

# The Structure and Semantics of Scientific Theories:

## Suggested Paper Topics

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**N.b.:** these topics are only suggested. You are not required to write on one of them. If you want to write on a topic markedly different from one of these, however, please do consult with me first about your proposed topic.

1. **Russell (1927)** claims that the assumption of the continuity of matter and its identifiability over time is a necessary assumption in order to have a secure ground for scientific knowledge. Explain why he holds this, in light of his structuralist account of scientific knowledge. You will have to discuss, among other things, his claim that physics would collapse epistemically without the inference to external objects as the cause of our perceptions, his explication of the idea of “objectivity”, and what grounds we have for formulating and accepting general laws. Do you think he is right that such continuity and identifiability is necessary for his account of scientific knowledge to work? Is it necessary for a more adequate one? If not, is some assumption similar to it necessary?
2. **Russell (1927)** offers a structuralist account of theoretical knowledge in science that in many ways stands as a clear precursor to Carnap’s analysis based on the Ramsey sentence (**Carnap 1966**). In what ways does Russell’s picture correspond to the Ramsey sentence and in what ways does it not? What are the advantages and disadvantages of each account?
3. **Carnap (1956b)** relies upon an idea of what it is for a group of language users to understand a language and to mean the same things when asserting the same sentences. Explicate his criteria for this, and discuss its reasonability. What role does this conception play in his account of how the observable part of a theory gains epistemic warrant?
4. **Carnap (1956b)** claims and argues that his explication of empirical significance for theoretical terms is neither too broad nor too narrow. Explain what he means and evaluate his claim. You will first have to explain the criterion of empirical significance, and what the possible problems are Carnap needs to address to make it work.
5. Explicate the idea of a Carnapian framework (**Carnap 1956a**). What work is such a thing supposed to do in Carnap’s account of the semantics and structure of a scientific theory? Explain the difference between internal and external questions, and relate this to the idea

that a partial interpretation of a formal theory is always radically underdetermined. Do you think Carnap was right to protest that he was not an anti-realist? (Stein 1992 will be particularly useful to take into account for this.)

6. I argued in lecture that Putnam's infamous model-theoretic argument (Putnam 1977; see also the notes by Demopoulos, <http://strangebeautiful.com/lmu/readings/demopoulos-putnam-model-arg.pdf>) should be interpreted as showing that, on Carnap's account, there is no principled distinction between a theory's being true and its being acceptable. Explain Putnam's argument and my interpretation of it. Using Carnap's idea of a framework, the distinction between internal and external questions, and the role of pragmatism in choosing a framework, explain why I argue that this is not a problem for Carnap. Do you think I'm right?
7. What are the main criticisms that Hempel (2001) levels against the "standard conception of scientific theories"? State them in your own words, explain why Hempel thinks they are problems, and evaluate the strengths of his critique. Is there anything the Logical Empiricists can say in reply to defend their position, or any more or less straightforward emendations of their positions they could make to address his challenges?
8. Suppes (1960, 1962) argues that theory (in the usual sense—"theoretical theory") does not predict the observations made in experiments. Explain what he thinks it is they can and do predict, and why one needs a theory of the experiment, of data models, and of experimental design in addition to the theoretical theory for this to happen. In particular, explain what each one of these "levels" of theory is, and how they all relate to each other. On this picture of scientific knowledge, where does epistemic warrant come from? Why are we justified in believing a theoretical proposition? In particular, what is it about the ways that experiments are modeled that gives us trust in the results of those models ("they're revealing something about the world"), and what is it about the ways that theoretical theory is connected with those models that lends them evidential support ("their representations get something right about the world")? Do you agree with Suppes that formalization is a virtue for addressing this problem, or do you think that over-formalization hides some important issues?
9. Explain why Suppes (1960, 1962) believes that statistics is so important in understanding the structure of scientific theory and the kind of evidential warrant we have for theoretical knowledge. Discuss in particular his account of the statistical analysis and synthesis of raw observation in turning it into data models (in his technical sense), and the further statistical manipulation of these required to put them into a form that can be directly compared with theoretical propositions. Why does he think that statistics as a branch of mathematics is peculiarly suited to his notion of a "model" and why is that so important for his understanding of the role statistics plays?
10. Explain the problem of the Hermeneutical Circle as explicated by Fraassen (1980). In particular, explain why van Fraassen, given his constructive empiricism and all of its philosophical commitments, would be unhappy if this problem could not be satisfactorily resolved. What would the negative consequence for the possibility of theoretical knowledge in science be?

Why does van Fraassen think that the Logical Empiricists account is not adequate for addressing the problem? Why does he think his own account is? Do you think he's right?

11. Compare Carnap's and van Fraassen's accounts of the distinction between the observable and the unobservable, their accounts of the difference between believing in and accepting a theory, and the relation each thinks to hold between that distinction and that difference. What are the virtues and demerits of each?
12. Halvorson (2012) uses a syntactic criterion of equivalence, *definitional equivalence*, to argue that the semantic view of theories does not give an adequate account of what it is for seemingly different theories to be in fact equivalent or inequivalent. Characterize definitional equivalence in your own words and explain his arguments against the semantic view. Is definitional equivalence a reasonable criterion to use as the ground for his arguments? If so, why, and if not, why not? In particular, will or should someone wedded to the semantic view accept a syntactic criterion of equivalence in such arguments? Argue that his examples either do or do not have the force he attributes to them if one does not use definitional equivalence.
13. da Costa and French (2005) defend a version of the semantic view of theories different in several interesting ways from that of Fraassen (1980). Explain at least three of the most important differences. What philosophical imperatives and needs drive da Costa and French to alter the view in the ways they do? Do you think their reasons for constructing the account differently are strong? Does the system they construct solve the problems they were intended to solve?
14. What is the "relativized *a priori*" as explicated by Friedman (2001), and what role does it play in structuring a scientific theory and in grounding an adequate semantics for it? In particular, how does Friedman think that such a thing has the capacity to allow empirical interpretation of formal theory by hooking it up with experiment? In what ways is the relativized *a priori* "constitutive" of the kind of physical systems the theory represents, and how does this help ground and determine the theory's semantic content? On Friedman's account, do you think there can be objective, scientific grounds for modifying one's relativized *a priori* principles in a rational, principled way? If so, what sorts of evidence can be brought to bear, and how? If not, why not?
15. Is the project Friedman undertakes in Friedman (2001) "philosophy" in the sense that he explicate the idea in the book, *viz.*, as the creator and articulator of scientific frameworks (the relativized, constitutive *a priori*), and the adjudicator among them (crudely speaking)? If you think so, explain why and argue for your position. If you think not, then explain why, and argue either that Friedman's project is not legitimate according to his own conception of philosophy, or that it is legitimate in so far as it is a different notion of philosophy compatible or even synergistic with the one Friedman articulates in the book.
16. Explain the idea of scientific representation sketched by Suárez (2004), "epistemic representation". How does it differ most generally in form from the picture of representation one gets on Carnap's view and from that one gets on anything like the standard semantic view? What consequences do those differences have for the way to understand the epistemic warrant

theoretical propositions gain by being involved in a piece of successful scientific reasoning? What exactly is it that a network of inferential patterns, capacities and possibilities can “represent”?

17. Howard Stein is right about everything. Agree or disagree.

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