Molecularity in the Theory of Meaning and the Topic Neutrality of Logic

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Introduction.

Without directly addressing the Demarcation Problem for logic—the problem of distinguishing logical vocabulary from others—we[1] focus on distinctive aspects of logical vocabulary in pursuit of a second goal in the philosophy of logic, namely, proposing criteria for the justification of logical rules.[2] Our preferred approach has three components. Two of these are effectively Belnap's, but with a twist. We agree with Belnap's response to Prior's challenge to inferentialist characterisations of the meanings of logical constants. Belnap argued that for a logical constant to exist, its rules must be conservative over a previously given consequence relation and guarantee the uniqueness of the constant. The twist is that we require logical vocabulary to be provably conservative, not over a previously given formal consequence relation, but over a previously given meaningful vocabulary of a language. Uniqueness is also a feature defined in terms of provability: if two syntactically distinguished expressions are governed by the same rules, then formulas with them as main operators are interderivable. Belnap's criteria are not only those for the existence of a logical constant, but more: they are what distinguishes logical vocabulary from all other expressions. It is the defining mark of a logical constant that it is provably conservative over the fragment of the language which excludes it and that its rules guarantee its uniqueness. The third component is the topic neutrality of logic.

The provable conservativeness of logic over a previously given vocabulary of a language is motivated, in part, by appeal to molecularism in the theory of meaning. Molecularity is a feature endorsed by the theory of meaning as a whole, so it does not distinguish logical constants from other expressions. The same is true for conservativeness. We argue that molecularity, and hence conservativeness, are implicit presuppositions of speakers' use of language: the addition of new vocabulary to a language is presupposed to be conservative. But this presupposition is one that we should be able reflectively to endorse (such as when attempting a rational reconstruction of the use of the vocabulary). Thus, where conservativeness is found to fail, this defect should be remedied and the use of the vocabulary corrected (as in classical negation) or excised altogether (as in pejoratives). We go on to characterise a notion of topic neutrality, which we argue applies to logical vocabulary. We then note that reflective endorsement of the conservativeness of a topic neutral vocabulary requires a *proof* that the vocabulary is conservative relative to any base vocabulary. Thus we require that logical vocabulary be demonstrably conservative. Allying this requirement, distinctive of logic, to a general consideration about the commitments of assertion yields a mode of justification for logical constants akin to some conceptions of Harmony, i.e., to the idea that the consequences of assertion of a logical complex need to be warranted by the grounds and ought to be the strongest consequences warranted by the grounds. Intuitionistic logic acquires a somewhat familiar justification but emanating from a new motivation.

[1] For help and engagement we'd like to thank two reviewers and each other.

[2] The present account gives a handle on the demarcation problem, as we single out a distinctive feature of logical vocabulary, but spelling out the details is left for further work.

1. Molecularism and Conservative Extensions

Michael Dummett[3] argues that any acceptable linguistic practice ought to submit to a description which discerns a partial order in expressions based on their meanings:[4] speakers understand certain expressions before others because the meanings of the latter depend on those of the former but not *vice versa*. There is a relation of *dependence of meaning* between the expressions of the language, which imposes this partial order on them and reflects how speakers come to understand the expressions higher up in the order on the basis of those lower down. We allow deviations from the pattern to allow for small local holisms: regions of language in which there's no partial ordering of expressions on the basis of their meaning. Expressions forming a local holism need to be understood *en bloc*. Plausible examples include pairs such as 'adult' and 'child'; and groups such as colour terms, 'red', 'blue', 'yellow', 'green'. Thus, strictly speaking, the relation of dependence of meaning holds between sets containing small numbers of expressions forming local holisms.[5] We set aside the question how small a local holism needs to be, only noting that they must be small enough for them to be linked to a manifestable capacity of speakers. Which expressions form a local holism is a question that depends on the language under investigation and would be decided by a theory of meaning for that language. For simplicity, in the following we'll often speak of languages being extended by expressions, rather than small sets of expressions that form a local holism. But anything we say applies to local holisms as well.

The resulting view is called *molecularism*. Its proper motivation might well be questioned[6] but will not be questioned here. Instead our question is: how does molecularism relate to the acceptability of a logic?

Dummett argues, surely correctly, that molecularism requires that an extension of a region of language ought to be conservative relative to the favoured meaning determining feature. (Dummett 1993a: 217ff) So, if assertibility conditions are meaning determining then a sentence of the original language ought not to acquire new assertion conditions on extension of the language; if (inclusive) inferential role[7] is taken as meaning determining then the extension of the language ought not to introduce new inferences into the original language that were not previously accepted; if truth conditions are taken as meaning determining then a sentence of the original language ought not to acquire new truth conditions on the extension of the language; if the consequences of assertions are meaning determining, then a sentence of the original language ought not to acquire new consequences on extension of the language; and so on.

Dummett also insists that the introduction of logic into a language ought to constitute a conservative extension of its non-logical base. (Dummett 1993a: 246ff) But, as is clear from the previous remarks, which made no distinction between kinds of expressions, molecularism is a *global*

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[3] See, for instance his 'What is A Theory of Meaning II' in *Truth and Meaning*, edited by G. Evans and McDowell, 1976, reprinted in his 1993c, pp. 38-42 in the latter.

[4] By 'meaning' we shall mean semantic content, acknowledging that there may be other aspects to meaning more broadly construed such as Fregean colour or tone.

[5] For Dummett's discussion of molecularism, see (Dummett 1993b, c). For the notion of dependence of meaning, see in particular (Dummett 1993a: 222ff) and (Dummett 1993b: 44). Dummett gives the example of colour words in (Dummett 1993a: 223).

[6] See (Wright 1986: 446-9; 2014: 254-6); and the more sympathetic treatment by (Tennant 1987: 31-58).

[7] So including language entry and exit rules in inferential role.

constraint on language. So this requirement would hold of *any* extension of language. It isn't, therefore, a distinctive feature of *logic*. Let us bracket the question about distinguishing logic for the moment.

There are (at least) three ways of understanding the constraint of conservative extension. We'll speak of languages as made up of vocabularies, that is, sets of expressions taken as having definite meanings. If L' is a conservative extension of L, then, L' being an extension of L, the vocabulary of L is a proper[8] part of the vocabulary of L', and being conservative means that the shared vocabulary is the same in L' and L.

$M<L,x>$ is the meaning determining feature of x in L. The plan is now to capture a distinction between cases where we introduce a new vocabulary, each element of which conservatively extends a vocabulary, and cases where the new vocabulary as whole extends the original conservatively.

> C_T: L' is an *atomistic conservative extension* of L iff whenever e is an expression of (L'-L) then (L+e) is a conservative extension of L relative to the meaning determining feature, i.e., $(\forall x)(\forall y)(x\in L \& y\in(L'-L)\rightarrow M<L,x>=M<L+y,x>)$.

> C_G: L' is a *global conservative extension* of L iff L' is a conservative extension of L relative to the meaning determining feature, i.e, $(\forall x)(x\in L\rightarrow M<L,x>=M<L',x>)$.

To be sure, one reason for distinguishing these might be that the new vocabulary of L' is a local holism. In that case if $y\in(L'-L)$ then we can't talk about the vocabulary L+y, but only of L', because y cannot stand meaningfully on its own without the the rest of L'-L. So an extension might be globally conservative without being atomistically conservative. The notion of atomistic conservative extension is intended to capture a notion of separability[9] between the different pieces of vocabulary introduced by the extension.

We can also have the stronger property:

> Strong-C_T: L' is a *strong atomistic conservative extension* of L iff whenever e is an expression of (L'-L) then L' is a conservative extension of (L'-e).

This property is intended to capture a slightly different notion of separability. Here each element of new vocabulary conservatively extends the language formed by its omission.

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[8] Requiring the vocabulary to be a proper part conveniently excludes various trivial cases in the definitions below. But nothing hangs on it and the definitions are easily adjusted to accommodate them.

[9] See, e.g., (Steinberger 2011).

It seems clear that the mere requirement of molecularity simply requires the global property, provided that the extension is small enough to count as a local holism: so global is okay when it is local! And, thus framed it might appear to be a weak requirement.[10]

2. Brandom and Dummett

Brandom (1994 :107-116 and 123-5) provides us with a distinctive reason for requiring conservative extension in logic, namely, logical expressivism. But what notion of conservative extension is motivated by logical expressivism? Logical expressivism, roughly, is the view that the role of logic is to explicitate inferential practice. It enables us to formulate as claims proprieties of inference. In making the practice explicit as claims it brings the practice itself within the sway of rational, reflective debate: the practice of asking for and giving reasons itself becomes subject to asking for and giving reasons. In order for logic to play this expressive role it needs to be conservative over the meanings—hence inferential roles, given Brandom's inferentialism—which it enables us to discuss. So we seem to need at least C_G relative to the inferential proprieties in the pre-logical language. But more, since Brandom is wont (op cit: 123-5) to ascribe the expressive role to logical vocabulary piecemeal, viz., each piece of vocabulary plays an expressive role, we seem to need C_T. And finally, since each piece of logical vocabulary plays its expressive role independently of the base language and since it therefore continues to play that role in complex languages, we surely have reason for insisting on Strong-C_T.

It's worth comparing Brandom and Dummett for a moment. Dummett rejects holism and so motivates conservative extension through an insistence on molecularity. Brandom is a meaning holist and so has no general requirement of conservativeness; rather, given the particular expressive role of logic, the requirement applies only there. Each sees an assertion as forging an inferential licence from its grounds to its consequences. For Dummett, since the resulting inference is forged via meaning, it must be seen as logically good: we need to be able to derive the consequences from the grounds. In essence, if something becomes assertible as a consequence of another new assertion, it ought to have been assertible independently of that assertion. Applying these thoughts to the logical constants themselves leads to a requirement that the grounds and consequences of a

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[10] It is worth stressing that our notion of conservativeness is a meaning theoretical notion. As such it does not coincide with notions of conservativeness formulated by Dummett, which are epistemic notions. For a plausible way of spelling out such an epistemic notion of conservativeness in the spirit of Dummett, see Cozzo 2002. It is also worth stressing the neutrality of our notion of conservativeness: its definition does not depend on any specific meaning determining feature. Dummett would favour a notion of verification conditions as that in terms of which meanings are determined, or sometimes falsification conditions. Other authors prefer truth conditions or consequences of assertions. They can all accept our notion of conservativeness. If some notions of conservativeness are not acceptable to some theorists of meaning, say, an epistemic notion of conservativeness to a truth conditional theorist of meaning, this again shows that these notions of conservativeness are not ours.

Prawitz (1987) argues that Gödel's Incompleteness Theorems show that arithmetic, though molecular, is not conservative relative to provability. It's worth noting that the construal of molecularity that Prawitz has in mind is what he calls Dummett's second notion of molecularity, which amounts to no more than compositionality: 'the specification of [the meaning determining] feature of a compound sentence should be determined in terms of this feature for the constituents and the way they are put together' (1987: 129). The notion of conservative extension used here is allied to a stronger notion of molecularity, namely, one in which the meaning of a sentence is given by reference to, at most, a fragment of the language. The bearing of Gödel's results is, of course, an interesting topic and may call for a distinctively non-formal characterisation of canonical proof—for argument to this effect see Dummett (1973) and Weiss (1997)—but investigation of this issue cannot be on the current agenda.

logically complex sentence 'match'. This is the requirement of harmony[11]. Harmony between grounds and consequences thus applies to every expression of the language. That is why only one of those features should be taken as basic in specifying the meaning of an expression in a theory of meaning, while other other must be derived from it. (Dummett 2010: 227) According to Dummett, 'joint specification [of grounds and consequences] is, in general, an illegitimate procedure, which may be allowed when harmony is apparent or at least demonstrable, but not when it is not.' (2007: 621)

In contrast, Brandom embraces the idea that meanings (of assertions) might forge *substantive* inferential connections, that is, inferential transitions which are only contingently good. The question isn't so much whether the inference can be underwritten by logic but whether, on explicitation and reflection, we are prepared to endorse it.

It thus seems as if Dummett's molecularity requirement drives him to adopt conservative extension as a global requirement and that this, given his holism, is lacking in Brandom's picture of things. But we do well to move a little more slowly and to make a distinction before doing so. Let's suppose that A is an assertible sentence, made so by the extension of L to L'. G_A is a ground for the assertion of A; and that C_A is a consequence of the assertion of A; C_A and G_A are expressible in L. That L' conservatively extends L might be a demonstrable fact. Dummett wants it to be so because he wants to *ensure* that the meaning of C_A is unchanged by introduction of A. Though asserted on the basis of A, we can show that it would anyway have been assertible on the basis of G_A. So the inference from G_A to C_A is not substantive, i.e., is not merely contingently good: it's a product of the meaning already ascribed to C_A. In contrast, Brandom thinks of that inference as substantive and that the introduction of A may have changed the meaning of C_A (and also of G_A). But thought about like that this seems odd: the meanings of G_A and C_A change so as to incorporate the inference from the former to the latter, yet the inference is also supposed to be seen as substantive. There is a clear tension here: seeing the inference as substantive requires seeing the meanings of G_A and C_A as unchanged. But then that seems to force us into Dummett's position which eradicates any substance to the inference. Once A has been introduced, though we want to say that its content is given by the inference from G_A to C_A[12], we seem not to be able to say this, just because G_A and C_A don't have the meanings they used to have[13]. There has simply been a shift in the way the language works: new vocabulary and new inferential proprieties. So what we want to be able to do is to ensure that the meanings of G_A and C_A haven't changed, which will both satisfy the molecularist and capture the content of A; yet we don't want to do this by adopting Dummett's position of *demonstrating* that the inference is good, because this means that A has no substantive content.

3. Problems with Brandom and Dummett and the Need for a Middle Path

Brandom and Dummett are both right and wrong. Brandom is right that inferences of this kind are substantive, but he is wrong to accept that they may change the meanings of expressions involved.

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[11] See below for more discussion and motivation.

[12] There seems to be some tension here between this conception of the content of assertions, in general, and Brandom's logical expressivism. For, the assertion A seems to express as a claim the inferential commitment from G_A to C_A. But that was logic's peculiar role.

[13] This chimes with some of Dummett's complaints about holism, namely, that '[f]or the holist, we ought not to strive to command a clear view of the workings of our language, because there is no clear view to be had' (1993a: 241). Here we think we have a clear conception of the content of A, in terms of the inferential connection it forges. But its very introduction changes the content of the terms of that inference and so demolishes our handle on its substantive content.

Dummett is wrong to insist that inferences of this kind are not substantive, but right that they do not change meaning.

Let's illustrate this with an example. Suppose that vocabulary for ascribing toothaches to people is introduced into a language. 'has a toothache' is asserted of people who exhibit behaviour typically caused by toothaches, such as wincing, groaning, clutching of jaws, etc.. The ascription of 'has a toothache' to a person in turn warrants assertions that they are unfit for certain activities, such as chewing chewy things. So the grounds for asserting 'Fred has a toothache' are that Fred exhibits toothache behaviour, and its consequences are that assertions of 'Fred can't chew that toffee' and the like are warranted. Before the introduction of the vocabulary for ascribing toothaches, there need have been no generally accepted inference from attribution of toothache behaviour to assertions of being unfit to chew chewy things. Nonetheless the presupposition of the introduction of toothache-talk is that when unfitness is ascribed by means of such an inference it could have been ascribed on the basis of usual criteria for the ascription of unfitness. That's the presumption of molecularity.

Dummett, however, would require that it is demonstrable that the grounds for asserting 'x has a toothache' had all along warranted the assertion 'x cannot chew chewy things'. And this seems wrong on two counts. First, we may not be in possession of such a demonstration (not even in principle); second, Dummett's requirement voids the inference of any substance, while it seems that it must be substantive: there is no *logical guarantee* that we could have established that Fred is unfit to chew chewy things before the introduction of toothache-talk. The inference is merely contingently good: in alternative circumstances people may get on just fine chewing chewy things despite their toothache-behaviour. This is why it is a substantive inference. If Dummett was right, and the addition of toothache vocabulary is demonstrably conservative, the inference should hold as a matter of necessity.

Brandom, on the other hand, would allow that the meaning of 'cannot chew chewy things' changed after the addition of 'has a toothache'. And this, too, seems wrong: the reason the inference is substantive is that we have found a new way of asserting 'x is unable to chew chewy things' according to the meaning it already had. If it changed its meaning, the new grounds are not new: what is new is the entire ensemble of expressions and their meanings.

The same lesson emerges from Dummett's example of Boche. (Dummett 1981: 454) Assume that it is governed by the following rules: 'x is Boche' follows from 'x is German' and from 'x is Boche' one may infer 'x is prone to barbaric cruelty'. Dummett complains that the meaning of 'Boche' is illicit since it forges an inference from 'x is German' to 'x is prone to barbaric cruelty', and since the latter doesn't follow from the former, this combination of grounds and consequences is a misconstruction of meaning. Dummett and Brandom agree that 'Boche' should be rejected, but, whereas Dummett thinks this is because the requirements of molecularity are compromised, Brandom thinks that it is because the meaning incorporates a material inference which we reject as bad, the inference made explicit by the conditional 'If x is German, then x is prone to barbaric cruelty'. There is surely much to be said for Brandom's over Dummett's position. Brandom protests that it is not the construction of the meaning of 'Boche' that is at fault, but its incorporation of a material inference which we reject. Thus we should object to the meaning of 'Boche' and renounce it. Our concern with the Brandomian scheme is that the inference we object to is the inference from 'x is German' to 'x is prone to barbaric cruelty', under the meanings these claims have prior to the introduction of 'Boche'; but once that term is introduced into the holistic, inferential construction of meanings, according to Brandom's scheme, the nature of the inference changes.

How to find a middle path between Dummett and Brandom? Well it can be a tacit presupposition[14] of accepting a new vocabulary into the language that it be a conservative extension. So we move towards Dummett but resist the collapse by resisting the demand that conservativeness be demonstrable. The upshot is: all extensions of language are implicitly presumed to be conservative by speakers. This gives us enough to satisfy the global requirement of molecularity.

We make it a substantive presupposition in taking a term like 'Boche' into our language, namely and in this instance, that when we come to assert 'x is prone to barbaric cruelty' on the basis of 'x is Boche' it would have been assertible on the basis of its previous warrant for assertion. That is to say, we presuppose that the extension of the language by introduction of 'Boche' constitutes what is, as a matter of contingent fact, a conservative extension of the language. That presupposition needs to be capable of reflective—though not purely logical—endorsement. Here we would need to endorse the contingent(ly false) claim that all Germans are prone to barbaric cruelty.

The particular focus of attention here is logical vocabulary. Logic is often considered to be *topic neutral*. So let us work our way towards it by offering an account of topic neutrality. Our aim is to clarify a notion of topic neutrality which, in the particular case of logic, justifies a stricter sense in which it should be conservative relative to its base.

4. Topic Neutrality

Consider the practice of assertion. To assert is to deploy (appropriately) some vocabulary. To have the capacity to make an assertion is, plausibly, to have the capacity to make many assertions[15]. Those many assertions are circumscribed by the combinatorial possibilities of a vocabulary and its semantic dependencies. We can thus think of possible linguistic, and specifically assertional, competences as charting the terrain of a language into different regions, thought of as vocabularies enabling a practice of assertion. Brandom introduces us to the notion of an autonomous discursive practice, namely, 'a language-game one could play though one played no other' (2008: xvii)[16]. Associated with each such practice will be a vocabulary; let's call such a vocabulary autonomous. A vocabulary may form a proper part of an autonomous vocabulary, without itself being autonomous; others will themselves form autonomous vocabularies. Because the former are, in this sense, not self-standing we can call them *dependent* vocabularies. So for any such dependent vocabulary, V, if V is part of an autonomous vocabulary, W, then there is some non-empty U such that W=V+U. Now the reason for this situation will be a semantic dependency of the vocabulary V on that of U. We say that the vocabulary V semantically depends on U; but don't say what feature of U it depends on. The semantics of vocabulary in V may depend on the semantics of the vocabulary in U; the meaning of terms in the former may depend on the meanings of terms in the latter. Were this the case one would suppose that any autonomous vocabulary of which V is a part would be one of which U is a part also. The reason for this situation will be that expressions in W which utilise vocabulary from V depend on the semantics of vocabulary from U. This may be because expressions in W which utilise vocabulary from V invariably include vocabulary from U; but it may

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[14] See (Weiss 2007: 609-14).

[15] Cf. The Generality Constraint (Evans 1982: p. 75).

[16] Brandom, following Sellars, is sceptical about whether there could be an autonomous practice purely of observational reporting, arguing that observational reporting is only possible in the context of inferring too. We're not here concerned with this level of nuance and will treat reporting and inferring as asserting—the latter depending on semantic relations between assertions.

be because there is some other relation of semantic dependency. For instance, it may be that assertions made in the vocabulary of V are inferred from claims made using the vocabulary of U. Deploying U may be necessary for deploying V, i.e., for any autonomous W′, if V is part of W′ then U is also part of W'; but it may be only sufficient. And, if it is sufficient, it may be that some distinct vocabulary U′ is likewise sufficient, i.e., it may be that there is some autonomous W′ such that W′=V+U′. We'll call a vocabulary *topic neutral* just in case V+U is autonomous for any autonomous U.

The claim we want to make here is that logical vocabulary is topic neutral and by this we mean that where L is logical vocabulary, L, is dependent and such that any autonomous vocabulary U is sufficient for deploying L, i.e., U+L is autonomous, for any autonomous U. What this means is that deploying logical vocabulary always depends on another vocabulary but depends only on the formal features of a given vocabulary—we access formality by means of universality—so, in this sense, logic is topic neutral[17].

The one direction of the claim that logic is *distinctively* topic neutral is, we take it, easy to justify. The typical vocabulary of sentential logic can be grafted onto any autonomous vocabulary, i.e., vocabulary apt for the self-contained practice of asserting, and thereby forms an autonomous vocabulary. Quantificational vocabulary simply requires that the assertional practice at logic's base includes predicates and names and possibly pronouns. So any assertional practice suffices for the introduction of logic into an autonomous discursive practice; and some such practice is necessary. Logic is thus dependent and topic neutral.

However the converse claim might give one pause: are there not practices which are topic neutral but not, or at least not obviously, logical? Some obvious cases include propositional attitude ascription and talk of truth. Let us be clear: our interest is in using properties of logic to develop constraints on the acceptability of a system of logic. So the project doesn't require a solution to logic's demarcation problem. But the issue is independently interesting; so let us digress briefly.

Let's consider propositional attitude ascription[18]. Any assertional practice will enable formation of declarative sentences which are fit for expression of a content apt to be the subject of a propositional attitude. And propositional attitude ascription is not possible without such an ability. So it seems to be both dependent and topic neutral. The observation may be accurate, but doesn't deliver the conclusion without the additional claim that the resulting vocabulary is autonomous. And this we might doubt because of the inferential relations between ascriptions of propositional attitudes and behaviour. Ascriptions of belief, for instance, are justified by citing instances of behaviour (at least in part); and are withdrawn when suitable behavioural evidence is cited. So a vocabulary L expanded to enable ascription of propositional attitudes whose contents are expressed

[17] Brandom also develops a conception of logic which makes it topic neutral—'I will argue that logical vocabulary both can be algorithmically elaborated from and is explicative of practices that are PV-necessary for the autonomous deployment of *any* vocabulary at all' (our emphasis; 2008: 28)—but arrives at such a view from his expressivist understanding of logic, namely, that the role of logic is in explicitating inferential practice. The issue is somewhat tangential to current concerns; but our sense is that it would be better to understand logic in terms of its topic neutrality (treated as distinctive). Weiss thinks logical expressivism falters because its expressive role depends on a prior role of compounding contents; and the notion of explicitating is radically unclear (2010: 247-62).

[18] We might agree with Brandom (see chapter 5 of his 1994) that truth need not be metalinguistic and is logical; though our reasons for holding this would be to do with its neutrality rather than its expressive role.

in the vocabulary of L is not autonomous. Propositional attitude ascription is dependent but not topic neutral: vocabulary needed for reporting behaviour is necessary to its deployment.

Obviously this line of thought crucially depends on the idea that semantic competence with propositional attitude ascriptions depends on semantic competence with statements about behaviour, and does so because the latter figure as reasons for or against the former. Equally obviously it'd be highly controversial to assume that any relationship of giving or rejecting a reason was a matter *purely* of semantics, and so accessible via an exercise of distinctively semantic competence. So the argument we presented in the last paragraph is apt, perhaps, to raise some eyebrows. So be it. Having revealed these commitments[19] and noted a debate for another occasion, let us move on.

5. <u>Topic Neutrality and Conservativeness</u>

We make the following conjecture: a vocabulary which can be known to be topic neutral is *demonstrably* conservative relative to any base.

Let's begin by considering a region of language which is not demonstrably conservative, indeed, perhaps not conservative at all; we hark back to the example of 'Boche', under the previous construal of its semantics. Here there is a (substantive) condition required for the extension by inclusion of 'Boche' to be conservative, namely, it needs to be the case that all Germans are prone to barbaric cruelty. And, if the extension involved introducing a range of such terms, then one could imagine the condition being strengthened to accommodate them all; let's call this the condition for conservativeness, CC. Reflectively we ought to be able to endorse the condition for conservativeness, CC, whatever it proves to be--otherwise we ought to revise our use of language. Let's now consider the situation when our extension involves introduction of topic neutral vocabulary. If introduction of such a vocabulary into the language is acceptable then we need to be able to endorse the CC developed by its being a conservative extension relative to each (autonomous) vocabulary. Moreover, since we don't want the notion of topic neutrality to be relativized to the actual expressive power of the language, we need this to be the case with respect to every possible autonomous vocabulary. So topic neutrality, given molecularity, generates, what we might call, a condition for universal conservativeness, CUC.

It will help to illustrate our case, if we begin by dismantling an example. Suppose V is topic neutral and demonstrably conservative relative to any autonomous vocabulary; then it would seem we can easily manufacture a vocabulary V', which is topic neutral but not demonstrably conservative relative to every autonomous vocabulary. V' is such that if V enables $G_A \vdash C_A$, then V' enables $G_A \vdash (C_A$ and grass is green). If the former inference is demonstrably good then the latter is good but this is contingent on grass being green. No such example can be accepted. For recall that the consequences are to hold in each V_i, where these include all possible vocabularies. So these include vocabularies which don't include 'grass is green'. So any such manufactured counterexample can be excluded by finding an appropriate vocabulary, appropriately lacking in expressive resources.

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[19] Namely, that discourse involving ascription of propositional attitudes depends semantically on discourse involving behavioural ascriptions.

We might generalise[20] so as to include a contingent truth expressible in each V_i, i.e., $G_A \vdash (C_A$ and $s_i)$ where s_i is a contingent truth expressible in V_i. But such a condition couldn't be known to be satisfied.

The case illustrates a general problem with supposing a topic neutral vocabulary merely *contingently* extends its base vocabularies conservatively. For each such vocabulary, V_i, we have a CC_i. The CC_i in turn are generated by the condition for the goodness of inferences which it forges between grounds and consequences (inferences of the form $G_A \vdash C_A$). The problem now is that we generate an irresoluble tension between our ability to know that all the CC_i hold; and their aptness relative to each V_i. For the former requires some uniformity between the CC_i, else we couldn't know that the potential infinity of them actually hold; but the latter requires that grounds and consequences are expressible in each V_i, and this, given the range of potential vocabularies, militates against any uniformity in the CC_i.

So if a vocabulary can be known to be topic neutral then it is demonstrably conservative relative to any autonomous base vocabulary.

6. **Assertion and Harmony**

Consider now this artificial case. Imagine a vocabulary, L, which shares its introduction rules with those of propositional logic but which lacks elimination rules. L would be topic neutral and so would need to be demonstrably conservative relative to any base vocabulary. And indeed it is, trivially so; since it lacks elimination rules it fails to have consequences in the base vocabulary. So it fails to provide a warrant for any claim in the base vocabulary, which hitherto lacked a warrant. L would thus seem to be unimpeachable. Well, being acceptable as a topic neutral vocabulary need not be all there is to being an acceptable vocabulary. To be an acceptable vocabulary also requires that the vocabulary can be deployed to make assertions. To make an assertion is to perform a speech act which incurs commitments. Those commitments will be closely related to the consequences of the content asserted. Since putative assertions, made using the vocabulary of L, lack consequences, such assertions fail to incur commitments, and thus fail to qualify as genuine assertions. At minimum, an assertion generates the commitment to provide one's warrant for assertion: if challenged and unable to fulfil this commitment then the assertion ought to be withdrawn[21]. So a consequence of an assertion is the very warrant which entitled it. Putative assertions made using the vocabulary of L fail to generate commitments, fail to generate even this minimal commitment and so fail to be genuine assertions. Thus conservativeness limits the power of elimination rules, and the

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[20] Helping ourselves to a suitable mode of generalising over sentences: not straightforward because substitutional quantification would be limited by the resources of a language, whereas we are concerned with all possible vocabularies. Being in a position feasibly to obtain a warrant is to have a warrant. It is a further question whether agents are thereby also in a position to know that they have a warrant. We do not assume a transparent notion of warrant. On the other hand, transparency would appear to follow if it is the case that if an agent can feasibly achieve a purely epistemic goal, then they ought to be able to reflect on this and come to know it. Thus transparency would follow from the additional assumption that agents can always reflect on what they can feasibly do. If we reject transparency of warrant, it is this latter thought we should reject.

[21] Testimony might seem to constitute a counter-example and, though it involves deferring a commitment to another, it does involve the commitment to provide one's testimonial warrant. So, rather than being a counter-example, this kind of case falls into a mixed bag of what Dummett calls indirect warrants for assertion.

nature of assertion demands they have a certain strength relative to their introduction rules. So there is a requirement of harmony.

Let's consider the introduction rules for the logical connectives and illustrate how this consideration suffices to generate elimination rules. Let's begin with ∧.

∧I: $$\frac{A \quad B}{A \wedge B}$$

If one asserts A∧B and is challenged one ought to be able warrantedly to assert A and warrantedly to assert B, which were required for warranted assertion of A∧B. So we arrive at the following elimination rules:

∧E: $$\frac{A \wedge B}{A} \qquad \frac{A \wedge B}{B}$$

Now take ∨.

∨I: $$\frac{A}{A \vee B} \qquad \frac{A}{A \vee B}$$

If one asserts A∨B and is challenged one ought to be able warrantedly to assert A or warrantedly to assert B. So one is committed to being able to do either of two things, and thus one's commitment fails itself to constitute an elimination rule. But with this we can construct an elimination rule by characterising a single thing one is entitled to do, if one is entitled to do either of those two things. Take it that C is a consequence of A (together with Σ) and of B (together with Δ). Now if one is in a position to assert A∨B then one is either in a position warrantedly to assert A or warrantedly to assert B. So, given one's entitlement to Σ∪Δ, one is either in a position warrantedly to assert A∪Σ, or to warrantedly assert B∪Δ. Either of these delivers a warrant for asserting C. So one is in a position to obtain a warrant for asserting C. Thus, given that (knowingly?[22]) being in a position to obtain a warrant is to possess a warrant, being in position warrantedly to assert A∨B, and Σ∪Δ, is to be in a position warrantedly to assert C. So the elimination rule for disjunction is justified:

∨E: $$\frac{A \vee B \qquad \overset{[A],\,\Sigma}{C} \qquad \overset{[B],\,\Delta}{C}}{C}$$

Quantum disjunction is subject to the same introduction rule but doesn't permit use of collateral premises in the elimination rule. The question is: which elimination rule is appropriate? The point just made is that the commitment of assertion is the commitment to furnishing either A or B, and either commitment in conjunction with appropriate collateral premises yields warrant for C. It's up

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[22] See Dummett's discussion of the relation of demonstrations to canonical proofs, the former being a means, recognizably, to furnish the latter (2000: 269-74).

to a quantum logician to frustrate this reasoning and it is hard to see how to do so, unless she has a general complaint about using collateral premises. But she doesn't. So she must admit that her elimination rule is too weak. We return to this question below. The challenge we discuss there is this. Since introduction of traditional disjunction into a language with quantum disjunction is non-conservative, it seems that *traditional* disjunction offends against tropic neutrality.

Now → .

$$\rightarrow\text{I:}\quad \frac{\begin{array}{c}[A], \Sigma \\ B\end{array}}{A \rightarrow B}$$

So, if one is in a position to assert A→B, then one is able, given one's ability warrantedly to assert each of Σ, to transform any warrant for A into a warrant for B. So, if one is in this position, and is, in addition, in a position warrantedly to assert A, then one is in a position to obtain a warrant for asserting B, which, given that being in a position to obtain a warrant is to possess a warrant, is to have a warrant for B. So the following elimination rule is applicable:

$$\rightarrow\text{E:}\quad \frac{A \rightarrow B \qquad A}{B}$$

Now ⊥:

⊥I: A warrant for assertion of ⊥ is a warrant to assert A, no matter what sentence A is, i.e., it is a warrant to assert any sentence. So, in effect, its introduction rule renders it unassertible.[23] It is, obviously, subject to the following elimination rule,

$$\bot\text{E:}\quad \frac{\bot}{A} \qquad \text{for any A}$$

Now ¬:

$$\neg\text{I:}\quad \frac{\begin{array}{c}[A], \Sigma \\ \bot\end{array}}{\neg A}$$

If we are in a position to assert ¬A then we are in a position to obtain a warrant for ⊥ from a warrant for A. So, since we have a warrant for A, we have a warrant for asserting ⊥, and thus we have a warrant for B, no matter what B is. So we get the following elimination rule:

$$\neg\text{E:}\quad \frac{\neg A \qquad A}{B}$$

[23] Grasp of the rule is manifestable. In grasping the syntax of the language, a speaker has a manifestable capacity to recognise any sentence of the language; and in grasping the introduction rule for "⊥" a speaker recognises that a warrant to assert "⊥" is a warrant to assert any member of the set of sentences, which, as just noted, she grasps via grasp of the syntax of the language.

The aim here was to characterise a notion of topic neutrality applicable to vocabularies. We did this by distinguishing dependent vocabularies as those which require another vocabulary for their deployment and then noted that a topic neutral vocabulary is one which is dependent and whose deployment is rendered possible by any autonomous vocabulary. We then noted that logical vocabulary is topic neutral in this sense. Given that, and given a molecularist philosophy of language, we then motivated a constraint on logical systems, namely, that these are demonstrably conservative relative to any base vocabulary. Finally, we argued against an objection that this constraint is too easily satisfied by appealing to a feature of the act of assertion, namely, that legitimate assertings commit the assertor to providing her grounds for assertion. In the wake of noticing this minimal commitment, assertions need to be seen as having consequences. These consequences enable the derivation of elimination rules, given introduction rules, via what is a constraint of harmony.

7. What is Wrong with Quantum Disjunction?

If the requirement of provable conservativeness for the logical constants is right, we are presented with the following challenge: introduction of (ordinary) disjunction into a language which includes quantum disjunction is non-conservative relative to the derivability relation in that language[24]. So, if the language including quantum disjunction is acceptable, then, given strong-C_T, we seem to challenge the acceptability of ordinary disjunction as a logical connective.

Quantum disjunction has the same introduction rules as ordinary disjunction and a restricted elimination rule which requires the minor premises C to be derived from A alone and from B alone, that is, the sets of formulas marked by Σ and Δ in ∨E are required to be empty:

$$u\text{I:} \quad \frac{A}{AuB} \qquad \frac{A}{AuB} \qquad\qquad u\text{E:} \quad \frac{AuB \qquad \begin{matrix}[A]\\ C\end{matrix} \qquad \begin{matrix}[B]\\ C\end{matrix}}{C}$$

When ordinary disjunction is added to a system with quantum disjunction, the unrestricted elimination rule is derivable for quantum disjunction and quantum disjunction collapses into ordinary disjunction. This is because $A \vee B$ follows from AuB, by ∨I and uE, and so if there are deductions of C from A together with assumptions Σ and of C from B together with Δ, C follows from AuB by ∨E. (For graphic representation, see figure 1.)

So, given what has just been said about the separability and topic neutrality of the connectives, this ought to make apparent a fatal flaw in intuitionist disjunction. However, the problem is not with intuitionist disjunction but with quantum disjunction, whose rules are disharmonious because they fail to deliver all the consequences warranted by the grounds[25].

Dummett and Prawitz require that, for the rules of a connective c to be in harmony, maximal formulas arising from concluding the major premise of an elimination rule for c with an application of an introduction rule for c be removable from deductions.

[24] See (Steinberger 2011: §5).

[25] As we mentioned above, p.XX.

Figure 1:

$$\dfrac{\dfrac{A\underline{\vee}B \qquad \dfrac{\overline{A}^{\,1}}{A\vee B}\,\vee I \qquad \dfrac{\overline{B}^{\,1}}{A\vee B}\,\vee I}{A\vee B}\,1\ \overline{\vee}E \qquad \begin{array}{c}\Delta,\ \overline{A}^{\,2}\\ \Pi_1\\ C\end{array} \qquad \begin{array}{c}\Sigma,\ \overline{B}^{\,2}\\ \Pi_2\\ C\end{array}}{C}\,2\ \vee E$$

Figure 2:

$$\dfrac{\dfrac{\begin{array}{c}\Sigma\\ B\end{array}}{A\vee B}\,\vee I \qquad \begin{array}{c}\overline{A}^{\,i}\\ \Pi_1\\ C\end{array} \qquad \begin{array}{c}\overline{B}^{\,i}\\ \Pi_2\\ C\end{array}}{C}\,i\ \vee E \qquad \rightsquigarrow \qquad \begin{array}{c}\Sigma\\ B\\ \Pi_2\\ C\end{array}$$

Figure 3:

$$\dfrac{\dfrac{\begin{array}{c}\Sigma\\ B\end{array}}{A\underline{\vee}B}\,\overline{\vee}I \qquad \begin{array}{c}\overline{A}^{\,i}\\ \Pi_1\\ C\end{array} \qquad \begin{array}{c}\overline{B}^{\,i}\\ \Pi_2\\ C\end{array}}{C}\,i\ \overline{\vee}E \qquad \rightsquigarrow \qquad \begin{array}{c}\Sigma\\ B\\ \Pi_2\\ C\end{array}$$

Ordinary disjunction satisfies this requirement. Suppose A∨B is derived by ∨I, say from the conclusion B of a deduction Σ, and is the major premise of ∨E. Then there is a deduction Π_2 with an open premise B that concludes a minor premise C of ∨E. Thus, instead of taking the detour through introducing and eliminating A∨B, we can use the deduction Σ to derive the open assumption B of Π_2 and conclude C directly. (For graphic representation, see figure 2: transform the deduction to the left of squiggly arrow into the deduction to its right.) But this transformation is also possible for quantum disjunction, because there cannot be any applications of *u*E on the path from open premise B of Π_2 to its conclusion C, as *u*E discharges all open premises above its minor premises (i.e. the unique ones corresponding to each disjunct of its major premise).

In both cases, whether the transformations can be carried out as part of the normalisation procedure for a system of logic with those connectives depends on further features of the other connectives that are present.

In the context of intuitionistic logic, the reduction procedure for removing maximal formulas of the form A∨B always transforms correct deductions into correct deductions. Thus, should the transformation, for one reason or other, lead to incorrect applications of rules in the reduced deduction, it is not disjunction that is to blame: any such clashes would be due to restrictions on the applications of rules for other expressions, whereas the rules for ordinary disjunction are completely general and without any restrictions on their application. It is those other rules with their restrictions and lack of generality that are to blame for any clashes.

The deduction that shows that quantum disjunction collapses into ordinary disjunction has a feature Dummett and Prawitz require ought to be eliminable from a logic: the deduction introduces A∨B by applications of ∨I only to eliminate it again by ∨E. Due to the intermittent application of *u*E, this is not a maximal formula, but a maximal segment. (Prawitz 1965: 49) The latter, just as the former, count as undesirable and should be removable from deductions. In the presented case, the maximal segment should be reducible to two maximal formulas by permuting the two applications of *u*E and ∨E. These maximal formulas should then be removable from the deduction by reduction procedures that show that the detour through the maximal formula A∨B was superfluous. But that, in a system containing both disjunctions, cannot be done. Permuting the application of ∨E upwards creates an illegitimate application of *u*E.

In intuitionistic logic, the conclusion of ∨E need never be the major premise of an elimination rule: such constellations can be removed from deductions by permuting the application of the lower elimination rule upwards (and doubling it up), so that it concludes what then becomes a minor premise of ∨E. (Troelstra and Schwichtenberg 2000: 179) This transformation is not possible for quantum disjunction: if the elimination rule applied to the conclusion of *u*E has minor premises, these may be derived from open assumptions, so permuting the application upwards would lead to an illegitimate application of *u*E. The transformation is only possible in special cases, if it just so happens that the minor premises of the lower elimination rule are derived from no open assumptions, i.e. if they are logically true. It is, so to speak, a transformation that is merely contingently good, if it just so happens that the minor premises of the lower elimination rule are derived in a suitable way: it lacks the generality required for logic. *u*E is in this sense too weak: it does not allow us to draw all the consequences we are entitled to draw, as it does not allow us to perform this transformation in all cases.[26]

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[26] For further discussion of the philosophical reasons of requiring permutation conversions see (Kürbis 2019: Ch 2).

The restriction on *u*E will also mean that, if implication is present in the logic, as surely it should be, then maximal formulas of the form A→B may not be removable from deductions, as, in order to be able to apply *u*E, surplus open assumptions may be discharged by implication introduction, only to be introduced again as premises of implication elimination.[27]

This should suffice to establish that it is quantum disjunction, not intuitionist disjunction, that is to blame for the non-conservativeness of an addition of the latter to a system with the former. It is time to move on to another condition that has been added to conservativeness as a criterion for logical constanthood.

8. Uniqueness

Arthur Prior posed a well known challenge to inferentialist accounts of the meanings of the logical connectives with his connective *tonk*. A*tonk*B follows from A, and it entails B, so adding it to our language everything follows from everything (Prior 1961). Belnap's solution to Prior's challenge started from the observation that 'we are not defining our connectives *ab initio*, but rather in terms of *an antecedently given context of deducibility*, concerning which we have some definite notions. … Before arriving at the problem of characterizing connectives, we have already made some assumptions about the nature of deducibility.' (Belnap 1962: 131) Belnap has in mind structural properties of a formal consequence relation, such as those given by Gentzen: reflexivity (for any A, A ⊢ A), transitivity (if **Γ** ⊢ B and Δ, B ⊢A, then **Γ**, Δ ⊢ A), weakening (if **Γ** ⊢ B, then **Γ**, Δ ⊢ B), and the contraction and permutation of formulas to the left of ⊢. There may be others. Belnap himself would be uneasy about weakening, for instance. There is also no requirement that the context of deducibility be a formal one. The material inferences accepted as basic by Brandom would do, too. Prior's *tonk* is absurd because we do not accept that everything follows from everything. In a context of formal deducibility, we do not have A ⊢ B, but adding *tonk* to a logic that has transitivity (and some axioms that allow deductions to get started) has this effect. Likewise, Brandomian material inferences prohibit the propriety of inferring anything from anything.

Belnap's solution to Prior's challenge then consists in proposing that the addition of a logical connective must leave this antecedently given context of deducibility intact: the addition must be conservative. Belnap proposes as a further requirement on an acceptable definition of the meaning of a connective * that the meaning of A*B be a function of A and B (Belnap 1962: 133): given the meanings of A and B, the meaning of A*B is uniquely determined by the meaning of *. Uniqueness is cashed out in terms of interderivability: the rules governing * should be such that for any connective # the rules of which are the same as those for * except with * replaced by #, we can show A*B ⊢ A#B and A*B ⊢ A#B. Belnap concludes: 'One *can* define connectives in terms of deducibility, but one bears the onus of proving at least consistency (existence); and if one wishes further to talk about *the* connective (instead of *a* connective) satisfying certain conditions, it is necessary to prove uniqueness as well. But it is not necessary to have an antecedent idea of the independent meaning of the connective.' (Belnap 1962: 134) By 'consistency' Belnap means conservativeness. According to Belnap, then, conservativeness and uniqueness are necessary conditions for a successful inferential definition of the meaning of a logical constant by the rules of inference governing it. Whether they are also sufficient conditions may be an additional question. No other conditions being mentioned, Belnap's discussion suggests that they are.

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[27] This manoeuvre effectively establishes the derivability of intuitionist disjunction elimination if quantum disjunction is coupled with intuitionist implication.

For Dummett and Prawitz, on the other hand, they are not sufficient. They impose additional requirements on the forms of rules: they must satisfy what Dummett calls the complexity condition (Dummett 1993: 258), lend themselves to a proof of a normalisation theorem (harmony) ((Prawitz 1965: 33f), (Dummett 1993: 245ff)), and have the further property of stability, a suitable converse of harmony (Dummett 1993: 280ff). There may be others. But none of these additional requirements, nor conservativeness *per se*, as we argued, single out the logical constants from all the other expressions.

This leaves uniqueness, and so there is a question: does uniqueness single out the logical constants from all other expressions?[28]

With respect to conservativeness, according to our previous argument, what singles out the logical constants is their *provable* conservativeness. For other expressions, conservativeness is not a matter of proof, but of reflective endorsement. Uniqueness is also a condition that involves proof.

Belnap is right in requiring the uniqueness of a constant as a necessary condition for its rules to define its meaning. For suppose that two expressions if * and # are governed by the same rules, i.e. the rules governing * are exactly those of #, only with # replaced by *, and conversely, but we do not have A*B ⊢ A#B and A#B ⊢ A*B. Then an assertion of A*B does not warrant an assertion of A#B, or an assertion of A*B does not warrant and assertion of A#B. We may assume that A*B and A#B have determinate assertion conditions, for otherwise there is already some defect in the expressions * and #, and Belnap's diagnosis applies: the rules governing * and # do not define their meanings. But if the meanings of A*B and A#B are not defective, there must be something to the meanings of * and # that accounts for the differences in their assertibility conditions. As *ex hypothesi* their rules are the same, that difference cannot lie in their rules, but must lie elsewhere, and hence those rules do not define the meanings of * and # completely.

Contrast with simple colour predicates. They have a 'logic'. Nothing is both red and green all over, nothing is both blue and orange all over, nothing is yellow and purple all over.

If C_1 and C_2 are complementary colours, then 'a is C_1' and 'a is C_2' are contraries. Cyan, magenta and yellow are the primary colours (let's talk of pigments, not of light). A secondary colour is a mix of equal parts of two primary colours. A primary colour is complementary to the secondary colour not containing it in the mix. And so on.

Now consider an interpretation induced by the inverted spectrum: here every colour predicate refers to its complementary. The internal logic of the colour words of the inverted spectrum interpretation is exactly the same as the internal logic of the colour words of the standard interpretation. The word 'magenta' of the inverted spectrum interpretation, for instance, is governed by exactly the same internal logic as the word 'magenta' of the standard interpretation. Likewise for all the others.

Nonetheless, their meanings are different, because in the standard interpretation, 'magenta' refers to magenta, while in the inverted spectrum interpretation 'magenta' refers to green.

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[28] One might object straightaway that the modal operators are not uniquely characterised by their rules of inference. But there is no justified worry here. Some notions of modality are metaphysical notions, so it is not surprising if formal rules do not determine their meanings completely. Maybe we also need to know something about the natures of things or their essences. (As argue, e.g., (Fine 1994, 1995) and (Hale 2013). For a review of the latter, see Kürbis (2015a).). For purely logical notions of modality, of which one would desire that they belong amongst the logical constants, this merely shows that a suitable modification of standard proof systems should be chosen for their formalisation in which they are uniquely characterised. Dosen's systems provide an example (Došen 1985).

Let's distinguish the colour words of the inverted spectrum interpretation by prefixing them by 'i'. Despite the sameness of the rules governing the colour words and the icolour words, we will not be in a position to prove that x is magenta if and only if x is imagenta, because x is imagenta if and only if x is green. In other words, we cannot prove the uniqueness of the colour words, on the basis of their internal logic.

This is of course what we should expect from Belnap's discussion: the 'logic of colour words' does not guarantee their uniqueness, hence the meanings of colour words are not defined by those rules. Few would disagree; and inferentialists try to make room for this observation by incorporating language entry and exit rules into their repertoire of meaning constituting inferential transitions.

9. <u>Topic Neutrality and Uniqueness</u>

For an inferentialist the meaning of a word is wholly captured by its inferential/substitutional role. As the example of colour predicates demonstrates, any plausible inferentialism must allow for language entry and exit rules; and so needs to see these in inferential terms. So it needs to see these still in terms of rules of use; rather than in terms of semantic success, i.e., in terms of referring or of being true. Let us suppose that uniqueness is a commitment of inferentialism; that is, whichever rules are seen as meaning determining must be such as to guarantee uniqueness. So, if two expressions are subject to the same meaning determining rules, then they ought intuitively (or pre-theoretically) to be judged synonymous and they ought not to differ in uses which are indirect implementations of meaning determining rules. Thus, quite generally, if '*' and '#' are subject to the same meaning determining rules then '…*__' ought to be interderivable with '…#__', on the basis of an explicit statement of the rules governing each piece of vocabulary.

Let's now generalise the notion of language entry and exit rules. Let's say that L' extends L by adding vocabulary V' to L's vocabulary V. Then call a rule a V'-entry rule if the conditions in which an expression of V' is introduced can be stated in L. And call a rule a V'-exit rule if the consequences of eliminating an expression of V' can be stated in L. Language entry and exit rules make the use of vocabulary sensitive to worldly facts. Vocabulary specific entry and exit rules, potentially, transmit this sensitivity from a basing language to its extension.

Now suppose that L' extends L by introducing logical vocabulary. So V' is some selection of logical connectives. There'll be a range of connectives such that each has its behaviour in L' determined by its V'-entry and -exit rules (and perhaps there'll be other connectives whose behaviour will be given in terms of introduction and elimination rules stated using the base set of connectives). As just remarked there will be language entry and exit rules which apply to the terms in V, and which via the V'-specific entry and exit rules, potentially render the use of terms in V' sensitive to worldly facts. The question now is whether the semantic contribution of a connective, '*', is sensitive to worldly facts. Well, the only way it could be is via the transmission of worldly sensitivity from language entries and exits for V to vocabulary V'-specific entries and exits. But logic is topic neutral; thus can be used to extend any vocabulary; and thus the semantic contribution of logical vocabulary cannot be sensitive to the worldly facts that a specific vocabulary is sensitive to; it is thus sensitive to no worldly facts. To add flesh to this abstract sketch, the, somewhat obvious, point is this: 'Fred is red and Fred is fat' is used appropriately only by being sensitive to worldly facts (to do with Fred's colour and degree of obesity); these are transmitted to it from the language entries and exits for 'is red' and 'is fat' by the vocabulary-specific entries and exits; but the semantic contribution of 'and' is shielded from these worldly facts, and needs to be, just because it can be employed in connecting any sentences, no matter their language entries and exits; in other words, just because it is topic neutral.

Thus the meaning of a logical connective is captured by perfectly general introduction and elimination rules; those rules determine the meanings of the connectives; and thus connectives governed by the same introduction and elimination rules are synonymous; in particular, they are intersubstitutable *salva veritate* and the results of so doing are inter-derivable.

So because of the universality implied by topic neutrality, the logical constants have the special feature of requiring only schematic rules of inference, which naturally are meaning determining. And the schematic or formal nature of these rules is an expression of the topic neutrality of the relevant vocabulary. Other vocabulary requires something outside intra-linguistic inferential relations that characterise their use. Nothing in the internal logic of colour predicates determines that 'magenta' means magenta rather than green, because 'magenta' and 'green' are governed by structurally analogous rules.

So knowable topic neutrality, which we suspect is the distinguishing feature of logic, implies uniqueness, and provable conservativeness relative to any base vocabulary.

Conclusion

Logic is topic neutral. And thus, since molecularism holds in the theory of meaning, it constitutes a demonstrable conservative extension of any base language. It delivers assertible contents and thus it also sustains a version of Harmony. In concert, these provide a motivation for intuitionistic logic. Quantum disjunction is not a valid connective both because it cannot be shown to be Harmonious and because it disrupts the Harmony of other logical expressions.

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