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FOR AN EPISTEMOLOGY “FROM WITHIN”
An introduction to Suppes’ work

As pointed out by the title of the three volumes edited by Paul Humphreys and published in 1994, *Patrick Suppes: Scientific Philosopher*, Suppes is the most scientific of contemporary philosophers of science. His approach, characterized by a deep aversion to all sorts of philosophical “isms”, shows an equally deep concern for all aspects of science, from experimentation to theorizing. This attitude, rooted in Suppes’ double militancy as a philosopher and an experimental scientist, inspired his utterly original perspective, whose impact on traditional philosophy of science inherited from logical empiricism has been no less revolutionary than that of the more celebrated Kuhnian revolution. Suppes insisted that epistemology analyse all aspects of knowledge “from within”, in a genuinely pluralistic and pragmatist spirit. In what follows, an attempt will be made to describe the main traits of Suppes’ innovative epistemology, and point out what lessons can be drawn from his work.

Suppes’ epistemological shift can be traced back to the view of scientific theories he put forward in the early Sixties, at a time when

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1 See Humphreys (1994), which contains a great number of articles expanding on Suppes’ ideas, with final comments by Suppes himself. The reader will find in Volume 3 an overview on Suppes’ perspective, in M.C. Galavotti, “Some Observations on Patrick Suppes’ Philosophy of Science”.

the "received view" worked out by logical empiricists such as Rudolf Carnap and Carl Gustav Hempel was still dominant. According to that view, a theory is an axiomatic system whose axioms are formulations of scientific laws specifying the relationships holding between the theoretical terms, and including (explicit or partial) definitions of the theoretical terms by means of observational terms. To this view, Suppes opposed an alternative approach, whose crucial feature is that of being centred on models, rather than laws. Suppes accompanied this shift in emphasis from laws to models with a formalization within general set theory, instead of the traditional formalization in first-order calculus.

While the adoption of a different formalization is the most apparent difference between the two approaches, much more substantial changes lie behind it. For one thing, Suppes takes a more flexible attitude toward the relationship between theory and observation, abandoning the rigid difference between theoretical and observational terms fostered by logical empiricists. Moreover, he broadens the analysis of theories -- and of scientific knowledge in general -- to cover experimentation. In so doing, he left behind the logical empiricist distinction between a context of discovery and a context of justification, pertaining respectively to scientists and to epistemologists. The epistemological approach envisaged by Suppes goes hand in hand with a pragmatic approach, according to which scientific knowledge has an irreducibly local character, and is to be analysed within a specific context. This led Suppes to divorce a comprehensive theory of science of the kind logical empiricists had in mind, in favour of a pluralistic view, imbued with probability. In fact, Suppes claims that probability enters all stages of a comprehensive analysis of science and knowledge in general, and in this spirit he labelled his own approach "probabilistic empiricism".


\footnote{See Suppe ([1977], [1979]), p. 12ff. for a more detailed account of the received view of scientific theories.}
ideas developed in such papers eventually merged into his most recent book *Representations and Invariance of Scientific Structures* [2002]. According to Suppes, theories are representable by means of a hierarchy of models, characterized by different degrees of abstraction, which range from empirical models, or "models of data" describing experimental evidence, to abstract mathematical models characterizing the theory. The models linking a theory to empirical phenomena can be shown to preserve a certain structure under certain operations. In Suppes’ words: “the structure of a set of phenomena under certain empirical operations is the same as the structure of some set of numbers under arithmetical operations and relations” (Suppes [1967], p. 59). Accordingly, “empirical structures” become an object of investigation no less important than “logical structures”.

This approach led Suppes to reformulate the distinction between theoretical and observational terms, not as a clear-cut distinction, but as intrinsically context-dependent. In other words, theoretical and observational models cannot be construed as separate because there is a continuous interplay between theoretical and observational model components. Suppes’ position in this connection is anti-reductionist, as stated in “On Deriving Models in the Social Sciences” [1990], where it is claimed that:

any program for the elimination of unobservable theoretical variables would seem [...] to be completely mistaken, and contrary to almost all the deeper developments in present-day scientific psychology, not to speak of the important role of assumptions about the unverified and often unverifiable assumptions about individual choices and preferences in neo-classical economic theory. (Suppes [1990], p. 27)

The importance ascribed to “empirical structures” emphasizes experimental methodology, including measurement, statistical techniques “for constructing and abstracting empirical structures in all domains of science” (Suppes [1988b], p. 23), and statistical methods for testing and appraising hypotheses of various kinds. Furthermore, a detailed analysis of such methods imposes a pluralistic approach to theory construction, because the same set of experimental operations (like measurements) can be described by a number of models, which represent empirical structures. The relation between models at dif-
ferent levels of abstraction is not univocal, and the shift from models describing empirical structures to models describing theoretical structures is far from straightforward.

By considering theories not abstractly, but rather in connection with experimentation, Suppes is led to maintain that: "a whole hierarchy of models stands between the model of the basic theory and the complete experimental experience. Moreover, for each level of the hierarchy there is a theory in its own right" (Suppes [1962], p. 260). In such a hierarchy of models, characterized by an increasing level of abstraction, there is a continuous interplay between levels. At the same time, in all sorts of practical situations there is a natural way of passing from bottom to top, in the sense that, given a model of the data which exhibits a certain statistical structure of the phenomena under investigation, one looks for a theoretical model that fits it. Suppes' position regarding theories is well described by the following passage:

If someone asks "what is a scientific theory?" it seems to me there is no simple response to be given... What is important is to recognize that the existence of a hierarchy of theories arising from the methodology of experimentation for testing the fundamental theory is an essential ingredient of any sophisticated scientific discipline. (Suppes [1967], pp. 63-64)

This is the lesson to be learned from a careful consideration of the role played by statistical methodology in experimentation and theory making. An analysis of these aspects of science has been traditionally overlooked by philosophers of science, "who write about the representation of scientific theories as logical calculi" and "go on to say that a theory is given empirical meaning by providing interpretations of coordinating definitions for some of the primitive or defined terms of the calculus" (ibidem). According to Suppes, this lesson emerges most explicitly from some branches of the social sciences, like learning theory, to which he often refers. Making extensive use of sophisticated methods of evaluating evidence and testing hypotheses is a common feature of those disciplines that have not attained a highly developed theoretical status. It is noteworthy that at least part of the research done in econometrics points exactly in
the direction indicated by Suppes, and fosters a pluralistic view of model building, bearing a strong resemblance to the approach outlined in “Models of data”.

While no univocal answer can be given to the question “What is a theory?”, careful analysis of empirical structures shows that not even the question “What are data?” can be given a straightforward answer. In fact, “the ‘data’ represent an abstraction from the complex practical activity of producing them. Steps of abstraction can be identified, but at no one point is there a clear and distinct reason to exclaim, ‘Here are the data!’” (Suppes [1988b], p. 30). Depending on the desired level of abstraction, different pieces of information will count as ‘data’, and what qualifies as “relevant” will inevitably depend on a cluster of context-dependent elements.

Suppes’ refusal of a unique characterization of theories is a crucial feature of his philosophy and he repeatedly stressed that the complexity of phenomena and the variety of practical situations in which phenomena are investigated are such that important notions of science, as well as philosophy, cannot be forced into some definition given once and for all. In other words, there is no unique way of representing scientific structures, on the contrary, a multiplicity of representations can be produced, resulting in a multi-faceted view of scientific knowledge. Plurality represents for Suppes one of the tenets of the ‘new metaphysics’ by means of which he fights the chimeras of the traditional view of rationality, retained by logical empiricism. In the pragmatist tradition represented by C.S. Peirce, W. James, J. Dewey and his own mentor Ernest Nagel, Suppes takes science to be a perpetual problem-solving activity, and regards scientific theories as constructs which “like our own lives and endeavours … are local and are designed to meet a given set of problems” (Suppes [1981], pp. 14-15). The local character of theories goes hand in hand with the idea that “the collection of past, present, and future scientific theories is not converging to some bounded fixed result that will in the limit give us complete knowledge of the universe” (Suppes [1984], p. 10). The ideal of completeness of kno-

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3 This is argued in detail in Galavotti and Gambetta [1990] and [1999].
edge is just another chimera that, together with those of certainty and determinism, is left behind by Suppes' new perspective, as expounded in his wonderful book *Probabilistic Metaphysics*.

Probabilism is, together with pragmatism, the hallmark of Suppes' philosophy, which he baptized "probabilistic empiricism", to contrast it with "logical empiricism". Plainly, the opening of philosophy of science to experimentation brings with it a probabilistic element, since probability is an essential ingredient of experimentation and measurement. But the role of probability within Suppes' perspective is much more pervasive. Probability is involved in the very essence of rationality, as argued in the article "Probabilistic Empiricism and Rationality", where Suppes writes that "it is probabilistic concepts rather than logical concepts that provide a rich enough framework to justify both our ordinary ways of thinking about the world and our scientific methods of investigation" (Suppes [1980], p. 171).

In connection with rationality, Suppes distinguishes between a "kinematic" and a "dynamical" approach. The kinematic approach applies to action choice and is ruled by the principle of maximising expected utility, while the dynamical approach, which he dates back to Aristotle, takes to be rational an action that is performed in accordance with reasons tending to achieve some purpose. The kinematic approach is linked to the Bayesian tradition, and is centred on the adoption of the Bayesian model, which is taken by Suppes with his usual pluralistic and pragmatical attitude. In particular, Suppes calls attention to the need to weaken in various ways the classical Bayesian model, in order to give it a wider applicability, and develops an approach to estimation in terms of interval probability values. It is noteworthy that Suppes put forward original solutions to vexed problems in Bayesian terms, such as the paradoxes of confirmation and the problem of total evidence.

The dynamical approach is developed in terms of justified procedures, building on the idea that good reasons should be provided to support the procedures adopted to attain a given purpose. Suppes

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4 See Suppes [1966a] and [1966b].
points out that the adoption of such procedures is necessarily referred to expected results, and this introduces a probabilistic component also into this kind of rationality, which is to be seen as complementary to the kinematic approach. Essential ingredients of both approaches are for Suppes intuition, intention and individual judgment. There results a flexible view of rationality combining quantitative and qualitative elements in a comprehensive framework, whose dominant character is uncertainty. Suppes’ view of rationality also includes an “ergodic theory of freedom”, grounded on the conviction that “freedom and uncertainty are inextricably entwined” (Suppes [1996], p. 183).

Special mention is due to Suppes’ probabilistic theory of causality, which had a great impact on the literature. The monograph A Probabilistic Theory of Causality, which appeared in 1970, opened a new era in the debate on the notion of causality and fostered an intensive exchange of ideas between philosophers and researchers operating in various fields, especially economics, where the notion of cause had never ceased to be used, in spite of the major crisis it underwent in physics around the beginning of the last century. Suppes’ theory of causality exemplifies beautifully his attitude towards all epistemological notions, which are accounted for locally, rather than forced into a more general frame. Intended for application in different fields, Suppes’ theory can be formulated both in terms of events and statistical variables. Remarkably, no “ultimate” or “genuine” causes are contemplated; on the contrary, the notion of cause, genuine or spurious, is strictly linked to the specification of the body of concepts, on which the set of events that act as causes in a given context is to be defined. Such a relativistic notion of cause might raise some perplexity, because a long philosophical tradition has accustomed us to a stronger notion. As a matter of fact, a stronger notion of causality, intended to specify ultimate causes and to provide explanations of events, is embraced by other upholders of a probabilistic view of causality, like Wesley Salmon. Unlike Salmon, Suppes does not regard causality as intertwined with explanation, and does not pay much attention to causation referred to single events, rather focusing on causation referred to kinds of events.
At first glance, the picture of science outlined by Suppes looks more fragmentary than that depicted by logical empiricists, while in fact it goes deeper, and is more liable to capture the peculiar features of scientific knowledge in different fields. With his pioneering ideas, Suppes paved the way to subsequent research in a number of areas, including the analysis of measurement and experimentation, probabilistic causality, procedural rationality and, last but not least, the nature of models and their role within the making of scientific knowledge. The conviction that models offer a fruitful tool with which to address foundational and epistemological issues is gaining ground along with the literature on the topic. The peculiar character of Suppes’ position, with respect to such literature, lies no doubt with his pluralism. To those who have been trained by a long tradition to search for overarching views and comprehensive patterns, this feature of Suppes’ epistemology might look like a weak basis to stand on. In the light of his accomplishments, however, Suppes’ pluralism represents an impressive breakthrough, bound to give way to a better understanding of knowledge, science, and rationality. His book *Representation and Invariance of Scientific Structures* is incontrovertible evidence in this regard.

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PER UNA EPISTEMOLOGIA "DALL'INTERNO"
Una introduzione al lavoro di Suppes

Riassunto

Patrick Suppes è il più scientifico dei filosofi della scienza contemporanei. Il suo approccio, profondamente avverso a tutti gli "ismi", è caratteriz-
zato da un interesse profondo verso tutti gli aspetti della scienza, dalla spe-
rimentazione alla teorizzazione. Questo atteggiamento, che affonda le sue rad-
dici nella duplice militanza di Suppes come filosofo e scienziato sperimenta-
le, ispira una posizione altamente originale, il cui impatto sulla filosofia della
scienza tradizionale, coniata dall'empirismo logico, non è stato a tutt'oggi
esplorato fino in fondo. Suppes ha insistito che l'epistemologia deve analizz-
zare tutti gli aspetti della scienza "dall'interno", con spirito genuinamente
pluralistico e pragmatista. Il presente articolo intende introdurre il lettore al-
l'epistemologia di Suppes, e indicare quale lezione se ne possa trarre.