

# WHAT CAN WE DO WITH SCIENTIFIC THEORIES?

## The meaning of theories from an external perspective

Tihamér MARGITAY

Dept. of Philosophy and History of Science  
Technical University of Budapest  
H-1521 Budapest, Hungary

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### Abstract

It is a paper about how we should approach the interpretation of scientific theories from externalist viewpoint. We consider all the factors – also which are external to the internal research activity of science – which influence the meaning of scientific theories.

*Keywords:* scientific theories, interpretation, meaning, knowledge.

Philosophers who have drawn sociological aspects into philosophy of science and epistemology insist that scientific research is integrated into the social structure which bears not only on the scientific activity, but also on the outcome of that activity, namely on scientific knowledge.<sup>1</sup>

According to this view, we should say that theories provide us with knowledge in a social context and they play their cognitive roles in a social context. This brings us to an *externalist* viewpoint. Scientific research is embedded in a broader social and cultural framework. Other social activities and cultural products initiate, support and interact with a particular scientific research project. A particular scientific theory emerges as a result of this research. KUHN (and others) argued convincingly that *the cognitive value*, the *knowledge claims* of a theory so developed should be assessed in the light of all these interactions. But his conception of theories still remains internal in a sense. He wants to understand scientific theories, and hence, the meaning of scientific theories from an internal analysis of a particular scientific research community and their activity. He persists in seeing theories as means to the cognitive ends of that community, adding only that a theory must have an extra sociological role to organize the particular research community and activity.<sup>2</sup> What a theory means is thought by the *Weltanschauung* approach (as well as by the formalists), to be given independent of how the rest of the world is and in what other social or cultural contexts the theory is used *outside the particular research group* developing that theory. Everything that is necessary to understand the theory, and not

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<sup>1</sup>See MANNHEIM [1925], KUHN [1970], BLOOR [1976], BARNES and BLOOR [1982].

<sup>2</sup>Needless to say that formalists are also internalists, but usually in a far stronger sense of the word.

involved in the presentation is carried by the scientific community's world view (the research community's metaphysical assumptions, epistemological values, methodological prescriptions, etc.). The assumption is that it is enough to observe the research group working on a particular field – the group on its own. It is enough to study what they do and believe in order to understand their theories and in order to see how their theories are interpreted. Theories and their interpretation are seen *only within* the discourse of a delimited (though undetermined) group of scientists. This assumption should be reconsidered if externalism is taken seriously. For, clearly, science is not a self-contained and self-sustaining cultural enterprise. Theories appear in various social and cultural contexts.

KUHN has strong implicit assumptions also concerning the research community in normal science. He assumes the identity of the metaphysical assumptions, the homogeneity of the methods and values of the research community. KUHN also supposes that this community uses the paradigmatic theory exactly in the same sense, and the meaning of this theory derives only from this unanimous use. In other words, he assumes an ideally homogeneous group as to the world view of the members of this group and as to the use of a particular theory. These are clearly untenable idealizations. It is easy to find quantum physicists with a diversity of metaphysical assumptions. Some of them are formalists, others adopt a sort of Copenhagenian view and yet others entertain some sort of Wignerian thoughts.<sup>3</sup> Even if we were lucky to select an ideal homogeneous group of the 'top ten' theoretical physicists working in the same restricted field, we should bear in mind that they do more with a theory than simply develop it, use it, and employ it in discussions amongst themselves. For example, they have to teach the theory to the next generation of 'top ten' physicists. Teaching has its own peculiar cognitive aims, values and methods, and what is also important, teaching of a particular theory has its own didactic exemplars and applications.

Interpretation of a theory in a high school or university textbook differs from the interpretation of that theory found in a state-of-the-art report published, e.g., in the *Physics Review Letters*. The first kind of interpretation has the aim to introduce the apprentice into the subject on the basis of the student's background, and the presentation includes the necessary didactic methods and exemplars. While the second kind of interpretation aims at updating physicists working in the given field or adjacent to it. The second kind of interpretation refers to the latest and the most important applications of the theory. Readers are familiar with the subject and need only a systematic survey of the latest results. The two kinds of presentations are clearly different kinds of interpretation of the same theory.

Many different and highly inhomogeneous social groups use a theory,

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<sup>3</sup>I venture that the diversity of metaphysical backgrounds is not a 20th century phenomenon. Imagine 18th century physicists, one infected with Newton's metaphysics, another educated in Leibniz's metaphysics, etc.

influence its development and contribute to it. We are entitled to expect that interpretations of theories bear the marks of the impacts coming from different components of the social and cultural sphere, and also that a particular interpreted theory itself may exert impact on other components of the social and cultural sphere. Theories are used by various social groups in various cultural contexts. Such a variety of uses brings theories into various connections with other theories and with various social activities. These social activities have different cognitive aims, methods, they are governed by different cognitive values, and they variously apply a theory. On a fully-fledged externalist view, not only research activity, but also theories should be seen as socially and culturally embedded. Even if we focus only on the cognitive functions of scientific theories, theories can only be analyzed, I think, in terms of the whole social context of their use and of their cultural interactions rather than in a parochial way within an unwarrantedly isolated, self-contained, and self-sustaining scientific discourse.<sup>4</sup>

These considerations have direct consequences to the normative aspects of meaning. In so far as there is something to be called use – in principle – it can serve as a yardstick for correctness, even if this use is idiosyncratic, and counts as a misuse in the view of the majority of users. Allowing so many social groups to use a theory in so many different ways (see below) we cannot refer to some idealized, more or less monolithic, single *normal use* of terms and theories when we are to decide about the correctness of a particular use. We should consider successful, accepted uses of terms and theories as measures of correctness and as a starting point of the enquiry into meaning and interpretation.

To see the social and cultural contextuality of a theory, we should turn to its different presentations as we come across them in communication. We can find different interpretations of a theory among the presentations in which the theory is put in different contexts. A rough and ready list of different uses of a theory will throw some light on the diversity of interpretations that should be dealt with. (What follows is not a logical classification in any sense: it is not meant to be disjunctive, not even exhaustive.)

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<sup>4</sup>I consider, in this thesis, only the cognitive aspects that a theory is intended to play in a given social context. The cognitive role refers to what can be learnt from a publication of the theory under scrutiny. Though this epistemological aspect heavily depends on other theories (e.g., on our epistemology, conception of theories, etc.) and thus varies accordingly. This aspect is usually considered to be the primary one in regards to the scientific activity. This stance is admittedly still rather parochial because scientific research has obviously many other functions in our society. By treating science as a knowledge supplying institution I confine the scope of the present paper to those functions of scientific theories that are connected with knowledge. If one feels uneasy because of this restriction, s/he may expand the scope of inquiry by asking what other (economic, political, persuasive, rhetorical, etc.) functions a theory can have. From this perspective, the analysis of interpretation should also deal with the style, persuasive power, etc. of theories.

(a) Formal elements of a theory<sup>5</sup> can be found in publications that merely present that formal structure and analyze it from a mathematical point of view. On these occasions these formal elements of the theory are given hardly any interpretation except that the mathematical structure presented is meant to define the mathematical models of such and such a physical theory, and the like.

Such publications emerge mainly in the area of mathematical physics cultivated by both mathematicians and physicists or in formal reconstructions of philosophers.

(b) Interpretations of a theory are used in an instrumentalist sense to classify, predict, and control certain data and to provide explanation for them. A theory interpreted in this sense is often put into experimental contexts.

Outside experimental physics, and outside theoretical physics developing phenomenological theories, these sorts of interpretations are typical of the publications of material sciences, engineering sciences, etc., and in many other 'applied' contexts.

Such interpretations should be looked for in experimental reports and textbooks of experimental physics, textbooks presenting phenomenological theories of physics, and the publications of applied sciences.

(c) Other physical interpretations go far beyond the data, beyond the observational or phenomenological level. Some theories are used as part of a conceptual system and interpreted to describe the physical world, to provide theoretical 'pictures' of the world, to rationalize it. Theories so interpreted are (parts of) world views as taken by the *Weltanschauung* conception, they serve as theoretical foundations for our understanding of the world and for the rest of the theories.

Interpretations of these sorts also deal with creating the phenomena on the basis of the theoretical description of the underlying physical world.

These interpretations are most common in publications devoted to the fundamentals of physics, textbooks on Quantum Mechanics and the Theory of Relativity. Traditionally this is also the realm of the philosophical interpretation of these physical theories.

The majority of the publications in physics present interpretations falling in the last two, (b) and (c) clusters.

(d) A theory interpreted in either of the above ways is a contribution to the system of methodologies, values and exemplars. An interpreted theory is used to show the ways of its own interpretations, and applications. It is also used to lay down *metatheoretical principles* and values, theoretical and experimental methodology, to develop skills, tacit 'how to' knowledge, etc.

First appearances of a theory are usually also interpreted this way, and textbooks, problem books and guides to lab practices are the presentations

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<sup>5</sup>Only those kinds of theories are considered which possess a formal, mostly mathematical core.

of a theory of this kind. Philosophical interpretations are often devoted to such questions, too.

(e) Interpretations of a theory are used to form auxiliary hypotheses to control experiments of other theories. A theory also explains and is explained by, interprets and is interpreted by, approximates and approximated by other theories. A theory is used to point out relations between the phenomena in its domain and phenomena in other theories' domain through intertheoretical relations between the theories in question.

Publications primarily devoted to other theories contain these interpretations of a particular theory.

(f) A theory is also a contribution to history of science. Not only providing material for the history, philosophy and sociology of science, but it contributes to the development of science itself by providing background. That is, such interpretations determine the problem field, the 'boundary conditions', heuristic devices, etc., for the next discoveries. In short, such interpretations of theories determine the context of discovery for scientists to work out other theories. A theory is used in an interpreted form to formulate problems, questions, contradictions, mistakes, etc.

Such interpretations can turn up in research papers about a new theory initiated by the theory at issue, papers and monographs responding to the problems brought up by the theory at issue, publications in history, philosophy and sociology of science, and memoirs of scientists.

(g) An interpreted theory is used in technological and practical considerations. It interacts with technology. These manifest themselves in applied sciences.

A theory is used in this way in the context of design documentations, in documents of technological development projects, in patent documents, etc.

(h) A theory usually has interpretations which are designed for laymen, and which place the theory in the context of the 'laymen's knowledge'.

A theory is often a part of a subject and included in university and high school text books. It is taught as a standard part of educational programs – sometimes as early as in elementary school. To appreciate teaching as part of genuine scientific activity it is enough to point out the coincidence of the research staff with the staff who teaches at universities, writes the textbooks and writes even the best of popular scientific books<sup>6</sup>.

For the public, a theory turns up in popular scientific books, in interviews with scientists. It may even serve as a resource of other cultural productions, e.g., of science fiction and films.

(i) Theories are interpreted for 'laymen' also in other ways. They are put in the context of economic, environmental, social, and political issues. Theories also emerge in grant applications.

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<sup>6</sup>Two of the most distinguished scientists wrote the two recent popular science best-sellers on relativity (HAWKING [1988]) and on quantum physics (PENROSE [1990]).

Interpretations of theories are used in political debates to support or defend certain decisions pertaining to science and technology policy, or for the implementation of certain technology, or to prompt certain (e.g., environmentally conscious) behaviour on the part of the public.

Admittedly, publications could have been arranged in many other ways<sup>7</sup>, but the particular classification is not decisive to my present point. The list is invoked to display the possible variety of markedly distinct presentations of a theory. The difference in the use of the theory is conceived of as a difference in the interpretation of the theory. A theory of interpretation should give an account of the different *interpretations*, that is, the distinct meaningful presentations of a theory, suggested by the (a)-(i) list above.

It is easy to anticipate the following reaction to the (a)-(i) list of the interpretations of theories above. It is the cognitive (instead of historical, social, political, etc.) aspects of interpretation that we are interested in. The empirical content should be focused on: what we have learnt *about the world* by an interpretation of a theory. So we can ignore most of the items as irrelevant of this problem.<sup>8</sup>

First, what sort of interpretations is relevant to this criterion? Do we not learn, for example, by historical analysis? Furthermore, I think, we can also learn about the phenomena, because a historical analysis can put the phenomena in a new perspective. All the distinct interpretations of a theory clearly involve some cognitive progress and it is hard to decide which knowledge concerns the 'world', or the 'phenomena', and which does not. I fear an epistemology that would narrow down the problem of interpretation to its 'empirical content' would be too harsh and even expel some kind of empirical knowledge. Besides, there are many epistemologies and many different selections on the list. After all, why should the scope of a semantical analysis be restricted in advance on the basis of a certain epistemological taste?

Secondly, a theory of interpretation based on any selection in the list would leave the rest of the list unexplained. How can the rest of the presentations be meaningful units of the social discourse? To put it in epistemological terms, how can they bring knowledge to students, lay public or political decision makers?

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<sup>7</sup>The clumsiness of the list partly derives from the trial to marry two motivations. I tried to display in one list what philosophers of science usually take into consideration, on the one hand, and how I think the issue should be looked upon, on the other hand. In order to develop a socially integrated view of theories, it would be desirable that presentations of a theory, or its interpretations be classified according to their possible social (and cultural) functions. A prerequisite for a classification of this kind is a detailed theory of the social (and cultural) functions of scientific theories. But, unfortunately, to my best knowledge, there is no such theory on the market, and to develop one goes beyond the scope of this thesis.

<sup>8</sup>Philosophers urging for restriction to cognitive aspects would probably select only (a) and (b) as proper instances of interpretation.

Thirdly, presentations are linguistic fragments. As linguistic fragments, they possess both descriptive and communicative functions. The reduction of the problem of interpretation to 'empirical content', amounts to ignoring the communicative functions of presentations. It would be a serious defect of a theory of interpretation to ignore the communicative function. For the communicative functioning of an interpretation of a theory is just as necessary a condition for scientific knowledge as the descriptive functioning of presentations, once we recognize that science is a *community* enterprise. When we study the meaning of theories, we are also looking for an answer – at least a partial one – to the question: How is it possible that we have such a variety of the uses of theories? It should be clear from the foregoing arguments that we do much more than merely describing the phenomena. A theory of the interpretation of scientific theories should be able to account for the meaning of all the above variety of presentations, hence all the variety of meaningful interpretations of a theory.