

## Tropes, Intensional Relative Clauses, and the Notion of a Variable Object

It is a common view, since Aristotle, that terms of the sort in (1) refer to tropes, that is, particularized properties (particular, non-sharable features of individuals) (Woltersdorff 1977, Williams 1973, Campbell 1990).

(1) a. *the wisdom of Socrates*      b. *the originality of the book*      c. *the simplicity of the dress*

Given general diagnostics for trope reference, there are equally good reasons to take the terms below to be terms referring to tropes, namely quantitative tropes (Campbell 1990, Moltmann 2009):

(2) a. *the number of planets*      b. *the height of the building*      c. *the length of the vacation*

There are closely related terms, however, that present a significant challenge to trope theory. These are terms with relative clauses containing an intensional verb:

(3) a. *the originality of the book John wants to write*  
b. *the simplicity of the dress Mary needs for the occasion*  
c. *the wisdom of the director the institutes should hire*

(4) a. *the number of people that fit into the car*                      b. *the height of the desk John needs*  
c. *the length of the time John might be away*

Tropes as discussed in philosophy are meant to be real entities, involving a real object as bearer, but the tropes the terms in (3) and (4) seem to refer to lack an actual bearer. The diagnostics for trope reference apply to such terms in the very same way, though, for example the applicability of predicates expressing properties of concreteness, such perceptual predicates and predicates describing causal relations:

(5) a. *John observed Mary's politeness.*      b. *John noticed the small number of woman that were present.*  
c. *John noticed the number of screws that were missing.*

(6) a. *The heaviness of the bag she was carrying made Mary exhausted.*  
b. *The weight of the lamp caused the table to break.*  
c. *The length of the paper John needed to write frightened him.*  
d. *The number of people that fit into the car astonished Mary.*  
e. *The number of screws that were missing caused the table to fall apart.*

Moreover both sorts of terms accept predicates such as *exceed*, *great*, *high*, or *negligible*, predicates which are not naturally applicable to the corresponding abstract objects (properties or numbers)

(7) a. *The simplicity of Mary's dress exceeds the simplicity of Sue's dress*  
b. *The number of women exceeds the number of men.*  
c. *The number of people that fit into the bus exceeds the number of people that fit into the car.*

An obvious semantic approach to the terms in (3)-(4) would be to take them to refer to tropes with individual concepts as bearers, that is, (partial) functions from worlds (or situations) and times ('indices' for short) to individuals (or collections of individuals). That individual concepts of some sort are the denotations of NPs with intensional relative clauses as has in fact been argued by Moltmann (2008) for terms like (8a) and, for the closely related construction in (8b), by Grosu/Krifka (2007):

(8) a. *The assistant John needs must speak French fluently.*  
b. *The gifted mathematician that you claim to be could solve this problem in no time.*

I think making use of reference to individual concepts and of individual concepts as bearers of tropes raises a range of problems, ontologically, conceptually, empirically, and regarding the compositional semantics of NPs of the sort in (3) and (4). The ontological problem concerns the notion of a trope itself: tropes are causally efficacious entities *in the world*, which means they have objects as bearers, not intensions or functions. The conceptual problem concerns substitution problems that reference to individual concepts in general give rise: an abstract function has quite different properties (that is, is a bearer of quite different tropes) than 'the book that John needs to write'. The empirical problem concerns the particular behavior of NPs as in (3)-(4) with respect to the Modal Compatibility Requirement (MCR)(Grosu/Krifka 2007, Moltmann 2008), the requirement that the predicate contain a 'matching' modal to, apparently, 'access' the values of the individual concept. Sometimes such NPs are subject to the MCR, sometimes they are not:

(9) a. *The originality of the paper John needs to write ?? exceeds / must exceed the originality of the papers he has so far written. (MCR)*  
b. *The number of people that fit into the bus exceeds the number of people that fit into the car. (no MCR)*  
c. *The number of papers John might write ?? exceeds / might exceed the number of papers Mary will write. (MCR)*  
d. *The originality of the paper John wants to write exceeds the originality of the papers he has so far written. (no MCR)*

I will propose a novel ontological account for the analysis of the terms in (3)-(4), by developing a notion of a variable object (a notion closely related to Fine's 1999 notion of a variable embodiment, see also Koslicki 2008) and corresponding notions of a variable trope and a trope 'driven by' a variable object. I will argue that NPs as in (8) and others commonly held to refer to individual concepts (*the temperature, the president of the US*) refer to variable objects, objects that may have different manifestations as distinct individuals at different times and / or in different worlds or situations ('indices' for short). In the cases of (3)-(4), these will be variable objects that may have no actual manifestation. I will adopt the following conditions from Fine (1999) for variable objects:

(10) a. Existence: A variable object *f* exist at an index *i* iff *f* has a manifestation at *i*.

b. Property inheritance: A variable object *f* has an (index-relative) property *P* at an index *i* iff *f*'s manifestation at *i* has *P*.

Variable objects, in fact, have two sorts of properties: local properties, inherited from a manifestation at a time or in a situation, and global properties, which may concern several manifestations at different times (for example properties of change). Variable objects moreover may have properties that are not index-bound (though may be attributed relative to an index). A variable object has a property *P* in that sense if all its manifestations at any index have *P*. These conditions also hold when *P* is understood as a particularized property, a trope.

Using variable objects in this sense has first of all a significant advantage over the individual-concept approach for the compositional semantics of terms with intensional relative clauses, as below:

(11) *the book* [*John needs to write e* ]

Using individual concepts, either *e* is considered a variable for individual concepts and all predicates are lifted to predicates of individual concepts (Grosu/Krifka 2007) or else *e* is considered a variable for individuals (or rather a functional term of the sort *f(i)*) and the relative clause operator is considered a special operator binding a function-variable (for individual concepts *f*). Both approaches suffer from a lack of independent motivation. Moreover the second approach faces serious difficulties with NPs of the sort in (3)-(4) and even more so with terms for second-level tropes like the one below:

(12) *the impact of the number of books John plans to write*

The approach would have to take both *number* and *impact* to be interpreted somehow in a lower position inside the relative clause, which is hardly possible.

The variable-objects approach allows for a rather simple compositional analysis of (11), avoiding a type ambiguity among predicates entirely. Assuming, as is plausible, that the head noun *book* is interpreted in the lower position inside the relative clause, the lower variable will stand for a variable object, to which the relative clause attributes certain properties at particular indices. Such a variable object can then be the argument of a function mapping it onto a trope, as in the cases in (3) and (4). There are two such functions only one of which will lead to the MCR being imposed:

[1] One function maps the variable object onto a trope of which the variable object is the bearer. This is the case of a variable object bearing an index-independent property based on the sharing of that property by all the manifestations at any index. This is what we have in (9b) (given that the same number of people fit into the bus / the car at the different circumstances). In such a case no MCR is imposed.

[2] The other function maps the variable object onto a variable trope whose variability is 'driven by' the variability of the object. This is what we have in (9a). In such a case the MCR is imposed.

The first function cannot apply in (9c) because here the manifestations are likely to be different in number in the different circumstances and thus do not share the same number property.

(9d) is exempt from the MCR because *want* has another interpretation as an intentional rather than an intensional verb, an interpretation on which *want* takes a particular entity, an intentional object, as argument (rather than, let's say, an intensional quantifier)

## References

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