Prolegomena 16 (1) 2017: 7–21

# Competing Ontologies and Verbal Disputes

JAKUB MÁCHA

Department of Philosophy, Masaryk University, Arna Novaka 1, 602 00 Brno, Czech Republic
macha@mail.muni.cz

ORIGINAL SCIENTIFIC ARTICLE – RECEIVED: 05/03/16 ACCEPTED: 14/01/17

ABSTRACT: The notion of ontology originates in philosophy. It has been recently employed in computer science and information technology for representing knowledge. In the first part of the paper, I argue that there is a significant overlap in these notions of ontology. Utilizing this overlap, I show in the second part that ontologies can be used for developing a new powerful heuristic method for resolving verbal disputes in philosophy. Verbal disputes can be defined in terms of ontologies: A dispute over two texts P and S is *verbal* if and only if both of them can be mapped into the same ontology. In the appendix, I analyze the dispute over logical pluralism and indicate how my method of resolving verbal disputes can be employed.

KEY WORDS: Agreement, alignment, conflict, disagreement, logical pluralism, matching, ontology, verbal dispute.

## Introduction

The expression "ontology" has been used in a philosophical sense for the study of the nature of being, existence, and reality. I will take ontology primarily in its Aristotelian sense, as the study of categories of being. Ontology is, however, used in a different sense in computer science and information technology for representing the knowledge of a source domain and making it easily retrievable, surveyable, combinable, and especially susceptible to automatic processing. One of the main assumptions of this paper is that – apart from obvious etymological and historical affinities – these contemporary senses are compatible with each other.

First, in its more formal philosophical sense, ontology is the aspect of metaphysics aiming to characterize reality by identifying all of its essential categories and setting forth the relations among them. This Aristotelian account has been contested by recent philosophers of the analytic tradition, most notably by Carnap (1950) and Quine (1951; 1960; 1970). Carnap argued that so-called external questions concerning the nature of existence or

essential categories are not questions about reality, but rather practical questions about whether or not to accept linguistic forms describing these categories and the relations among them. Once accepted, ontological sentences within a linguistic framework are trivial and meaningless outside of it. Quine, by his argument against the distinction between analytic and synthetic sentences, undermines, in fact, the distinction between a linguistic framework and its content. The consequence of adopting this strategy is ontological relativity, i.e. the thesis that ontology is relative to language.

Second, the notion of ontology was introduced into information science in the 1970s by researchers in the field of artificial intelligence (AI). These researchers had been interested in the nature of human reasoning rather than in the nature of reality.[1] The meaning of ontology shifted in the early 1990s toward more content based models: Ontology in information science aims to represent the knowledge of a source domain.

There have been several efforts to bring these two notions closer to each other. Hirsch (1993) introduced the notion of *soft ontology* which has later been used in information science (Collao et al. 2003). Another line of thinking has focused on the notion of *naïve physics* (Smith and Casati 1994). I would like to propose a rather deflationary account of the distinction between the philosophical and the information science notion of ontology.

I want to restrict the source domain to texts and philosophical texts especially. Ontology aims, then, to represent the knowledge about a philosophical text in a possibly surveyable form. Such an ontology itself is, however, represented by an ontology language like RDF/OWL.[2] A particular ontology is represented by a text and we may ask what the ontology of this text is. By iterating this idea we may then arrive at something which may be considered a hierarchy of ontologies:[3]

(1) reality,
(2) an ontological$_p$ text about reality, i.e. about (1),
(3) a description of the ontology$_{t1}$ of (2),
(4) a description of the ontology$_{t2}$ of (3),
(5) a description of the ontology$_{t3}$ of (4),
(6) …

[1] See Guarino (1995) for an overview.

[2] Resource Description Framework (RDF) is a data model for modeling entities and their properties and relationships. These elements are combined to make simple statements in term of triples: subject – predicate – object. Web Ontology Language (OWL) is an extension of RDF allowing a description of ontologies. It adds vocabulary for classes, relations between classes, properties of relationships etc. It can express first order predicate logic statements and inferences between them.

[3] To avoid confusion, I label an ontology in the *philosophical* sense as an ontology$_p$ and an ontology of a *text* as an ontology$_t$.

The aim of an ontology$_{t1}$ is to survey a text which presents ontology$_p$ which describes the nature of reality. The aim of an ontology$_{t1}$ is to highlight an ontology$_p$. The aim of an ontology$_{t2}$ is to highlight the ontology of the text describing the ontology$_{t1}$. The aim of an ontology$_{t3}$ is to highlight the ontology of the text describing the ontology$_{t2}$ etc.[4] How are these ontologies related to each other? A natural requirement for any construction of a text ontology$_t$ could be that such a text ontology$_t$ preserves the ontological commitments of the text. Then the ontology of (2) has to be included in the ontology of (3), or more generally, the ontology of (n) has to be contained in the ontology of (n+1). The upper level ontology (n+1) can extend the ontology (n) by elements of the ontology language itself (individuals, concepts, relations, classes etc.). In order to stop this infinite hierarchy of ontologies$_t$, we have to build the upper ontology$_t$ (n+1) in such way that it is equal to the ontology$_t$ (n). It is a natural requirement of text encoding to make a given text surveyable and accessible *without modifying it*. An upper level ontology, ideally, should not add anything new to the text. This requirement is sometimes difficult to meet, because formal language need some means of representation of a given domain.

To sum up, the formal ontology$_t$ (3) extends the informal ontology$_p$ (2). All the ontologies$_t$ are collapsing into a single ontology$_t$. Our hierarchy is now:

(1) reality,
(2) an ontological$_p$ text about reality, i.e. about (1),
(3) a formal ontology$_t$ of (2).

This collapse of the hierarchy happens regardless of adopting either the Carnapian or the Quinean conception of language and ontology described above. Moreover, we can omit the language of ontology$_p$ and say that ontology$_t$ itself describes the nature of reality. In other words, there is no *ontological*, but only an *ontic* difference in these ontological texts. If the question as to which ontology (language) we adopt is a practical one, it is reasonable to pick the language that presents the most surveyable knowledge of the source domain. Under this practical perspective we can say that the formal language that makes the text most surveyable is the language that best captures the ontology$_p$ of the text. This claim is the most important presupposition of my argument which is going to be presented in the next sections.

[4] This model is not opened up for branching, i.e. for the possibility of having competing ontologies on the same level (an ontology$_{t3a}$ and an ontology$_{t3b}$). Here I assume a linear hierarchy of ontologies of a single text. Branching and competing ontologies are introduced by competing interpretations of the original text. This text has to be extended by adding this or that interpretation (which has a textual form). Competing ontologies are based on (partly) different texts.

## 1. Backbone ontology

The previous section was indifferent to the question of whether we adopt the Carnapian or the Quinean conception of language. The hierarchy of ontologies collapses in both cases. The resulting ontology will, however, be different with regard to these two conceptions of language. If we accepted the distinction between a linguistic framework and its content, the resulting ontology would involve a backbone ontology and its content. The notion of a *backbone* ontology is crucial here. A backbone ontology aims to capture everything that belongs to the representation framework. A *backbone ontology* consists of "bedrock"[5] concepts, their relations, truths involving these concepts (i.e. axioms) and perhaps other classes.[6] In the Carnapian setting, the formal ontology$_t$ of (2) consists of the ontology$_p$ of (1) plus a backbone ontology. I would like to point out several problematic questions and indicate possible answers as well.

(1) We can ask simple questions: Should this or that entity be part of the backbone ontology? We can include all entities defined in OWL and add some entities defined in *ISO 704:2009 Terminology work – Principles and methods*, e.g. some individual and general concepts, and concept relations. We can further specify the types of concept relations according to *ISO 087–1:2000*. Or we can draw on a *concept relation typology* as suggested in (Nuopponen 2014). Accordingly, we can ask whether we need intensional relations (based on concept characteristics) in addition to extensional relations (based on concept extensions).

(2) Can a backbone ontology become a subject of (philosophical) dispute? The question whether we can allow intensional concepts is an important (and yet unresolved) philosophical dispute. Or so it seems. My question would be rather whether this philosophical dispute can be reduced to the choice of a backbone ontology. If a backbone ontology becomes a subject of philosophical dispute, it would involve a language which gives us a perspective on this ontology. Then, however, we would run towards a hierarchy of ontologies which eventually would collapse back.

---

[5] The notion of *bedrock* originates in later Wittgenstein: "If I have exhausted the justifications I have reached bedrock, and my spade is turned." (1958: §217) Bedrock concepts are invariants within a given language-game (i.e. in the given context). This is not incompatible with their alteration in another language-game. Chalmers takes the bedrock concept to be "a concept so basic that there is no hope of clarifying [it] in more basic terms" (2011: Sec. 7). We have reached bedrock in a dispute when our vocabulary is exhausted.

[6] If an ontology is encoded in OWL, the backbone ontology would include all the entities of OWL ("Class", "ObjectProperty", "DataProperty", "Datatype", "Individual", "Literal"), the relations between and the operations on them (e.g., "SubClassOf", "DataComplementOf", "ObjectIntersectionOf" etc.), and axiom declarations ("Declaration", "ObjectPropertyAxiom", "ClassAxiom", "Assertion" etc.).

(3) Are all backbone ontologies of the same value? I.e., is ontological relativism true?

(4) These questions lead us to the following one: What criteria could help us to prefer one backbone ontology over another one? Ontologies in information science were designed for heuristic purposes. The heuristic criteria can perhaps be helpful in this framework too. The aim of this paper is to develop a heuristic method for solving philosophical disputes or more precisely for deciding whether a philosophical dispute is a verbal one. It would be natural to prefer such a backbone ontology that helps us to decide over this or that philosophical dispute.

(5) Does any privileged backbone ontology exist? If the dispute over different backbone ontologies is not possible, the backbone ontology we actually possess (e.g. the ontology of our language) would become the privileged one. There is the worry, however, that an affirmative answer to this question would bring us back to Aristotelian realism. Another answer could be that we would prefer such a backbone ontology that as much as possible helps us to resolve philosophical disputes. So we can strive for a domain-independent backbone ontology suitable for all philosophical disputes or design a domain-dependent backbone ontology for this or that dispute.

(6) What sorts of truths can a backbone ontology comprise? E.g. observational truths (as Carnap suggested), the most "general facts about our nature" (Wittgenstein's suggestion), normative truths (a Kantian suggestion), causal truths, etc.

Adopting the Quinean holistic picture, no privileged structure is possible. There would be no backbone ontology in a strict sense. A Quinean ontology would become a linked web of expressions including sentences and words, none of them being privileged there. This would, however, undermine the very notion of ontology as a hierarchical structure. To avoid this concern, we might follow a suggestion made by Chalmers (2011: Sect. 7) saying that the Quinean scholar "may still be entitled to the notion of a bedrock family of concepts". Some of these families may constitute the backbone ontology; other concepts and concept families are then dependent on this (tailored) backbone ontology.[7]

[7] This hypothesis resembles Wittgenstein's notion of a language-game in several respects: (1) language-games have an internal structure; (2) there are horizontal relations between language-games (one language-game is based on another one); (3) language-games are, like ontologies, primarily heuristic tools. The view derived from Quine allows for suggesting local ontologies which can be described as hierarchical structures within a global holistic picture. We could alternatively speak of three conceptions of language: Carnapian, Wittgensteinian and Quinean.

## 2. Verbal disputes

One of the most prominent topics in contemporary (meta)philosophy is the problem of verbal disputes and disagreement (see Hirsch (2005; 2009), Sider (2006), Chalmers (2011), Jenkins (2014)). The idea is that some philosophical disputes which seem at first glance substantive, important and somehow deep, can reveal that they are actually disputes over the meanings of some of the involved terms. The main challenge in this deflationist line of thinking is to distinguish substantive disputes from verbal disputes. See the seminal definition of verbal dispute[8] by David Chalmers (2011: 522):

> A dispute over [sentence] S is (broadly) verbal when for some expression T in S, the parties disagree about the meaning of T, and the dispute over S arises wholly in virtue of this disagreement regarding T.

A dispute is resolved if it is identified as a verbal dispute.[9] But how do we find out that a *prima facie* substantive dispute is the verbal one? Chalmers provides a heuristic method of locating the expression T whose meaning the parties disagree with. Chalmers calls this heuristic method the *method of elimination*. The method proceeds as follows: In order to find out whether a dispute over S is verbal with respect to T, one eliminates the term T from the vocabulary and tries to find the sentence S' such that the parties disagree over S', and such that the disagreement over S' is part of the dispute over S. If there is no such S', the dispute is verbal. The method also aims to eliminate all the terms from S that do not cause the verbal character of the dispute over S.

In the view derived from Carnap, the method will sooner or later reach a bedrock concept which cannot then be eliminated. Then the dispute is not verbal and we can ask the questions from the previous section. In the Quinean setting, there is no privileged stopping point. The method may be iterated, unless a verbal character of the dispute will be discovered or one runs out of vocabulary.

Chalmers' definition of a verbal dispute is restricted to one sentence and is parameterized by one particular expression occurring in the sentence. I want to propose a generalized definition of a verbal dispute which takes into account several sentences (a text) and is not parameterized by any expression:

> A dispute over two texts or two sets of sentences P and S is *verbal* if and only if both sets can be mapped into the same ontology.

---

[8] Several authors have recently proposed various definitions of verbal disputes and their cognates: merely, broadly, narrowly verbal etc. I will briefly comment on the proposals by Hirsch (2005) and Sider (2006).

[9] A verbal dispute is still a dispute over a meaning of some expression. To put it differently, verbal disputes concern language, substantial disputes concern what language is about.

The idea behind this definition is that the texts or sentences are first represented by or mapped into formal ontologies that are subsequently compared. If there is any disagreement between these texts, it should be rendered as a disagreement between the ontologies representing these texts. We have to clarify the two main concepts involved in this definition: (1) How a text can be *mapped* into an ontology? (2) How do we compare two ontologies in order to determine whether they are the same or whether they *disagree*?

As to the first point, building a textual ontology is a creative process that involves interpreting the text (as opposed to engineering a backbone ontology that should be open for any further interpretation). Mapping a text into an ontology cannot do without also interpreting the text. Ontologies, thus, represent the given text together with its particular interpretation. Therefore, agreement or disagreement over different ontologies involves agreement or disagreement over different interpretations.

It seems therefore that Chalmers' definition does not involve such a mapping and hence it does not involve any interpretation of the two sentences. But this is not so. The parties may disagree about the sentence S as a result of their different interpretations of S (or of some expressions in S). Roughly speaking, an interpretation is basically an assignment of meaning. If the disagreement comes about only in virtue of the disagreement in interpretations, the dispute is verbal. Hence, verbal disputes always involve different interpretations. Chalmers' definition reduces differences in interpretations to disagreement over the meaning of a single expression T. The aim of my definition is to allow for more complex patterns of disagreement.

Furthermore, the underlying backbone ontology might not be rich enough in order to capture all the substantial differences between the two texts. On the other hand, the ontologies might be too complex, so there would be no advantage in comparing them over the comparing of the original texts (which is what Chalmers does). There is a kind of trade-off. Hence ontology engineers have to reach the middle ground between too simple and too complex ontologies. This consideration thus applies to all employment of textual ontologies after all.

As to the second point, we have to clarify the notion of *sameness* or difference between two ontologies. The sets S and P do not need to lead to strictly the same ontology. It is crucial here that there must be no *disagreement* between these ontologies in order to proclaim the dispute as a verbal one. But sameness is not equal to the absence of disagreement. Therefore, we have to focus on the notion of disagreement. The presence of logical contradiction is not the only type of disagreement in ontologies (d'Aquin 2009). Disagreement in ontologies may arise on two levels: There might be disagreement in entities or disagreement in statements. Coping with disagreement in entities is

the problem of *ontology matching* (Shvaiko and Euzenat 2013). Agreement in entities means in Quinean terms that both sets of sentences have the same *ontological commitments*. Any agreement or disagreement in statements presupposes (at least partial) agreement in entities. If two ontologies completely disagree in entities, they cover different domains and there cannot be any agreement or disagreement.

Based on these considerations we can make our definition more precise:

> A dispute over S and P is verbal if, given their mapping in ontologies, (1) both sets have the same ontological commitments (i.e. there is agreement in entities), and (2) every statement from P follows from S and every statement from S follows from P (i.e. there is agreement in statements).

When trying to resolve a dispute, it might occur that a conflicting statement concerning a bedrock concept is found. As stated above, bedrock concepts cannot be defined in terms of other concepts; they are part of the backbone ontology. Let me give an example. Let S and P be theories in first-order predicate logic. S contains quantifiers that range over the individuals (of a universe) whereas P contains in addition to it quantifiers that range over functions or terms that have such individuals as their values. Now, when trying to resolve a disagreement between S and P, one may reach the point that the parties would disagree over the question whether the ontology contains intensional concepts or it does not. This is, however, the matter of the backbone ontology. This question has to be decided before we try to resolve the dispute over S and P. Which backbone ontology is taken is something that the parties have to agree on before they start to resolve their dispute. They may, however, come to the diagnosis that their backbone ontology is not philosophically neutral. In this case, one dispute is reduced to another, which is a kind of progress. But we still do not know whether the dispute is a verbal one. We have to build a more general backbone ontology that will be philosophically neutral to the problem in question. Within this general backbone ontology, we can pose questions over whether some entities can be reduced to other. Hence, to continue in our example, the question whether there is a need for intensional entities becomes the question whether intensional entities are reducible to first-order entities. If so, they can be subsequently eliminated from the backbone ontology. We have to, so to speak, in order to achieve a philosophical neutrality, build a maximal ontology which can be subsequently reduced to its bedrock elements.

### *1.1. Disputes in term of ontologies are more general*

The sets S and P may differ only in one sentence. If set P contained only one sentence and set S its negation, we would have arrived at Chalmers' scenario. The definition of verbal dispute proposed here is, however, more general than

the one proposed by Chalmers. Consider, for instance, that both the sets P and S contain the expressions $T_1$ and $T_2$. The meanings of $T_1$ and $T_2$ are not independent from each other, i.e. $T_1$ occurs in the definition of $T_2$, and $T_2$ occurs in the definition of $T_1$. Their meanings are, however, swapped, i.e. when $T_1$ has in P the same meaning as $T_2$ in S and $T_2$ has in P the same meaning as $T_1$ is S. Disagreement over P and S is clearly verbal and can be handled by the techniques of ontology matching. According to Chalmers' definition, the dispute over P and S still does not need to be verbal, because we cannot guarantee that after eliminating, say, $T_1$, we will be able to eliminate $T_2$ as well. Such a case occurs when $T_2$ can be defined only by using the expression $T_1$ which, however, has been already eliminated from the vocabulary. After eliminating $T_1$, we have reached the point of vocabulary exhaustion. This means that both $T_1$ and $T_2$ are bedrock concepts, they belong to the backbone ontology. This scenario is possible only in the Quinean conception of language/ontology[10] (in the Carnapian conception, such circular definitions are not possible). We thus have an example of a bedrock dispute that is nevertheless intuitively verbal. Chalmers, however, in contrast, claims that "a bedrock dispute is a substantive dispute for which no underlying dispute can be found by the method of elimination" (2011: 545).

I see in my definition two main advantages over Chalmers' one: (1) It is able to handle the Carnapian as well as the Quinean conception of language/ontology. What we have to do is compare the ontology of P with the ontology of S. In the Quinean view, there are verbal disputes where the parties do not disagree about the meaning of any particular term exclusively, but they can disagree over the whole web (the subject of their disagreement is spread throughout the context). The scenario described in the previous paragraph is such a case. Chalmers (ibid: 549) admits to not having any conclusive arguments against holistic opponents. (2) Second: If verbal disputes are defined in terms of ontologies, algorithmic heuristic methods as well as methods of automatic processing are available to solve them. This becomes a significant advantage over Chalmers' *method of elimination* which amounts to a step-by-step checking of the expressions from S as to whether this or that expression is responsible for the possible verbal character of the dispute.

These two points bring us to the competing characterizations of verbal disputes given by Hirsch (2005) and Sider (2006). They are based on the notion of the *charitable interpretation* and the *translation* respectively. Hirsch (2005: 72) defines verbal disputes as follows:

> The general characterization of a verbal dispute is one in which the controversial sentences are most plausibly interpreted as having different truth conditions

[10] A meaning holist might say that the more similar the meanings of $T_1$ and $T_2$ are, the more this dispute is being verbal.

> in the different languages associated with the contending positions, so that each position turns out to be correct in its associated language.

Sider, although his approach differs in particular details, uses the similar notion of the translation. A dispute is verbal if one can translate everything that the one party says into the language of the other party and vice versa so that both parties accept the corresponding sentences (Sider 2006; Chalmers 2011: 556, fn. 26).

Chalmers criticized Sider's definition that "in cases involving bedrock expressions, one cannot infer similarity or difference in content from similarity or difference in these inferential roles" (ibid). But following the ontology based account advanced here, one can diagnose the similarity or difference of these expressions by techniques of ontology matching. Even if there is no explicit definition for a bedrock expression, it must have a corresponding place in the ontology and this place is determined by its relations to other entities within the ontology. We do not need to involve inferential roles here. Hence, if we apply these two definitions by Hirsch and Sider onto our scenario with the swapped meanings of $T_1$ and $T_2$, the dispute would be identified as verbal (the translation manual would be very simple). More generally, Hirsch and Sider would also identify some disputes in backbone ontology as verbal.

What is, however, lacking in their proposals – in contrast to Chalmers' and mine – is a (general) method of evaluating disputes.[11] The definitions of a verbal dispute by Hirsch and Sider are nominal (in Locke's sense). The definition proposed here is a real one, for it gives a method how to find out whether there are mutual translations or charitable interpretations between the disagreeing parties.

### *1.2. Techniques for resolving verbal disputes with the help of ontologies*

I want to conclude this section with an overview of the available techniques in resolving verbal disputes with the help of ontologies. The process of resolving philosophical disputes will never be a fully automatic process as there will never be a fully automatized argumentation. Ontologies can be used, however, to formalize the argumentation taking place in ontology engineering processes. Hence, in order to find out whether two ontologies agree or disagree, we can employ, for example, *Argumentation Ontologies* based on the IBIS argumentation model (Tempich et al. 2005). In such a scenario, we can take disagreeing agents and build the same ontology over the union of S

[11] Sider concludes his paper by claiming that "Constructing translations with the right inferential roles is a non-trivial task." (2006: 95)

and P. Their success will indicate that the dispute was verbal. If they do not succeed, their disagreement typically does not affect the whole ontology, but only some of its parts. So even a failure to build a single ontology will help the agents to locate where exactly their disagreement lies.

*Ontology Blending* (Hois et al. 2010) is another technique that may help in resolving disputes. Suppose the agents have already built their ontologies over S and P. Since these sets may be distinct, but covering the same domain, the resulting ontologies may be conceptually different, they must nevertheless be structurally similar. This means there will be a substantial disagreement in entities. Ontology blending allows the combining of two thematically different ontologies to create an ontology describing a newly created domain. This is typical in philosophy where overcoming two competing interpretations in a creative process leads to a new interpretation.

Another approach is *Multi-Connected Ontologies* (Davies et al. 2011). It suggests a way in which different ontologies can be connected together into a larger multi-connected ontology. Ontologies are represented mathematically as ordered trees. Then for two ontologies to be identical, they must agree in entities, though not necessary in statements linking these entities. This is so because two trees of equal number of nodes but different links could be combined into a single tree.

## 3. Case study: the dispute over logical pluralism

In this supplementary section I would like to illustrate the framework sketched above. I deliberately avoid examples that are paradigmatic in the context of discussing verbal disputes like the disputes over free will, physicalism, the existence of abstract objects, mereological sums, temporal parts – partly because these disputes are rather over-discussed and partly because I would like to give an example of a dispute where the account of verbal disputes given here makes a difference. Disputes in logic take usually the form of the question whether one logical system is preferable over another logical system. Except for a logical realist, these disputes are about the meanings of the terms that are involved. Carnap said famously in his principle of tolerance: "Everyone is at liberty to build his own logic, i.e. his own language, as he wishes." (1937: §17) Intuitively, not all disputes in logic are unsubstative. The definition of a verbal dispute advanced in this essay allows for substantial, i.e. non-verbal disputes that are about the meanings. Furthermore, logical systems are parsimonious, they do not usually contain redundant expressions. Hence, no expression can be easily eliminated from a given logical system. Chalmers' method of elimination would immediately reach the point of vocabulary exhaustion and, thus, classify every dispute in logic as substantial.

Let us adjust the scenario with the swapped meanings of $T_1$ and $T_2$ to a dispute in logic. Let us have two systems of propositional logic, P and S. There are only two logical connectives in each of them, one unary and one binary. In P, "not" stands for propositional negation and "con" stands for propositional conjunction. In S, the meanings of "not" and "con" are swapped, i.e. "not" stands for conjunction and "con" stands for negation. The dispute over whether P is preferable to S is intuitively verbal. It is classified as a verbal one according to the definitions of Sider and Hirsch, because there are (trivial) translation rules between S and P. The dispute is also verbal according to the definition advanced here, for in the corresponding ontologies the arity of the connectives must be preserved, i.e. the unary connectives in P have to match with the unary connectives in S and the binary connectives in P have to match with the binary connectives in S. Chalmers' method of elimination is of no use here, for we cannot eliminate either of the connectives.[12] The upshot is that according to Chalmers' definition, the dispute over P and S would be classified as a substantial one.

Let us turn to the less trivial cases of disputes in logic. Logical pluralism says that there are more correct logical systems. Logical monism says that there is only one correct logical system. From the quotation above it follows that Carnap was an advocate of logical pluralism (and that this dispute is essentially over the choice of a language of logic). Let us exclude the trivial cases in which the parties disagree over the meanings of "logic" and "correct" (cf. Russell 2014). Let us exclude also the rather opaque cases of logics determined by cultural or biological factors (like a female logic, a bourgeoisie logic, a Buddhist logic etc.). What is now meant by the competing logics are rather systems such as intuitionistic, paraconsistent, paracomplete, or quantum logic. The dispute over logical pluralism comes on two levels. There is a meta-dispute as to the question of whether there are more correct logical systems, or whether there is only one. If there is only one correct logical system, we can the ask which one it is among the given alternatives. Beall and Restall (2006) argue for an even more radical version of Carnap's pluralism. The opposite view, logical monism, has been advocated by Priest (2006, 2008). The dispute over logical pluralism usually take the form of a dispute about the relation of logical consequence. Pluralists claim that there can be different instances of logical consequence that disagree in at least one case. For classical or intuitionistic logic, the disjunctive syllogism $P \vee Q, \neg Q \vDash P$ is a valid

[12] One may argue that we can eliminate both the connectives in favor of a universal connective like the Sheffer stroke. But this connective is, by presupposition, not available in the original logical systems, and the method of elimination does not count with any possibility of introducing new terms into vocabulary.

case of logical consequence, whereas it does not hold in paraconsistent logic. The rule of double negation elimination $\neg\neg P \models P$ is valid in classical logic, but it is not in intuitionistic logic. Now, if it turns out that the dispute over different cases of logical consequence were verbal, then logical pluralism would not be a distinctive position and the meta-dispute over it would be verbal too.

One line of argument facing this problem is to insist that the disagreement comes in virtue of the meanings of the logical connectives that are involved here – as Priest (2006: 171 & 204) seems to argue. If so, we can employ the method of resolving disputes by their mapping into ontologies. Of course, the disagreement between, for example, classical logic and intuitionist logic is more complicated than our case of swapped meanings. But to make the case for the claim that the disagreement arises in virtue of the meanings of logical connectives involves presenting translation rules for these connectives. Mapping into ontologies can facilitate this task.

If one manages to show that disputes over these logical systems are verbal with a help of mapping into ontologies, they can employ the strategy of stepping into a more general backbone ontology as indicated above. There may be a more general system that allows us to decide which logic is appropriate for this or that sort of situation or reasoning context. Priest (2008: 213) indicates indeed that what we need to do is "stepping back and looking at the bigger picture." The logic of this bigger picture must allow for local inconsistencies. This argument leads to favorizing Priest's own paraconsistent logic: "Some paraconsistent mechanism must get in on the act." (ibid)

We can say in conclusion that the method of resolving disputes by their mapping into ontologies does not offer any easy solutions. To map a complicated philosophical dispute into an ontology is a fussy work which can employ various techniques as mentioned in Sect. 2.2. Mappings into ontologies can be, however, a powerful method of philosophical reasoning.[13]

[13] The author would like to thank Alois Pichler, Deirdre Smith and various audiences at FOIS 2014 (Rio de Janeiro), the University of Zagreb and the University of Bergen for illuminating discussions. A special thank goes to the anonymous reviewers of *Prolegomena*.

## Bibliography

Collao, A. Jr., Diaz-Kommonen, L., Kaipainen, M., and Pietarila. J. 2003. "Soft Ontologies and Similarity Cluster Tools to Facilitate Exploration and Discovery of Cultural Heritage Resources", *Proc. DEXA 2003*, Prague, Czech Republic, 75–79. doi: 10.1109/DEXA.2003.1232001

Beall, J. and Restall, G. 2006. *Logical Pluralism* (Oxford: Oxford University Press).

Carnap, R. 1937. *The Logical Syntax of Language* (London: Kegan Paul).

Carnap, R. 1950. "Empiricism, Semantics, and Ontology", *Revue Internationale de Philosophie* 4, 20–40.

Chalmers, D. 2011. "Verbal Disputes", *The Philosophical Review* 120, 515–566. doi: 10.1215/00318108–1334478.

d'Aquin, M. 2009. "Formally Measuring Agreement and Disagreement in Ontologies", *K-CAP '09* (New York: ACM), 145–152. doi: 10.1145/1597735.1597761.

Davies, P., Newell, D., Davies, A., and Karagozlu, D. 2011. "Multi-Connected Ontologies", *CoRR* abs/1112.6090, *http://arxiv.org/ftp/arxiv/papers/1112/1112.6090.pdf [accessed January 14th 2017]*.

Guarino, N. 1995. "Formal Ontology, Conceptual Analysis and Knowledge Representation", *International Journal of Human and Computer Studies* 43, 625–640. doi:10.1006/ijhc.1995.1066.

Hirsch, E. 1993. *Dividing Reality* (Oxford: Oxford University Press).

Hirsch, E. 2005. "Physical-object Ontology, Verbal Disputes, and Common Sense", *Philosophy and Phenomenological Research* 70(1), 67–97. doi: 10.1111/j.1933–1592.2005.tb00506.x.

Hirsch, E. 2009. "Ontology and Alternative Languages", in D. Chalmers, D. Manley, and R. Wasserman (eds.), *Metametaphysics* (Oxford: Oxford University Press), 231–258.

Hois, J., Kutz, O., Mossakowski, T., and Bateman, J. 2010. "Towards Ontological Blending", in D. Dicheva, D. Dochev (eds.), *Artificial Intelligence: Methodology, Systems, and Applications* (Berlin: Springer), 263–264.

Jenkins, C. S. I. 2014. "Merely Verbal Disputes", *Erkenntnis* 74, 11–30. doi: 10.1007/s10670–013–9443–6.

Nuopponen, A. 2014. "Tangled Web of Concept Relations. Concept relations for ISO 1087–1 and ISO 704", *Terminology and Knowledge Engineering 2014*, Berlin. <hal-01005882>, *https://hal.archives-ouvertes.fr/hal-01005882 [accessed January 14th 2017]*.

Priest, G. 2006. *Doubt Truth to be a Liar* (Oxford: Oxford University Press).

Priest, G. 2008. "Logical pluralism hollandaise", *The Australasian Journal of Logic* 6, 210–214.

Quine W. V. O. 1951. "Two Dogmas of Empiricism", *The Philosophical Review* 60, 20–43.

Quine, W. V. O. 1960. *Word and Object* (Cambridge, MA: The MIT Press).

Quine, W. V. O. and Ullian, J. 1970. *The Web of Belief* (New York: Random House).

Russell, G. 2014. "Logical Pluralism", in *The Stanford Encyclopedia of Philosophy* (Spring 2014 Edition), *http://plato.stanford.edu/archives/spr2014/entries/logical-pluralism/ [accessed January 14th 2017]*.

Shvaiko, P. and Euzenat, J. 2013. "Ontology Matching: State of the Art and Future Challenges", *IEEE Transactions on Knowledge and Data Engineering* 25(1), 158–176. doi: 10.1109/TKDE.2011.253.

Sider, T. 2006. "Quantifiers and Temporal Ontology", *Mind* 115, 75–97. doi:10.1093/mind/fzl075.

Smith, B. and Casati, R. 1994. "Naive Physics: An Essay in Ontology", *Philosophical Psychology* 7(2), 225–244. doi: 10.1080/09515089408573121.

Tempich, Ch., Pinto, H. S., Sure, Y., Staab, S. 2005. "An Argumentation Ontology for DIstributed, Loosely-controlled and evolvInG Engineering processes of oNTologies (DILIGENT)", in A. Gómez-Pérez, J. Euzenat (eds.), *The Semantic Web: Research and Applications: Second European Semantic Web Conference* (Berlin: Springer), 241–256.

Wittgenstein, L. 1958. *Philosophical Investigations*, transl. by G. E. M. Anscombe (Oxford: Blackwell).