ON PARADIGMS, THEORIES AND MODELS

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COMENTARIOS Y DEBATES

The conflation of the distinct terms *paradigms*, *theories*, and *models* is an all-too-frequent source of confusion in the social sciences. The purpose of this brief note is to alert the reader to this confusing state of affairs in the social sciences, trace a few of the causes, and offer some tentative distinctions that may make our discourse a bit clearer. It should be acknowledged at the outset that there are genuine philosophical difficulties that are the subject of debate on the frontiers of contemporary philosophy of science; however, most social science discussions do not involve these debates —the confusions are fairly elementary, but remain unacknowledged. A bit of classic Wittgensteinian "linguistic therapy" is all that is needed for most purposes. And that is exactly what I intend to offer here. After clearing up an elementary difficulty regarding what counts as an almost "natural and intuitive" notion of theory and model in some circles, I will proceed to rigorously compare and contrast the concepts of *theory* and *model*, turning to the concept of paradigm later. The reason for this are the multiple meanings and implications of paradigm. In addition, previous work on theories and models will help making sense of paradigms later. Thus, the expository order will in fact follow a certain logical order.

However, I should first make an elementary point regarding *formal* vs. *ordinary* languages. Some economists, in particular, dogmatically tend to assert that only formal "theories" should count as bona fide theories. This, of course, conflates theories with formal models, and begs an interesting question: Under what conditions is a theory identical with a model? The answer implicit in this tendency is: Under all conditions. This assertion needs to be reexamined.

If we depart from this type of dogmatism —and there are good reasons for such a departure— then we have to concede the status of theories for at least some ordinary

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language formulations. For instance, we could include, under the term theory, Smith's original ordinary language formulations of the market economy system, Hume's price-specie flow mechanism, Ricardo's trade theory. To rule these out as non-theories on the grounds that they are not formal does not seem sensible since they all yield testable implications, which is a commonly accepted criterion for allowing the term *scientific theory* to be applied to a string of propositions in a substantive area of research and discourse.

Finally, the argument with respect to rigor that is sometimes offered in defense of the proposition that "without formalization there are no theories" cannot withstand logical and historical scrutiny, either. Historically, many fields that are not formal (*e.g.*, geology) gained the status of theory-based science when interesting causal structures that were not necessarily formal were advanced (*e.g.*, the theory of plate tectonics). Logically, both formal and ordinary languages can be used either rigorously or non-rigorously. Of course, an unintentional lack of rigor always exposes proposed theories to the possibility of outright rejection. But this can happen in the case of formal as well as ordinary language formulations. In what follows, I assume that scientists who propose new theories can formulate their propositional syntaxes in the most rigorous manner without logical inconsistencies, regardless of the nature of the language used.

Having cleared up this initial difficulty, I will proceed now as I promised earlier and attempt to define the concepts of *theory* and *model* more rigorously than I have done thus far. The final step will be to introduce the idea of *paradigm* and show the difficulties involved in addressing this slippery concept.

Theories and Models: Explanatory Schema

Both theories and models are said to be explanatory in nature. They might also be predictive; but as many natural scientific theories are not predictive, this is, at best, not a requirement that all theories can fulfill in the social sciences.[1] Therefore, my proposal is to drop this requirement, which is a legacy of logical empiricism's Vienna Circle days. The key task then is to begin with a coherent logical sketch of explanation.

The logical form of an explanation is that of a Modus Ponens. Hence, the schema can be expressed as:

If P then Q
P
Therefore, Q

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[1] It will become clear from the discussion of explanation that given the explanation scheme *retrodiction* is possible. Once an event has taken place, with careful work, in principle, we can always uncover the causal mechanism that brought it about.

The main point is that P may involve theoretical and unobservable terms and auxiliary hypotheses as well as some observable ones. Q is the set of observation statements to be explained.

The naïve Popperian position is to recognize, based on the above, that no theory can ever be completely confirmed, and to offer (naïve) falsificationism as the way for science to maintain integrity and progress. For this, we have to use the logical form of *Modus Tollens*, *i.e.*:

If P then Q

Not Q

Therefore, not P

Clearly, this ignores the problem of joint hypothesis testing, or more deeply and generally, the Duhem-Quine problem. If P is a set of hypotheses (some of which may be auxiliary hypotheses, but others —the plural is important here— are part of the theory itself), then the observation sentence "Not Q" does not by itself automatically lead us to a valid inference regarding which of the hypotheses (one or more) are to be rejected.

The key point is that the *modus ponens* and *modus tollens* forms are accessible to both ordinary languages and formal languages. Thus the theoretical status of an ordinary language theory is not threatened simply because it is formulated in ordinary language. We can now turn to the question of models rigorously derived from such theories.

Suppose we have a theory *T* in an ordinary language *O*. In order to form a (partial or total) model *M* of *T* in a formal language we have to translate the terms of *T* to the terms of the formal language *L*. If the translation from *O* to *L* is complete, *T* and *M* are logically and empirically equivalent. If the translation from *O* to *L* is incomplete then the model necessarily captures less content —logically and empirically— than does *T*.

To recapitulate, in the language introduced above, we explain an observable phenomenon (*e.g.*, inflation, unemployment, legal institutions) with the help of either *T* or *M*, if we can deduce the observation statement from some lawlike statements and a set of auxiliary hypotheses. The latter are particularly important. Hence, the best way to explain the concept I have in mind is to discuss its role as well as the role of lawlike statements in a logical schema by giving the concrete example set forth below:

An example of changing an auxiliary hypothesis in the Asian Crisis explanations in the World Bank study

The role of the auxiliary hypotheses has been discussed in philosophy of science literature by Hempel, Putnam, Boyd and others. Briefly, in a deductive-nomological (*D-N*) "model"

of explanation first advanced by C.G. Hempel the scientist uses the following logical scheme:

L: L_1, L_2, …………L_n

   (laws or lawlike statements)

A: A_1, A_2, …………A_n

   (auxiliary hypotheses)

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E: Explanandum (*i.e*., that which is to be explained)

The line above the explanandum indicates that the statements under *L* and *A* together lead to the logical deduction of *E*.[2] In the above explanation model (*D-N*) the set of laws or lawlike statements *L* is usually accepted without reservations unless there is a scientific revolution underway providing a "new paradigm" with a new set *L** of laws, etc. The set of auxiliary hypotheses *A* is accepted on a more provisional basis. These hypotheses range from matters such as instrumental reliability in the physical sciences to things such as institutional structures/stylized facts in the social sciences. An example of such an explanation in economics and the crucial role of switching auxiliary hypotheses for the purpose of explaining the East Asian miracle and debacle is given below.

In the East Asian miracle and related studies the government-business relationship is accorded the status of serving an informationally-efficient role in explaining allocation of investment funds, among other things. How does this work? In reality, the argument can become quite complicated, but the following somewhat simplified version maintains the basic structure and premises of the explanation and can be used for illustrative purposes.[3]

One possible way to formulate the argument is as follows:

L_1: Efficient markets operate through price-flexibility leading to market clearing.

L_2: When prices do not carry all the information, "other institutional mechanisms" in addition to fairly well-functioning markets are necessary to make markets function efficiently so that investment can be allocated properly.

A_1: In East Asian (miracle) economies some (a relatively small number-mostly in the financial markets) prices did not carry all the relevant information.

A_2: However, government-business exchange of information substituted (to a large extent) the missing information in A_1.

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E: Investment was allocated efficiently (for the most part) in the miracle economies.

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[2] Although Logical Positivists like Hempel and Scientific Realists such as Putnam and Boyd use the same logical scheme, a crucial difference is that the latter group accords *real* ontological status to theoretical entities such as quarks, genes, human *rationality* or *institutions*, see Putnam (1975) and Boyd *et al.* (1980; 1991).

[3] See Khan and Yanagihara (1999) for an extended discussion of explanations of the asian miracle and crisis.

However, in the post-crisis period the auxiliary hypothesis A2 has been changed to something akin to the following:

a2: (Crony-capitalist) government-business relations led to distorted signals and created serious moral hazard and adverse selection problems.

Notice how easily this change leads to the seemingly correct explanation according to which:

e: There has been a serious misallocation of investment in East Asia.

Not only does this switch seem to logically explain the misallocation of investment —claimed to be an integral part of the Asian crisis— but it also gives "crony-capitalism" an explanatory salience that is most unexpected given the explanation of the success of Asian economies in the past. This example illustrates both the ease with which auxiliary hypotheses can be changed under most (perhaps all) theories and models and the difficult issues involved in testing whether the switch is legitimate as a scientific exercise. Only extensive historical and institutional research complemented perhaps by careful econometric work that clearly identifies the role of each and every auxiliary hypothesis and these hypotheses' logical relations to one another and the laws or lawlike statements within a complex scientific explanation can begin to address the task of proper testing in this instance.

What is interesting in this example is that it shows that theories and models may coincide if and only if the theory can be formalized completely without a loss of content. Otherwise they need not coincide, and the model will always be simpler than the (at least partially) ordinary language theory. At the same time, the model will in general be clearer than the (more complex) ordinary language theory. Hence, under circumstances in which theory is more complex than a model there seems to be a trade-off between comprehensiveness and clarity. Perhaps this is in part what Nelson had in mind when he tried to draw a distinction between *appreciative* and *formal* theories. However, appreciative theories could be fine-tuned, and not always by being made more formal. After all, if formal language is limited in certain ways, going from the ordinary language theory to a formal model will always involve a loss of content. This violates the condition given earlier for the coincidence of a theory and its model.

To avoid confusion, I should also mention here that by *model* people often mean an *analogical device*. For example, in using a globe as a model of the earth, we are using an analogical device. In the sense in which I have used the term *model*, an economic (or physical, biological, sociological, political, etc.) model is not just an analogical device; it is a simplification of empirical reality (what Marx called "the chaotic concrete" in the Grundrisse), but it attempts to describe, explain and, sometimes, predict, in a formal way. A theory does the same, but it need not be always formal.

I now turn to the issue of paradigms.

Paradigms: What Are They?

Ever since Thomas Kuhn published *The Structure of Scientific Revolutions*, the use of the word paradigm has proliferated. So much so that even politicians do not shrink from using it. And, of course, we are used to hearing of "new paradigms". Kuhn himself became dismayed by this development, and as anyone familiar with his work knows, new paradigms do not arise in such large numbers and or with the frequency that current ordinary and even academic usage would seem to imply.

However, Kuhn is not completely blameless either. The density of his prose and the ambiguities in his original version are at least partially responsible. In 1965, Margaret Masterman pointed out twenty-two different senses in which Kuhn uses *paradigm* in his short monograph. In the end, however, these can be reduced to three main categories:[4]

1) Paradigm as a sociological construct: this version is popular among relativists and sociologists of knowledge. Paradigms come into being when enough people in a scientific community accept them as frames of reference and as the latter are then used for the "puzzle-solving" activities in normal science. Clearly, in this formulation, truth-claims are relative to the paradigm. It is not clear if people can communicate across paradigms. Paradigms may include theories and models in the sense developed above, but it is not necessary to have full-blown theories and model to carry out the social activity called "normal science."

2) Paradigm as an exemplar or an artifact: This is what Kuhn later claimed he had in mind all along. Graduate students are trained using "paradigm" cases and examples. In experimental sciences research methods are taught by example. This usage is close to the idea of scientific training as an apprenticeship. Again, theories and models are neither necessary nor sufficient for this to happen, although all mature sciences have them.

3) Paradigm as theory: This is the most restrictive sense. However, this has textual support, as well. Kuhn's critique of logical positivism involved pointing out the "theory-ladenness" of observations. Therefore, "normal science" would seem to involve theoretical terms. Furthermore, scientific revolutions, when they occur, seem to change our theoretical vocabulary. Thus, quarks entered the scientific lexicon with the development of the quantum mechanics revolution in physics. In the neoclassical school of economics, the idea of cardinal utility was replaced with the idea of ordinal utility and indifference curves arising from the (partial) ordering of preferences.

Since *paradigm* is used in so many different ways, my inclination is to avoid using it unless necessary in a particular context. For most ordinary scientific discourse and debate,

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[4]   See Kuhn (1970; 1977) and Lakatos and Musgrave (1970).

theories and *models* are sufficient. As shown above, these terms can be defined clearly and used to raise relevant questions about choice among different theories and models. From this perspective, *paradigm* seems to be an example of the traps that beset a careless user of ordinary language. Wittgenstein was the most important modern philosopher to point this out generally. To state this in somewhat Wittgensteinian terms, *paradigm* is an example of a language game that has somewhere gone awry. But we still have the language games of models and theories that are eminently serviceable for social science discourse.

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