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3.2

Models, Hypotheses, and Theory

chapter fou

Sociological concepts—the abstractions from reality which we dis cussed in the previous chapter—should not exist as isolates. Rathe they are usually organized, with varying explicitness, into system of related concepts. These systems are meant to represent the sys tems of phenomena in which the sociologist is interested.

As we rummage through the literature of the social sciences, we inevitably encounter several such systems of concepts, often pre sented under different labels. For example, we might find a conceptual system referred to as a conceptual framework; or we might encounter a taxonomy, a model, or a theory.

It is possible to distinguish more or less subtle variations in meaning among these labels, not all of which are agreed upon. But they do have in common a reference to some systematic ar rangement of the various concepts utilized in a given scientific discipline such as sociology. We will briefly consider the function of such conceptual systematizations in science. However, first we must indicate some ground rules by way of indicating some distinctions among the several conceptual labels.

MODELS

Basically we will distinguish between a model and a theory, for these are the two expressions most frequently used to describe conceptual organizations. Put most simply, we may view a model as a likeness of something. *A model is an imitation or an abstraction from reality that is intended to order and to simplify our view of that reality while still capturing its essential characteristics.* Thus, for example, an engineer might have a model of a machine such as an aircraft. The aircraft model is a miniature reproduction of the real aircraft, including scale representation of some of the real airplane's features—its structure—while omitting other aspects, such as, perhaps, its control instruments and engine. The model aircraft might serve to physically and visibly represent the structure and features of the aircraft. Or more than that it might be used in place of the real machine in order to test certain structural features. For example, the engineer might subject his model to the effects of a wind tunnel—itself a model or simulation of the environmental condition—to determine how a genuine aircraft might perform.

This example is illustrative of the manner in which we normally conceive of a model. But a model need not be a three-dimensional structural imitation. Often, as is the case in sociology, a model will consist of symbols rather than of physical matter. That is, the characteristics of some phenomenon, including its variable components, and the relationships among these components, will be represented in the arrangements among the words or concepts agreed upon in a discipline.

Ideally, the relationships will have been deliberately and carefully specified. But sometimes this conceptual arrangement will in large part be implicit, with a number of concepts having become associated by disciplinary convention. These are often of a

descriptive nature such that the essential intention is to identify the characteristics of the phenomenon in question rather than to specify the relationships among variable components. In such instances we are dealing with models which at various times have been termed *taxonomies, conceptual frameworks,* or *typologies.* These are literally inventories of concepts relevant to some given phenomenon. They serve the function of pointing out distinctions among phenomena—identifying types. Thus, for example, Robert Redfield and others have listed several conceptual characteristics that distinguish "folk societies" from "modern" or "industrial societies" (Redfield, 1947). The former are small, simple, isolated, and homogeneous, with a slight division of labor, while the latter are large, complex, in frequent communication, heterogeneous, and so on. The characteristics of folk and urban societies are listed, without any explicit suggestion of the nature of the relationships among the several factors, but the rationale for their designation could suggest possible relationships.

Because models include some suggestion of explanatory relationships, we may speak of them as *explanation sketches* or *theory sketches* (Dumont and Wilson, 1967, 43–44). Such sketches suggest possible explanatory relationships among variables—possible relationships rather than verified relationships.

An example in our view, of a theory sketch in which the relationships are explicit rather than implied is Robert Merton's specification of the relationship between societally defined goals, societally defined means to the realization of these goals, and different forms of deviance, as indicated in Figure 4–1 (Merton, 1957).

Thus, dependent upon whether one accepts (+) or rejects (−)

Behavioral Types	Goals	Means
Conformist	+	+
Ritualist	−	+
Innovator	+	−
Retreatist	−	−
Revolutionist	− +	− +

FIG. 4–1. MERTON'S PARADIGM

the societally defined goals and means will depend the nature of one's response. The possibility of disparity between goals and means suggests an explanation for the behavioral types.

HYPOTHESES

Merton's model, in suggesting an explanation for the behavioral types identified, provides a source of hypotheses. *An explanatory hypothesis is an untested or unproven relationship among two or more variables.* Thus, for example, we might hypothesize that: "The higher the aspirations of students, the greater the incidence of cheating among students." Thus, a relationship is being suggested between two variables—aspiration levels and cheating behavior. These variables would of course have to be adequately defined and operationalized if the hypothesis were to be tested. But our interest here is in noting that this potential relationship is deduced from Merton's model. The model suggests that, in the context of some given social system, the acceptance of goals might lead to deviant behavior in pursuit of these goals if legitimate means are in some way inadequate. Logically, then, the greater the aspirations (that is, the more difficult or elaborate the goals), the greater the probability that the legitimate means may prove inadequate and illegitimate or deviant means might be employed. Thus a student who aspires to be a pharmacist, for example, might be more likely to cheat in school than students who aspire to be ditchdiggers.

The genesis of hypotheses is the more important function of a model. Models may organize our conceptual apparatus, but they also suggest relationships among these concepts and the phenomena the concepts represent. A model may also suggest descriptive hypotheses in the sense of expectations as to what phenomena a researcher might be expected to discover without any attempt to explain these phenomena.

For example, a researcher embarking upon a study of an agrar-

ian society in Africa would expect it to be homogeneous in ethnic and class composition and with a relatively simple division of labor, as suggested by Redfield's model of folk or rural social systems. The model suggests a descriptive hypothesis, thereby providing guidelines to research.

Earlier we discussed the manner in which various environmental influences might affect the selection of a research problem. Thus, for example, perhaps because it offends us morally, or perhaps because our employer defines it as wasteful, we might be interested in researching the causes of student cheating. This general research interest will be focused upon specific hunches or hypotheses on the basis of some prior information—information or speculation organized, in effect, in some model, whether this model be detailed, elaborate, or very vague and sparse. The model will serve to narrow down the research interest into a form amenable to investigation; to wit, hypotheses. Hypotheses, the necessary step in the design of any explanatory research, are thereby derived from preconceptions inherent in the scientific discipline. These internal preconceptions will guide research and suggest the kind of data to be collected, and to some extent, the meaning attached to these data, as indicated in Figure 4-2.

Models: Induction and Deduction

In science we often encounter the idealized distinction between induction and deduction. *Induction* has been taken to mean *the process of organizing isolated observations or facts into some set*

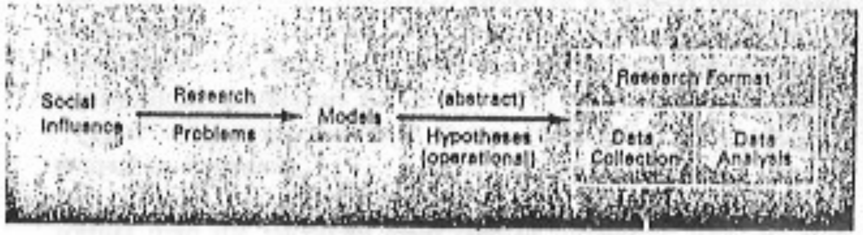

FIG. 4-2. THE SOCIAL DERIVATION OF A RESEARCH PROJECT

of ordered relationships, or generalizations. On the other hand, *deduction refers to the derivation of relationships which are unobserved from previously established generalizations.* Induction begins with a set of observations from which we infer higher order statements which seem to account for these observations, and thereby realize a plausible explanation of these observations. For example, we might have numerous observations which indicate that students who plan a professional career are more likely to cheat in school than are students aspiring to lower level occupations. These observations might suggest to us the more general statement that the higher the aspirations, the greater the probability of deviant behavior. This in turn might be recognized as a special case derivative of Merton's model dealing with means and goals. In short, the initial observations may eventually be explained by reference to a general model of which the observed phenomenon is a particular instance.

This is quite different from explanation achieved deductively. Previously we began with the Merton model and derived the hypothesis about student cheating. If the general model is valid, the hypothesis should be proved empirically correct. The hypothesis might be tested by comparing cheating behavior of professionally oriented and nonprofessionally oriented students. If there is empirical support for the hypothesis, we increase our confidence in the entire model relating goals, means, and deviant behavior. We have moved from the general, to the particular, and back to the general. When proceeding purely inductively, however, we move from the particular to the general. So doing, we will always have the illusion of explanation, since we are adding higher order statements in an ad hoc fashion. Deductive systems are therefore to be preferred because they derive previously unobserved relationships from systems of stated relationships; the unexamined relationships are literally deduced, and the deduction is *falsifiable.* Newman comments:

> There is no evidence . . . that a single scientific discovery ever was made by induction as conceived by Bacon. On the contrary it is quite clear that to engage in research without the stimulus and guidance of hypotheses, rules, preconceptions, anticipations, control criteria and the like is a hopeless if not indeed frivolous activity (Newman, 1961, Vol. 1, 91).

Rather than the Baconian ideal type of induction, what we find is a continual interaction between observations and the conceptual models of a science.

Thus, models serve a guiding and exploratory function. The relationships comprising the model, built up through cumulative observation and speculative logic, are relationships which might be profitably tested in the "real" world. The relationships of the model are hypotheses—sometimes stated in a general form meant to apply to a broad range of behavior, such as deviance in general rather than cheating in particular. Thus, the researcher can deduce testable relationships among variables from a conceptual model.

Generally it is the case that any model serves the inevitable role of reality filter. Because models are incomplete representations of reality, they inevitably are limiting factors in any science. As guides or lenses to scientific reality, models will lead the researcher to expect certain outcomes, to perceive certain things, and to fail to perceive other things. For example, Barber and Fox describe an instance in medical research in which two scientists perceiving the same phenomenon proceeded in different directions—the one discovering the "cause" of the phenomenon, and the other failing to even be interested in it (Barber and Fox, 1958). Models, therefore, typically become overviews of a science's subject matter. As such, there are related assumptions or beliefs that may result in the failure to isolate some specific relationship. Butterfield believes that this is what accounted for the persistence of Ptolemaic astronomy. As Butterfield writes: "The truth was that Ptolomy in ancient times had rejected the hypothesis of the movement of the earth, not because he had failed to consider it, but because it was impossible to make such a hypothesis square with Aristotelian physics. It was not until Aristotelian physics had been overthrown in other regions altogether that the hypothesis could make any serious headway . . ." (Butterfield, 1962, 45).

The thesis has been seriously advanced that any science proceeds in a dialectic fashion. At any given time, one model will dominate a scientific community. So long as that model is deemed satisfactory and research findings do not overwhelmingly refute its assumptions and specifications, it will persist. But as anomalous findings accumulate—data which do not fit the model—the point is eventually reached where the model is challenged and another substituted (Kuhn, 1962).

It is debatable whether we could view social science as progressing in this manner. Some might not agree that in sociology, for example, there is a model sufficiently dominant and broad that it governs the perceptions and the research of all or most sociologists. However, it would seem that we can discern indications of such a process through the history of sociology. The progressive refinement of the functionalist model of society as data became available from several societies was a process of response to unanticipated findings that failed to correspond to the statements and assumptions of the functionalist model. These prompted changes in the model in the manner that Merton suggests is an inevitable function of empirical research (Merton, 1948). Eventually, it may lead to the rejection of the model altogether.

A model, therefore, is an inevitable perceptual filter. It will shape research in a scientific discipline by governing the kinds of research questions which will be posed, how they are stated, and how they are examined. Thus, where we have previously noted the several extra-scientific influences upon the derivation of research problems, we would now have to include a source of predilections intrinsic to the given science, as we illustrated in Fig. 4-2.

THEORY

In addition, a researcher may deduce relationships from a theory. In some sense, *a theory is a model that has been tested.* More specifically, the concepts used in the model have been

operationalized and the relationships between these factors have been verified. A theory—or what Dumont and Wilson call an "explicit theory"—has "epistemic significance" and "constitutive significance" (Dumont and Wilson, 1967, 42-43). The former refers to the operationalization of the constitutive concepts such that the words or conceptual abstractions are linked to observable features of the empirical world, and linked, moreover, by explicit rules of correspondence. By "constitutive significance" is meant that the concepts comprising the theory are interlinked in that they serve to predict and explain empirically discernible behavior (Dumont and Wilson, 1967, 44). A theory, then, consists of a set of propositions that are interrelated, a proposition taken to mean a verified statement of relationship between variables.

Note that an apparently unsuccessful testing of a model may be due to four factors: 1) the model is indeed wrong and needs respecifying; or 2) the concepts have been poorly operationalized so that we are not really testing what we think we are; or 3) our deduction of hypotheses from the model is inadequate, that is, illogical; or 4) the research format employed to test the hypotheses is in some way inadequate, perhaps failing to control for confounding variables.

Of course we never really test or prove an entire model, but insofar as we are deriving hypotheses from a model, testing these hypotheses, and verifying them, these verified outputs—propositions—are the building blocks of theory. And by virtue of their derivative origin we may think of a theory as the verified counterpart of some model(s).

As used above, the relationships expressed in a theory are known as propositions. *A proposition is an established or proven relationship among variables.* This implies that the conceptual components of a theory have been previously operationalized in that the variables comprising the model have been examined empirically such that relations among them have been proven. This is unlike the case with a model, where many of the concepts which comprise it may not have been operationalized. Thus, for example, the many concepts making up Talcott Parsons's systems model have not all been operationalized, and those which have been, only tentatively (Parsons, 1951). This is consistent with a model's speculative nature. But a theory, strictly viewed, represents fact and not speculation. The relationship among hypotheses, models, propositions, and theories can be viewed as parallel continua, as in the illustration below (Figure 4–3).

A theory consists, then, of propositions. These propositions are arranged such that one can deduce lower-order propositions from higher-order propositions. That is, the propositions vary in generality or scope. A more general proposition will express the meaning or conditions represented by lower-order propositions, and then some. Moreover, the higher-order propositions will serve to explain the lower-order relationships. That is, relationships at the higher level account for relationships at the lower level; the latter are logically and empirically derivative. Thus for example, assuming verification for purposes of illustration, the proposition:

The greater the occupational aspiration, the greater the incidence of cheating

would be derivative of and explained by the more general proposition:

The greater the aspirations, the greater the incidence of deviance.

Theory, therefore, is an explanatory system. It may suggest hypotheses relating to as yet unexamined or unverified relationships. Not only models but also theories will suggest hypotheses. But at least, whether relating to extensive phenomena or not,

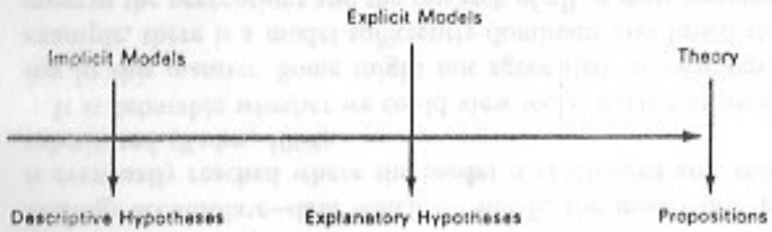

Fig. 4–3. Degree of Formalization

theory is distinguished by its factual nature. It is an explanatory system, not a speculative system, although a theory might indeed incite speculation. Theory, then, is the object or goal of science, and therefore theory is the output and result of cumulative research.

As research is conducted, the findings are in a sense collated—they are gradually arranged into a theoretical system. Thereby certain orientations and assumptions will be built into every science not only because of the models utilized but also because of the theory. This is inevitably so in that it is unlikely that a theory would ever encompass all the pertinent phenomena of a given science.

A theory, therefore, is always limited. Potentially, then, it can always grow. As research continues, additions will be made to the theory. And, since there is no ultimate or perfect verification in any science because of the fallibility of conceptualization and measurement, there will inevitably be corrections and deletions made in theory. Similarly, as research proceeds, the cumulative findings and theory will necessarily affect the system of preconceptions, assumptions, and speculation which we have called models. Thus, in sociology, as in any science, there will not only be an interaction between theory and research as Merton suggested (Merton, 1948) but also an interaction between research, theory, and models.

Conceptual Isolates

We have been presenting a view that has emphasized conceptual order. The assumption from which we have operated is that the ideal of any science is the explicit theory—that is, an explanatory system. This is consistent with our earlier view that the object of social science is explanation and prediction.

It should be noted, however, that there is some considerable and necessary departure from the ideal. Not all concepts are carefully related to others. There are what Dumont and Wilson call "conceptual isolates" (Dumont and Wilson, 1967, 44). These are vaguely defined words which convey a broad range of meaning. They will have some ill-defined relationship to observable behavior from which they were derived. But they have yet to be refined, and in fact they may never be, for they may be abandoned as unsatisfactory. These conceptual isolates may be viewed as exploratory conceptualizations that may or may not eventually be incorporated into conceptual systems—that is, theory sketches or theories.

It is also the case that not all concepts are operationalized. The conceptual isolates noted above may be so vague as to defy operationalization. But there are also concepts used in explicit theories that are not operationalized (Hempel, 1952, 39–50). These are in a sense representatives of missing theoretical links—the unknown factors that permit the organization of those operationalized concepts making up the explicit theory. These unknown factors may eventually come to be operationally specified or they may eventually come to prove unnecessary. But in the meanwhile they serve a necessary function in the logic of theoretical organization.

Explicit theories, then, are a goal. And operationalization is the means to the realization of that goal. But we will not find a science in which all concepts—even all those used in an explicit theory—are operationally specified.

THEORY AND SOCIAL ENVIRONMENT

In Chapter 2 we considered that research findings will likely be applied. For example, there may be interest in the correction of some social problems, such as delinquency. Research and theory will therefore affect the environmental influences that themselves influence research. Thus there is an interaction or constant feedback among the several items we have outlined schematically in Figure 4–4.

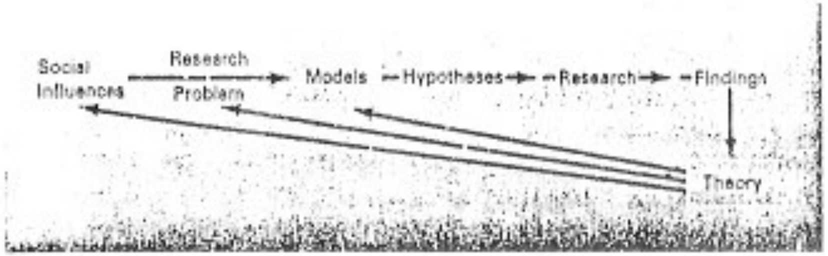

FIG. 4–4. FACTORS INFLUENCING RESEARCH

CONCLUSIONS

Social scientists do not wander about selecting research problems at random. Nor do they collect information randomly in the fond expectation that some day it will all make sense. A research problem will have been isolated by a scientist subject to numerous social influences, and guided by existing preconceptions in a given science. Ideally, the researcher will have deduced hypotheses from highly formalized conceptual systems. But whether the deduction has been explicit or not, the researcher invariably will have been influenced by models with which he is familiar.

Outlined very generally, the steps in research would be as follows:

General Steps	*Example*
Selection of problem	Cheating among students.
Selection of plausible model (theory sketch)	Mertonian outline of relationship between societal goals, means, and deviant behavior.
Deduction of hypothesis	Other factors being equal (for example, social class), professionally oriented students (higher aspirations) are more

General Steps	*Example*
	likely to cheat (deviant behavior) than are nonprofessionally oriented students (lower aspirations).
Operationalization of concepts	1) professional versus nonprofessional distinguished by self-reported plans; 2) cheating distinguished as copying from notes during examinations and copying from published or unpublished work of others for papers, as self-reported in anonymous questionnaires.
Analysis	Comparison of professionally oriented and nonprofessionally oriented students on frequency of cheating.
Interpretation of findings	If consistent with model you have some increased confidence in its applicability. If inconsistent with model, question model itself, your logic, operationalizations, and testing and analysis procedures.

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