A Technical Difficulty of Structural Realism

Sicun Gao

Nov 4, 2009

It surprises me that structural realism is considered as the best possible stance between realism and antirealism. Supporting its second-order ontology is metaphysically demanding and technically difficult, yet motivating examples are only vaguely seen in a small fragment of physics – in the end not much more than an ambiguous framework has been established. I first argue that there is a small but serious problem in the framework, such that structural realism either has to stay ambiguous, or leads to paradoxical situations.

Structural realism is the view that through the changes of scientific theories, there is a "structural invariant" that are shared among the theories which can be extracted as ontological existence. Let us formally clarify the idea. Let T_1, T_2, ..., be a sequence of legitimate scientific theories, listed in the order that T_{i+1} is newer and more advanced than T_i. Now what the structuralists need is a function F, which takes a sequence of theories and returns the ontological structural core of the theories. Namely, write

$$F(T_1, T_2, ..., T_i) = O_i$$

where O_i is the ontological core that is extracted from T_1, T_2, ..., T_i. Now, consider two consecutive "ontologies" returned by F,

$$F(T_1, T_2, ..., T_i) = O_i$$

$$F(T_1, T_2, ..., T_i, T_{i+1}) = O_{i+1}.$$

Without arguing about any particular formulations about F that structuralists may have (Ramsey sentences, partial isomorphism, etc.), there is a requirement on O_i and O_{i+1} that is formally derivable, which is:

$$O_{i+1} \subseteq O_i.$$

The reason is simple: More things can only share less in common. Feeding one more new theory into F, which can be thought of as a fancy conjunctive operator, will only restrict the output of F to a subset of the previous one. Hence, $O_1, O_2, ..., O_i, ...$ is a downward chain in terms of set inclusion.

This leads to a difficult stance for structural realists. The more advancement we achieve in science, i.e., going up in the sequence of T_i, the smaller "ontology set" we have in the sequence of O_i. (To be precise, there is a possibility that all the Ois are equal, but apparently this cannot be seriously taken, since it implies that the first two scientific theories we ever had have already told us everything about ontology.) Structural realists may have different views about whether the "ontology set" is an epistemological one or a metaphysical one. We have concrete difficulties in both cases:

1. The epistemological reading would suggest that the ontology sets obtained from F are sets of knowledge that we have for the real ontology. But then the downward chain translates to that the more advancement we gain in science, the less ontological knowledge we have.

2. The metaphysical reading suggests that we take sets very seriously as the ontologies we can ever find. Now to explain the downward inclusion problem, the only sensible response would be that the new Oi+1 would subsume Oi that we used to have. But that is saying Oi could have been reduced and should not have been deemed as the ontology, and the pessimistic meta-induction is applicable again on these "ontologies".

As a consequence, I find structural realism not any more defensible than the naive realism. The same unrealistic hope of deducing ontological knowledge from what we have (naive realism) or had (structural realism), is the source of all the difficulties. However, I do not agree that this negative conclusion necessarily lead to antirealism. The pessimistic meta-induction is resulted from a naive and far-too-coarse categorization of sciences into right and wrong, which lacks detailed understanding of how and where they are. This is not what I will go on to argue against, though. Instead, I propose a different possible middleground between realism and antirealism, which I think is intuitively closer to real scientific practice. The key move to make is to accept a syntax/semantics separation between theories and the "real world". We

shift our focus from grasping directly the semantic "real world", say M, to just trying to collect more true assertions about it, i.e., in $Th(M)$. ($Th(M)$ is the set of propositions evaluated to true on M.) $Th(M)$ contains both propositions about the observables and the unobservables. We agree that propositions about the observables are the ones that we can obtain and be sure about. With this set up, we can have the following formulations which seem natural:

1. Scientific theories aim to give sets of propositions that significantly overlap with $Th(M)$. The theories can be refuted if they are inconsistent with the propositions in $Th(M)$ about the observables.

2. The idea that sciences are converging to truth can interpreted as that we are successfully covering bigger and bigger subsets of $Th(M)$.

3. The continuation of scientific theories that the structuralists are trying to address can be termed as that the new theories try to conservatively extend the old theories (one theory is a conservative extension of another if the propositions deducible in the latter can be deduced with in the former) – although I am also skeptical about the existence of such strict continuations.

The obligation for such a view would, still, be how we can explain the success of sciences. A proposal is that we do know when we are capturing the correct propositions about the observables, and the structure of our theories forces the link between those "verified" propositions and propositions about the unobservables. Note that although structures of theories are indeed put into use here, no ontological commitment is necessary at all, since the structures are very likely just linguistic constructions arbitrarily proposed by scientific theories, which need to stand up to the test of their capability of deriving "true propositions". In fact, in scientific practices we are never really serious about assertions for the unobservables before they become observable. An image of atoms obtainable from a scanning tunneling microscope is the single most convincing evidence for the success of atomic theory. The Hubble Space Telescope is still out looking for black holes. String theory will remain controversial in the near future. People jump off buildings before the LHC starts up, no matter how defensible it is from Hawking's theory that black holes will never be generated in the experiments.

In conclusion, I find structural realism an indefensible stance between realism and antirealism. Better ways of reconciling the impasse are possible,

and much more detailed investigations into real scientific practices have to be made before conclusions are drawn.