CARNAP SENTENCES AND THE NEWMAN PROBLEM

LARISA-IOANA GOGIANU

Abstract. In this paper I discuss the Newman problem in the context of contemporary epistemic structural realism (ESR). I formulate Newman's objection in terms that apply to today's ESR and then evaluate a defence of ESR based on Carnap's use of Ramsey sentences and Hilbert's ε-operator. I show that this defence improves the situation by allowing a formal stipulation of non-structural constraints. However, it fails short of achieving object individuation in the context of satisfying the Ramsified form of a theory. Thus, while limiting the scope of Newman's argument, Carnap sentences do not fully solve the problem.

Keywords: epistemic structural realism, Newman problem, Ramseification, ε-operator, individuation.

I. Introduction

This paper discusses M.H.A. Newman's objection to structuralism, in connection with today's structural realism and Carnap sentences. In this section I will present Newman's main points against Bertrand Russell's early version of structuralism in a reformulated version, in order to indicate how it applies to epistemic structural realism. Then, in the following sections, I propose to expand the argument for structuralism by introducing Rudolf Carnap's use of Ramsey sentences and Hilbert's ε-operator as a way of getting around the Newman problem. The main aim of this paper is to consider whether Newman's problem can be solved by applying Carnap sentences to the Ramseified theory. I maintain that the use of Ramsey sentences together with the Carnap sentence can elucidate a great deal of Newman's problem, but it does not dissolve it completely.

Today's epistemic structuralists' strategy of obtaining the structure of a theory Φ involves the use of Ramsey sentences. The Ramseification of a theory Φ substitutes theoretical terms of which we do not know whether or not they denote with existentially quantified predicate variables. The corresponding Ramsey sentence for a theory $\Phi(O_1 \ldots O_n; T_1 \ldots T_m)$[1] will be $\exists t_1, \ldots, \exists t_m[(O_1, \ldots, O_n; t_1, \ldots, t_m)]$. The Ramsey sentence of a theory states only that there are some objects, properties or relations that satisfy a certain structure, but we do not know exactly what those objects, properties or relations are. Ramseification has the advantage of eliminating theoretical terms of which we do not know whether they have a referent or not in the real world, thus showing that we need not to commit to the existence of these entities.

The Newman problem says that structure is not sufficient to uniquely pick out any relation in the world. Suppose that the world consists of a set of *n* objects that satisfy a structure *W* with respect to some relation *R* about which nothing else is known. If this is the case, then only the number *n* of elements is relevant for satisfying *W*, meaning that any collection of things can be organised in that same structure, with the single condition that it contains enough elements. Thus formal structure is irrelevant for our knowledge, since it does not single out any unique referents to satisfy a certain relation.

Ladyman (1998) points out that Newman's difficulty regarding structuralism is applicable to today's epistemic structural realism. If the Ramsey sentence of a theory Φ is empirically adequate (when all its observational consequences are true), then Φ is necessarily true as well, as a simple matter of high-order logic.

We can reformulate Newman's problem for the epistemic structural realism as follows:

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[1] Where $O_1 \ldots O_n$ are observational terms, and $T1 \ldots T_m$ theoretical terms.

a. If ESR is true, then it is sufficient to know the formal structure of relations.
b. Suppose that the world consists of a set of objects that satisfy the structure W with respect to R.
c. If nothing else is known about R, then any set of objects arranged so that it takes the structure W.
d. If the structure can be obtained using any set of objects, then the formal structure does not individuate R.
e. Hence, it is not sufficient to know the formal structure.

: . Hence, ESR is false.

Clearly, the most obvious way to get around the Newman problem is to deny premise (c), which stipulates that, in a structuralist view, any set of objects can satisfy a certain structure. But how can one argue against premise (c) without further stipulating other things that go beyond structural description, such as referring to a particular relation by specifying a certain context for it?

II. Carnap sentences and the ε-operator

Friedman (2011) addresses the use of Carnap-sentences in the context of recent discussions on structural realism and concludes that the Newman problem raised in the said context does not represent a viable objection for Carnap's conception (Friedman 2011, p. 13). In what follows, I will attempt to explain how Friedman reaches this conclusion.

Friedman's own formulation of the Newman problem[2] is focused on the fifth premise of our initial reformulation of the argument. He states that the problem is that if the Ramsey

2 'The problem, roughly, is that, if the Ramsey sentence is empirically adequate (if all its observational consequences are true), then it is necessarily true as well—true as a simple matter of (higher-order) logic. So it does not seem, after all, that the Ramsey sentence, as Carnap proposes, can faithfully represent the *synthetic* content that our original theory is supposed to have.' (Friedman 2011, p. 4)

sentence of a theory is empirically adequate, then it is logically true – given the fact that any set of objects could satisfy the implied Ramsey sentence; but if this is the case, then the Ramsey sentence cannot faithfully represent the synthetic content of the original theory – hence, it is not sufficient to know the structure of a theory. However, Friedman notices that Carnap's Ramsey sentences have factual content simply because they state that there are observable events in the world such that there are *numbers or classes of numbers*, which are correlated with the events in a prescribed way. Thus here lies the key in avoiding the Newman problem: it seems that Carnap does not presuppose that an abstract theory has any synthetic or factual content beyond its empirical adequacy. Thus there is no synthetic content such that the Ramsey sentence would fail to successfully represent. The Newman problem is eluded as a consequence of Carnap's neutralism.

Roughly, Carnap believes that we are not ontologically committed to the idea that theoretical terms have real denotation. He stipulates that the values of the variables of a theoretical language range over a domain of entities including not electrons or atoms, but a denumerable sequence isomorphic to the natural numbers. Thus, the domain *D* of entities contains only numbers and classes of numbers. Proceeding to physics, all entities needed as values for the variables are constructed within the mathematical domain *D*. Therefore, having a language that contains theoretical terms becomes a matter of preference[3].

Moreover, Carnap makes use of Ramsey sentences but only as a constituent of the full formalisation of a theory. The Ramsey-

[3] 'It is obvious that there is a difference between the meanings of the instrumentalist and the realist way of speaking. My view, which I shall not elaborate here, is essentially this. I believe that the question should not be discussed in the form: 'Are theoretical entities real?' but rather in the form 'Shall we prefer a language of physics (and of science in general) that contains theoretical terms, or a language without such terms?' From this point of view the question becomes one of preference and practical decision.' (Friedman 2011, pp. 2-3)

sentence of a theory, (∃u)TC(u, o)[4], only captures the synthetic aspect of a theory, while the analytic feature is pictured by a meaning postulate. Roughly, Carnap takes a theory TC to be equivalent with ‘^{R}TC & (^{R}TC • TC)’ (Psillos 2000b, p. 268), where ‘^{R}TC’ is the Ramsey-sentence of a theory that gives the factual content, while ‘^{R}TC • TC’ is a meaning postulate which says that if there is a class of entities that satisfy the Ramsey sentence, then the theoretical terms of that theory refer to the members of that class.

Now, as far as this goes, it seems that Newman’s problem has actually deepened under the Carnap abstraction of a theory. Since any set of objects could realise the structure given by the Ramsey sentence, it follows from the postulate that the terms of any theory denote. But Carnap ingeniously makes use of Hilbert’s ε-operator such that relations are properly satisfied by relevant entities and not by any random set of objects. Thus, theoretical terms are to be explicitly defined, but only partially, with the help of the ε-operator (Psillos 2000a, p. 156), which picks up certain entities from a non-empty class, such that those entities satisfy the implied relation.

The ε-operator is defined by the following axiom: ∃xFx • F(εxFx) – if anything has the property F, then the entity εxFx has the property F, where εxFx is an ε-representative of the elements of a non-empty class F, without further specifying which element it stands for. For instance (Psillos 2000b, p. 171), take ε_n, where n = 1 or n = 2 or n = 3. Take ‘a’ to be the abbreviation of the ε-expression that is an element of the class which contains the elements 1, 2 and 3. Now what we know is that *a* is either 1 or 2 or 3, but we cannot say whether a=1 is true or false.

Therefore, if we have a theory TC whose theoretical terms form an n-tuple $t=\langle t_1 \ldots t_n \rangle$, then the Hilbert ε-operator allows us to select an arbitrary class among the classes of entities which satisfy the representative of the i^{th} member of the n-tuple. This way we can define every theoretical term of the theory such that it is not the case that any set of objects could be arranged to satisfy the formal

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4 We use this simplified form instead of ‘$(\exists u_1)\ldots(\exists u_n)TC(u_1 \ldots u_n, o_1 \ldots o_n)$’ where ‘$u_1 \ldots u_n$’ are the variable that stand for logical terms.

structure of the theory. The Carnap sentence of a theory can now be re-written in the following form: 'TC((εuTC(u, o)), o) · TC(t, o)'.

III. A problem of individuation

I trust that I am not mistaken in saying that not all epistemic structural realists would come to terms with Friedman's response to the Newman problem through Carnap sentences. Clearly, it is Carnap's neutralism that makes his Ramsey sentences immune to Newman's problem by stipulating that the values of the variables of his theoretical language range over a domain containing numbers and sets of numbers. This view is definitely compatible with epistemic structural realism, since it does not imply any ontological commitment towards objects; however, it can rather satisfy a more instrumentalist kind of epistemic structuralist.

It might be possible to make use of the Carnap sentence such that it could also offer a solution to the Newman problem for the epistemic structural realists. Having an epistemic constraint on realism means commitment to the structure of our best scientific theories but agnosticism about the rest of the content. In other words, the variables of a theory are taken to range over whatever there is which satisfies the structure, yet the things that satisfy the said structure can be known only by description. In this case, the use of the ε-operator can function more or less as a *definite* description, picking up exactly those things that satisfy a certain relation, such that it is not the case that *any* set of objects could satisfy the structure of a theory.

Up until now, the conclusion is that it is no longer the case that we can obtain the structure *W* using any set of objects, since the Hilbert operator picks up elements that are relevant for satisfying certain relations. This means that an important part of Newman's problem is indeed avoided by Carnap's use of Ramsey sentences together with the ε-operator. But does it also solve the problem of individuation indicated in premise (d) of Newman's problem?

The point raised by Maxwell when introducing Ramsey sentences for eliminating theoretical terms from our discourse was that we can only have epistemic access to unobservable entities (be it objects or processes) through description, and not by acquaintance (Ladyman 2014). Thus we can only know the structural properties of these entities, such that we can merely understand the meaning of theoretical terms structurally. But dealing with descriptions is already a problematic matter.

Take the case of definite descriptions – suppose your neighbours are twins, but you do not know that. However, you use the description 'the neighbour that lives across the hall, with tiny, black eyes and greasy hair' to refer to one or the other. The description is still a definite description in virtue of its syntactical form, but it is satisfied by two different objects. Russell would say that the above definite description is not a correct one, since it does not pick up a unique object[5]. However, based solely on its structure, we have a case of isomorphism. In reality, we know that the implied description is not a correct definite description because we can also get to know the twins by acquaintance and not only by description.

Let's get back to the example used in the previous section to illustrate the use of the ε-operator. Take ε_n, where n = 1 or n = 2 or n=3. When you take 'a' to be an element of the class which contains the elements 1, 2 and 3, you know that 'a' is either 1 or 2 or 3, but you cannot say whether a = 1 is true or false. With respect to the problem of individuation, the ε-operator works no better than a flawed definite description – it picks up one of the numbers which correspond to satisfying the description, but it does not individuate, since it can be either of the three given options.

In physics we cannot always know whether there is a case of isomorphism or not. Hence the formal structure can still not individuate properly. If this is the case, then the structuralist has to either accept the fact that a problem of individuation remains

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5 'Now *the*, when it is strictly used, it involves uniqueness; we do, it is true, speak of "*the* son of So-and-so" even when So-and-so has several sons, but it would be more correct to say "*a* son of So-and-so".' (Russell 1905)

unsettled, or to defend the idea that isomorphism does not represent an issue for our knowledge of scientific theories.

It might be inviting to conclude that the Newman problem undermines *all* forms of structural realism, in so far as it shows that some or other kind of non-structural information must be added as constraints over the range of the variables of the Ramsified theory. Rudolf Carnap, on the other hand, shows that we can impose *some* constraints on the range of the variables, constraints which we would not describe as 'non-structural information'. These guarantee that it is not the case that *any* set of objects can satisfy the Ramsified form of a theory, hence they dissolve a great deal of the Newman problem. Nonetheless, even if the Carnap sentences idea represents an improvement over the Ramsified form of a theory, it does not solve the problem of individuation.

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