by permission of Holt, Rinehart and Winston, CBS College Publishing.

Correlation It is quite common for a theory to specify that two variables are related. A **correlation** serves as a mathematical indicator of the degree of relationship between two sets of scores on two variables (X and Y) paired in the following fashion:

	X	Y
Pair one	1	1
Pair two	2	2

In this case, the scores on X are identical to the scores on Y for each pair, and the correlation takes on a value of 1. However, it is known that the value of a correlation is determined in part by the number of pairs of scores that are considered. Therefore, it is not appropriate simply to interpret a correlational value. In fact, every time a correlation is calculated based on two pairs of scores ($n = 2$), it has a magnitude of 1 and the probability of a statistical explanation is 1. But if an infinite number of pairs ($n = \infty$) of scores are examined, then by definition the number of pairs would not influence the value taken on by a correlation, and the probability of statistical explanation is 0. Between these two extremes, the number of pairs on which a correlation is based should have some influence on the values taken on by this indicator. Simply stated, the statistical paradigm offers a way of testing whether an obtained correlational value is due to what we call "statistical artifacts" (in this case, the number of pairs of scores on which it is based).

The notion of an ideal true or **population correlation** — which is a theoretical correlational value — is introduced in order to perform such tests. Assume that a correlation "really" or "truly" equals 0 (or some other value); then it can be asked what the probability is that the correlation will take on a value greater than 0 due solely to the number of pairs of scores. Given only two pairs of scores, the probability is 1 that a correlation will take on a magnitude of 1. Suppose, however, that three pairs of scores are considered, as in the following example:

	X	Y
Pair one	1	1
Pair two	2	2
Pair three	3	3

In this illustrative case, the correlation again equals 1. If it is assumed that the true correlation between these scores equals 0, what is the probability of obtaining this or any other value simply as a result of using three pairs of scores in calculating the correlation? This question is addressed in the statistical paradigm by generating a theoretical distribution of scores, in this case of $\hat{t}$ scores, based on the number of pairs of scores. Since every correlational value can be converted to an obtained t score (see Chapter 5), the probability of any correlational value given three pairs of scores is determined. This procedure is applied for any number of pairs of scores or, more generally, for any number of degrees of freedom.

The resulting probabilities can be interpreted as indicating the likelihood that various correlational values are due to the number of pairs of scores in the data. By convention, probabilities less than or equal to 0.05 are taken to indicate that a correlational value is not very likely to be explained by the number of pairs of scores on which the correlation is based. The result of applying these conventions and procedures can be illustrated from the following values presented by Guilford (1965, pp. 580–81):[2]

Pairs of Scores	Correlational Values Required at the 0.05 Level
3	0.997
5	0.878
12	0.576
202	0.138
502	0.088

How would one evaluate the case of three pairs of scores resulting in a correlation of 1? A correlational value of 1 is greater than 0.997 and is therefore viewed as unlikely ($p \leq 0.05$) to be simply a result of the number of pairs of scores used to calculate the correlation.

This example and the illustrative values from Guilford (1965) serve to indicate the cognitive structure that underlies the statistical paradigm. Essentially, as the number of pairs of scores or degrees of freedom increases, the magnitudes of the correlations required to be statistically significant decrease. As shown above, in a case with 502 pairs of scores, a correlational value of 0.088 would be statistically significant. Of course, given an infinite number of pairs of scores, any correlation that is not exactly 0 would be viewed as statistically significant. Consequently, as pointed out by Hays (1973), any set of results can be made statistically significant by increasing the number of scores included in a study. This is a logical and appropriate limitation inherent in the paradigm and one that affects any research relying on the statistical approach. Nevertheless, the statistical paradigm, as is apparent from its widespread use, provides a number of ways to formulate theory and analyze data such that theory and data analytic indicators are aligned into an inferential system.

Theory

In order for a researcher to use the statistical paradigm, a theory only need specify or provide a way to generate scores, which in turn can be reduced to values for an empirical indicator; a wide variety of variables is thus permitted when the paradigm is used. For example, variables with space-time metrics (height, width, depth, and time) are permitted in addition to variables with non-space-time metrics that reflect purely intellectual constructs (such as organizational climate). There are differing views about variables in the social sciences; for example, Ghiselli (1974) has indicated that many variables of interest in organizational behavior are intellectual constructs, whereas Miller (1978) has suggested that only variables with space-time metrics should be

[2] From *Fundamental Statistics in Psychology and Education*, by J. Guilford. Copyright © 1965 by McGraw-Hill. Used with the permission of the McGraw-Hill Book Company.