

# Aristotle on Predication

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*Abstract:* A predicate logic typically has a heterogeneous semantic theory. Subjects and predicates have distinct semantic roles: subjects refer; predicates characterize. A sentence expresses a truth if the object to which the subject refers is correctly characterized by the predicate. Traditional term logic, by contrast, has a homogeneous theory: both subjects and predicates refer; and a sentence is true if the subject and predicate name one and the same thing. In this paper, I will examine evidence for ascribing to Aristotle the view that subjects and predicates refer. If this is correct, then it seems that Aristotle, like the traditional term logician, problematically conflates predication and identity claims. I will argue that we can ascribe to Aristotle the view that both subjects and predicates refer, while holding that he would deny that a sentence is true just in case the subject and predicate name one and the same thing. In particular, I will argue that Aristotle's core semantic notion is not *identity* but the weaker relation of *constitution*. For example, the predication 'All men are mortal' expresses a true thought, in Aristotle's view, just in case the mereological sum of humans is a part of the mereological sum of mortals.

A predicate logic typically has a heterogeneous semantic theory. Subjects and predicates have distinct semantic roles: subjects refer; predicates characterize. A sentence expresses a truth if the object to which the subject refers is correctly characterized by the predicate. Traditional term logic, by contrast, has a homogeneous theory: both subjects and predicates refer; and a sentence is true if the subject and predicate name one and the same thing. In this paper, I will examine evidence for ascribing to Aristotle the view that subjects and predicates refer. If this is correct, then it may seem that Aristotle, like the traditional term logician, problematically conflates predication and identity claims. I will argue that we can ascribe to Aristotle the view that both subjects and predicates refer, while holding that he would deny that a sentence is true just in case the subject and predicate name one and the same thing. In particular, I will argue that Aristotle's core semantic notion is not *identity* but the weaker relation of *constitution*. For example, the predication 'All men are mortal' expresses a true thought, in Aristotle's view, just in case the mereological sum of humans is a part of the mereological sum of mortals.<sup>1</sup>

Here is the plan for the paper. I will note that, both syntactically and semantically, a simple sentence has a tripartite structure. Syntactically, a simple sentence is composed of two referring terms connected by a copula (§1). Semantically, a simple sentence expresses a relation of either separation or combination (§2). Under a standard interpretation, these relations are set-

theoretic; but I will argue for a mereological interpretation of these relations and discuss the differences between this interpretation and the set-theoretic interpretation (§3). I will then respond to several objections and draw a conclusion (§4).

## 1

I will begin with some initial remarks, so to defend the interpretative strategy of ascribing to Aristotle any semantic theory at all. Aristotle neither explicitly nor consistently distinguishes the surface syntax of natural language utterances and the underlying semantics of such utterances. There are occasions where he makes a claim which is ambiguous between a syntactic and a semantic thesis, and we will need to propose a disambiguation. Moreover, Aristotle does not explicitly formulate truth conditions. Rather, he states a requirement for truth and falsity generally (namely, that certain relations of combination and separation obtain). There are other passages where Aristotle provides an interpretation of the categorical propositions (namely, in mereological terms). We will need to conjecture that there is a connection between these claims so to ascribe to Aristotle a detailed semantic theory.<sup>2</sup> But by carefully attending to the syntax-semantics distinction, and by ascribing to Aristotle a fleshed out semantic theory, I hope to offer a precification of what is present but imprecisely drawn in Aristotle, and not to impose an anachronistic framework.<sup>3</sup>

I will argue that, even if predicates refer, a simple predication is not an identity claim. Of course, this conditional may be true regardless of whether Aristotle holds that predicates refer. I will begin however by noting that there's good evidence to ascribe to Aristotle the view that predicates indeed refer. Initially, I will largely restrict my attention to simple predications with general terms and without explicit quantity or mood—such sentences as 'Man is mortal' and 'Man is not mortal'.<sup>4</sup> I will relax some of these restrictions later in the paper. These affirmations and negations are used to express syllogistic premisses and, at 24<sup>a</sup>16–17, Aristotle writes that 'a premiss is a sentence that affirms or denies something of something'. Syntactically, such sentences have a tripartite structure: they are composed of two terms connected by a copula:

I call that a term into which a premiss may be broken up, i.e. both that which is predicated and that of which it is predicated (whether 'is' or 'is not' is added or removed). (24<sup>b</sup>16–18)

Notice that this passage does not commit Aristotle to claiming that there are distinct nouns and verbs but only that there are terms that stand in subject position and terms that stand in predicate position. Indeed, the passage is consistent with the thesis that one and the same term can stand in subject position or in predicate position. This interchangeability is crucial for the syllogistic, for without it Aristotle could not express the first figure syllogisms and conversion rules.

In the *De Interpretatione*, Aristotle analyses a simple sentence as composed syntactically of a subject and a verb. This has led some to hold that Aristotle is canvassing a rival linguistic theory from the *Prior Analytics*.<sup>5</sup> But the *De Interpretatione* analysis is consistent with the *Prior Analytics* analysis, for Aristotle implies at 16<sup>a</sup>3–9 that these have the same semantic function:

Now spoken sounds are symbols of affections in the soul, and written marks symbols of spoken sounds. And just as written marks are not the same for all men, neither are spoken sounds. But what these are in the first place signs of—affections of the soul—are the same for all; and what these affections are likenesses of—actual things (*pragmata*)—are also the same. These matters have been discussed in the work on the soul.

Aristotle holds that terms signify or symbolize directly affections in the soul, regardless of their place in a sentence. These affections of the soul in turn resemble extra-mental objects. I will not discuss in detail the nature of significance or resemblance in Aristotle's philosophy of language.<sup>6</sup> It suffices for my present purposes to note that there is some *prima facie* evidence that the semantic role of a term is reference, the mapping of linguistic items onto extra-linguistic entities.<sup>7</sup>

Furthermore, Aristotle states at 16<sup>b</sup>19–25 that a verb by itself is a name:

When uttered just by itself a verb is a name and signifies something—the speaker arrests his thought and the hearer pauses—but it does not yet signify whether it is or not. For 'to be' and 'not to be' are not signs of the actual thing (*pragmatos*) (nor if you say simply 'that which is'); for by itself it is nothing, but it additionally signifies some combination, which cannot be thought of without the components.

This cannot be a syntactic claim, for a predicate alone is not an abstract noun. Rather, Aristotle is making a semantic claim. One of the semantic roles of a predicate is modelled on the relation holding between a name and its bearer—that is to say, a relation of reference. These passages then give us *prima facie* reason to hold that both subjects and predicates refer.<sup>8</sup> So predicates are not distinguished from subjects by a distinction between two kinds of semantic role, one based on the name-bearer relation and the other based on the model of characterization. Both expressions refer and Aristotle retains the name-bearer relation as the key semantic function of both terms in subject position and terms in predicate position. Aristotle describes a second semantic role of a term in predicate position, in contradistinction to a term in subject position, at 16<sup>b</sup>6–10:

A verb is what additionally signifies time, no part of it being significant separately; and it is a sign of things said of something else. It additionally signifies time: 'recovery' is a name but 'recovers' is a verb, because it additionally signifies something's holding *now*. And it is always a sign of what holds, that is, holds of a subject.

Terms in predicate position have an *additional* semantic role (*prossêmainon*); they also indicate tense; they do not have an entirely *different* semantic role.

To note that Aristotle holds that predicates name is not, of course, to provide a full description of Aristotle's theory of reference. In characterizing the semantic role of predicates as naming, I am relying on what is, I hope, for the reader an intuitive model of reference. The relation obtaining between a name and its bearer is familiar to us all. However, the identification of the referent of a term with its bearer—what it is the name *of*—is a substantial and controversial thesis. The view is that the contribution a term makes to the conditions under which any sentence containing that name is true, that is to say, the semantic role of the expression, is the object picked out by that term. And notice that the name-bearer model provides a construal of reference distinct from rival construals of denotation. Frege, for example, held that the referent of a subject expression in an oblique context is not its bearer but the sense of that expression. Frege also held that sentences refer to truth values but it would be implausible to take a sentence to be a name for a truth value. And the claim that the semantic role of predicates is to name is especially controversial. In contemporary predicate logic, as standardly understood, predicates denote *extensions* but are not thereby *names*.<sup>9</sup>

Let me remind the reader of the worry that arises for the view that predicates refer. The view that both subjects and predicates are referring expressions was commonly held by term logicians. On this view, a sentence is true if the subject and predicate refer to one and the same thing. As such, Geach (1962) charges the term logician with the conflation of predication and identity claims. If Aristotle holds that predicates name referents, then it seems that he is open to the same charge. Since predicates are names, a predication such as 'Socrates is pale' resembles an identity claim such as 'Superman is Clark Kent'. A natural suggestion on this view is that a sentence is true, if the subject and predicate name one and the same thing: for example, 'Socrates is pale' is true just in case 'Socrates' and 'pale' name one and the same thing. Geach does not ascribe this mistake to Aristotle. He rather ascribes to the Aristotle of the *Prior Analytics* a hybrid semantic theory: subjects refer and predicates characterize, but a term can stand in either subject or predicate position. However, as I ascribe to Aristotle the view that predicates name, this way of escape is not available for us.

I will make a disclaimer before proceeding. I have noted that there is good initial evidence for ascribing to Aristotle the view that predicates refer. For a general term, regardless of its place in a sentence as a subject or a predicate, is a name which signifies an affection of the soul which in turn resembles an extra-mental object. Although this falls short of a complete defence, I will assume that both subjects and predicates refer. My aim in this paper, however, is not to defend this claim but to show that, even if we ascribe the view to Aristotle, he is not committed to the view that all apparent predications are identity claims. Moreover, the claims of the paper hold under the weaker thesis that subjects and predicates share a semantic role, even if this role is not reference. And, as I will argue in the next section, there is good evidence to hold that both subjects and

predicates make the same contribution to the conditions under which any sentence containing that term expresses a true thought.

## 2

Although Aristotle is willing to call sentences, arguments and even individuals and universals true or false, strictly speaking, truth bearers are thoughts. Thoughts are composed of the affections of the soul signified by terms.<sup>10</sup> Aristotle is concerned with the conditions under which sentences express true thoughts.<sup>11</sup> He connects truth and falsity to notions of combination and separation. For example, at *Categories* 2, 1<sup>a</sup>16–19 Aristotle writes:

Of things that are said, some involve combination while others are said without combination. Examples of those involving combination are ‘man runs’, ‘man wins’ and of those without combination ‘man’, ‘ox’, ‘runs’, ‘wins’.

Aristotle classifies utterances into those involving *symplokês* or interweaving, and those which do not. From the examples it is clear that Aristotle means to distinguish terms from complete sentences. See also, for example, *Categories* 10, 13<sup>b</sup>10–11: ‘Nothing, in fact, that is said without combination is either true or false’. A necessary condition for a linguistic expression to be a complete sentence, and so capable of expressing a truth or falsehood, is complexity.

A subject and predicate term are together insufficient for forming a sentence. Aristotle views the copula as a distinct third element, not itself a part of the predicate. At 25<sup>b</sup>21–4, he notes that the copula turns a list of terms into an affirmation. It is a significant linguistic element, in the sense of indicating information relevant for determining the conditions under which any sentence, in which the copula occurs, expresses a true thought. Compare 16<sup>b</sup>23–5:

For ‘to be’ and ‘not to be’ are not signs of the actual thing (nor if you say simply ‘that which is’); for by itself it is nothing, but it additionally signifies some combination, which cannot be thought of without the components.

Aristotle holds that the copula does not signify anything but the composition of the subject and predicate.

In these passages, Aristotle is pointing out that terms alone do not express truths or falsehoods, and so the referents of terms are not truth bearers. As such, this may be just a claim about the composition of the surface structure: well-formed sentences, in order to express truths or falsehoods, are composed of terms. However, Aristotle does not merely make a claim concerning the surface structure of natural language sentences. Thoughts are also complex. See, for example, *De Interpretatione* 1, 16<sup>a</sup>9–18:

Just as some thoughts in the soul are neither true nor false while some are necessarily one or the other, so also with spoken sounds. For falsity

and truth have to do with combination and separation. Thus names and verbs by themselves—for instance ‘man’ or ‘white’ when nothing further is added—are like the thoughts that are without combination and separation; for so far they are neither true nor false.

A sentence is composed of terms; a thought, of the significations of these terms; and a *pragma*, of the extra-mental objects which these significations resemble. But Aristotle cannot mean by combination here merely the composition of a sentence, a thought or a *pragma*. For the association of falsity with separation is unintelligible on this reading, since thoughts which fail to resemble the facts are composed of the significations of the terms, no less than thoughts which succeed in resembling the facts. Moreover, Aristotle recognizes that there are well-formed sentences which are not assertions and so express neither true thoughts nor false: at 17<sup>a</sup>4, he gives the example of a prayer. These sentences are composed of the same sentential components as assertions but, differing in linguistic force, arguably do not involve combination and separation. So it cannot be linguistic items that are combined and separated. Rather, I propose that it is the constituents of the conditions, under which a thought is true, that bear relations of combination and separation.

Aristotle associates individuals and universals with notions of combination, separation, division and indivisibility. For example, at 3<sup>b</sup>10–18, Aristotle characterizes individuals as indivisible (*ta atoma*). A second occurrence of this characterization is at 1<sup>b</sup>6–9:

Things that are indivisible and numerically one are, without exception, not said of any subject, but there is nothing to prevent some of them from being present in a subject; for example, the individual item of grammatical knowledge is one of the things present in a subject.

Aristotle also often talks of genera as if they were aggregates divided by species. For example, he describes governments as being divided into monarchies and aristocracies and such in *Politics* 4.2 (1289<sup>a</sup>26); he speaks of dividing a genus into species, for example, at *Prior Analytics* 1.31 (46<sup>a</sup>38) and of a genus being divided by differentiae, for example, at *Metaphysics* 7.12 (1038<sup>a</sup>9). On some of these occasions such talk may be colloquial and merely metaphorical. However, Aristotle uses mereological terminology in more technical contexts. For example, he provides a semantics for universal categorical propositions early on in the *Prior Analytics*:

‘One thing is wholly in another’ is the same (*tauton*) as ‘one thing is predicated universally of another’. (24<sup>b</sup>26–28)

I take *tauton* here to indicate equivalence of the expressions. That is to say, the conditions under which a universal affirmation such as ‘All men are mortal’ expresses a true thought are given by a relation of mereological inclusion. This is a weaker and less contentious interpretation of this passage than, for example, the reading that 24<sup>b</sup>26–28 asserts the sameness of *meaning* of its two mentioned expressions. Although Aristotle only explicitly provides a semantics for universal

affirmations here, the extension to universal negations, particular affirmations and particular negations ought to be clear: these express true thoughts when relations obtain of mereological exclusion, overlap and non-overlap, respectively. This mereological interpretation of the categorical propositions is not uncommon throughout the *Prior Analytics*.<sup>12</sup> Moreover, it may be Aristotle's view that any general proposition is one of a universal affirmation, universal negation, particular affirmation or particular negation.<sup>13</sup> And so 24<sup>b</sup>26–8 and these other passages suggest an extension to a comprehensive account of general predication.

Aristotle's discussion of predication in mereological terms has struck some as confused or careless. Kirwan (1993: 174), for example, expresses this concern well, writing that

Aristotle's treatment of genera and forms as both non-quantitative and related as whole to part is indicative of his vagueness about their status. *Being negro* is not a part of being human, and *humanity* has parts only because the word is taken to denote the human race, which is a quantitative set or class.

To give a second example, Ackrill (1963: 76) and others have held that Aristotle conflates the relation between an individual and its species with the relation between a species and its genus, for the former is class membership and the latter, class inclusion.

The difficulty of interpretation here is partly that Aristotle is employing mereological notions which are foreign to us. Among various senses of 'whole', Aristotle distinguishes at *Metaphysics* 5.26 (1023<sup>b</sup>26–33) between what became known as quantitative wholes and integral wholes.<sup>14</sup>

We call a whole . . . that which so contains the things it contains that they form a certain unity; and this in two senses—either as each part being one, or as a unity made up out of the parts. For what is universal and what is said wholly, since it is a certain whole, is universal in the sense that it contains many things by being predicated of each and by being all those and each of them one, as for instance man, horse, god are one because they are all living things. But the continuous and limited is also a whole, whenever there is a certain unity from the many.

Aristotle draws the contrast between quantitative and integral wholes by appealing to two distinct kinds of constitution relations. A quantitative whole is *homoioimerous*: the sum of animals, for example, is composed of parts each of which is itself an animal. An integral whole, by contrast, is *heteroimerous*. A house, for example, is not a quantitative whole: its parts—the roof or the door, say—are not themselves houses; and not all of what can be said of a house—that its final cause is to provide shelter, say—can be said of the parts of a house. So, for example, associated with the species humanity is a sum composed of individual humans. Any typical individual human has, of course, such parts as hands and feet. But these are integral parts of the individual, not quantitative parts. And so the hands and feet of the individual human are not themselves parts of the sum associated with the species.

The homoiomereity of quantitative wholes may strike the reader as peculiar. In what sense is, for example, the mereological sum of humanity *itself* human? Or how can that which can be said of the individual be said of the whole? For example, in what sense is not merely each individual human mortal but the whole, humanity, mortal? This worry arises however only under an anachronistic model of predication as characterization. The mereological sum of humanity is not *characterized* as human. And ‘Callias is mortal’ and ‘Man is mortal’ are both true *not* because the individual and the universal are both correctly characterized as mortal but rather because both Callias and the mereological sum of humans are parts of the mereological sum of mortals.

If this is the relevant sense of division, then the claim that individuals are indivisible is the claim that individuals cannot be divided into distinct entities which are homoiomerous parts of that individual, and so that of which the individual is said. Genera, by contrast, are said of species and species are said of individuals. So Aristotle holds that a genus can be correlated to a collection of the various species falling under that genus. A species likewise can be split into subspecies and so on. But individuals provide the limit case, as items which cannot be further divided into parts of the same kind. Aristotle is not as explicit on the mereological relation holding between universals and individuals as we might hope: in his example in 1023<sup>b</sup>26–33, above, he only claims that a genus is associated with a whole of which species are parts; in the passages 1<sup>b</sup>6–9 and 3<sup>b</sup>10–18, also mentioned above, he only claims that individuals are indivisible, not that they are themselves parts of species. I conjecture that all universals correlate to sums of which individuals are parts. However, it suffices for my present purposes to show that universals correlate to sums. The conjecture that these sums decompose into individuals is dispensable.

The association of universals with quantitative wholes in 1023<sup>b</sup>26–33 suggests (although of course it does not irrefutably establish) that the relevant sense of ‘whole’ in 24<sup>b</sup>26–28 is quantitative and so the conditions under which a universal predication expresses a true thought are given by quantitative mereological inclusion. And, by extension, the conditions under which any predication expresses a true thought are given by quantitative mereological relations. I do not expect that these comments will entirely dispel for the reader the foreignness of Aristotle’s mereological views. I cannot discuss in detail the relevant metaphysics. However, it suffices for my present purposes to bring out that Aristotle appeals to a notion that he *characterizes* as mereological, so to formulate the conditions under which ordinary predications express true thoughts. I will next attempt to establish that this relation is *genuinely* mereological.

### 3

In this section, I’ll discuss the formal features of the quantitative part relation. According to most of our best available theories of parts and wholes, any legitimate part relation is at least a partial order—a reflexive, antisymmetric and



transitive relation.<sup>15</sup> So everything is a part of itself; if one thing is a part of another, and that other a part of the first, then the one and the other are identical; and any part of a part of a thing is itself part of that thing. If we allow 'Pxy' to stand for 'x is a part of y', then we have the following axiom schemata:

- (P1) Pxx (Reflexivity)  
 (P2) Pxy  $\wedge$  Pyx  $\supset$  x = y (Antisymmetry)  
 (P3) Pxy  $\wedge$  Pyz  $\supset$  Pxz (Transitivity)

These could be expressed as axioms were the variables bound by the appropriate quantifiers, but I will leave these omitted for ease of presentation. (P1)-(P3) characterizes a relation broader than any part relation. A partial order need not be a part relation: for example, the less-than-or-equal-to relation is a partial order on the real numbers. For a system to be a mereology, we need to expand the axiom set. One common strategy for expansion is to introduce a supplementation principle. A commonly held intuition is that whenever an object has a proper part, it has more than one proper part. That is to say, there is always a mereological difference between a whole and a proper part. Let us call this difference a *remainder*. The necessity of a remainder doesn't follow from (P1)-(P3) alone. For example, consider a model of (P1)-(P3) with just two objects, one part-related to the other but not vice versa. To express the view that, when there is some proper part of a whole, there is always a distinct part of the same whole, it will be useful to define the notions of overlap and proper part. One mereological sum overlaps another just in case there is a shared part, i.e.

$$Oxy =_{df} \exists z (Pzx \wedge Pzy)$$

A proper part is a part which is non-identical with its whole, i.e.

$$Ppxy =_{df} Pxy \wedge \neg(x =_{id} y)$$

Then the intuition that a proper part implies a remainder can be expressed by the axiom schema:

- (P4) Ppxy  $\supset$   $\exists z$  (Ppz y  $\wedge$   $\neg Ozx$ ) (Weak Supplementation)

Simons (1987), for example, holds that any system that can be truly called a mereology must conform to at least (P1)-(P4).

Notice, however, that to establish that a relation is mereological, we need not show directly that all of (P1)-(P4) obtain. A transitive and weakly supplementary relation is antisymmetric, so if we can show (P3) and (P4), then (P2) follows. Moreover, taking (P1) as an axiom is a matter of choice. The part relation is reflexive but the proper part relation is of course irreflexive. It is common to take the part relation as primitive, but we might take the proper part relation to be primitive and define the part relation in terms of it. So, since Aristotle characterizes the relation holding between a quantitative part and a whole as mereological, he

is *prima facie* committed to the transitivity and weak supplementation of the relation. Moreover, as I will now argue, we have the textual evidence to establish that the quantitative part relation is transitive and weakly supplementary. This supports Aristotle's characterization of the quantitative part relation as mereological. In what follows, I rely on the association of terms with quantitative parts and wholes, and certain kinds of predications with certain quantitative part relations. So the argument of this section is: if the thesis of the previous section is correct, that the contribution a term makes to the conditions under which a sentence containing that term expresses a true thought are what Aristotle calls part relations, then those relations are genuine mereological relations.

Aristotle asserts the transitivity of mereological containment at *Prior Analytics* 1.4 (25<sup>b</sup>32–26<sup>a</sup>2):

Whenever three terms so stand to each other that the last is wholly in the middle and the middle is either wholly in or wholly not in the first, it is necessary for there to be a perfect deduction of the extremes. I call 'the middle' that which both is itself in another and has another in it—this is also middle in position—; the extremes are the terms which are [solely] in another [or solely] have another in them. If A is said of every B and B of every C, then it is necessary for A to be predicated of every C. For we have said earlier how to read 'said of every'.

Aristotle here defends the validity of the syllogism known by its medieval mnemonic 'Barbara' by the transitivity of containment. I believe that the final sentence refers to the mereological interpretation of universal propositions, given at 24<sup>b</sup>26–8 and quoted above. I discuss the role of mereological principles such as the transitivity of containment in Aristotle's philosophy of logic in detail in P. Corkum, unpublished data.

Secondly, Aristotle claims that a universal term is predicated of many subjects at *De Interpretatione* 7 (17<sup>a</sup>39–<sup>b</sup>1):

I call a universal that which is by its nature predicated of many things, and individual that which is not; man, for instance, is a universal, Callias an individual.

So Aristotle is committed to Weak Supplementation. When there is some quantitative proper part of a whole, there is always a distinct part of the same whole. Since a universal is predicable of several subjects, when there is some quantitative proper part of a whole, there is typically a distinct part of the same whole. There are passages where Aristotle allows for there to be unique members of a kind. For example, at 1023<sup>b</sup>29–32, Aristotle includes a singular god among the species of the genus *living thing*. This is not to say that there is a universal term which has as its referent a mereological sum composed of just one individual, since it is not obvious that Aristotle identifies universals and species. Nonetheless, the 'by its nature' proviso at 17<sup>a</sup>40 may allow for there to be exceptional cases of universals with just one instance: if so, then a weakly supplementary partial order models the norm.

The characterization of the quantitative part relation as a weakly supplementary partial order is the weakest and least contentious ascription to Aristotle. Whatever else the quantitative part relation may be, it is a weakly supplementary partial order if it is a genuine mereological relation at all. Furthermore, these weak commitments suffice for our present purposes. However, let me mention that the quantitative part relation is arguably a stronger relation. Many mereologies are stronger than a weakly supplementary partial order. For example, some have the principle that whenever one thing is not a part of a second, there is a part of the first which does not overlap with the second:

$$\neg Pyx \supset \exists z (Pzy \wedge \neg Ozx) \text{ (Strong Supplementation)}$$

It is easy to see that Strong Supplementation entails Weak Supplementation but not vice versa. Strong Supplementation yields an extensional mereology. In an extensional mereology, a whole is individuated by its parts. That is to say, for distinct composite things, there must be at least a part of one which is not a part of the other.

We now have enough background terminology on the table for me to address an objection to my claim that the quantitative part relation is weakly supplementary. Malink (2009) discusses asymmetric conversion, which Aristotle in *APr* 2.22 68<sup>a</sup>16–21:

When A belongs to the whole of B and of C and is predicated of nothing else, and B belongs to all C, then it is necessary for A and B to convert. For since A is said only of B and C, and B is predicated both of itself and of C, it is evident that B will be said of everything of which A is said except of A itself. (Smith's (1989: 98) translation.)

As Malink (2009: 108) notes, commentators are in agreement that the passage is perplexing: see, for example, Ross (1949: 480), Smith (1989: 218), Barnes (2007: 494). Malink argues that the difficulty in understanding this passage stems from a shared assumption that the semantics for universal predication is extensional: terms are identified with their extensions and so are co-referential just in case they have as their extensions the same class of individuals. For asymmetric conversion asserts that B is predicated universally of everything of which A is universally predicated except of A itself. This would seem to entail that every individual which falls under A falls under B. Yet then, by extensionality, A is identical with B. But Aristotle denies that B is predicated of A, while being predicated of itself. Asymmetric conversion, Malink persuasively argues, is understandable if the relation corresponding to universal affirmation fails to conform to Strong Supplementation. A mereology satisfying Strong Supplementation is extensional. By denying Strong Supplementation, then, Malink, avoids the above puzzle. For A and B may share all and only the same individuals yet be distinct. And so the claim that B is not predicated of A, while being predicated of itself, is unproblematic. I agree that the quantitative part relation is non-extensional and so fails Strong Supplementation.

Malink, however, requires the stronger claim that the relevant relation fails not only Strong Supplementation but also Weak Supplementation. For suppose A and B asymmetrically convert: A is predicated universally of everything of which B is universally predicated including B itself, while B is predicated universally of everything of which A is universally predicated except of A itself. Since A is predicated universally of B and A and B are distinct, the B-sum is a proper part of the A-sum. According to Weak Supplementation, then, there is a proper part of the A-sum which does not overlap with the B-sum. But since A and B asymmetrically convert, every proper part of the A-sum is part of the B-sum, and hence every proper part of the A-sum overlaps with the B-sum. And indeed, Malink characterizes the relation as a mere preorder, a reflexive and transitive relation but neither weakly supplementary nor a partial order. I believe there is compelling textual evidence that the relation is weakly supplementary. Moreover, any genuine mereological relation meets Weak Supplementation so I fail to understand Aristotle's use of part-whole terminology if Weak Supplementation fails. As such, and despite Malink's sophisticated discussion, I agree with the standard commentary: 68<sup>a</sup>16–21 remains problematic.

I mentioned that (P1), reflexivity, is typically taken to be axiomatic for mereologies. The textual evidence for the reflexivity of the quantitative part relation is less compelling. 68a19 is the only instance of which I am aware where Aristotle explicitly claims that a term may be predicated of itself. This would of course entail that the quantitative part relation is reflexive. But, as we have noted, this passage is problematic. Another point of evidence occurs earlier in the *Prior Analytics*. Recall, Aristotle claims that one thing being wholly in another is equivalent to one thing being predicated universally of another. Aristotle draws a result which became known as the *dictum de omni*: 'And we say 'one thing is predicated universally of another' whenever none of the subject can be taken of which the other cannot be said' (24<sup>b</sup>28–30). It is easy to see that the implication, if none of the B's can be taken of which A cannot be said, then A belongs to all B, is true under any substitution for the schematic letters whatsoever only if the relation of belonging to all is reflexive. Since Aristotle believes that the implication follows from the association of universal predication with the quantitative part relation, this passage gives us some reason to hold that this relation is reflexive.

Notice however that this passage concerns the consequent of one thing being predicated of *another* and the antecedent of there being none of the one of which the *other* cannot be said. We might take the expressions *heteron heterō* and *thaterou thateron* at 24<sup>b</sup>27, 28, 30 as referring to *distinct* items. If so, then the implication is not intended to be true under any substitution for the schematic letters whatsoever. So one might read the *dictum de omni* as providing the conditions under which one thing is predicated universally of a different item, while having no application to the question whether a thing is predicated universally of itself. As such, the passage fails to provide conclusive evidence for or against the alleged reflexivity of the quantitative part relation.

However, the question need not detain us. If the quantitative part relation is reflexive, then the tie between individuals and universals is a part relation; and, if irreflexive, then the tie between individuals and universals is a *proper* part relation. Moreover, provided that the quantitative part relation is transitive and weakly supplementary, it is a *genuine* mereological relation. So the question of the reflexivity of the relation is not germane to issue whether Aristotle's part-whole talk is genuinely mereological.

Another strategy for extending (P1)-(P3) is to make the domain closed under operations such as sum and product. However, quantitative composition does not seem to be closed under such operations. We might introduce a gerrymandered predicate for sums. For example, the sum of humans and horses yields a collection of individuals whose only common property is that each is either a man or a horse. We might arbitrarily introduce a predicate, 'cloak', to denote this purported disjunctive property. But Aristotle denies that a sentence containing a disjunctive predicate is a single predication. For example, he holds that our predicate 'cloak' signifies either two things or nothing, not one thing.

An affirmation or negation is single, signifying one thing of one thing, whether a universal of a universal or not like this. . . . But if a certain name is stretched over two things out of which there is not one, then there is not a single affirmation. For example, if a certain name, say 'cloak', is spread over both a horse and a man, then such a sentence as 'a cloak is pale' is neither a single affirmation nor a single negation. For this is no different than saying that a horse is pale and a man is pale. So if such things signify many things and are themselves many, then it is clear that the original sentence signifies either many things or nothing, for a given man is not a horse. (18<sup>a</sup>18–26)

So it seems likely that quantitative composition is restricted.

Finally, some mereologies exhibit atomicity. Mereological atoms lack proper parts. It may well be that the quantitative part relation exhibits atomicity and Aristotle holds that there are items which are parts but which themselves lack quantitative parts. For the characterization of individual terms as indivisible strongly suggests that this feature is central to Aristotle's interest in individuals in the *Categories*. But, since the extensionality or non-extensionality, the restricted compositionality and the atomicity of the quantitative part relation plays no role in the rest of the paper, I will leave further discussion for another occasion.

Rather, I will compare quantitative mereology with set theory.<sup>16</sup> Where set theories typically distinguish between set membership and subset inclusion, mereologies typically have a unitary relation between parts and wholes. This is not a merely technical observation. The relation between a set and its members and the relation between a set and its subsets are distinct. But the relation between a part and its whole does not vary according to whether that part has itself parts. This will also prove significant in my response to certain objections, below.

Let us sum up. I have argued that the conditions under which categorical propositions express true thoughts are provided by a weakly supplementary partial order. The relevant mereology is weaker than several well-studied mereologies and distinct from set theory. There are features of the quantitative part relation which is relevant for our discussion. In particular, a mereology, unlike a set theory, typically employs a unitary part relation and not distinct membership and inclusion relations; this will prove significant for my response to Ackrill's objection. Other features of the quantitative part relation are more controversial and less relevant for our discussion. I have left unanswered the questions whether the quantitative mereology is extensional, atomic or employs restricted composition. But since these features do no work in my subsequent discussion, I will leave these questions unanswered.

## 4

I will now respond to a few objections. First, I have considered evidence for ascribing to Aristotle the view that predicates refer. Geach (1962: 34–5) objects to the traditional term logician's view that both subjects and predicates refer:

Of a name it always makes sense to ask what it names, but it is clearly nonsense to ask which cat 'cat' stands for in 'Jemima is a cat', or which dog 'dog' stands for in 'Jemima isn't a dog'. I suppose somebody might try saying that in 'Jemima is a cat' 'cat' stands for Jemima, because the proposition is true. But what the names in a proposition stand for cannot be determined by whether the proposition is true or false: on the contrary, we can determine whether the proposition is true only when we know what it is about, and thus what the names contained in it do stand for.

The difficulty for assimilating predication to identity claims is vivid for predications with singular subjects. For there is not readily available a referent for the predicate which is plausibly identical to the individual picked out by the subject term and which makes an informative contribution to the conditions under which the sentence is true. There is good evidence that Aristotle indeed holds that predicates refer. So the worry that Aristotle is conflating predication and identity claims is pressing.

In this paper, I have argued that we can ascribe to Aristotle the view that both subjects and predicates refer, while holding that he would deny that a sentence is true just in case the subject and predicate name one and the same thing. In particular, I have argued that Aristotle's core semantic notion is not identity but the weaker relation of constitution: an ordinary predication such as 'Man is mortal' expresses a true thought, in Aristotle's view, just in case the mereological sum of humans is a part of the mereological sum of mortals. And there are plausible mereological sums so to formulate the condition under which 'Jemima is a cat' expresses a true thought. The conditions do not require that we first

determine the truth of the sentence and then identify the predicate with the particular cat that Jemina is. We need only to identify the sum of cats: the sentence is true just in case Jemina is a part of this sum. So there are referents available for terms in both subject and predicate position but the truth of the sentence does not depend on the terms naming the same thing.

Secondly, recall the objection, voiced by Ackrill and others, that Aristotle confuses membership and inclusion. On this objection, Aristotle conflates the relation between a species and a member of that species with the relation between a genus and a species that falls under that genus. As we have seen, Aristotle holds that to predicate is to gather the subject together with like individuals. Central to Aristotle's views on predication, then, are notions of collectivity. Collections in recent years have been cashed out in terms of sets. The assumption that, if Aristotle is talking of collections, then he must be thinking of sets, underlies Ackrill's objection. The objection would be compelling were set-theoretic notions—under which, for example, class membership and class inclusion are sharply distinguished by the objects which are collected, individuals and subsets, respectively—the only options for a viable theory of collections. But this is not obviously correct. A mereology may collect items with a unitary notion: both individuals, which lack proper parts, and wholes which have proper parts, compose mereological sums by means of the same part relationship. Set theory, with its distinction between membership and inclusion, and mereology, typically with a unitary part relation, are rival theories of collectivity.

I have argued that Aristotle captures his intuition that to predicate is to collect by means of a genuine mereology and not a set theory. As such we have no reason to hold that Aristotle conflates membership and inclusion. Of course, one might argue that Aristotle is *wrong* to use a mereology, and not a set theory, so to provide truth conditions for general statements. But one ought not charge Aristotle with a simple *confusion*.

And finally, Mignucci (2000) argues that 1023<sup>b</sup>29–32 cannot be read as providing an analysis of predication. Recall, the passage is:

what is universal and what is said wholly, since it is a certain whole, is universal in the sense that it contains many things by being predicated of each and by being all those and each of them one, as for instance man, horse, god are one because they are all living things.

The original suggestion was that predication would be explained in terms of universals, taken to be mereological sums. But in the characterization of universals as wholes, Aristotle employs the notion of predication. So it seems we cannot take this passage to provide an explanation or reductive analysis. Mignucci (2000: 8) concludes that the passage does not 'imply a reductionist claim, in the sense that it means that predication is reduced or explained or elucidated by means of the part relation, as if the latter were more perspicuous or clearer or more basic than the former.' The worry is that Aristotle cannot *define* predication elsewhere in terms of quantitative wholes, since he

employs the notion of predication here to define quantitative wholes; such a putative definition, it might be claimed, would be circular and uninformative. Rather, Mignucci (2000: 4) endorses the weaker claim that 'according to Aristotle, predication can always be expressed in terms of the part relation'. Mignucci presumably intends that, when a thought is expressed by the sentence 'Socrates is pale', for example, that sentence is synonymous with, or can be paraphrased by, a sentence expressing the claim that Socrates is a part of the mereological sum of pale things, although the paraphrase does not *explain* the original predication.

I ascribe to Aristotle the view that certain mereological claims provide informative truth conditions for the thoughts which are expressed by categorical predications. This is not to say that such predications can be reductively analysed into mereological claims. Indeed, I do not even claim that the sentences expressing the relevant mereological claims are synonymous with the original predications. In general, the material equivalence between a proposition and its truth condition need not be an analytic truth, and the truth condition of a proposition need not be a paraphrase of the sentence expressing that proposition. Consider the equivalence: 'Hesperus is Venus' expresses a truth just in case Phosphorus is Venus. This equivalence is not an analytic truth and the phrase expressing the truth condition is not synonymous with, or a paraphrase of, the sentence mentioned on the left-hand side of the equivalence. 'Hesperus is Venus' and 'Phosphorus is Venus' do not have the same linguistic meaning: a competent speaker could recognize that just one sentence expresses a truth. As this example illustrates, the biconditional linking a thought and its truth condition need not be an analytic claim true solely in virtue of the meanings of the expressions contained in the sentence expressing the proposition.

However, elucidating the notion of a quantitative whole by means of predications is consistent with holding that quantitative wholes are used in informative truth conditions for ordinary predications. Indeed, one could hold that the appeal to mereological notions *explains* the truth of true thoughts, expressed by ordinary predications, even though Aristotle elsewhere uses predication to get the reader onto the relevant mereological notions. In general, the truth conditions of a given proposition may be explanatorily prior to that proposition in some contexts, while being explanatorily posterior in others. For example, the fact that Phosphorus is Venus may explain why it is true that Hesperus is Venus in a context where it is known that Hesperus is Phosphorus; outside of this context, the fact that Phosphorus is Venus would provide a poor explanation why it is true that Hesperus is Venus. Likewise, what is an *explanans* in some contexts may, in other contexts, be explicated by appeal to the *explanandum*. There's reason to hold that 1023<sup>b</sup>29–32 is just such a context. For Aristotle's aim in this passage is to distinguish quantitative wholes from integral wholes, and the appeal to predication may serve this purpose in this context. Elsewhere, Aristotle aims to provide truth conditions for predications, and appeal to quantitative wholes may serve this purpose in this context.<sup>17</sup>



I'll bring the paper to a conclusion. I've argued that, even if predicates refer (and there is *prima facie* evidence that they do), a predication is not an identity claim but expresses the weaker relation of constitution. The contribution a predicate makes to the conditions, under which any sentence expresses a true thought, is a mereological sum. These modest observations are sufficient to mount a response to Geach's and Ackrill's objections. I have conjectured that a predicate refers to a universal, and that the corresponding mereological sum is composed of individuals. However, I hesitate to identify the sum and the universal. Indeed, the argument of the paper relies on neither the specification of the referent of a predicate nor the composition of the corresponding mereological sum. To be sure, I have left many issues in Aristotle's semantic theory inadequately addressed—singular terms, negation and quantity among them. I have merely broached several topics in Aristotle's views on parts and wholes, including the questions whether the quantitative part relation is extensional and atomistic, and whether composition is restricted. *And* I have not discussed the relevant metaphysics of properties.<sup>18</sup> I leave these topics for another occasion.<sup>19</sup>

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## NOTES

<sup>1</sup> For recent precedents to the view advocated in this paper, see Mignucci (1996, 2000) and Malink (2009). Mignucci associates predication and mereology in Aristotle but denies that the quantitative part relation provides informative truth conditions for categorical predications. Malink characterizes the relevant terminology as a mere preorder and so not a genuinely mereological relation. I discuss both authors further below.

<sup>2</sup> I will assume that there is a consistent view of predication in the corpus. This assumption is of course defeasible, but I believe that the success of the resulting interpretation in solving certain textual difficulties lends support to the assumption.

<sup>3</sup> Irwin (1982) argues that Aristotle does not offer a theory of meaning. Aristotle does not offer an *analysis* of meaning as does, for example, Grice (1989). And Irwin is correct that Aristotle's comments on signification do not provide a theory of meaning alone. But we can extract a theory of truth which can serve as a theory of meaning—that is to say, an organized body of information representing what a competent speaker of a natural language tacitly understands. For the view that a homophonic theory of truth can adequately provide a theory of meaning, see Davidson (1984).

<sup>4</sup> Aristotle distinguishes between two kinds of predication, according to which a predicate is *present in* a subject or *said of* a subject (1<sup>a</sup>20–29). Both general and singular predicates can be *present in* a subject (2<sup>a</sup>34–b7) but only general terms can be *said of* a

subject. Since I will not discuss in detail singular terms, I will largely restrict my attention to *said of* predications. I discuss the *present in* predicative tie at length in Corkum (2009).

<sup>5</sup> Geach (1962) holds that, in the *De Interpretatione*, Aristotle endorses a fully heterogeneous theory: names and verbs have distinct semantic roles and are not interchangeable. However, the analysis of a sentence into a subject and verb in the *De Interpretatione* is not obviously inconsistent with this *Prior Analytics* analysis. Aristotle explicitly takes at least some subject–verb bipartite constructions and subject–copula–predicate tripartite constructions to be equivalent, as in 24<sup>b</sup>16–18, quoted in the main body of the paper. Aristotle also offers the example of ‘Socrates walks’ and ‘Socrates is walking’ in *De Interpretatione* 10 and *Metaphysics* 7.7. The equivalence is not an idle observation. Aristotle uses it to determine the denial of a sentence in SV form and represent it in the canonical ‘S is P’ form at 21<sup>b</sup>9 and 51<sup>b</sup>13ff. And he uses the equivalence to read the categories off various kinds of predicates at 1017<sup>a</sup>27–31. For a given sentence with a bipartite surface structure, there may not be a well-formed equivalent sentence with a tripartite surface structure. A natural language may lack the expressive resources to provide such an equivalent sentence, if there are finite verbs which lack a corresponding gerundive. Nonetheless, there is good reason to believe that Aristotle holds that any ordinary predication has a tripartite *semantic* structure. A sentence with a tripartite surface structure, such as ‘Socrates is pale’, displays the underlying semantics perspicuously. But even utterances such as ‘Socrates walks’ expresses a relation between two terms, regardless of whether the object language possesses the resources to make this structure explicit.

<sup>6</sup> Irwin (1982) argues that signification is not reference, for two names may be co-referential yet have distinct essences: for example, ‘man’ and ‘risible thing’. However, Irwin assumes that these terms are co-referential. On my interpretation, Aristotle could hold that the semantic contribution made respectively by ‘man’ and ‘risible thing’ are coextensive but distinct mereological sums, if the quantitative mereology is nonextensive. However, I hesitate to identify signification with reference. For signification is a broader notion than reference. Verbs additionally signify tense. Secondly, the copula linking terms signifies, as we’ll see, a certain combination or separation among the referents of the terms. Thirdly, an empty term, such as Aristotle’s example of a goat-stag, lacks a referent but possesses signification. And finally, a name signifies an essence through the mediation of a definition. Aristotle holds that a name signifies a formula (*logos*) and a formula signifies a definition (*horismos*): *Meta.* 1012<sup>a</sup>22–24, *Top.* 106<sup>a</sup>1–4. Moreover, a name and a formula signify the same thing (*Top.* 129<sup>b</sup>30–35, 162<sup>b</sup>37–163<sup>a</sup>1). And a definition signifies an essence: *Top.* 101<sup>b</sup>38.

<sup>7</sup> The Greek *pragmata* likely includes the individuals and universals of the *Categories* as well as facts. *Pragma* derives from the verb *prassein*, to achieve, manage affairs or practice. In non-philosophical Greek, the substantive can mean deed, affair, circumstance or thing. Plato uses it as a concrete referent opposed to an *onoma* at *Crat.* 391b. Aristotle also opposes a *pragma* to an *onoma*, for example at 175<sup>a</sup>8, to a *logos* at for example 146<sup>a</sup>3, and to what is *en dianoia* at 1027<sup>b</sup>31; he associates *pragma* with *alêtheia* at for example 263<sup>a</sup>17 and claims no *pragma* is separate from sensible magnitudes at 432<sup>a</sup>3–4.

<sup>8</sup> Modrak (2001) argues that verbs do not signify things but her argument relies on following Ackrill in preferring the addendum *oude* for *ou* at 16<sup>b</sup>22. On this reading, the passage is claiming that not *even* the copula is a sign of things with the implication that, *a fortiori*, predicates are neither.

<sup>9</sup> For Frege’s discussion of oblique reference and view that sentences refer to truth values and, for discussion, see his (1980).

<sup>10</sup> Aristotle occasionally gives the impression that linguistic items are also truth bearers. For example, at 16<sup>a</sup>9–18, discussed in detail below, he claims that spoken sounds are true and false. And Crivelli (2004), for example, takes truth bearers to include utterances. Aristotle may (as we often do) call an utterance true if it expresses a truth in the context of the utterance, but it is the thought so expressed which bears truth. Arguments also may be called true if they are valid. And individuals and universals may be called true, if they exist. These last two uses, in particular, are likely loose and inaccurate *façons de parler*.

<sup>11</sup> The conditions under which sentences express true thoughts are not obviously truth conditions. For example, 'Hesperus is Venus' expresses a truth just in case Phosphorus is Venus, since Hesperus and Phosphorus are necessarily identical. But it is available to Aristotle to hold that 'Hesperus is Venus' does not express a true thought just in case Phosphorus is Venus. If so, then Aristotelian thoughts are finer grained than truth conditions. However, for ease of exposition, I will occasionally speak of the truth conditions of a sentence where it would be more accurate to speak of the conditions under which a sentence expresses a true thought.

<sup>12</sup> The etymology of Aristotle's terminology is suggestive. The Greek term of art *ho katholou* is traditionally translated by 'universal' but might be transliterated by 'that according to the whole'. Universal propositions are called *en holōi* throughout the *Prior Analytics*, for example, at 25<sup>b</sup>33, 30<sup>a</sup>2, 47<sup>a</sup>13, 53<sup>a</sup>21, 58<sup>b</sup>27–29, 66<sup>b</sup>15–16 and 79<sup>a</sup>36–40. The Greek *holos* is synonymous with *pas*, denoting the universal quantifier at, for example, 55<sup>a</sup>6, 37, 56<sup>a</sup>28–29, 67<sup>a</sup>33–34, 68<sup>a</sup>16–17, 21–22, 68<sup>b</sup>21. Particular propositions are called *en merei* or *kata meros* at for example 24<sup>a</sup>16–17, 25<sup>a</sup>5–6, 42<sup>a</sup>10, 42<sup>a</sup>16, 49<sup>b</sup>37, 64<sup>a</sup>17, 64<sup>b</sup>12, and 69<sup>a</sup>14.

<sup>13</sup> See 24<sup>a</sup>16–22.

<sup>14</sup> For an overview of this distinction in medieval mereology, see Arlig (2008).

<sup>15</sup> These characteristics are not entirely uncontroversial. For example, the transitivity of the part relation was questioned by Rescher (1955).

<sup>16</sup> Where set theories typically have an empty set, a set which is a member of every set, mereologies typically lack a corresponding null individual, an object which is a part of everything. Some take the empty set to have an arbitrary referent: see, for example, Lewis (1991: 13). An empty set is a technical convenience. For example, it allows us to provide a referent for the intersection of otherwise disjoint sets. However, the absence of a null individual in mereologies is a point of some significance and not merely a technical observation. Where the notion of a set arguably allows for there to be memberless sets, there are by contrast no empty fusions. This contrast between set theory and mereology explains the existential import of universal affirmations and the semantic profile of predications with empty terms. Aristotle holds that true universal affirmations entail true particular affirmations: if 'All humans are mortal' is true, for example, then 'Some human is mortal' is true as well. So it seems that universal affirmations have existential import: true generalizations entail that there are instances. Moreover, Aristotle holds that, although affirmations with empty terms in subject position are all false, empty negations are all true: if 'Socrates' lacks a referent, then both 'Socrates is well' and 'Socrates is ill' are false but both 'Socrates is not well' and 'Socrates is not ill' are true.

<sup>17</sup> I also hold that affirmations express containments and negations express failures of containment. Disjointedness does not require that both terms correspond to mereological sums: terms A and B are vacuously disjoint when one or more term fails to correspond to a sum. However, one might object that providing true thought conditions for negations by means of disjointedness fails to provide an analysis of negation. For I hold that 'A is

not B' expresses a true thought just in case A and B are disjoint, and this is just to say that it is not the case that A is contained in B. To articulate the condition, under which a negation expresses a true thought, we employ a negation. However, although there is evidence that Aristotle aims to provide an informative semantics for categorical propositions, it is not obvious that Aristotle aims to provide an analysis of quality. If Aristotle's intention is merely to shed light on predication by appeal to certain mereological relationships, then the objection lapses.

<sup>18</sup> I broach these issues in Corkum (2013).

<sup>19</sup> This article is proximally related to a paper delivered at the American Philosophical Association Pacific Division Meeting, San Francisco, in 2010. And the article is distally related to papers delivered at the American Philosophical Association Eastern Division Meeting, New York, and the Ontological Dependence Conference, Colorado, in 2009. Thanks to the auditors and especially to Jeff Brower, Alan Code, Kit Fine, Michael Flood, Ian Flora, Kathrin Koslicki, Christian Lee, Bernie Linsky, Keith McPartland, Richard Mohr, Daniel Nolan, Scott O'Connor, Ori Simchen, Alex Skiles, Benjamin Schnieder, Martin Tweedale and Charlotte Witt for discussion. I gratefully acknowledge the financial support of the Social Sciences and Humanities Council of Canada Standard Research Grant # 410-2008-0431.

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