

The Newman Objection and Pragmatic Structural Realism in Linguistics

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Aim of this talk:

- 1 Discuss the Newman objection
- 2 Develop a pragmatic, Carnapian response
(Joint work with Otávio Bueno, University of Miami).
- 3 Present structural realism in linguistics.

Content

- 1 Structural realism and the Newman objection
- 2 A pragmatic way out of the Newman objection
- 3 Structural realism in linguistics
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1. Structural realism and the Newman objection I: Two main types of structural realism

- Arises from the debate on scientific realism and theory change in the philosophy of science.

Epistemic structural realism (ESR): All we can know is structure (Henri Poincaré, Bertrand Russell, John Worrall, and others).

Ontic structural realism (OSR): All there is *is* structure, and there are no individual objects at the ontologically fundamental level (Steven French, James Ladyman, and others).

1. Structural realism and the Newman objection II: The underlying assumptions for SR I

- Our empirical theories are not completely overthrown when they change, the structural parts are retained.
- We don't have direct epistemic access to the referents of the (unobservable) entities which appear in our empirical theories. But we can have knowledge of the mathematical structures that describe the behaviour of these entities.
- If it occurs that the same equations are part of radically different empirical theories, for the structural realist it seems reasonable to assume that what represents the world as best possible are these equations.

1. Structural realism and the Newman objection III: The underlying assumptions for SR II

- If we can identify which structures are retained through theory change, it makes it reasonable to assert that the persistence of these structures "reflects" in every specific case a specific part of the structure of the world.
- The persistence of certain structures makes it reasonable to assume that at least the structural part of our empirical theories represents the world correctly.

1. Structural realism and the Newman objection IV

- Newman's objection criticizes the Ramsey-view. According to this view, the structural content of a theory can be fully given by its **Ramsey-sentence**:

Given an empirical theory with theoretical and observational terms:

$$TC(t_1 \dots t_n, o_1 \dots o_m)$$

We substitute the terms for variables and existentially quantify over them:

$$\exists x_1 \dots \exists x_n TC(x_1 \dots x_n, o_1 \dots o_m)$$

1. Structural realism and the Newman objection V

- “The” Problem for SR: Structure is not sufficient to uniquely pick out relations in the world:

Any collection of things can be organized so as to have the structure M , provided there are the right number of them. Hence the doctrine that only structure is known involves the doctrine that nothing can be known that is not logically deducible from the mere fact of existence, except ('theoretically') the number of constituting objects (Newman 1928: 144).

- Given only the formal structure, it is not possible to identify a unique referent for this class of relations. We could stipulate that we are talking about the intended class of relations. But, as will become clear below, this move goes beyond a purely structural description.

1. Structural realism and the Newman objection VI

Stathis Psillos: *... all one needs to note is the following theorem from second order logic: that every set A determines a full structure, i.e. one which contains all subsets of A , and hence every relation-in-extension on A . Since all relations-in-extension are contained in the posited domain of unobservable entities (considered as a set), it follows that **one can never fail to generate the required structure W on this domain.** So, the claim that there is a relation ... such that the structure of the unobservable world is W says very little. In fact, **all it says is that the posited domain of unobservable objects must have a certain cardinality** (1999: 62).*

1. Structural realism and the Newman objection VII: Responses to Newman I

- **Two attempts to answer Newman's objection:**

From the semantic conception: *the Newman problem is obviated if one does not think of structures and relations in first-order extensional terms* (French and Ladyman 2003a: 33).

From an ESR-perspective: *First of all, it should be made clear that if all the structural realist is arguing for is the claim that there exist relations with particular structures, then this is obviously trivial for the reasons Newman mentions. But no structural realist makes such a claim!* (Votsis 2004: 122).

1. Structural realism and the Newman objection VIII: Responses to Newman II

- It is an open question whether versions of SR within the semantic conception of theories don't get affected by the Newman objection. After all, Newman's formal result holds regardless of the mathematical framework that is in use.
- Ontic structural realism is unaffected by Newman's objection, since it is not an epistemological position, but rather a view about what there is. **An obvious problem: In order to claim what there is, don't we need to *know* what there is first?** Relation OSR - ESR is not entirely clear.
- In agreement with Votsis: One wants to say more than just that there exist relations within particular structures. This leads to a pragmatic version of SR.

2. A pragmatic way out of the Newman objection I

- We accept, of course, the formal result of Newman's Objection, but we wonder about its philosophical impact.
 1. In debates on structural realism (mostly on ESR), we search for cases of structural continuity between apparently radically different theories.
 2. Given these cases, one can employ a variety of different formal tools to reconstruct them—Ramsey-sentence views, or semantic approaches.

2. A pragmatic way out of the Newman objection II

3. When we specify the structure of an empirical theory in a formal framework, Newman's problem doesn't emerge. After all, we need to state explicitly what the domain of the theory consists of (particles, genes, markets, etc.), and it's no longer a trivial matter whether structures of the appropriate kind can be constructed.

- **But doesn't this leave structuralism behind?** No! It is a pragmatic move, which allows one to incorporate the content of Newman's result, while questioning its philosophical import.
- However, if one stays merely at an abstract level (disregarding the content of the theories in question), Newman's objection arises.

2. A pragmatic way out of the Newman objection III

Semantic approaches in the philosophy of science typically make use of set-theoretic predicates, relying on Suppes' (1957) original proposal. We can characterize a set-theoretic predicate as a predicate that specifies:

- the type of a structure $\langle D_1, \dots, D_k, R_1, \dots, R_n \rangle$, where k is the number of base sets, and n the number of relations;
- the typification of the relations R_1, \dots, R_n ;
- the axioms that the relations R_1, \dots, R_n need to satisfy.

As a result, the structure $\langle D_1, \dots, D_k, R_1, \dots, R_n \rangle$ will eventually satisfy the set-theoretic predicate.

This tool allows one to represent the structure of scientific theories (e.g. within ESR).

2. A pragmatic way out of the Newman objection IV

An example: A potential model of *Classical Collision Mechanics*:

$M_p(\text{CCM}) = \langle P, T, \mathbb{R}, v, m \rangle$ (see Balzer *et al.* 1987):

- 1 P is a finite, non-empty set;
- 2 T contains exactly two elements;
- 3 $v : P \times T \rightarrow \mathbb{R}^3$;
- 4 $m : P \rightarrow \mathbb{R}^+$.

P is a set of discrete bodies that can be called 'particles', T is a set of two instants, one time instant before the collision, and the other time instant after the collision. v is the velocity function, assigning to each particle p and point of time its velocity as an element of \mathbb{R}^3 . Velocity is a time-dependent vectorial function whose range are triples of real numbers. It assigns a three-component vector (one component for each direction in space) to each particle at each time. m is the mass function, assigning to each particle its mass.

2. A pragmatic way out of the Newman objection V

- The information provided by a theory representation using a set-theoretic predicate is not trivial (as Newman would have claimed), since we say explicitly what the elements of our basic domain are—in this case, particles.
- To provide a structuralist representation of an empirical theory, with a set-theoretic predicate, is no trivial task: a structure of the relevant kind (about the objects in question) may not be available.
- Our proposal is that, if the SR wants to be safe from a trivialization charge, a pragmatic stance is needed. **The pragmatic move consists in specifying explicitly the empirical system that is being represented, and to determine concretely the domain of objects and their relations.**

2. A pragmatic way out of the Newman objection VI: Founded relations I: A Carnapian proposal

... can the structuralists avoid the Newman charge of triviality without abandoning their structuralist outlook? Not really. The whole point is precisely that *the notion of 'important relation' cannot admit of a purely structuralist understanding* (Psillos 1999: 63).

- In the *Aufbau*, Carnap introduces *founded relations*:

we want to call relations that correspond to an experienceable, 'natural' relation, whose corresponding parts do have something experienceable in common, 'founded relations' (Carnap 1928: §154).

→ The relations specified by set-theoretic predicates are experienceable and "natural" in Carnap's sense.

2. A pragmatic way out of the Newman objection VII: Founded relations II

- Following Carnap, founded relations are experienceable (*erlebbar*). Given this feature of founded relations, it is possible to specify only those structures that are relevant for the description of our empirical knowledge, namely, those corresponding to experienceable relations.
- Thus, we begin by picking out *real*, existing, physical relations.
- We then provide a description of such real relations in terms of set-theoretic predicates, and we select those set-theoretic relations that stand for the appropriate experienceable relations.

2. A pragmatic way out of the Newman objection VIII: Founded relations III

- This Carnapian proposal provides an answer to the Newman objection, for it restricts the possible structures only to *experienceable* relations.
- These are any relations that one *can* experience. Some are experienced directly (directly observable relations); others are experienced indirectly (via instrumental access). But in none of these cases are we concerned with *any abstract* structure.
- As soon as one tries to talk about structure in a more general and abstract way, the Newman objection may rise again.

2. A pragmatic way out of the Newman objection IX: On Structuralism I

Have we given up on pure structuralism by moving to experienceable relations?

- It depends on what the requirements are on structuralism. If pragmatic considerations are not considered part of the structuralist framework, structuralism is left behind.
- But without such a pragmatic component, pure structuralism makes very little sense, since one cannot specify what the structures that are introduced in one's theories are *about*.
- The intelligibility of structuralism ultimately demands this pragmatic feature.

2. A pragmatic way out of the Newman objection X: On Structuralism II

David Chalmers (2012) proposes a similar move: see his notion of *Structural Scrutability*:

The analog of weak structuralism is Structural Scrutability: roughly, the thesis that all truths are scrutable from truths using logical vocabulary plus structural expressions, where (to a first approximation) a structural expression is one that expresses a basic relation. Logical Scrutability is undermined by Newman's problem, but Structural Scrutability remains on the table (ibid.: 409).

2. A pragmatic way out of the Newman objection XI: On Realism

Have we given up on realism by moving to experienceable relations?

- We have emphasized the empiricist requirement on experienceable relations, but we have understood such relations broadly (some are directly experienceable, others are indirectly so). Three interpretations:
- (a) *Constructive empiricist reading*: The experienceable relations (those to which one should assign an epistemic role) are restricted only to directly observable relations.
- (b) *Broadly empiricist reading*: The experienceable relations include directly observable relations and indirectly observable relations—as long as one knows that the relevant instruments satisfy epistemic conditions akin to observation (Bueno 2011).

2. A pragmatic way out of the Newman objection XII: On Realism II

- (c) *Realist reading*: The experienceable relations include directly observable relations and indirectly detectable relations (that is, one can detect them with instruments that need not be akin to observations).

Thus, depending on how one interprets the experienceable relations, realist and anti-realist views can be accommodated within the framework we propose.

3. Structural realism in linguistics I: Theory change in linguistics

On Zellig Harris' role:

- *While linguists are aware that the term "transformation" comes from the work of Chomsky's mentor Zellig Harris, and some have noted that Harris probably took the term from Carnap (1934), it has gone almost entirely unremarked that the underlying mathematics is largely present in much earlier work, overlooked by linguists because Chomsky never cited it (Pullum 2011: 284).*
- *The contributions of Zellig Harris are also somewhat downplayed in Syntactic Structures . . . Harris clearly saw that formal axiomatic systems could be exploited as generative production systems, generating well-formed strings rather than logical theorems. And he saw it ten years before Syntactic Structures appeared (ibid.: 293).*

3. Structural realism in linguistics II: Harris' Transformational Theory

- Harris aimed at a systematization of sentence-types.
- He developed a method that enabled linguists to describe how sentences are built and changed, like from active to passive. These changes he called *transformations*.
- By introducing a formalism to label different types of phrases (noun phrases (N), verbal phrases (V), prepositional phrases (P), \leftrightarrow , etc.), Harris started with the formalization and mathematization of linguistic theory (mathematization as a central element of the process of maturation of scientific theories).

3. Structural realism in linguistics III: Harris' Kernel Sentences I

- The basic entity in his theory is the *kernel sentence*:

The kernel is the set of elementary sentences and combiners, such that all sentences of the language are obtained from one or more kernel sentences (with combiners) by means of one or more transformations (Harris 1957: 335).

Example of an elementary sentence: *Bastian fouled Cristiano.*

3. Structural realism in linguistics IV: Harris' Kernel Sentences II

Our picture of a language, then, includes a finite number of actual kernel sentences, all cast in a small number of sentence structures built out of a few morpheme classes by means of a few constructional rules; a set of combining and introducing elements; and a set of elementary transformations . . . (ibid.: 339).

Sentences like:

Bastian fouled Cristiano, The cat sits on the mat, The tree is old, Kevin is a pretty decent basketball player, etc... .

3. Structural realism in linguistics V: Harris' Kernel Sentences III

Let us consider the following example: The kernel sentence:

(i) *Bastian fouled Cristiano*

in active, is obtained from the passive

(ii) *Cristiano was fouled by Bastian*

through a transformation. Harris' formalism in this case is as follows:

$$N_1 V N_2 \leftrightarrow N_2 V^* N_1$$

where N_1 is 'Bastian', V the verb ('fouled' or V^* 'was fouled by' respectively), and N_2 is 'Cristiano'. The \leftrightarrow is the transformation operator.

→ There are good reasons to think that kernel sentences play a crucial role in Harris' theory. Such sentences are structural entities.

3. Structural realism in linguistics VI: Generative Grammar

- The notions of *Deep Structure* and *Surface Structure* were introduced later (with Chomsky, 1965).
- Chomsky's proposals imply more controversial views on the relation between semantics and syntax.
- For Chomsky, every sentence had a deep structure and a surface structure. In the beginning, Chomsky claimed that deep structure determined meaning, etc.

3. Structural realism in linguistics VII: Deep Structure - Surface Structure

- For the 1965 Chomsky, even interrogative sentences like

Which car did John wash?

had a deep structure, where their real meaning was

John washed that car.

3. Structural realism in linguistics VIII: Ontic Structural Realism in GG I

- Chomsky (1965, 141):

A deep structure enters the semantic component and receives a semantic interpretation; it is mapped by transformational rules into a surface structure, which is then given a phonetic interpretation by the rules of the phonological component.

3. Structural realism in linguistics IX: Ontic Structural Realism in GG II

- Originally motivated by contemporary physical theory, OSR states that at the ontologically fundamental level, there are no objects, but only structures.
- Analogously to linguistic theory: *Kernel sentences* as what there is at the fundamental ontological level.
- In more recent Chomskyan words: *I-Language* is what exists at the fundamental level.

4. Summary I

- Newman's objection holds if we make just abstract structural claims. But understood in this way, the objection has no connection to SR in the philosophy of science, where concrete cases of actual theories are at issue.
- By invoking a set-theoretic predicate formulation of the structure of a physical theory, we need to state explicitly the domain of objects the theory is about. By doing so, one is forced to leave behind the territory of abstract knowledge claims.
- We then emphasize the crucial role of experienceable relations, and provide a broad framework in which these relations can be multiply interpreted.

4. Summary II

- Harris systematized an important part of syntactic theory.
- This made it possible to give linguistic theory stronger explanatory power and certainly helped linguistics to become a *mature* science.
- The epistemic structural realist wants to find structural continuities through (somehow radical) theoretical change.

4. Summary III

- Such continuities can be seen as mere re-appearances of equations, but also as more general intertheoretical relations.
- We have seen that at least in the field of syntax, Harris' syntactic theory developed already central aspects of Chomsky's early theory. Between Harris and Chomsky, there is a structural continuity.
- From the perspective of OSR, what there exists at the ontologically fundamental level in GG, is what has been called *Deep Structure*, later on *I-Language*.

4. Summary IV

- Hills (2010) already argued for structural realism in Generative Grammar.

→ But: He *only* analyzes continuities *within* the development of *Chomskyan Linguistics*.

- From the point of view of the philosophy of science, structural realism arises when it applies to cases of more radical theory change (scientific revolutions), such as the case of linguistics before and after Chomsky.

Thank you!

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