

An Aristotelian View on Modal Propositions (and on Kit Fine's Literalist Terms)

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Abstract. Aristotle's syllogistic does not recognize a distinction between singular and general terms. It is based on a mereological rather than set-theoretic notion of predication. Aristotle's mereology, I shall argue, may fail to meet the mereological principle of extensionality (supplementation). As a result, the truth of propositions does not only depend on the extension of the subject term, but also on the subject term itself. Aristotle relies on this kind of non-extensional predication in his account of modal propositions in the modal syllogistic. In doing so, Aristotle will be shown to be consistent where set-theoretic approaches take him to confuse de re and de dicto readings of modal propositions. The dichotomy between de re and de dicto is alien to Aristotle. Finally, I shall discuss how Aristotle's mereological approach to predication can serve as a basis for first-order logic containing what Kit Fine has called literalist singular terms.

1. A NON-EXTENSIONAL MEREOLGY OF TERMS

However familiar the distinction between a syntactic type of singular terms and a syntactic type of general terms may be to us post-Fregeans, we are not likely to find it anywhere in Aristotle. Aristotle does, within the realm of beings, distinguish between individuals and universals.¹ As a consequence, there are terms such as ‘man’ which are associated with a universal and may therefore be called general terms, while other terms such as ‘Socrates’ are associated with an individual and may therefore be called singular terms. But this does not prevent the two kinds of term from being of the same syntactic type. For Aristotle, the predicative relation holding true between a singular term and a general term (‘man’ belongs to ‘Socrates’) is of the same kind as the predicative relation holding true between two general terms (‘animal’ belongs to ‘man’).²

Aristotle’s syllogistic is based on a mereological rather than set-theoretic notion of predication.³ Just as Aristotle does not maintain a point-set-account of universals, reducing these to collections of individuals, he does not reduce propositions such as ‘ a belongs to all b ’ to ‘ a belongs to every individual to which b belongs’. A non-reductive approach to Aristotle’s syllogistic can be based on a language consisting only of one kind of term and a primitive relation $\mathbb{A}ab$ stating that a belongs to all b . The relation \mathbb{A} is taken to be a preorder, i.e., to meet the two most typical features of a mereological improper part-whole relation: reflexivity and transitivity. These two assumptions yield an adequate model for Aristotle’s non-modal syllogistic, provided universal negation is taken as mereological disjointness and the two particular propositions as the negation of the two universal ones (besides the reflexivity of \mathbb{A} , no presupposition concerning existential import is needed).

Being only reflexive and transitive, \mathbb{A} is a rather weak part-whole relation which may fail to meet many conditions which are essential to what is nowadays known as classical extensional mereology.⁴ In particular, it may fail to meet the principle of extensionality (or strong supplementation) of classical mereology.⁵ One of the consequences of this principle is that the truth of $\mathbb{A}ab$ does not depend on the subject term b itself but only on its proper parts, provided b has some proper parts. More precisely, the notion of proper part is defined as

¹For Aristotle’s classification of beings (*onta*, *pragmata*) into individuals and universals, cf. De interpretatione 17a38-b3, Prior Analytics 43a25-43 and Categories 1a20-1b9.

²Cf. Prior Analytics 43a30-32, Categories 1b12-15, 3a38f. Cf. also Ackrill (1963:76), Mignucci (1996:11-13).

³Cf. Stekeler-Weithofer (1986:76), Mignucci (1996, 2000).

⁴For a survey of modern classical mereology, cf. e.g. Simons (1987:25-41) and Varzi (1996:260-265).

⁵That is, the principle $\neg\mathbb{A}ab \supset \exists z(\mathbb{A}bz \wedge \neg\exists v(\mathbb{A}zv \wedge \mathbb{A}av))$.

$$(1) \mathbb{A}^<ab =_{df} \mathbb{A}ab \wedge \neg\mathbb{A}ba,$$

and atomic terms are taken to be those terms not having proper parts:

$$(2) \mathbf{AT}a =_{df} \neg\exists b\mathbb{A}^<ab.$$

The principle of extensionality implies that, provided b is not atomic, $\mathbb{A}ab$ is true iff every proper part of b is a proper part of a .⁶ Call the proper-part-extension of a term a the collection of its proper parts, i.e., the collection of the terms c such that $\mathbb{A}^<ac$. The principle of extensionality implies that, provided the subject term b is not atomic, the truth of $\mathbb{A}ab$ depends only on the proper-part-extension of the argument terms. Substitution by terms with the same proper-part-extension preserves truth. This consequence can be strengthened by considering atomic mereologies, i.e., those where every term \mathbb{A} -belongs to at least one atomic term:

$$(3) \exists c(\mathbb{A}ac \wedge \mathbf{AT}c).$$

This principle of atomicity, together with the principle of extensionality, implies that the truth of $\mathbb{A}ab$ depends only on the atomic terms to which the subject term \mathbb{A} -belongs, but not on the subject term itself (if this is not atomic):⁷

$$(4) \forall c(\mathbf{AT}c \wedge \mathbb{A}bc \supset \mathbb{A}ac) \leftrightarrow \mathbb{A}ab.$$

Call the extension of a term a the collection of atomic terms c such that $\mathbb{A}ac$. Then extensionality and atomicity imply that the two argument terms of \mathbb{A} -predication can be substituted *salve veritate* by any terms having the same extension. \mathbb{A} -predication depends only on the extension of the argument terms. It does not depend on any features of the argument terms which are not encoded in their extension, in particular not on the predicate term itself or on the subject term itself (unless these happen to be atomic, i.e., to be a member of their own extension). Mereological \mathbb{A} -predication can be reduced to generalized material implications whose universal quantifier only takes into account atomic terms.

Let us assume that atomic terms are viewed as a kind of singular terms. One could then introduce new symbols $\mathbf{A}, \mathbf{B}, \mathbf{C}$ and $\mathbf{a}, \mathbf{b}, \mathbf{c}$ simulating the distinction

⁶That is, $\neg\mathbf{AT}b \supset (\forall c(\mathbb{A}^<bc \supset \mathbb{A}^<ac) \leftrightarrow \mathbb{A}ab)$. A proof of this claim can be found in Simons (1987:29).

⁷The direction from right to left follows by the transitivity of \mathbb{A} . For the converse, we proceed in two steps. First we show that, by atomicity, the left hand side implies $\forall c(\exists d(\mathbb{A}cd \wedge \mathbb{A}bd) \supset \exists e(\mathbb{A}ce \wedge \mathbb{A}ae))$ (this formula is abbreviated by \ast). So assume $\mathbb{A}cd \wedge \mathbb{A}bd$. Atomicity gives an e such that $\mathbb{A}de \wedge \mathbf{AT}e$. Transitivity of \mathbb{A} yields $\mathbb{A}ce \wedge \mathbb{A}be$. The left hand side $\forall c(\mathbf{AT}c \wedge \mathbb{A}bc \supset \mathbb{A}ac)$ implies $\mathbb{A}ae$, which yields $\mathbb{A}ce \wedge \mathbb{A}ae$. Second, we show that, by extensionality, \ast implies $\mathbb{A}ab$. So assume $\neg\mathbb{A}ab$. Extensionality gives a c such that $\mathbb{A}bc \wedge \forall d(\mathbb{A}cd \supset \neg\mathbb{A}ad)$. By the reflexivity of \mathbb{A} , $\mathbb{A}bc$ implies $\exists d(\mathbb{A}cd \wedge \mathbb{A}bd)$. This contradicts $\forall d(\mathbb{A}cd \supset \neg\mathbb{A}ad)$ and \ast .

between singular and general terms in first-order logic. One could go on to take Bc as abbreviation for $\mathbf{AT}c \wedge \mathbb{A}bc$. Given atomicity and extensionality, Aristotle's mereological notion of predication $\mathbb{A}ab$ is equivalent to

$$(5) \forall c(Bc \supset Ac).$$

While all this is marvellous and Aristotle's non-modal syllogistic will happily work (existential import is guaranteed by atomicity), there is no reason to take for granted that Aristotle would restrict himself to contexts where atomicity and extensionality are valid. We are invited to drop these two assumptions and to consider non-extensional contexts where \mathbb{A} -predication does depend on the argument terms themselves. In this case, reflexivity and transitivity guarantee that $\mathbb{A}ab$ is equivalent to

$$(6) \forall c(\mathbb{A}bc \supset \mathbb{A}ac).$$

\mathbb{A} -predication can still be expressed as a generalized material implication. The universal quantifier, however, is not restricted to atomic terms, but takes into account any terms to which the subject term \mathbb{A} -belongs, in particular the subject term itself. Next, we shall see how Aristotle's treatment of modal propositions relies on this kind of non-extensional unrestricted quantification.

2. AN APPARENT TENSION BETWEEN MODALITY DE RE AND DE DICTO IN ARISTOTLE'S MODAL SYLLOGISTIC

The extensional interpretation of universal affirmation ' a belongs to all b ' in the sense of ' a belongs to every individual (atomic term) to which b belongs' gives rise to an apparent ambiguity between a de re reading and a de dicto reading of universal negative necessity ' a necessarily belongs to no b '. For on the one hand, Aristotle maintains the validity of an inference which has come to be called Celarent NXN:

$$(7) \begin{array}{l} a \text{ necessarily belongs to no } b \\ \quad b \text{ belongs to all } c \\ \hline a \text{ necessarily belongs to no } c. \end{array}$$

Given the extensional interpretation of the second premiss, this inference is obviously valid if the universal negative necessity in the first premiss and in the conclusion is given the de re reading 'for every individual (res) to which b belongs, a necessarily fails to belong to it'. The inference fails on the de dicto reading of universal negative necessity 'necessarily: for every individual to which b belongs, a fails to belong to it'. The failure can be illustrated by a situation where only men are in this room. It should be de dicto necessary that 'horse' belongs to no individual to which 'man' belongs, and 'man' belongs to every individual to which the term 'being in this room' belongs; but it is not

de dicto necessary that ‘horse’ belongs to no individual to which ‘being in this room’ belongs.

On the other hand, Aristotle maintains the validity of the conversion of universal negative necessity:

- (8) $\frac{a \text{ necessarily belongs to no } b}{b \text{ necessarily belongs to no } a.}$

This inference is obviously valid on a de dicto reading of universal negative necessity. But it is invalid on a de re reading. Consider, again, a situation where only men are in this room. For every individual to which ‘being in this room’ belongs, ‘horse’ necessarily fails to belong to it; but it is not the case that for every individual to which ‘horse’ belongs, ‘being in this room’ necessarily fails to belong to it. What is going wrong here is that de re necessity states a relation of necessarily not belonging between the predicate term and every member of the extension of the subject term without stating anything about the relation between the predicate term and the subject term itself. On the other hand, a de dicto proposition such as ‘necessarily: white belongs to no individual to which black belongs’ can be viewed as stating a direct relation between the subject term and the predicate term without stating anything about the relation between the predicate term and the members of the extension of the subject term.

Thus, when adopting an extensional interpretation of universal affirmation and thinking in terms of a dichotomy between de re and de dicto readings, Aristotle’s modal syllogistic appears tacitly to switch from one to the other reading.⁸ The first inference seems to require a de re reading stating a relation between the predicate term and every individual (atomic term) to which the subject term happens to belong. The second inference, on the other hand, seems to require a more analytic reading stating a relation between the predicate term and the subject term itself. Aristotle, I submit, does not assume an extensional interpretation of universal affirmation, and he does not think in terms of a dichotomy between de re and de dicto readings. Let us consider Aristotle’s justification of the first inference, Celarent NXN:

For since a belongs or does not belong necessarily to all b , and
 c is one of the bs , clearly one or other of these will be necessary
for c too. Prior Analytics 30a21-23

In virtue of the premiss ‘ b belongs to all c ’, c is taken to be one of the bs . In virtue of the other premiss ‘ a necessarily belongs to no b ’, a is said necessarily to fail to belong to every term which is one of the bs – in particular to the term c . This is everything Aristotle says is needed to establish the validity of

⁸This view is taken, for instance, by Becker (1933:42), Hintikka (1973:139f), Sorabji (1980:202), Striker (1994:40f), Patterson (1995:23-44).

the inference. The crucial point is that the term c , a term of the same kind as a and b , is directly seized by the quantifier of the universal negative necessity premiss. The quantifier of universal necessity propositions is taken to apply to terms which are able to serve as the subject term of universal affirmative propositions such as ‘ b applies to all c ’. The quantifier does not apply to what one would call singular terms, nor is it restricted to atomic terms.

Instead, the quantifier takes into account the subject term itself and all its improper parts, including the atomic terms to which it belongs. A relation of necessarily not belonging is stated to obtain between the predicate term and every improper part of the subject term, including the subject term itself and its atomic parts. This can be seen as a unification of the analytic de-dicto-pole and the de-re-pole of the tension sketched above.

Thus we obtain a scale between de-dicto-likeness and de-re-likeness which is not determined by the scope of sentential necessity operators. Aristotle does not think of modality as a sentential operator that can be attached to any arbitrary (closed or open) sentence. Rather he thinks of modality as (integral part of) a predicative relation, a copula, applied to two terms in order to constitute a sentence.⁹ Instead of the scope of sentential necessity operators, the scale between de-dicto-likeness and de-re-likeness is determined by the degree to which non-atomic terms are relevant for the truth conditions of propositions. If only atomic terms (the extension of terms) are taken into account, we obtain a de-re-like reading without analytic de dicto components. If all proper parts of the subject term – but not the subject term itself – are taken into account, we obtain an intermediate reading with some more de dicto components. Finally, if all improper parts of the subject term – including the subject term itself – are taken into account, we obtain the full strength of combined de-re-likeness and de-dicto-likeness. In a similar way, the reverse direction yields a scale whose starting point is a pure de-dicto-like reading without de re components and whose end point is, again, a combined de-re- and de-dicto-like reading.

Such a combined de-re- and de-dicto-like reading can readily account for Aristotle’s two inferences discussed above. All we need is a binary symmetric relation of necessarily not applying, which may be called **is incompatible with**. This relation may be taken as primitive (in which case symmetry can be guaranteed by an axiom), or it may be taken as defined by means of some other predicative relations we wish to take as primitive (in which case symmetry can be guaranteed by the definition). In any case, the internal structure of the universal negative necessity proposition ‘ a necessarily belongs to no b ’ can be formulated as:

$$(9) \forall c \forall d (\mathbb{A}bc \wedge \mathbb{A}ad \supset c \text{ is incompatible with } d).$$

⁹Cf. Patterson (1995:15-41), Whitaker (1996:159), Charles (2000:383).

Given the symmetry of *is incompatible with*, the universal negative necessity in (9) is symmetric as well, and thus accounts for the conversion inference in (8). On the other hand, if the universal negative necessity in (9) obtains between a predicate term and a subject term, it also obtains between the predicate term and any improper \mathbb{A} -part of the subject term. Thus (9) accounts for the validity of the inference Celarent NXN in (7), and is in accordance with Aristotle's explanation of this validity. The tension between *de re* and *de dicto* readings which might seem to be caused by Aristotle's maintaining the two inferences is merely apparent.¹⁰

3. LITERALIST SINGULAR TERMS

Aristotle's modal propositions take into account both the extension of the subject term and the subject term itself. This approach to modal propositions is similar to an approach to first-order quantification into modal contexts put forward by Kit Fine. The approach is based on literalist singular terms, i.e., those terms whose occurrence in a first-order sentence brings about that 'the truth value of the sentence may depend not only on the referent of the term but also on the term itself' (Fine 2005:79).¹¹ I want to indicate how Aristotle's mereological approach to modal propositions can be used as an underlying basis for a literalist first-order language.

To this end, we consider a way of reconstructing within Aristotle's mereological language the non-Aristotelian notions of a singular term and of a referent of a singular term. Let us think of atomic terms as singular terms. Since mereological \mathbb{A} -predication may fail to be antisymmetric, there may be different atomic terms \mathbb{A} -belonging to each other. Let us think of any two such atomic terms as having the same referent; for example, 'Cicero' and 'Tullius'. The referent of an atomic singular term can then be reconstructed as its equivalence class of atomic terms with respect to mutual \mathbb{A} -predication. Thus the referent of an atomic term is exactly the extension of an atomic term as introduced above (p. 3), i.e., the collection of atomic terms to which it \mathbb{A} -belongs.

The extension of an atomic term consists of exactly one referent, i.e., of exactly one equivalence class of atomic terms. On the other hand, the extension of many non-atomic terms consists of more than one referent. However, there may also be non-atomic terms whose extension consists of exactly one referent. Such terms, too, can be viewed as singular terms. Thus, *a* is a singular term iff it \mathbb{A} -belongs to at least one atomic term and if any two atomic terms to which it \mathbb{A} -belongs are members of the same equivalence class:

¹⁰There are, of course, more tensions in Aristotle's modal syllogistic, which are not our concern here. For how the mereological framework sketched so far can be extended to a consistent model of the whole of Aristotle's modal syllogistic including syllogisms with possibility premisses, cf. Malink (2006).

¹¹For literalist singular terms, cf. Fine (2005:79-83, 116-118).

$$(10) \exists b(\mathbf{AT}b \wedge \mathbb{A}ab \wedge \forall c(\mathbb{A}ac \supset \mathbb{A}bc)).$$

Every atomic term is a singular term (due to the reflexivity of \mathbb{A}), but the converse fails.¹² There is a distinction between singular terms which are atomic and those which are not. The referent of a non-atomic singular term is the single equivalence class of atomic terms to each member of which it belongs. Atomic singular terms are members of (the equivalence class which is) their referent, while non-atomic singular terms are not. Thus, atomic singular terms are more closely connected with their referent than non-atomic ones; we may also say that atomic singular terms are favoured names of their referents while non-atomic singular terms are less-favoured names of their referents.

Let us say that two singular terms are coreferential if they have the same referent. Due to the transitivity of \mathbb{A} , every term which \mathbb{A} -belongs to a non-atomic singular term \mathbb{A} -belongs to every coreferential atomic singular term. The converse fails. A term c may \mathbb{A} -belong to an atomic singular term a while it does not belong to a coreferential non-atomic singular term b . If the symbol $=$ is taken to indicate coreference, and \mathbf{Ca} is taken as abbreviation for the statement that a is a singular term such that $\mathbb{A}ca$, the following is true:

$$(11) a = b \wedge \mathbf{Ca} \wedge \neg \mathbf{Cb}.$$

Leibniz' Law fails within the present reconstruction of first-order predication by means of Aristotelian mereological predication. The reason for the failure is that the singular terms a and b are literalist in the sense that the truth of \mathbf{Cb} does not only depend on the referent of b but also on the term b itself. In order for \mathbf{Cb} to be true, the predicate term c must not only \mathbb{A} -belong to (each member of the equivalence class which is) the referent of b , but also to the term b itself. Thus substitution of coreferential terms may fail even in contexts which are not explicitly modalized.

A similar failure of Leibniz' Law can be observed in possible world semantics when predication is over individual concepts and identity is contingent in the sense that it indicates coincidence of possibly distinct individual concepts in the world under consideration. For example, in Bressan's (1972:71-94) modal predicate logic, the substance term – or, as he calls it, the absolute concept – 'number' is truly predicated of the singular term 'nine', but is not truly predicated of the singular term 'the number of planets'. Within the present account, 'nine' would be a favoured atomic singular term, while 'the number of planets' is a less-favoured non-atomic singular term.

'The problem of interpreting the most interesting form of quantification in, appears in various guises: as the problem of making trans-world identifications,

¹²If the principle of extensionality mentioned in note (5) is at disposal, the converse becomes true so that the distinction between atomic terms and singular terms in the sense of (10) collapses. The following remarks make only sense in the context of a non-extensional mereology of terms.

as the problem of finding favored names, and as the problem of distinguishing “essential” from “accidental” properties’ (Kaplan 1968:209). Aristotle’s mereological approach and Kit Fine’s literalist approach focus on the second and third guise rather than on the first one. In this respect, they differ from Bressan’s approach, and from the majority of recent approaches in analytic philosophy.

Having failed in non-modal propositions, Leibniz’ Law can also fail in modal propositions. Consider, for example, the universal negative necessity proposition in (9) above. If this kind of universal negative necessity obtains between a predicate term and a non-atomic less-favoured singular term, then, due to the inference Celarent NXN in (7), it also obtains between the predicate term and every favoured atomic term which is coreferential with the non-atomic singular term. Again, the converse may fail. The universal negative necessity in (9) may, for instance, obtain between the term ‘being greater than 10’ and the favoured atomic singular term ‘nine’, while it does not obtain between ‘being greater than 10’ and the coreferential non-atomic less-favoured singular term ‘the number of planets’.

In the sense of the literalist universal negative necessity in (9) which takes into account all improper parts of the subject term and, therefore, possesses the full strength of combined de-re- and de-dicto-likeness, it is not true that ‘being greater than 10’ necessarily fails to belong to ‘the number of planets’. On the other hand, there is a sense in which ‘being greater than 10’ can plausibly be said necessarily to fail to belong to ‘the number of planets’. On the approach pursued here, this would be the sense of a de-re-like non-literalist necessity which can be obtained by restricting the two quantifiers in (9) to atomic terms.

The term ‘the number of planets’ (and also the term ‘being greater than 10’) has the same status in the two readings. The difference between the two readings is brought about by a different predicative relation; in the first case this is literalist, in the second not. On a Fregean view, by contrast, the subject term ‘the number of planets’ would be supposed to have different referents in the two readings. In the de-re-like reading it would have its standard referent, in the other more de-dicto-like reading it would have a non-standard referent, viz. its sense. The truth conditions of first-order predication would only depend on the referent of the singular term, but the referent may be a different one in different contexts. Unlike in the literalist approach, Fregean singular terms receive a non-uniform semantic interpretation in different contexts.

However, a semantically uniform treatment of singular terms in the two contexts is not bound to be literalist. For instance, according to Carnap’s (1947) approach, the singular term would be assigned two values in either context, one value being its extension (or referent) and the other value being its intension. In a de-re-like context, only the extension-value of the singular term is relevant while in a more de-dicto-like context also the intension-value would be relevant. In both contexts, the singular term would have the same

semantic interpretation, but in neither of them the singular term itself would be relevant and would therefore not be a literalist singular term. Another uniform non-literalist approach can be found in systems of possible world semantics such as Bressan's mentioned above where the semantic value of singular terms is an individual concept determining the referent of the term in every single possible world.

In all these non-literalist approaches, non-referential aspects of singular terms are made explicit as part of the semantic value of the term, be it as a non-standard referent, as an intension-value or as a function determining the referent of the term in several possible worlds. In literalist approaches, the non-referential aspects of terms are not made explicit in the semantic value (unless one wishes to regard the term itself as part of its own semantic value). Rather these aspects are regarded as implicitly represented by or encoded in the term itself. Thus literalist terms provide an ontologically neutral way of treating non-referential aspects of terms. There is no need for an ontology of senses, intensions or possible worlds. Instead, the literalist approach which emerges from Aristotle's treatment of modal propositions is based on a mereology (or algebra) of terms.

Aristotle's mereology of terms does not presuppose a primitive distinction between singular and general terms. Nor does it take for granted a notion of reference or a distinction between referential and non-referential aspects of semantic content. Instead, it takes for granted a single notion of a term, and a relation of parthood obtaining between terms. The reconstruction of non-primitive notions of a singular term and of a referent of a singular term allows us to distinguish in an explanatory way between favoured and less-favoured names of referents. On the other hand, when the notion of a singular term and its referent is taken as an unstructured primitive, favoured singular terms would have to be distinguished from less-favoured ones in an arbitrary way (cf. Fine 2005:125).

Thus Aristotle's pre-Fregean literalist approach can help to shed light on the complex phenomenon of modality by not taking for granted distinctions which are sometimes perhaps too familiar to us.

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