Title
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Journal
Synthese, 200(2)

ISSN
1111-4924

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Publication Date
2022-04-01

DOI
10.1007/s11229-022-03495-3

The Structuralist Approach to Underdetermination*

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Abstract

This paper provides an exposition of the structuralist approach to underdetermination, which aims to resolve the underdetermination of theories by identifying their common theoretical structure. Applications of the structuralist approach can be found in many areas of philosophy. I present a schema of the structuralist approach, which conceptually unifies such applications in different subject matters. It is argued that two classic arguments in the literature, Paul Benacerraf's argument on natural numbers and W. V. O. Quine's argument for the indeterminacy of translation, can be analyzed as instances of the structuralist schema. These two applications illustrate different kinds of conclusions that can be drawn through the structuralist approach; Benacerraf's argument shows that we can derive an ontological conclusion about the given subject matter, while Quine's structuralist approach leads to a semantic conclusion about how to determine linguistic meanings given radical translation. Then, as a case study, I review a recent debate in metaphysics between Shamik Dasgupta, Jason Turner, and Catharine Diehl to consider the extent to which different instances of the structuralist schema are conceptually unified. Both sides of the debate can be interpreted as utilizing the structuralist approach; one side uses the structuralist approach for an ontological conclusion, while the other side relies on a semantic conclusion. I argue that this has a strong dialectical consequence, which sheds light on the conceptual unity of the structuralist approach.

1 Introduction

Assume that you faced a question that needs to be answered. It may be a simple yes-no question or an open-ended question that needs a more concrete answer. Also, you have a body of evidence that is available to you, which may support an answer or not. You are entitled to choose an answer if the body of available evidence determines it to be the acceptable answer; we can determine which answer enjoys more support than other possible answers. However, it is not guaranteed that the body of evidence always uniquely determines the answer; more than one incompatible answer may enjoy the same

* This is a preprint version of the paper to appear in *Synthese* as a part of Topical Collection on 'Indeterminacy and Underdetermination'.

evidential support. We may not be entitled to choose one answer since the evidence *underdetermines* the answers to the question.

This can be extended to the theory-level, which yields underdetermination of theories. More than one theory may aim to provide answers to the questions about some subject matter, and the body of evidence may not uniquely determine the theory that best addresses the questions; the evidence underdetermines the theories of the subject matter.

This paper provides an exposition of a specific type of approach to underdetermination, namely the *structuralist approach*. The structuralist approach is characterized by the way in which it resolves underdetermination; *if we can ascribe the same structure to the theories that are seemingly underdetermined by the total evidence, then the underdetermination can be resolved*. The structuralist approach has been employed in many areas of philosophy; each of them concerns underdetermination in a different subject matter, but they still employ the same strategy for resolving underdetermination. Hence, we can meaningfully inquire into the structuralist approach as a schema that underlies various attempts to resolve underdetermination in different subject matters, or so I argue in this paper.

First, I formulate the structuralist approach as a general schema that applies to an arbitrary case of underdetermination. I begin by considering the underdetermination of scientific theories by empirical evidence, which is a well-known case of underdetermination. Its domain-specific characteristics will be abstracted away to yield the generalized structuralist schema (Section 2). Then I consider two classic arguments, Benacerraf's (1965) structuralist argument about natural numbers and Quine's (1960b) indeterminacy of translation argument. I argue that they can be analyzed as applications of the structuralist approach. They are introduced to illustrate the kinds of conclusions we can derive by applying the structuralist approach; Benacerraf's argument establishes an *ontological* conclusion about what natural numbers are while Quine's argument leads to a *semantic* conclusion about the meanings of linguistic items (Section 3). Based on this characterization, I consider a case study that involves an interaction between these different conclusions of the structuralist approach. I review a recent debate between Dasgupta (2009; 2017), Turner (2011; 2017), and Diehl (2018), which involves many different applications of the structuralist approach. It is argued that the interplay between such different applications can play a major dialectical role in this debate, which indicates that different instances of the structuralist schema are conceptually unified in a significant sense (Section 4).

2 Characterizing the Structuralist Approach

In this section, I provide a general characterization of the structuralist approach to underdetermination. First, I describe the scope of underdetermination to which the structuralist approach is applicable (Section 2.1). Then I present in a schematic way how underdetermination can be resolved when you can identify the common structure of the theories, which yields the structuralist schema (Section 2.2).

2.1 Underdetermination

Underdetermination is a phenomenon that can arise in a wide array of subject matters, so an adequate characterization of underdetermination should be general enough to encompass different cases of underdetermination. As the first step, I specifically consider the underdetermination of scientific theories by empirical evidence, which is a well-known case of underdetermination *simpliciter*. For example, Turnbull (2018) offers the following characterization of scientific underdetermination:

> When we assert that scientific theory choice is underdetermined by evidence, we mean that evidence by itself cannot direct a scientist to accept or reject a theory. (Turnbull 2018, 2)

A well-recognized example of scientific underdetermination can be found in non-relativistic quantum physics.[1] Different physical theories, or 'the interpretations of quantum physics', have been proposed to account for the quantum phenomena, and it is widely agreed that the available empirical evidence from non-relativistic quantum physics underdetermines the theories. The theories enjoy the same predictive success and there is little consensus about which theory should be accepted based on the available body of evidence. Hence, it is claimed that theories of non-relativistic quantum physics are underdetermined by empirical evidence.

We can yield a more general characterization of underdetermination we need by tweaking Turnbull's above characterization of scientific underdetermination. First, "scientific theory" in the above characterization needs to be replaced with a more general notion that is not exclusive to the domain of empirical science. For example, the case of underdetermination which will be reviewed in Section 3.1 does not fall under the empirical domain, which implies that the notion of "evidence" needs to be generalized accordingly. Since the scope of underdetermination we discuss is not exclusive to the empirical domain, empirical data does not exhaust the notion of evidence in the present context. The

1 See, e.g., Lewis (2016, chap. 3) for an accessible introduction to the underdetermination of quantum theories.

notions of "theory" and "evidence" need to be understood in a way that encompasses non-empirical domains as well.[2]

Hence, we have a more generalized characterization of the underdetermination of theories by evidence. For the present purpose, this characterization also needs to be restricted though. First, we are only concerned with "contrastive" underdetermination (Stanford 2017, sec. 3), which involves more than one actual theory in rivalry. We are not asked to consider an individual theory in isolation but instead asked to determine which theory should be accepted among many. Underdetermination implies that there is no epistemic basis to determine which theory is to be accepted; the rivaling theories are in a stalemate. Second, we expect the rivaling theories to be underdetermined *in principle*. No further advance of knowledge should be expected to resolve the stalemate between the rivaling theories. The "transient" cases of underdetermination are not within the scope of the present notion of underdetermination; we do not mean to accommodate the case of underdetermination that seems to arise merely because the currently available evidence is limited (Sklar 1975; Stanford 2001).

Based on these qualifications, the notion of underdetermination we need can be schematically put as follows: Rivaling theories of the given subject matter are underdetermined if you cannot determine which theory to accept based on any evidence in principle. This formulation characterizes the intended target of the structuralist approach to underdetermination.

2.2 The Structuralist Schema

The structuralist approach aims to resolve underdetermination by closing the gap between the rivaling theories. Its key insight lies in ascribing the same structure to the seemingly underdetermined theories. Suppose that the theories T_1 and T_2 about the subject matter M seem to be underdetermined by the evidence in M. It turns out, however, that there is a reason to believe that T_1 and T_2 have the same

2 I remain neutral about the exact criterion of 'having the same evidential status', e.g., whether theoretical virtues such as simplicity and mathematical elegance also count as evidence, for two reasons. First, the criterion may be domain-relative. See, e.g., Mizrahi (forthcoming) for an empirical study on the use of theoretical virtues across different scientific fields and Saatsi (2017) for the discontinuity between science and metaphysics in their use of theoretical virtues. Second, the criterion is often disputed, especially when the structuralist approach is concerned. For example, as will be discussed in Section 3.1, Benacerraf's (1965) structuralist argument rests upon the premise that Zermelo and von Neumann accounts of natural numbers have the same evidential status, but Steinhart (2002) resisted the argument by appealing to von Neumann account's theoretical virtues (also see Clarke-Doane 2008; D'Alessandro 2018; Mount 2019). It indicates that even a well-received instance of the structuralist approach leaves room for further debate about 'having the same evidential status' (also see footnote 8). The aim of the present paper does not lie in vindicating the success of individual structuralist arguments, so we remain neutral about whether various pairs of theories considered by structuralists indeed have the same evidential status. I thank anonymous reviewers for this question.

theoretical *structure* on an independent standard. That is, we can identify, or at least be confident about, the common structure shared by the theoretical contents of T_1 and T_2.[3] The notion of 'same theoretical structure' can be possibly explicated in different ways; some may appeal to logical notions such as 'isomorphism', 'mutual interpretability', etc., while others may employ more abstract mathematical tools such as group theory or category theory.[4] It may also depend on what the subject matter M is; for example, theories in physics may embed "empirical structure" that goes beyond what is embedded in theories in pure mathematics, which may call for a different explication (Weatherall 2019b, sec. 1). Whichever explication we accept, the more important philosophical desideratum is that the structure we ascribe to both T_1 and T_2 should sufficiently capture the gist of the given subject matter M on its own; it should be strong enough to convince that the disagreement between T_1 and T_2 is not substantial, if at all, concerning M.[5] If we can indeed identify such a common structure of T_1 and T_2, then the theoretical contents of T_1 and T_2 should be construed as essentially the same, at least with regard to M; the disagreement between T_1 and T_2 is merely apparent.[6]

This explains why the total evidence available in M seems to underdetermine T_1 and T_2; if they are essentially the same theory, then they should trivially have the same evidential status. The debate

3 It should be noted that the present sense of 'structure' is ascribed to theories, which makes it different from Sider's (2011) notion of 'structure' that is ascribed to the world. For instance, Sider stresses that his "use of the term 'structure' has nothing to do with structuralism. The question is rather whether anything about mass, ontology, modality, or disjunction is woven into the ultimate fabric of reality, so to speak." (Sider 2020, 16) Nevertheless, Sider's notion of 'structure' plays an important role in his discussion of the structuralist sense of 'structure' (Sider 2020); see footnote 6 for a related discussion. I appreciate an anonymous reviewer for this question.

4 See Resnik (1981, sec. 2) and Shapiro (1997, sec. 3.4) for classic discussions of various logical notions as an explicans of the notion of the 'same' structure (or pattern) in mathematics, and see Korbmacher and Schiemer (2018) for a critical discussion of 'structural properties' in mathematics. Regarding the scientific domain, especially physical sciences, see Weatherall (2019a; 2019b) and Barrett (2020) for general surveys and Ladyman (2016, sec. 4.1) for the group-theoretic approach.

5 The present characterization presumes that the sameness of the structure is decided relative to the given subject matter M, rather than in a holistic fashion. It accords with, for example, Benacerraf's (1965) argument that identifies the common structure relative to arithmetic, but not to set theory (cf. McLarty 1993), as will be discussed in Section 3.1. It does not preclude, however, the possibility of a holistic approach, which requires generalizing the parameter M to all subject matters (see footnote 11 for a related discussion about Quine's approach). I appreciate an anonymous reviewer for this point.

6 It may be asked whether 'having the same structure' in this sense resolves into 'theoretical equivalence' *simpliciter*. I suggest that this is not necessarily the case. First, it may be argued that 'having the same structure' is insufficient for 'theoretical equivalence'. For example, suppose that no formal criteria can be given for theoretical equivalence (Weatherall 2019b, sec. 2); insofar as the notion of 'structure' is to be understood through some formal explication, the same structure cannot guarantee theoretical equivalence. Second, more importantly, 'having the same structure' may not be necessary for 'theoretical equivalence' given the assumption that we should be able to identify the common structure between different theories. For example, Sider's (2020, chap. 5) fundamentality-based approach to theoretical equivalence implies that theoretical equivalence is "nontransparent"; what determines equivalence is the fundamental reality that is represented by the theories, the epistemic access to which is not guaranteed by examining the theories given to us. If this is the case, the sense of 'theoretical equivalence' does not require 'having the same structure'. I appreciate an anonymous reviewer for this question.

between the proponents of T_1 and T_2 is largely misguided since, unbeknownst to them, they are arguing for the theories saying the same thing at the bottom. In the scientific domain, for example, Norton (2008) proposes that a pair of seemingly underdetermined theories can turn out to be the same theory in virtue of their common theoretical structure:

> If it is possible for us to demonstrate the observational equivalence of two theories in a tractable argument, then they must be close enough in theoretical structure that we cannot preclude the possibility that they are variant formulations of the same theory. (Norton 2008, 33)

When we can succinctly show that a pair of scientific theories agree in their observational consequences, Norton argues, there is a *pro tanto* reason to believe that their contents share the same theoretical structure. We might not be able to show their observational equivalence in any succinct way were it not for their common theoretical structure. Hence, even though a pair of theories may look incompatible, we can construe them as different formulations of the same empirical theory given their common structure.[7]

Once it is established that they are different formulations of the same theory, their underdetermination can be naturally resolved: Since the disagreement between the rivaling theories turns out to be merely apparent, accepting one theory does not amount to rejecting others. You can accept one theory and reject another only at the expense of self-contradiction because such different formulations turned out to have essentially the same content. Recall that theories can be underdetermined only if no available evidence directs us to accept one theory over another. As you cannot consistently accept one formulation and reject another at the same time, underdetermination cannot arise from the given scientific theories. It implies that our belief in the apparent case of scientific underdetermination was mistaken.

Norton's structuralist approach to scientific underdetermination can be applied *mutatis mutandis* to underdetermination in other subject matters. We can consider the following two conditions for the applicability of the structuralist approach:

(i) You should be entitled to believe that the rivaling theories are underdetermined by the total evidence.

(ii) You should be entitled to ascribe the same structure to the competing theories.

7 Also see Frost-Arnold and Magnus (2009) for a critical discussion of Norton's approach in the scientific domain.

The relationship between (i) and (ii) can be subtle: For example, if Norton is correct, (i) itself can be indicative of (ii) in the scientific domain. Conversely, if (ii) can be supported on an independent basis, one may use that to support (i); identification of the common theoretical structure can be employed as a reason to believe that the seemingly rivaling theories enjoy the same evidential status.[8] For the present context, all we need is that (i) and (ii) are together sufficient for the structuralist approach to be applicable.

When these two conditions are met, the structuralist approach concludes that there is a reason to believe that the seemingly competing theories are different formulations of the same theory about the given subject matter. The disagreement between them is merely apparent; the proponents of the competing theories are talking past each other when they argue about which theory to accept. Underdetermination in the given subject matter is thereby resolved.

This general description of the structuralist approach provides what I shall call '*the structuralist schema*' in a loose sense: Given any arbitrary subject matter, we can possibly tell an application of the structuralist approach by observing whether the schema can be satisfied by the theories of the subject matter. Hence, we can say that such different applications follow the same pattern; even though each application only applies to its own subject matter, underdetermination is resolved using the same general strategy.

Some disclaimers should be noted. First, the paper does not purport to provide a precise application procedure by which you can algorithmically tell whether the structuralist approach applies to the given subject matter; after all, it remains non-committal about the explication of key notions such as 'same theoretical structure'. Second, the paper does not aim to defend the reliability of the structuralist approach. It does not defend each individual structuralist argument from possible critiques that either the condition (i) or (ii) is unsatisfied, which may refute the applicability of the structuralist schema. Moreover, the validity of the structuralist schema itself can be questioned by its critics; it may be argued that making an arbitrary choice between the underdetermined theories is epistemically

8 A similar example can be found in Muller's (1997) analysis of Schrödinger's attempted proof of the mathematical equivalence between wave mechanics and matrix mechanics; Schrödinger attempted to show the empirical equivalence of wave mechanics and matrix mechanics by establishing their mathematical equivalence. I also suggest that the reason why Benacerraf's (1965) structuralist argument is widely accepted even after Steinhart's (2002) objection (see footnote 2) can be explained via (ii). As will be described in Section 3.1, we can identify the common structure between von Neumann and Zermelo accounts of numbers, and this discovery alone might have convinced structuralists to believe that they should have the same evidential status; given that theoretical virtues play a *pro tanto* evidential role at most, structuralists may argue that Steinhart's reason is not strong enough to overcome the justified belief that von Neumann's and Zermelo's accounts should have the same evidential status.

justified (Paseau 2009) or that we cannot derive a significant, especially ontological, conclusion about the identity of the underdetermined theories (Gasser 2015).

The aim of this paper does not lie in defending the structuralist approach against such possible concerns. Instead, it aims to examine different applications of the structuralist approach and ask how they fit together. At this stage, the structuralist schema is laid out in a rather abstract manner which tells us little about its instances; we know that its instances follow the same general strategy, but we cannot be sure if its instances bear any significant connection to each other in a philosophically interesting sense. It will be argued in the remainder of this paper that they indeed are conceptually unified in a significant way.

3 What the Structuralist Approach Tells Us: Ontology and Semantics

In this section, I examine the classic arguments by Benacerraf (1965) and Quine (1960b), arguing that both can be interpreted as applications of the structuralist approach. They take place in different domains, i.e., philosophy of mathematics and language respectively, yet it is argued they still follow the same schema. What makes them even more interesting is that they illustrate what *kinds* of conclusions we can draw from the structuralist approach. Benacerraf's argument allows us to draw an ontological conclusion about arithmetic (Section 3.1), while Quine’s conclusion grounds a (meta-)semantic principle about linguistic items (Section 3.2). These notable cases tell us different possible upshots of the structuralist approach, which will provide a background for the next section.

3.1 Benacerraf on Natural Numbers

In philosophy of mathematics, the structuralist approach can be naturally associated with structuralism. Recent scholarship has shed light on the historical and philosophical root of structuralist thoughts in mathematics that dates back far before the 20th century, but Benacerraf’s (1965) classic paper remains as an influential vantage point in the analytic tradition for several reasons.[9] First, his structuralist approach is directly motivated by underdetermination. Second, it is explicitly concerned with an ontological question of what natural numbers really are.

9 See Resnik (1981; 1997), Hellman (1989), and Shapiro (1997) for some classic structuralist accounts in the analytic tradition, and see Hellman and Shapiro (2018) and Reck and Schiemer (2020a) for recent surveys. Also, see Reck and Schiemer (2020b) for the historical background of structuralism.

Benacerraf's argument is based on his observation that the set-theoretic accounts of ordinals are underdetermined by what we take natural numbers to be. Both Zermelo's and von Neumann's set-theoretic accounts of finite ordinals are adequate for arithmetic, but they clearly disagree about which set-theoretic construct needs to be identified with each natural number. For example, they will give different answers to the question of whether 3 belongs to 17, which stems from their disagreement about what 3 and 17 amount to. Given the absence of evidence that favors one account over another, we are not in a position to choose either as the correct set-theoretic account in a non-arbitrary manner.[10] Zermelo's and von Neumann's accounts are underdetermined by the evidence about arithmetic.

> the correct one must be the one that picks out which set of sets is *in fact* the numbers. We are now faced with a crucial problem: if there exists such a "correct" account, do there also exist arguments which will show it to be the correct one? (Benacerraf 1965, 57)

Benacerraf argues that "such questions miss the point of what arithmetic, at least, is all about" since "the mathematician' interest stops at the level of structure." (Benacerraf 1965, 69) It has been known since Dedekind's ([1888] 1963) categoricity proof that there is a sense in which the same structure can be ascribed to any theory that counts as adequately describing natural numbers. The disagreement between Zermelo's and von Neumann's accounts has little to do with the abstract structure of Peano axioms, which is what arithmetic is about. Therefore, from an arithmetical point of view, Zermelo's and von Neumann's accounts should be construed as different formulations of the same theory.

> Arithmetic is therefore the science that elaborates the abstract structure that all progressions have in common merely in virtue of being progressions. (Benacerraf 1965, 70)

Hence, underdetermination is naturally resolved; since they concern the same structure, it is mistaken to believe that accepting one account amounts to rejecting another. Neither Zermelo's nor von Neumann's account should be understood as what uniquely describes the nature of natural numbers; what matters is the abstract structure that they have in common.

By resolving the underdetermination, Benacerraf draws an ontological conclusion that any set-theoretic attempt to define the intrinsic nature of a natural number is misguided. Since all that arithmetic commits us to is the abstract structure, natural numbers can only be characterized with reference to the abstract structure they belong to.

10 See footnotes 2 and 8 for related discussions about Benacerraf's observation of underdetermination.

> numbers are not objects at all, because in giving the properties (that is, necessary and sufficient) of numbers you merely characterize an *abstract structure* – and the distinction lies in the fact that the "elements" of the structure have no properties other than those relating them to other "elements" of the same structure. (Benacerraf 1965, 70)

Modern structuralists are divided about how to interpret the upshot of Benacerraf's argument; eliminative structuralists interpret it as dispensing with *the* natural numbers while non-eliminative structuralists still keep natural numbers as abstract entities in their ontology (Parsons 1990). What's more important in the present context is that the structuralist approach allows us to read off a revisionary ontology of the subject matter from the common structure. It indicates that the structuralist approach can be applied to other subject matters so as to derive an ontological conclusion. In Section 4.1, I will discuss another instance of the structuralist approach where its ontological upshot matters.

3.2 Quine on Linguistic Meanings

Benacerraf's structuralist approach is primarily concerned with an ontological thesis, but it can also be understood as supporting a semantic thesis about the referents of numerals. "The number words do not have single referents" (Benacerraf 1965, 71) since both Zermelo's and von Neumann's accounts can adequately offer the referents of natural number terms. It indicates that the structuralist approach can also bear a semantic conclusion about linguistic items.

Quine's (1960b) argument for the indeterminacy of translation has been recognized as a case where underdetermination compels us to accept a sweeping conclusion about the entirety of linguistic meanings.[11] His semantic conclusion can be stated as the following:

> manuals for translating one language into another can be set up in divergent ways, all compatible with the totality of speech dispositions, yet incompatible with one another. (Quine 1960b, 27)

A correct translation manual is expected to capture the synonymy between linguistic elements in different languages. If an English noun 'rabbit' means rabbit, an adequate translation manual between

11 Quine (1970; 1987) stressed that the indeterminacy of translation is not merely a special case of underdetermination of scientific theories by empirical evidence. According to Foellesdal's explanation, the difference is that "[i]n translation […] we are just correlating two comprehensive language/theories concerning all there is […] several translation manuals fit the same states and distributions of all elementary particles" (Foellesdal 1973, 295). That is, holism plays a decisive role in distinguishing the indeterminacy of translation from other cases of underdetermination (cf. Peijnenburg and Hünneman 2001). This paper does not take a stand on interpreting Quine's position, but the present characterization of the structuralist approach is consistent with such a holist approach as well (see footnote 5).

English and another language should be able to tell whether ‘rabbit’ is synonymous with a word in the language. Consider Quine’s beloved example ‘gavagai’. Some manuals may claim that ‘gavagai’ means rabbit as ‘rabbit’ does, while others may claim that ‘gavagai’ means something else. The correct manual is supposed to give a correct verdict about this question.

Quine observes that no available evidence can lead us to accept one manual over another when all we could appeal to is the radical translation. The only available evidence is “the totality of speech dispositions”, by which he means how a speaker of the language verbally reacts to the sensory stimulation she is subjected to. What we can establish at most is *stimulus synonymy* between linguistic items in different languages, which is determined by the sameness of the speech dispositions corresponding to each item. Stimulus synonymy falls short of providing synonymy that is expected. Even though ‘rabbit’ and ‘gavagai’ may be stimulus-synonymous, it does not guarantees that ‘gavagai’ means rabbit.

Hence, the translation manuals are underdetermined by the total evidence available. Given that the translation manual is expected to capture all there is about the subject matter of linguistic meanings, there is no fact of the matter that determines whether ‘rabbit’ is synonymous with ‘gavagai’. Moreover, it calls into doubt whether there is any meaning at all when it is not determined by the speech disposition.

> we recognize that there are no meanings, nor likenesses nor distinctions of meaning, beyond what are implicit in people's dispositions to overt behavior. (Quine 1968, 187)

Hence, for example, there is little reason to believe that ‘rabbit’ determinately means rabbit in English in the first place. It does not compel Quine to give up semantics altogether though. Just as Benacerraf identifies the subject matter of arithmetic as the common structure of Zermelo’s and von Neumann’s accounts, the subject matter of semantics should be “the objective reality that the linguist has to probe when he undertakes radical translation” (Quine 1960b, 39), i.e., stimulus meaning. For example, what linguists probe should be the stimulus meaning of ‘rabbit’, which is identical to that of ‘gavagai’. Different translation manuals may disagree about whether ‘gavagai’ is synonymous with ‘rabbit’ or not, but it falls beyond the subject matter of linguistics properly understood. Hence, from the linguistic point of view, every translation manual that correctly captures stimulus synonymy should be construed as having essentially the same content. The underdetermination is naturally resolved since the translation manuals can now be construed as different formulations having essentially the same content.

I argue that Quine's argument thus construed can be interpreted as an instance of the structuralist schema; it resolves underdetermination by identifying the common structure (i.e., that of stimulus synonymy) between the seemingly competing theories (i.e., translation manuals), which aligns with the structuralist interpretation of Quine's position.[12] Note that Quine's argument leads to the *semantic* conclusion that "a distinction of meaning unreflected in the totality of dispositions to verbal behavior is a distinction without a difference." (Quine 1960b, 26) For example, asking whether 'gavagai' *really* means rabbit or rabbit-part is misguided since it goes beyond the totality of speech dispositions; it is no less misguided than asking whether the natural number 3 *really* is the singleton of natural number 2 as Benacerraf pointed out. Nevertheless, this inscrutability of 'gavagai' should not be confused with the nihilist claim that 'gavagai' is meaningless. The term 'gavagai' has a stimulus meaning, which makes it synonymous with 'rabbit'. The structuralist approach motivates us to affirm the common semantic structure shared by competing translation manuals, which is well-determined by the totality of speech dispositions.[13] This semantic upshot motivates the following metasemantic principle: *If two linguistic items have the same speech dispositions, then they have the same meaning*. In other words, the meaning of a linguistic item supervenes on its speech disposition.

Again, the aim of this paper does not lie in defending Quine's argument. Quine's indeterminacy thesis itself has faced objections since its inception (e.g., Chomsky 1968), and it even remains open whether Quine himself would have agreed with the present interpretation of underdetermination.[14] Instead, I consider what implication Quine's semantic conclusion may have if it is true. In the next section, I consider a recent debate where this semantic conclusion plays a critical role, examining how it interacts with other applications of the structuralist approach.

12 See Peregrin (2008; 2020) and Frost-Arnold and Magnus (2009, sec. 5). For example, Peregrin (2020) interprets the indeterminacy of translation in the context of Quine's (1992b) "global structuralism". That is, "what Quine claims can, in effect, be expressed so that the semantic structure of any language allows for some nontrivial automorphisms that leave any detectable semantic properties intact" (Peregrin 2020, 86). Also, see Morris (2020) for an exegesis of Quine's structuralist thoughts in mathematics.

13 Note that the semantic conclusion of the structuralist approach remains independent, at least conceptually, from Quine's meaning holism. The following metasemantic principle, for example, is consistent with the view that each linguistic item has its own meaning.

14 For instance, Quine seems to have a narrower conception of underdetermination than the one presented here, when he suggests that underdetermined theories "cannot be rendered logically equivalent to it by any reconstrual of predicates." (Quine 1975, 322)

4 Case Study: The Generalism Debate

In the preceding sections, I gave an exposition of the structuralist schema as well as its instances in different domains. Nevertheless, it remains to be asked if we can draw any philosophically interesting conclusion from this. Does the structuralist schema impart conceptual unity to its instances? Are they mutually independent or do they fit together in a significant sense? In this section, I examine a recent debate between Dasgupta (2009, 2017), Turner (2011, 2017), and Diehl (2018) to address these questions. What makes the debate interesting is that it involves multiple layers of different instances of the structuralist schema, including both the ontological and the semantic kinds of conclusions. I consider how these different conclusions of the structuralist approach come into play at the same time, arguing that they form a coherent position together. Hence, this case study intends to show that we can ascribe some conceptual unity to different applications of the structuralist approach.

First, I consider Dasgupta's generalism, a metaphysical position about individual objects. It is argued that generalism can be justified as an ontological conclusion of the structuralist approach (Section 4.1). Generalism, however, faces a semantic problem; its theory cannot be adequately expressed without a proper language, which motivates Dasgupta to propose an alternative language (Section 4.2). Turner challenges Dasgupta by arguing that his alternative language does not help. To show this, he appeals to the Quinean principle, which amounts to a semantic conclusion of the structuralist approach. Hence, both sides of the debate rely on the structuralist approach but in two different ways (Section 4.3). I consider Diehl's critique of Turner's argument and argue that it faces an objection stemming from yet another application of the structuralist approach (Section 4.4). However, I argue that it has a dialectical consequence; Turner's argument can be dialectically self-undercutting. It indicates that such different instances of the structuralist schema are coherent as a whole in the sense that they are epistemically stable together (Section 4.5).

4.1 Generalism as an Ontological Conclusion of the Structuralist Approach

Dasgupta (2009; 2017) propounds the metaphysical position he refers to as 'generalism'. Its subject matter is "the structure of the *material* world" (Dasgupta 2009, 37), which is taken to be governed by our best theories in physical sciences. His metaphysical concern is whether primitive individuals such as chairs and electrons should be recognized in the ontology of the material world. Insofar as such primitive individuals are presumed to be physical entities, an adequate theory about the physical reality is expected to decide whether such individuals should be accepted in its ontology or not.

He does not see underdetermination in the contemporary physical theories themselves. A disagreement arises between a metaphysical theory about the physical reality that recognizes primitive individuals and an alternative theory that does not. This is where Dasgupta witnesses underdetermination; "It is a consequence of every physical theory considered over the past 400 years that primitive individuals are danglers" in the sense that primitive individuals can be consistently posited yet are physically redundant and empirically undetectable (Dasgupta 2009, 40). Nor does he believe that any future advance of technology can adjudicate this disagreement. Hence, no available evidence about the physical reality seems to determine whether we should accept the theory that recognizes primitive individuals or its alternative that doesn't.

> imagine a situation in which everything is exactly the same except that a different primitive individual is in front of you. Suppose this different individual has exactly the same qualities as the actual chair in front of you: imagine it were colored the same, shaped the same, and so on. The analogous thought to that in the case of velocity is that the situation would look and feel and smell exactly the same to you: we cannot tell the difference between situations that differ only in their individualistic facts. (Dasgupta 2009, 42)

Dasgupta's generalism concludes that we can dispense with primitive individuals from our fundamental ontology. He compares it to how absolute velocity is considered unreal, arguing that "we should reject primitive individuals for the same reason that contemporary orthodoxy rejects absolute velocity" for being underdetermined (Dasgupta 2009, 37).

Generalism can be understood with reference to the structuralist schema.[15] The underdetermination between a theory that recognizes primitive individuals and its rival that doesn't recognize individuals can be resolved; their common structure, which is described by the well-established physical theories themselves, is agnostic about primitive individuals from the start. The underdetermination itself arose only because we asked extra metaphysical questions about primitive individuals. From the physical point of view, the rivaling theories about material individuals should be

15 It is unclear if Dasgupta himself adopts the structuralist approach for deriving generalism since his "justification for [generalism] is broadly speaking Occamist" (Dasgupta 2009, 44), which resembles a more traditional appeal to ontological parsimony (cf. French 2018). It does not cause a problem in the present paper (especially in Section 4.5) because what will matter is the case that generalism *can* be derived on the basis of the structuralist approach as described in this section. Dasgupta's analogy with absolute velocity strengthens this point since the case of absolute velocity has been explained through the structuralist approach (Frost-Arnold and Magnus 2009).

viewed as different formulations of the same physical theory. Material individuals are, at best, nothing more than the "elements" of the holistic structure that is affirmed by the physical theories, which resembles Benacerraf's deflationary attitude toward natural numbers. Hence, Dasgupta's generalism, thus construed, can be understood as an ontological thesis that we can derive by applying the structuralist schema.[16]

4.2 The Expressibility Challenge

One of the serious problems with generalism Dasgupta anticipates concerns how to express the theory of the structure of the material world in a way that reflects the generalist ontology, which Diehl (2018) refers to as 'the expressibility challenge'. An adequate formulation of the physical theory should not be committed to primitive individuals that generalism is agnostic about. Dasgupta believes that the conventional language of first-order logic (FOL), which adopts quantifiers, is insufficient to meet this standard since it seems to be inherently committed to primitive individuals.

> [the FOL-formulation] is unacceptable. After all, we have been brought up to understand that quantifiers range over a domain *of individuals*. So our natural understanding of the facts listed above is that they hold in virtue of facts about individuals, and it would therefore appear that we have made no progress. (Dasgupta 2009, 50)

If your FOL language inevitably refers to primitive individuals that the physical theory fails to determine, then it lends itself to underdetermination since an unwanted question about primitive individuals can arise again. To prevent this from happening, Dasgupta considers an alternative theory that avoids any reference to individuals.

His preferred option is a variant of Quine's (1960a; 1976; 1981) predicate functor logic (PFL), which is proved to be intertranslatable with FOL. The primary characteristic that distinguishes his system from FOL is that its domain does not consist of individuals but properties of different adicities. The "functors" of PFL take such properties as their operands and generate more complex properties. A notable example is the 'derelativization' or 'cropping' functor 'c', the formal function of which is defined as generating an n-place property cF given an arbitrary (n+1)-place property F. Intuitively, the role of 'c' is comparable to that of '∃' in FOL:

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16 See French and Redhead (1988) for a very similar argument with relation to individuals in quantum physics (also see Section 5). I thank an anonymous reviewer for this point.

> if L^2 is the 2-place property of loving, which we ordinarily understand as holding between individuals *x* and *y* if and only if *x* loves *y*, then cL^2 is the 1-place property of being loved by someone, which we ordinarily understand as being instantiated by an individual *y* if and only if someone loves *y*. Very roughly, *c* partially "fills" a property by stating, as we ordinarily say, that something instantiates its first position. (Dasgupta 2009, 53)

While '*c*' in PFL is a counterpart of the existential quantifier in FOL, Dasgupta maintains that it does not refer to any primitive individual. For example, 'cL^2' only refers to the monadic property of being loved by someone without any commitment to an individual.[17] By the same token, you can yield the 0-place property ccL^2, which "we might ordinarily understand as a state of affairs, namely the state of someone loving someone." (Dasgupta 2009, 53) By claiming that the 0-place property obtains, you can replace an existential statement such as 'There exist *x* and *y* such that *x* loves *y*.'[18] Hence, by generalization, PFL proves to be an adequate alternative to FOL that does not refer to primitive individuals without compromising the expressive power of FOL.

The expressibility challenge concerns where ontology meets semantics. If generalism is to be maintained, the semantic criterion also needs to be met through a proper linguistic framework that prevents underdetermination. Dasgupta suggests PFL as the framework that meets this standard, arguing that the theory about the structure of the material world can be properly cast in a way that avoids a possible threat of underdetermination.

4.3 An Argument From (*) as a Semantic Conclusion of the Structuralist Approach

The premise of Dasgupta's solution to the expressibility challenge is that the cropping functor '*c*' (with the help of other functors) adequately replaces the existential quantifier '∃' without referring to primitive individuals. This is what makes PFL an 'ontologically innocent' replacement of FOL that aligns with generalism. Jason Turner (2011; 2017) challenges this premise, arguing that PFL is as 'ontologically guilty' as FOL is. Insofar as FOL refers to primitive individuals, PFL should be interpreted in the same way. Therefore, PFL does not successfully answer the expressibility challenge, which thereby puts generalism in danger.

17 Note that it is unclear if Quine himself endorsed this view about PFL's ontological commitment (see Quine 1992a, 27).

18 Dasgupta's (2009) own variant of PFL, which he calls 'G', has 'obtains' as an additional primitive operator that only takes 0-place properties as its operand. I will gloss over this difference in the present paper but see Turner (2017, sec. 3) for the critique of Dasgupta's approach specific to G.

Turner's argument aims to show that '*c*' effectively refers to primitive individuals as much as '∃' does. Technical details aside, his argument begins with constructing an analog of FOL, which I shall call 'FOL⁻'. By construction, FOL⁻ is a notational variant of FOL that is as ontologically guilty as FOL is. Nevertheless, FOL⁻ is nearly identical to PFL in that they share almost the same set of logical constants; instead of the set of operators used in a typical presentation of FOL, FOL⁻ is equipped with the logical functors that are employed in PFL. The only salient difference between FOL⁻ and PFL is that FOL⁻ has an operator '$\exists^-$',[19] which refers to primitive individuals by construction, in place of '*c*' in PFL. Consider, for example, the PFL sentence 'ccL^2', which roughly translates to 'someone loves someone'. Its FOL⁻ counterpart will be '$\exists^-\exists^-L^2$', which refers to primitive individuals, someone who loves and someone who is loved.

Given PFL and FOL⁻, Turner argues that '*c*' and '$\exists^-$' are synonymous; hence, it cannot be the case that '*c*' does not refer to primitive individuals while '$\exists^-$' does. To justify his conclusion, Turner proposes a metasemantic principle he calls '(*)', which can be broken down as follows:

(*)-principle (Turner 2017, 33; cf. 2011, 17)

- [(a)] If L_1 and L_2 are languages with all terms in common except that L_2 has a term β in place of L_1's term α, and
- [(b)] if all shared terms have the same interpretation in both languages, and
- [(c)] if speakers of L_1 will assent to a sentence with α when and only when speakers of L_2 will assent to the corresponding sentence with β replaced for α, and vice versa,
- then α and β have the same interpretation.

The conditions (a) and (b) require that L_1 and L_2 are identical with the exception of α and β; α in L_1 and β in L_2 should be mutually replaceable in every sentence. The condition (c) needs to be understood dispositionally; it should be the case that for any circumstance *C*, a speaker of L_1 is disposed to assent to the L_1 sentence with α in *C* iff a speaker of L_2 is disposed to assent to the corresponding L_2 sentence with β replaced for α in *C* (Turner 2011, 18). These three conditions together establish that α and β have the same speech disposition; an L_1 speaker is disposed to use α when and only when L_2 speaker is disposed to use β.

19 I will use the notations 'FOL⁻' and '$\exists^-$' instead of Turner's (2017) notations '$F_{\exists_P}$' and '$\exists_P$' for readability.

According to (*), α and β will have the same interpretation if all three conditions are met. Hence, (*) effectively amounts to the Quinean metasemantic principle introduced in Section 3.2; the same speech disposition implies the same meaning. It shows that the difference between α and β is merely apparent given that L_1 and L_2 share the same structure. Therefore, (*)-principle establishes that ‘*c*’ in PFL and ‘$\exists^-$’ in FOL^- have the same interpretation; PFL and FOL^- meet all three conditions by construction. For example, the PFL sentence ‘ccL^2’ and its FOL^- counterpart ‘$\exists^-\exists^-L^2$’ will be assented in the same set of possible circumstances, i.e., when and only when someone loves someone. As ‘*c*’ and ‘$\exists^-$’ have the same semantic interpretation, they should also agree on whether they refer to primitive individuals. Insofar as FOL^- with ‘$\exists^-$’ is as ontologically guilty as FOL with ‘∃’ is, PFL with ‘*c*’ cannot be ontologically innocent. The expressibility challenge remains unresolved for generalism.[20]

Thus, Turner argues against generalism using (*), the Quinean principle that amounts to a semantic conclusion of the structuralist approach. Such a critical reliance on (*) will be of central importance to Catharine Diehl’s (2018) critique of Turner’s argument.

4.4 Examining Diehl-style Counterexamples

In her discussion of the expressibility challenge, Diehl (2018) focuses on Turner’s use of (*), which she identifies as a dispositionalist principle that can only be justified based on the Quinean approach to linguistic meanings.

> [(*)] might be a good guide to radical translation, but it only serves as a good guide to *meaning* if we take the controversial—and, I think, ultimately unsustainable—view that interpretation under radical translation is equivalent to meaning. (Diehl 2018, 981)

Diehl aims to show that (*) is implausible, thereby undercutting Turner’s argument. To support this, she presents several pairs of linguistic items having the same speech disposition and yet intuitively different interpretations, which can be called ‘Diehl-style counterexamples’. For the sake of convenience, I will focus on her example that slightly modifies Benacerraf’s case discussed in Section 3.1.

20 I argue elsewhere that this inference is problematic for an independent reason even when we accept (*), but this is beyond the scope of this present paper. It allows us to maintain that a generalist can coherently overcome the expressibility challenge without rejecting (*), which makes generalism “epistemically stable” unlike the case that will be discussed in the next section. I thank an anonymous reviewer for this point.

Imagine Ernie and Johnny who learned about Zermelo and von Neumann ordinals respectively, calling them ‘VN-numbers’ and ‘Z-numbers’. Under the assumption of Platonism, both learned that such set-theoretic constructs are distinct from natural numbers, yet are capable of accounting for arithmetic relationships holding between natural numbers. Hence, they decided to replace the term ‘natural number’ that appears in every arithmetic statement with ‘VN-number’ and ‘Z-number’ respectively. For example, consider the following arithmetic statement:

(N) Every natural number has a natural number that is bigger than it.

Instead of saying (N), Ernie and Johnny will say the following:

(N-VN) Every VN-number has a VN-number that is bigger than it.

(N-Z) Every Z-number has a Z-number that is bigger than it.

Whenever they are disposed to say (N), Ernie now says (N-VN) and Johnny says (N-Z). Based on this setting, Diehl presents the following scenario:

> Now, imagine that they forget all the set theory they know. They both subsequently just use the language of arithmetic and the additional predicate ‘VN-number’ or ‘Z-number,’ but their languages differ in that Ernie says ‘VN-number’ where Johnny says ‘Z-number.’ According to (*), ‘VN-number’ and ‘Z-number’ have the same meaning because Ernie and Johnny will use them in all the same possible contexts, since they will agree on everything statable within the language of arithmetic. On the other hand, on the assumption that the meaning of a term depends on the act of reference fixing, ‘VN-number’ will be interpreted differently from ‘Z-number’ because the extension of ‘VN-number’ is the set of finite von Neumann ordinals. (Similar reasoning will hold for the predicate ‘Z-number.’) (Diehl 2018, 987)

Without set-theoretic knowledge, the terms ‘VN-number’ and ‘Z-number’ will have the same speech disposition. (*) will then imply that they have the same meaning, which seems incorrect; whether Ernie and Johnny remember it or not, ‘VN-number’ and ‘Z-number’ refer to distinct set-theoretic constructs. Hence, the pair of ‘VN-number’ and ‘Z-number’ constitutes a counterexample to (*).

I suggest that defenders of (*) can possibly offer a rejoinder to the Diehl-style counterexample. Its core idea is that affirming the Diehl-style counterexample leads to a revival of the underdetermination observed by Benacerraf (1965). That is, we will witness a massive disagreement about arithmetic despite the sameness of its structure. As discussed in Section 3.1, the structuralist approach resolves the disagreement by closing the gap between the seemingly competing theories, and I argue that this is not great news for the Diehl-style counterexample. For closing the gap between the theories also dissolves the difference in interpretation between 'VN-number' and 'Z-number', which refutes the Diehl-style counterexample.

The starting point for this argument is the desideratum of the Diehl-style counterexample that 'VN-number' and 'Z-number' have different interpretations; it aligns with Diehl's description that 'VN-number' stands for von Neumann ordinals and 'Z-number' for Zermelo ordinals.[21] Both Ernie and Johnny know what they mean before they forget set theory; Ernie was taught that von Neumann ordinals, which are referred to in (N-VN), are ontologically distinct from natural numbers, and *mutatis mutandis* for Johnny. The question is: What do Ernie and Johnny mean by (N-VN) and (N-Z) after they forget set theory? Without remembering anything about von Neumann and Zermelo ordinals, do Ernie and Johnny still mean different things when they say (N-VN) and (N-Z) respectively?

Is it possible for (N-VN) and (N-Z) to have the same meaning once the speakers forget set theory? The most serious problem with this option is that it does not sit well with the desideratum that 'VN-number' and 'Z-number' have different interpretations. Recall that (N-VN) and (N-Z) are identical except for (N-Z) having 'Z-number' swapped for 'VN-number' in (N-VN). Given the compositionality of meaning, (N-VN) and (N-Z) should have different meanings due to the supposed (truth-conditional) difference between the interpretations of 'VN-number' and 'Z-number'. Therefore, the given desideratum seems to prevent (N-VN) and (N-Z) from having the same meaning.

The remaining option, then, is to assume (N-VN) and (N-Z) as having different meanings even after Ernie and Johnny forget set theory. This is what leads to Benacerraf's underdetermination again. To see this, we may first contrast Ernie's epistemic states before and after forgetting set theory. Even though Ernie decided to say (N-VN) instead of (N), he did not believe that (N-VN) and (N) are synonymous before forgetting set theory; he knew that sets are distinct from natural numbers. Once he forgets set theory, however, he can no longer see the difference in meaning between (N-VN) and (N). For he no longer knows that the referents of 'VN-number' (i.e., von Neumann ordinals) exist apart from natural numbers; all he knows is that he can use the term 'VN-number' in arithmetic statements in

21 Diehl claims that "[t]he sort of meaning differences [in Diehl-style counterexamples] are all differences in the truth conditions for the terms" given that "[(*)] is supposed to hold for […] coarse grained meanings" (Diehl 2018, n. 28); the desideratum of a Diehl-style counterexample should be that the terms with the same disposition have different referents or extensions. It implies, for example, that the difference in *how* the referent is fixed does not constitute the "sort of meaning differences" we need by itself (see footnote 22 for a related discussion).

place of ‘natural number’. Hence, Ernie is now disposed to believe that (N-VN), the meaning of which he cannot distinguish from that of (N), expresses a truth of arithmetic and *mutatis mutandis* for Johnny.[22]

It results in Ernie and Johnny, unknowingly, getting into a disagreement; Ernie endorses (N-VN) while Johnny endorses (N-Z), which are assumed to have different meanings. Their disagreement does not stop here. By generalization, for any sentence in arithmetic that involves ‘natural number’, Ernie is disposed to believe that it is synonymous with the corresponding sentence with ‘VN-number’, and the same goes for Johnny. Hence, Ernie ends up endorsing the theory of von Neumann ordinals for arithmetic while Johnny endorses the theory of Zermelo ordinals. This is tantamount to the underdetermination Benacerraf (1965) observed; the disagreement between the theories endorsed by Ernie and Johnny cannot be settled by the arithmetical structure since they refer to distinct set-theoretic constructs. Of course, Ernie and Johnny are oblivious of what their theories *really* are since they forgot set theory. Nevertheless, the disagreement remains as long as we insist that (N-VN) and (N-Z) have different meanings whether the speakers are aware of it or not. We have two competing theories, Ernie’s and Johnny’s, which still share the common structure.

We saw in Section 3.1 how Benacerraf resolved the underdetermination by drawing an ontological conclusion of the structuralist approach; numbers are not sets and the theories of von Neumann and Zermelo ordinals should be viewed as different formulations of the same theory. The defenders of (*) will argue that we should follow in the same footsteps here. Ernie and Johnny’s theories in the given context should be construed as different formulations of the same theory; whether the theory involves the term ‘VN-number’ or the term ‘Z-number’ does not make difference to what the theory means. Once we accept this structuralist conclusion, it seems hard to maintain that ‘VN-number’ and ‘Z-number’ have different meanings in a situation where the speakers no longer remember set

22 When Ernie forgets set theory, does he also forget how the referents were fixed? If not, Ernie may still be able to discern the difference in meaning between (N-V) and (N); he knows at least that ‘VN-number’ and ‘natural number’ do not have the same meaning because he remembers the reference-fixing facts. Granted, this option is still at odds with Diehl’s broader project of confronting (*) though. She predicts that the knowledge of reference-fixing facts is exactly the kind of resources that the defenders of (*) may exploit to deflect her counterexamples; if the speakers knew the reference-fixing facts, then they would not react the same. As a response, Diehl argues that this response is unsuccessful “since to judge if two terms differed in meaning, we would have to know the reference of these terms” (Diehl 2018, 982); appealing to the reference-fixing facts presupposes that the given terms do not have the same interpretation, which is question-begging. In the present case, however, the onus is on the defenders of the Diehl-style counterexample, who argued that we can discern the difference in meaning through the knowledge of the reference-fixing facts. Hence, supposing that Ernie remembers the reference-fixing facts dialectically does not seem to help. I thank an anonymous reviewer for this point.

theory;[23] otherwise, the speakers may again be back in the same underdetermination. If this is true, the desideratum of the Diehl-style counterexample remains unfulfilled. Therefore, the Diehl-style counterexample seems suspect; the expressibility challenge, which is grounded in (*)-principle, can be defended.[24]

The point that I want to emphasize in this argument is that the defenders of (*) appealed to Benacerraf's structuralist argument, from which we drew an ontological conclusion. At the same time, recall that (*) itself is understood as amounting to a semantic conclusion of the structuralist approach. Hence, we came full circle; what we saw can be analyzed as a defense of a semantic conclusion of the structuralist approach by drawing an ontological conclusion of the structuralist approach. As we will see in the next section, this circle leads to an interesting connection between them.

4.5 From Ontology to Semantics to Ontology: The Dialectical Argument

The debate between Dasgupta, Turner, and Diehl indicates how the same structuralist approach can be employed by competing sides in a debate. Dasgupta's generalism can be espoused as an ontological conclusion of the structuralist approach, and yet it is challenged by Turner whose metasemantic principle (*) is grounded in the semantic conclusion of the structuralist approach. Diehl offered a counterexample to (*) as a rejoinder, but we saw that Benacerraf's ontological conclusion can dissolve it.

I argue that this interpretation of the debate has a dialectical consequence. Turner's argument against generalism can be self-undercutting given its reliance on (*); if defending (*) requires an appeal to ontological conclusions of the structuralist approach, then employing (*) to refute an ontological conclusion of the structuralist approach will undermine the ground for (*) itself. Hence, Turner's argument against generalism faces a dialectical impasse.

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23 This structuralist conclusion seems to force us to believe that the meanings of 'VN-number' and 'Z-number' shift when the speakers forget set theory. Can this conclusion be reconciled with the ambient theory of reference, i.e., the causal chain theory? While by no means conclusive, my tentative explanation is that the speakers no longer speak the same language when they forget set theory. As described by Diehl, they now speak "the language of arithmetic" with a small addition instead of the language of set theory; we cannot expect the meanings of the terms to be the same when they are in different languages. It may also be compared to the famous 'Santa Claus' case (Kripke 1980, 93); the present case involves a more drastic and widespread change that may be strong enough to sever the "chain". I appreciate an anonymous reviewer for this point.

24 Diehl anticipates "symmetry-breaking" counterarguments to her examples, which aim to establish the difference in speech dispositions. It is not related to the present ontological argument which does not appeal to speech dispositions from the start.

A caveat should be noted though. I do not argue that it is logically inconsistent to reject generalism while accepting (*). Nevertheless, as shown in Section 4.4, an ontological conclusion of the structuralist approach turned out to play a critical role in defending the validity of (*) against the Diehl-style counterexample. Given that generalism itself also counts as an ontological conclusion, it will be argued that rejection of generalism puts (*) in a vulnerable position. That explains why an argument against generalism based on (*) can be self-undermining; even though you may be logically consistent in rejecting generalism based on (*), it fails to be coherent in the sense that the positions you accept are not epistemically stable together.

Going back to Diehl's (2018) argument, recall that the instance we considered in Section 4.4 is only one of the many possible Diehl-style counterexamples that we can construct with ease. For example, Diehl considers an imaginary theistic community using the operator 'God decrees that there is' instead of the conventional existential quantifier; they may have the same speech dispositions but very different metaphysical interpretations, which constitute a Diehl-style counterexample. The defenders of (*) have to offer an answer that can systematically address such Diehl-style counterexamples.

In the previous section, I considered how the defenders of (*) can resolve the Diehl-style counterexample by adopting Benacerraf's ontological conclusion. For the sake of argument, let us grant that similar rejoinders can be given with respect to other Diehl-style counterexamples *mutatis mutandis* through ontological conclusions of the structuralist approach; the defenders of (*) can resolve any arbitrary Diehl-style counterexample. For instance, it may be argued that the alleged difference in interpretation between 'God decrees that there is' and the conventional existential quantifier can be resolved by applying an ontological conclusion of the structuralist approach.

Nevertheless, I argue that this is not necessarily good news for the defenders of (*). At this point, the defenders of (*) who employ Turner's argument against generalism are in trouble. For, as explained in Section 4.1, generalism itself can be derived as an ontological conclusion of the structuralist approach. All that is needed for a Diehl-style counterexample is that a pair of linguistic items have the same disposition but intuitively different meanings, which is a low bar. It seems that each Diehl-style counterexample can be resolved, without other available options, only through an ontological conclusion of the structuralist approach. Generalism cannot be an exception; we can construct a Diehl-style counterexample that can only be resolved through an ontological conclusion equivalent to generalism. The defenders of (*) should appeal to generalism to address this Diehl-style counterexample.

We can construct an example that corresponds to an actual debate in metaphysics, i.e., a debate in mereology about everyday observables: Universalist theories of everyday observables reify ordinary material objects such as tables, while nihilist theories avoid the reification by adopting other devices, e.g., a set of mereological atoms arranged tablewise.[25] Now assume, for instance, that a universalist refers to a table as ‘A’ and a nihilist refers to the corresponding set of mereological atoms as ‘B’. Insofar as both types of theories can accommodate everyday platitudes, ‘A’ and ‘B’ can be viewed as having the same speech disposition, at least in the context of everyday observables. Still, they intuitively have different meanings given their truth-conditional difference. Hence, ‘A’ and ‘B’ constitute a Diehl-style counterexample to which the defenders of (*) should respond.

As in the previous section, the defenders of (*) can appeal to an ontological conclusion of the structuralist approach to dismantle the Diehl-style counterexample. They can refer to the argument by O’Leary-Hawthorne and Cortens (1995), who espouse an ontological position equivalent to generalism based on the structuralist approach.[26] As Benacerraf did for arithmetic, O’Leary-Hawthorne and Cortens identify the common theoretical structure that deflates the concept of primitive individuals altogether, which allows both universalist and nihilist theories about everyday observables to be understood as different formulations of the same theory:

> It is clear enough what the [generalist] will say here. On her account, ‘There is a table here’ and ‘There are little bits arranged tablewise here’ express just the same fact, one that can all the more perspicuously be described by ‘It is tabling here’. […] This is just the result that many philosophers intuitively want. (O’Leary-Hawthorne and Cortens 1995, 160)

The same applies to the terms used by universalists and nihilists as well; once we accept the generalist ontology, there is little reason to believe that ‘A’ and ‘B’ have different meanings. Hence, for the defenders of (*) to adequately defend their principle from Diehl-style counterexamples, they should also be disposed to affirm generalism as an answer to this possible Diehl-style counterexample. Without affirming generalism, (*) remains vulnerable to possible objections.

25 See Lewis (1986) and van Inwagen (1990) for classic formulations of mereological universalism and nihilism respectively, and see Sider (2013) for the introduction of set-theoretic vocabularies in formulating nihilism.

26 O’Leary-Hawthorne and Cortens (1995) use the term ‘ontological nihilism’ to refer to their position, which Diehl (2018) uses interchangeably with ‘generalism’. The similarity has also been noted by Dasgupta (2009, n. 25).

Affirming generalism may not compromise (*) itself, but a problem emerges once the defenders of (*) ultimately aim to defeat generalism as Turner does. Recall that Turner invoked (*) to defeat generalism; a Diehl-style counterexample was meant to undercut Turner's argument by falsifying (*). The above example showed that the defenders of (*) should affirm generalism to save (*) from a Diehl-style counterexample, which means that Turner needs generalism to defend his use of (*). This leads to an ironic conclusion; Turner should appeal to generalism to defeat generalism, which is self-undermining. Thus, the defenders of (*) face a dialectical dilemma: If they intend to uphold Turner's argument and defeat generalism, then (*) principle itself is in peril. Alternatively, if they want to defend (*) principle, then they do not want to reject generalism. Therefore, even though Diehl-style counterexamples face rejoinders from the defenders of (*), the rejoinders will not help if their ultimate goal is defeating generalism. Generalism and (*) turn out to be epistemically stable together.

Where does this conclusion leave us? Within the generalism debate, it provides us a new reason to resist Turner's argument following Diehl; the expressibility challenge can be met. More generally, this case study allows us to see the extent to which these different applications of the structuralist approach hang together. We knew that both generalism and (*) could be derived through the structuralist approach, but it could still be asked whether they are unified in any stronger sense. That is, we did not know whether instances of the structuralist schema have any mutual connection besides the fact that the same strategy could be used to derive them. If Turner's counterargument to generalism succeeded, then you could coherently reject generalism by employing (*); the structuralist schema would mean little to its instances. However, if my argument is sound, then Turner's argument loses its dialectical upper hand; it would be epistemically unstable to accept (*) and reject generalism. That is, if you accept one application of the structuralist approach, then you should also accept other applications of the structuralist approach to maintain a coherent position. Hence, in this sense, such seemingly distant instances of the structuralist schema still fit together in a significant way; the conceptual unity imparted by the structuralist schema should not be underestimated.

5 Concluding Remarks

In this essay, I offered a selective overview of the structuralist approach to underdetermination. I provided a general characterization of the approach and considered two examples by Benacerraf and Quine, which displayed different kinds of conclusions we can draw from the structuralist approach.

Based on this, I reviewed the recent debate on generalism, which sheds light on the conceptual unity of the structuralist approaches.

Again, I emphasize that this paper is not intended to offer a defense of the structuralist approach *per se*. I aimed to sketch the common strategy of some approaches to underdetermination in the literature, asking what their philosophical upshots can be. I argued to the effect that such approaches are coherent together, but I leave open whether they are defensible as a whole.

This essay did not aim to provide a thorough survey of the topic. Some other prominent examples of the structuralist approach, e.g., the metaphysical underdetermination argument for ontic structural realism in metaphysics of quantum physics (Ladyman 1998; French 2014, sec. 2.7; 2020), deserve more recognition. The historical origin of the structuralist approach in different subject matters remains to be investigated more in-depth as well (Nefdt 2018). A more thorough survey of the structuralist approach is left for another paper.

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