
The Comparative Study of the Structure of Theories in the Natural and in the Social Sciences: Old Conundrums and New Challenges

Lubomir Savov Popov^{1, *}, Ivan Mihailov Chompalov²

¹School of Family and Consumer Sciences, Bowling Green State University, Bowling Green, OH, U.S.A.

²Department of Sociology, Edinboro University of Pennsylvania, Edinboro, PA, U.S.A.

Email address:

Lspopov@bgsu.edu (L. Popov), ichompalov@edinboro.edu (I. Chompalov)

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Abstract: The paper proposes methodological bases for comparison of the structure of theories in the Natural, Life, Social, and Human Sciences. The idea is that in order to study this problem, the ontological and epistemological peculiarities of these four major classes of disciplines should be considered. The analysis of the nature of the object and the concept of science is a prerequisite for stating the problem of comparison correctly. The nature of the object and the concept of science in the Natural Sciences are fostering Rationalistic world view and a Mertonian approach to the structure of theory, while in the Human Sciences there are grounds for developing an interpretative orientation, and a metaphoric use of the term. Social scientists appear to be deeply divided about which way to go. This methodological "tragedy" is due to the dual nature of the objects of their science. While large-scale social phenomena, such as social institutions or social classes, may behave similarly to the "natural objects" and therefore lend themselves to a more rationalistic theoretical treatment, small-scale phenomena (small groups, neighborhood communities, individuals) require a different kind of approach to gain adequate understanding, namely the detailed analysis and interpretation of meaning construction and modification.

Keywords: Theory, Natural and Social Sciences, Epistemology, Social Science Methodology

1. Introduction

The topic about the structure of theory poses a myriad of questions. Before attempting to define the elements of theory, we have to pass through successive stages of clarifying a number of notions and concepts. The most straightforward ways to theory structure are also the most deceptive. The straightforward confidence will yield nothing but a multitude of concepts, related only by their common subject area. The most probable outcome of such an approach is the formulation of quasi-problems about studying relationships between these methodologically distinctive concepts, or imposing superficial patterns and connections that make an impressive, but totally fake scheme.

Although this paper was conceived with the aim to present a well-grounded conclusion about the structure of the different types of theories in the Natural, Life, Social and Human Sciences, at the end of the study it was clear that it is better to describe the methodological preoccupation of such an endeavor, rather than to come to conclusions that are

fraught with risks. Hence, our paper has a methodological character. In this respect, our objective is to spur a discussion on the nature of theory and theoretical engagements in different academic disciplines. The intent of this initiative is to emancipate theory and debunk the myths about theory in various academic disciplines. We believe that the clarification of the issues regarding theory will help a number of academic disciplines to pay more attention to theory development versus empirical research; other disciplines might reconsider their conceptualization of theory, criteria, and norms of theoretical activities; and there is still room for some disciplines to go rogue and decline to follow such a demanding and challenging model of organizing knowledge.

To present in a clear-cut manner the differences between the theory types in different classes of disciplines, might look like an alluring task, but it is not so obvious and rewarding an enterprise for professional philosophers of science. In the course of the library search, investigations, and personal communications with philosophers, a notion evolved that one should be very cautious in making statements in that area.

Before proceeding any further, it must be noted that the internal variability of the phenomena that are studied will be reduced to several dominant types and all specific cases will be abstracted, even though they may be a big number. The objective is to make the picture as clear as possible, and there is hope that all these cases will be accounted for later, one by one. This type of reductionism is an instrumental necessity and it is not connected to philosophical commitments. On the contrary, the belief in the multiplicity of the realm of science and its phenomenological diversity made it possible to state the major research question of this paper.

The positive outcome of vigorous explorations and research at this stage is an understanding of how to approach the problem. This paper will be a vehicle for promoting such an understanding and is structured according to the rationale of the philosophical method that is employed. In the sense that an approach is a more general way of guiding a researcher in how to tackle a problem, whereas methodology is more specific in laying out a procedure with particular steps to solve a problem, this article is mainly methodological. The major points, singled out in consecutive order are: the nature of the object of science, the nature of science, the concept of theory, the structure of theory.

2. The Nature of the Object

It is an old epistemological principle that the nature of the object influences the nature of the scientific knowledge. What we take the object to be, influences the way we study it [1]. Unfortunately, very often these assumptions are neglected and at such moments major epistemological controversies and disputes arise. Instead of forwarding the notion of multiple epistemologies, hence multiple sciences, some of the philosophers of science start out with a fruitless and intellectually exhausting argument in defense of one or another epistemological system.

In the Natural and Life Sciences the objects are viewed as real, perceived by the senses (even if this is achieved by sophisticated instruments), and well defined. They are not a product of the mind and can be experienced. This leads to the assumption that they (or at least their effects) can be measured and studied. The object can be divided into independent separate parts (fragments) and these could be researched one by one, without influencing significantly the remaining parts, without changing their nature beyond an intolerable degree. Thus the researchers can concentrate vast intellectual and material potential on small bits of reality and achieve excellent results. The data that were produced in numerous research cases can be generalized, grouped into general categories, and these units can be connected to form a picture of the whole object. The presumption is that if something can be discerned without compromising its nature, it can be reconstituted afterwards, at least in an intellectual "plane."

Such objects preserve their identity in time or, if they change (as in the Life Sciences), all objects of that kind pass through the same stage and there are always examples to

study. The researcher is detached from the object and is careful (at least he or she tries) not to influence the measurements. So, research can be repeated to corroborate the data gathered in previous studies.

The object (or objects) in the Social Sciences is much more diffuse, and even "unstable." It can be viewed both in the way the objects of the Natural and Life Sciences are seen; or it can be portrayed as an active, self-conscious, intellectual system that has the ability to conceptualize the world itself and its relations to the world in its own way, and to conceive activities in terms of this conceptualization. There are at least two groups of social scientists that view this object in a completely distinctive way.

A suggestion will be introduced that there is not one fundamental class of objects in Social Sciences, but two or more major classes. The social reality is one and the same, but different parts of it display different types of "behavior." The notion of scale can enlighten the controversy. Large scale and small scale parts of social reality have completely different properties. This is not something unusual in comparison with the Natural and Life Science, where there is a range of scales. The great difference stems from the fact that at one point of discerning social reality, a new quality becomes dominant: the conscious and reflective "meaning producing" and "meaning driven" nature of human beings. This is the first turning point that challenges the conventional philosophers of science. They face a puzzle that can be solved by the simple assumption of the multiplicity of scales and the nature of social reality. In practice, economists study this world quite successfully by applying Natural Science on teleological assumptions and methodology. Although the whole economy is a product of meaningful self-reflective agents, the system functions as a "natural" object. Individuals have limited power in driving the system. Rather, it develops on its own terms and most often surprises human individuals with its cohesion and interconnectedness.

It is quite different if we focus on small portions of reality: small human groups and individuals. In such cases it is impossible to make sense of human action without taking into account how human beings produce and interpret meaning. Each human individual becomes a universe of its own that deserves to be studied from all possible aspects. In practice, it is impossible to study all individuals in that way and we most often resort to a number of compromises. This leads us to the study of meaning and the reduction of the complexity of the human individual to the process of meaning making.

And then, a third group of scholarly endeavor attracts the attention: history, cultural and art history, art theory and criticism, literature, linguistics, etc. In Europe it is pretty common to refer to these fields as Human Sciences [2], while in the Anglo-American cultural area, they are conceptualized as Humanities. In most of these academic disciplines (opponents can challenge their scientific status, but they cannot reject their academic status), it is the meaning of human action that is studied. If we conceptualize meaning as artificial, an artifact, a social construction produced by

humans, these disciplines can be seen as studying the artificial, although in a different way than "The Science of the Artificial" [3]. While the objective of the Social Sciences is the conscious production of the social world, Human Sciences (this term will be adopted for simplicity) focus on the production of meaning and the reconstruction of this process. In that aspect they are quite similar to what Kaplan [4] says about "reconstructed logic." These sciences reconstruct the process of constituting meaning. There is one view of their difference with the Social Sciences, that while the last study meaning in order to understand behavior/action, the Human Sciences study meaning by itself. The similarity is that the study of meaning is taken by both fields as a prerequisite for grasping the object.

These last speculations point out the necessity to review the concept of science in all disciplines, mentioned up to now. It is this image that makes the rules, norms, standards, and criteria for distinguishing between scientific research, on the one hand, and other forms of knowledge production and systematization, on the other.

3. The Concept of Science

Modern science developed its identity rather late, in the 17th and 18th century, under the umbrella of Rationalism, English Protestant pragmatism, and French Enlightenment. It is an outgrowth of natural philosophy characterized by systematic studies, field research (mainly experimentation), and refined method. Science is a creation of the emancipated mind of modern man, liberated by the dogmas of myth and religion during the Reformation. It is a consequence of the interaction of the new world-view (Rationalism), the nature of the objects studied at that time (natural phenomena), and the emotional impact of the new cultural and social processes. What happened more recently has had a huge impact on modern society. Specifically, the vibrant development of science and technology in the 19th and the first half of the 20th centuries created an environment of excitement and technological optimism, which unsurprisingly boosted positivist thinking. The unabated and rapid scientific and technological development during World War II has only helped to consolidate these beliefs, as well as rise the confidence in science and technology to a point when humankind has practically disregarded the wisdom of the humanities in exchange for the mechanistic rationality of the natural sciences. Despite that new attitude, a number of social developments at the end of World War II forced people to ponder again about the meaning of life and to re-examine the nature of human values. The swift technological progress was evidently making the humanistic side of our culture lag behind. As a consequence, many of the world's leading thinkers and intellectuals became aware of the dangers that technological breakthroughs can bring. The colossal war machine and the unspeakable destruction during WW II, the annihilating power of the nuclear bomb, and the unpredictable effects of the newly emerging space industry – all these developments made some of the leading intellectuals

think about the lost human dimension and the dangers of uncontrolled technological optimism.

The initial gradual development of science led to sophistication, increased complexity, and emergence of new specializations. Some of them stem out directly from Natural Philosophy, others came into being by "cloning" from existing sciences. In light of the present study, it is important to unveil the concepts of science adopted in the Natural, Life, Social, and Human Sciences.

Although complex and incomprehensible, the objects of Natural Science can slowly be deciphered, thus giving people greater confidence in the direction of the study already undertaken. The rigor of method, the systematic procedure applied to objects that are comparatively uniform and display persistent patterns, yields much better results than sole speculation or mythical reliance on supernatural forces. This situation in the Natural Sciences reinforces the self-confidence of humans in the power of the human mind.

All different variations of this worldview have the common belief that rigor and systematic effort of a researcher that is detached from the object of study characterize a new activity (science) that is far superior in yielding truth than any other cognitive activity. This way of thinking gave birth to a series of assumptions that underlie the intellectual standards and criteria for modern science.

The assumptions that all objects exist in reality and independently of the human mind, that they can be measured, that the results yielded by these studies can be generalized for a broad population, that the researcher can be impartial (in most Natural Sciences this is easy to be achieved), and standing aside, all these lead to ideals, norms, and standards, requiring rigor of investigation, systematic effort, neutrality of the researcher, possibility for generalizations, and systematic organization of the data and concepts. The success of Natural sciences lends them authority and makes them a reference point for many people that strive for knowledge. The Social Sciences branched from philosophy two centuries later and they were immediately shaped after the image of God (like the Natural Sciences). Emile Durkheim conceived sociology as "social physics," as did Auguste Comte. The revolt of Max Weber set the beginning of the *Verstehende Soziologie*. Karl Marx was more than sure that society has its own laws of development, and if people grasp them, social processes can be governed rationally.

Parallel with the development of rationalist science, another intellectual tradition progressed, although it is confined to the realms of language and literature. Its main proponents were Von Humboldt, Herder, and later Dilthey. Dilthey made groundbreaking contributions in modern linguistics, literary criticism, art history, cultural history, and history.

Although these academic disciplines are denied scientific status by the Rationalists, their modern performance could be an argument for accepting them in the guild of sciences. In fact, their rejection is confined to the English speaking world and the world of natural scientists and Rationalist philosophers of science.

In the Francophone and the Russian traditions they gained the status of scientific endeavors, although with a number of stipulations. The fundamental assumptions in these disciplines pertain to the nature of humans as social agents. Social reality is an object different in comparison with the nonhuman world. Social phenomena are produced by the rationality of people, and can be understood only by comprehending the way these people perceive the world, make sense of it, construct or reconstruct meaning, and form motivations. This world often cannot be explained, but can be understood (the rationalists aimed at explanation and prediction). Predictions are dubious and uncertain. In order to understand people, we must use empathy.

The data that we will obtain will describe the people (or their actions and results) studied, they will help us to understand their rationale, but no substantial generalizations can be made because the research object is very specific and the way we approach it is situational. The aim is not to discover laws and explain reality, but to understand it. Science becomes the art of interpretation (Hermeneutics).

The "understanding" paradigm is well known in sociology as the "Verstehende Soziologie" of Max Weber. Social sciences become a battlefield for the Rationalist and Interpretivist paradigms. Social scientists become deeply divided and a small part of them was accused of heresy and subjected to excommunication by the orthodox scientific community.

These views of science, together with the nature of its objects, make the ground for the study of the differences between the basic structure of theory in the four major classes of sciences. Different epistemological beliefs and methodological practices lead to different organizations of knowledge. The structure of theory emerges as a product of such considerations, beliefs, and practices that differ greatly across the disciplines and create their own scientific communities with a distinctive system of thinking.

4. The Structure of Theory

In most cases, theory in the Natural and Life Sciences is viewed as a set of statements, highly abstract and sometimes expressed in mathematical language, offered in order to make sense of a complex set of data [5]. The extreme opinion is that a genuine scientific theory is to possess a specified logical or structural form or else be rephrasable into an account that has the requisite form [6, p. 318]. The most permissible attitude is that what counts as a theory is, in part at least, an empirical issue, whose answer depends on the current state of scientific knowledge and thus cannot be determined on the basis of structure and logical form alone [6, pp. 318-319].

Theory in the Natural Sciences takes a deductive form, i.e., theories are universal statements from which particular connections between types of events under specified empirical conditions may be logically deduced and tested according to agreed procedures of validation [7]. The main purpose of such an entity is to explain the world and the

argument is deductive and requires context-free and value-free descriptions [7]. This paradigm (known as Rationalism, Positivism, etc.) employed by the Natural Sciences is singularly appropriate to the character of a world which is unpossessed of an intrinsic relevance structure and upon which, therefore, meaning may be conferred by the deductive analytical procedures of the community of scientists itself.

The theory in the Natural Sciences is deductive and it is seen in several similar ways: in the "received view" the theory is presented by calculus and rules of empirical interpretations [6, 8]. Another similar formula is: axioms and theorems. Theorems are viewed also as systems of laws [4, 9]. According to the Mertonian school of thought [10], the basic elements are concepts and propositions. Any other scheme will simply be a derivative. For example, Andrew Tudor [11] proposes the following structure: language (basic and logical terms), conceptual schemes (systems of terms selected from within the language), models (holistic accounts of how things work) and sentence systems (interrelated sets of propositions of empirical reference).

On the other pole of the scientific continuum are the Human Sciences, or the Humanities. The intellectual leaders in this field are the philosophers and social/human scientists Hans-Georg Gadamer, Jacques Derrida, and Michel Foucault. They cannot simply be dismissed as social or human scholars, because their contributions in these fields are tremendous. Foucault's studies of knowledge, discourse, the clinic, the prison, psychiatry, sexuality, method, power, etc. are much more enlightening than thousands of surveys. Gadamer is the leader and methodologist of the Hermeneutic Movement. Derrida is well-known to architectural theoreticians as the ideologist of Deconstructionism and his interest in architecture. Under the general meaning of Humanistic/Interpretivist paradigms, we can classify Garfinkel, Schutz, Berger, Silverman, Luckmann, Bourdieu and Brodel. We should not forget the contribution of Weber (Verstehende Soziologie) and Freud (psychoanalysis) for the making of the Humanistic paradigm.

The purpose of this listing was argumentative rather than informative. Although most of these intellectual innovators have done extensive work in the field of methodology, particularly Gadamer, Foucault, and Derrida, it is hard to find clear-cut definitions of theory. The emphasis in their methodological works is on method, knowledge, and truth [2, 12]. The main reason is that both the Hermeneutics of Gadamer, and the Phenomenology of Husserl and Heidegger are seen as methods, rather than theories or any kind of substantive knowledge. The structuring of the method (or approach) is quite different than the structuring of the substantive knowledge. Another reason is that humanists/interpretivists/phenomenologists do not strive for explanation but rather for understanding. They do not aim at generalizations, do not think that knowledge can be produced by deductions. They attempt to establish empathic connection with the object (or rather subject) of study that will reveal the case. According to them, there is no need of theory for studying meaning; it is the method that is important. And the

meaning inherent in the individual should not be generalized to outside situations.

The question about the structure of the theory in that paradigm (Foucault even does not use the term paradigm and introduces his own similar concepts: "discourse," "epistemes," and "regime"; while Althusser introduces "problematiques") is not a major one. It is displaced by the questions about the method, knowledge, truth, and is desubstantiated by the notions of context-bound and situation-specific knowledge.

There are no theories in the Human Sciences, if we conceptualize theory in the Rationalist paradigm. We cannot speak about general laws in that domain of social reality, and therefore we should use the rationalist term "theory" only as a metaphoric expression. Although the word is used extensively, the standards and criteria are so loose that natural scientists will view these structures of knowledge as "narratives." Anyway, we can impose the model of "concepts and propositions" because any text can be conceptualized in that way. But even in that case, there will be difference in the precise meaning of the terms.

Despite that, the concept of theory is widely used in the Human Sciences [13]. It is interesting that the term is applied by rationalist scientists to theoretical systems created by humanists, e.g., Hilgard [14] speaking in his review book on American Psychology about Freud.

After scanning the two poles, we can audit the methodological situation in the Social Sciences. It was noted at the beginning that their object is on the edge, and depending on the scale of reality it displays properties that make it more or less similar to the objects of the natural or Human Sciences. This makes the ground for a fierce controversy between rationalists and interpretivists.

The field of the Social Sciences is diverse, ranging from social geography to psychology and sociology. This makes it possible to apply the rationalistic paradigm in some fields, and to try the interpretivist paradigm in others. Such idea is purported by one of the eminent and controversial social methodologists of our time, Jürgen Habermas [15]. He proposes that labor should be studied by the means of empirical-analytical sciences with the aim of prediction and control. Interaction should be studied in order to get understanding and meaning, by historical-hermeneutic disciplines.

Power should be studied for achieving emancipation, and in that case Habermas' proposal is to use critical theory. Critical theory should have made the bridge between the rigor of the rationalist systematic thinking and the empathy and humanism of the interpretativists. Habermas, like Gadamer and Foucault has a profound interest in methodological and epistemological problems. Years ago he had begun work on unifying philosophy of science. It is interesting that the results so far are not viable. This intellectual structure has become too complex and clumsy. And there are no indications that the problem of the structure of theory is posed somewhere in the area of Critical Theory.

5. Conclusion

The present article tried to address the issue of comparing the nature and structure of theories in various scientific disciplines by employing a systematic methodology and re-evaluating the juxtaposition of "hard" and "soft" sciences. First, we analyzed the nature of the object in each and concluded that, while in the natural sciences and engineering the object is real, well defined, and reasonably predictable, that is far from true in the social sciences and especially the humanities, where the object is often diffuse, flexible, and saturated with human agency. One caveat worth exploring is the distinction between large-scale objects and small-scale objects in the "soft sciences." Whereas the former lend themselves to a similar treatment as in the "hard sciences," the latter cannot be explained without at least some reference to meaning creation and interpretation. Second, we highlighted the historical development of the concept of science and how it was influenced by the spectacular success of the natural sciences and engineering, whose mind-boggling applications and discoveries have shaped how we think about the scientific method and research. While initially the "softer sciences" tried to model themselves after this standard of excellence, more recently they have taken an "interpretivist turn" that strives after "deeper understanding" of human thinking, motives, and behavior. Third, we argued that the nature of the object and the concept of science logically lead to different structures of the theories in the "hard sciences" and the "soft sciences," respectively. Theories in the "hard sciences" are more rigorous and mathematical, they take a deductive form, and rely on the Rationalist paradigm. In contrast, theories in the "soft sciences" are less rigorous and scripted, more often than not they are inductivist (e.g., "grounded theory"), and typically are couched within the Humanistic/Interpretivist paradigm. Finally, we turn our attention to the implications and consequences of these salient differences between the two types of science and the bodies of knowledge they generate.

The problem of the structure of theory has its tradition in the Rationalistic paradigm that was used to explain the nature of inquiry and developments in the Natural Sciences. In that intellectual framework, it can be applied to any field of the hard sciences. The question is whether this paradigm is universal and appropriate for all classes of objects and for all systematic endeavors to explain phenomena—both in the natural and in the social world.

To answer this question, we briefly re-examine the nature of inquiry in the natural vis-a-vis the social sciences and humanities. The so-called hard sciences are mostly concerned with explanation and quantification of phenomena in a way that will make it possible to use scientific knowledge in the applied technical fields and engineering. This approach has dominated the intellectual landscape for at least two centuries, considering the developments in science and technology after the Industrial Revolution.

Later on, during Modernity, when science emerged as a large social enterprise with tremendous influence on society,

rationality has enjoyed an exceptional status. It goes without saying that objectivity, measurability, and predictability have become major objectives in the world of science and technology. This has brought into existence a particular value system, a way of thinking, and a system of corresponding practices. There have been times when measuring has been a major challenge and therefore its success was considered an important contribution. That way of thinking has allowed them to predict the relationships between inputs and outputs, to control processes and outputs, and most of all, to engineer artifacts that will produce the desired results. Not surprisingly, this mode of thinking has worked very well and has been very productive in engineering and similar practices.

More recently it has become clear that this type of rationality would not help much in understanding cultural phenomena, the world of ideas, and the realm of thinking and creating new ideas about the behavior humans and the social world. The sciences of culture from the time of Alexander von Humboldt have reached somewhat of a competitive position even before the Industrial Revolution and have attempted to produce a high standard for research. Nowadays, the Postindustrial society has revived this thrust, which is often perceived as a major threat to established and institutionalized ways of producing knowledge and ideas. This brings us to the present dilemma of how the “two cultures” are different and whether we could and should study social phenomena using the rigorous methods of the natural sciences and engineering.

Our answer is that, when it comes to investigating human behavior, human groups, and individuals, the reality turns out to be more complicated, less predictable, and hence harder to fit into a neat rationalistic theoretical model. Moreover, when we distinguish between different levels of analysis—macrosocial and microsocial, these disparate scales have different properties.

While large-scale social phenomena, such as social institutions or social classes, may behave similarly to the “natural objects” and therefore lend themselves to a more rationalistic theoretical treatment, small-scale phenomena (small groups, neighborhood communities, individuals) require a different kind of approach to gain adequate understanding, namely the detailed analysis and interpretation of meaning construction and modification.

Thus, in the interpretative paradigm the structure and rational construction of theory is neither methodological, nor a knowledge-constitutive major interest and hardly anybody gives it any attention. As far as the word “theory” is used in

that tradition, it is to denote major frameworks of knowledge that promote understanding of the social reality. Therefore, it is our conviction that the problem of the structure of theory is confined mainly to the rationalist tradition in the philosophy of science.

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