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## ***The Number of People that fit into the Bus: Tropes with Intensional Bearers?***

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### **1. The puzzle**

Apparent trope-referring terms with intensional relative clauses:

- (1) 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
- (2) 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

Trope-referring terms (Aristotle, Woltersdorff, Strawson, Lowe, Williams, Campbell, Bacon):

- (3) a. the wisdom of Socrates
  - b. the originality of the book
  - c. the simplicity of the dress

Quantitative tropes (Campbell):

- (4) a. the number of planets (Moltmann, to appear)
  - b. the height of the building (Moltmann, 2009)
  - c. length of the vacation

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### **2. Tropes**

Characteristic properties of tropes

Dependence on a bearer (ontological dependence)

Similarity relations:

- Tropes instantiating the same property are similar
- Tropes instantiating the same natural property are exactly similar

*The same as* expressing similarity:

- (5) a. The quality of Mary's dress is the same as that of Sue.  
 b. The number of women is the same as the number of men  
 c. The height of the desk is the same as the height of the lamp.

The *is* of numerical identity:

- (6) a. ?? the quality of Mary's paper is the quality of John's paper.  
 b. ?? The number women is the number of men.  
 c. ??The height of the table is he height of the lamp.

Properties of concreteness:

- temporal location / duration:

(7) John's happiness lasted only a year.

- spatial location?

(8) a ?? John's happiness was in Munich

- b. John's happiness in Munich
- c. ?? John's heaviness on the table

- objects of perception:

Tropes are the immediate objects of perception (Williams, Campbell, Lowe).

- (9) a. John noticed the simplicity of the dress.  
 b. John observed Mary's politeness.  
 c. John noticed the small number of woman that were present.

Tropes as relata of causal relations:

- (10) a. The heaviness of the bag she was carrying made Mary exhausted.  
 b. The number of invitations astonished Mary.  
 c. The weight of the lamp caused the table to break.

Other properties of concreteness:

- description-independence

Tropes generally have an internal structure 'below' the description used to refer to them:

(11) a. John described Mary's beauty.

Contrast: states, facts:

- b. ?? John described (the state of) Mary's being beautiful.

(12) a. John compared Mary's beauty to Sue's beauty.

Contrast: states, facts:

b. ?? John compared (the state of) Mary's being beautiful to (the state of) Sue's being beautiful.

Tropes can in principle be described in various different ways:

the redness of the apple = the intense redness of the apple

Socrates' wisdom = Socrates' most important quality

- part-whole structure, measurable extent

Tropes may have part-whole structure and a measurable extent

facts / states / states of affairs have no part-whole structure and do not have a measurable extent

linguistic indications:

(13) a. all of Mary's happiness / talent / comfort / beauty

b. \* all of the fact that Mary likes Bill – namely Mary, Bill and the liking relation

c. \* all of the state of Mary's liking Bill – namely Mary, Bill and the liking relation

(14) a. Mary's happiness exceeds Bill's.

b. \* The fact that Mary likes Bill exceeds the fact that Mary is tall.

c. \* The state of Mary's liking Bill exceeds the state of Mary's being tall.

→ Tropes referred to with predicates, however determinable, unspecific, quantificational, are always maximally specific, must be grounded in instances of natural (sparse) properties, but not so facts, states or states of affairs.

→ There are no determinable tropes.

Other properties of tropes:

Do tropes inherit properties of their bearer?

Tropes do not have the properties they instantiate, only their bearers do, but they share evaluative properties with their bearers:

predicates of 'quantitative', 'neutral' comparison:

(15) a. John exceeds / equals Mary in eagerness.

b. John exceeds / equals Mary in sloppiness.

(16) a. The eagerness of John exceeds / equals the eagerness of Mary.

b. The sloppiness of John exceeds / equals the sloppiness of Mary.

- (17) a. ?? The property of being very eager exceeds the property of being not so eager.  
 b. ?? The property of being extremely sloppy exceeds the property of being somewhat sloppy.

Predicates of quantitative, 'neutral' evaluation:

- (4) a. The eagerness of John is high / great.  
 b. ?? The property of being very eager is high / great.  
 c. ?? John is high / great in eagerness.

Application to quantitative tropes, number tropes:

- (18) a. The height of John exceeds / equals the height of Mary.  
 b. John exceeds / equals Mary in height.  
 (19) a. The number of men exceeds / equals the number of women.  
 b. The men exceed / equal the number of women.  
 c. The number 13 ??? exceeds / is greater than the number 8.

Second-level tropes:

- (20) a. the greatness of the beauty of the landscape  
 b. the enormity of the number of students
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### 3. Functional uses of trope terms

- (21) a. The beauty of the landscape has changed.  
 b. The amount of corruption in this administration has become more noticeable.  
 (22) a. The number of students has changed.  
 b. the increasing number of students  
 (23) a. The number of students is getting higher and higher.  
 b. The number of teachers sometimes exceeds the number of students.  
 c. The increasing number of students causes problems for the current availability of class rooms.

Tropes reference with functional trope terms:

- (24) a. the constancy of the number of students  
 b. the impact of the increasing number of students

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#### 4. Trope terms with intensional relative clauses

*The number of* terms with intensional verbs:

- (25) a. the number of people that fit into the car  
 b. the number of books John wants to write  
 c. the number of assistants John needs  
 d. the number of screws that are missing

*The number of* as a numeral replacement, rather than functional trope expression:

- (26) a. John saw a number of people.  
 b. John kissed a great number of babies.  
 (27) Mary counted the number of screws that are missing. (?)

A potential analysis of (25a) on a numeral placement use:

just like number-comparatives:

- (28) a. John ate more apples than Mary did.  
 b. John ate a greater number of apples than Mary did.  
 c. For any  $n$ , such that Mary ate  $n$ -many apples, there is an  $n'$  such that John ate  $n'$ -many apples, and  $n' > n$ .  
 (30) a. the number of people that fit into the car  
 b. the maximal  $n$  [  $n$ -many people fit into the car ]  
 (31) the maximal  $n$  [for  $n$ -many people  $x$ ,  $x$  fit into the car]

Evidence for a trope-referential use of *the-number-of*-terms with intensional relative clauses:

Predicates of neutral comparison:

- (31) a. The number of people that fit into the bus exceeds / equals the number of people that fit into the car.  
 b. The number of people that fit into the bus is high.  
 c. The number of screws that are missing is negligible.  
 d. John compared the number of books Mary wants to write to the number of books Sue wants to write.

Predicates of perception and causation:

- (32) a. The number of people that would fit into the car astonished Mary.

b. John noticed the number of screws that are missing.

Predicates of similarity and identity:

(33) a. The number of women in the room is the same as the number of men in the room.

b. ?? The number of women in the room is the number of men in the room.

(34) a. The number of books Mary wants to write is the same as the number of books Sue wants to write.

b. ?? The number of books Mary wants to write is the number of books Sue wants to write.

The generality of the phenomenon

Other quantitative trope terms:

(35) a. the height of the building John wants to build

b. the height of the desk John needs

c. the length of the trip John is planning

d. the length of the time John might be away

(36) The height of the desk John needs exceeds by far the height of the desk John is using right now.

Qualitative trope terms:

(37) a. the originality of the book John wants to write

b. the simplicity of the dress Mar needs for the occasion

c. the elegance of the decoration of the house Mary expects to live in

Predicates of neutral comparison:

(38) a. The originality of the book John wants to write exceeds by far the originality of any book John has so far written.

b. The elegance of the dress that the bridesmaid needs should not exceed the elegance of the dress that the bride will wear.

c. The height of the desk John needs exceeds by far the height of the desk John is using right now.

Predicates of causation:

(39) Mary was astonished by the length of the time John might be away.

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## 5. Tropes with intentional bearers

Fictional entities are bearers of tropes:

- (41) a. the strength of Hercules, the intelligence of Anna Karenina, the beauty of Helena  
 b. The strength of Hercules exceeds the strength of Bill.

### The distinction between intensional verbs and intentional verbs

Intentional verbs: *think of, mention, describe, imagine*

Intensional verbs: *need, look for, want, owe, own, recognize*

Criteria for intensional verbs (Moltmann 2007):

#### 1. Nonspecificity

Intensional verb exhibit nonspecificity of complement, but not intentional verbs:

- (42) a. John needs a horse, any will do.

b. John needs at least two assistants.

nonspecificity of the complement of intensional verbs fundamentally distinct from the indeterminateness of the objects that intentional verbs may take as their argument (underspecification with respect to properties)

*Need* as a modal verb of absence:

- (42) a'. 'For any situation *s* exactly satisfying John's needs, there are at least two assistants John has in *s*' (Moltmann 1997, 2008).

Some intensional verbs also act as intentional:

- (43) a. John wants the house described in the book. (intentional)

b. John wants at least three children. (intensional)

#### 2. Special quantifiers

Intensional verbs require impersonal proforms, regardless of whether the complement is specified as human or not:

- (44) John needs something / ?? someone, namely an assistant.

- (45) a. There is something / ?? someone John needs, namely an assistant who speaks French.

b. There is something John made reference to, namely a person who speaks French fluently.

intentional verbs involve proforms that match the features of the NP complement they

replace:

(46) John mentioned someone / ? something, a woman (in fact, a woman that does not exist).

### 3. 'Identity conditions'

Two distinct occurrences of intensional verbs share the same object ('the same thing') just in case they would take the same property or quantifier as argument:

(47) Mary needs an assistant.

John needs an assistant, thus John.

Mary need the same thing.

(48) a. John needs the same thing as Bill, namely an assistant that speaks French.

b. ?? John mentioned the same thing as Bill, namely a woman that speaks French.

For two intentional verbs to share the same object, the intentional acts they describe need to be directly or indirectly coordinated (the 'intentional objects' need to be the same):

(49) John mentioned a woman with red hair.

Bill mentioned a woman with red hair.

John and Bill mentioned the same woman.

4. 'Nonexistence' only with intentional verbs, not intensional verbs:

(50) a. There is a book John mentioned that does not exist.

b. ?? There is an assistant John needs that does not exist.

### Reinterpreting intentional and intensional verbs

psychological verbs of absence may have intentional use:

(51) a. There is a woman John is thinking about that does not exist.

b. There is a woman John is looking for that does not exist.

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## 6. NPs with intensional relative clauses

NPs with intensional relative clauses:

(52) a. the paper John needs to write



Reference to individual concepts, of some sort ('satisfaction types', Moltmann 2008):

- (52) b. The partial function which maps a situation exactly matching John's needs to the paper John writes in that situation (and which is undefined otherwise).

Assumptions about interpretation of relative clause:

Head noun is interpreted inside the relative clause, relative clause operator binds functional variable, head noun acts as restriction inside the relative clause:

- (53) a. The paper [John needs to write e paper]  
 b. The  $x_f$  [John needs to write  $x_{\text{paper}}$ ]  
 c. the  $f$  [for all  $s$  ( $s R_{\text{need, John W}} \rightarrow \text{write}(\text{John}, f(s)) \ \& \ \text{paper}(f(s))$ )]

Constraint in property attribution to NPs with intensional relative clauses:

Modal compatibility requirement (see also Grosu /Krifka 2008):

- (54) a. The book John has to write will have to be 200 pages long.  
 b. ?? The book John has to write is 200 pages long.  
 (55) a. The desk John needs does not have to be very high.  
 b. The desk John needs does not have to be very high.

Modal compatibility requirement explained on individual concept analysis, as in (53), if predicate is analysed as predicate of individual concepts  
 the  $f$  [for all  $s$  ( $s R_w \rightarrow 200 \text{ pages long}(f(s))$ )]

A related case (Grosu/Krifka 2008):

- (56) a. The gifted mathematician that you claim to be should be able to solve this problem in no time.  
 b. ?? The gifted mathematician that you claim to be is able to solve this problem in no time.

Some issues about individual concepts:

- Restrictions on reference to individual concepts:

- (57) a. The book John reads in the evenings has changed  
 b. The paper John needs to write has changed.

- Individual concepts as denoted by terms with intensional relative clauses cannot bear properties directly, it seems, unlike time-based individual concepts.

Substitution problems:

- Why can't individual concepts have the properties of formal functions?
- Why can't formal functions have the properties of individual concepts?

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## 7. Tropes with intensional bearers?

How can an individual concept act as a bearer of a trope?

A plausible condition on an individual concept bearing a trope:

In all worlds / situations for which the function is defined the value of the individual concept has the property of which the trope is an instance, i.e. is the bearer of a similar / exactly similar trope.

Functions as bearers of tropes?? Substitution problems, even more severe

A solution to the substitution problems: Fine's theory of variable embodiment

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## 8. Tropes with variable embodiments as bearers

Fine (1999) (see also Koslicki 2008):

Rigid embodiments: e.g. a particular quantity of water: constituting matter is not replaceable

Variable embodiments:

- objects allowing for replacement of material parts, constituting matter, manifestations over time

Examples:

- artifacts
- 'the water in the river'
- 'the president of the US'

'The president of the US': single entity, different manifestations as individuals at different times

General conditions on variable embodiments:

F principle of variable embodiment, picks out manifestations at different times

Variable embodiment  $f = /F/$

Existence:

A variable embodiment  $f$  exist at a time, at a world iff  $f$  has a manifestation at  $t$  in  $w$ .

Location:

If a variable embodiment  $f$  exists at  $t$  in  $w$ , then its location at  $t$  in  $w$  is that of its manifestation at  $t$  in  $w$ .

Property inheritance:

A variable embodiment  $f$  has a (time-relative) property  $P$  at a time  $t$  iff  $f$ 's manifestation at  $t$  has  $P$ .

'The paper John needs to write':

As an individual concept:

function mapping a situations exactly satisfying  $J$ 's need to a paper written by John in that situation.

as a variable embodiment:

entity whose manifestations are the papers John writes in situations exactly satisfying John's needs.

Property inheritance:

Has a property  $P$  in a situation  $s$  iff its manifestation in  $s$  has  $P$  in  $s$

Trope inheritance

Variable embodiment  $f$  bears a trope in a situation  $s$  iff its manifestation in  $s$  bears a similar trope in  $s$ .

Variable embodiment  $f$  bears a trope  $t$  iff every manifestation of  $f$  in a situation  $s$  bears a trope similar to  $t$  in  $s$ .

The metaphysical issue:

Common assumption:

Tropes have a unique bearer – because tropes ontologically depend on their bearer.

Thus: how can the individual concept / variable embodiment share a trope with its values / manifestations in the relevant situations?

Sharing of tropes is possible under certain circumstances, e.g. when the entities are constitutionally related (cf. Moltmann, to appear b):

e.g. the sweater inherits redness from the wool of the sweater

But individual concepts / variable embodiments may pose another problem for trope inheritance:

The individuals that are values of the individual concept / variable embodiment may manifest the property in question differently.

But tropes are fully specific, determinate!

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## 9. Looking again at the data

Qualitative tropes:

- (58) a. The originality of the paper John wants to write exceeds the originality of the papers he has so far written.
- b. The originality of the paper John needs to write ?? exceeds / must exceed the originality so far written of the papers he has so far written.

In (58a) *want* acts as an intentional verb!

Thus: modal compatibility requirement also for trope terms with intensional relative clauses

Functional uses of trope terms:

(59) The originality of the papers John writes has increased.

Reference to a function mapping a relevant situation *s* to the manifestation of originality of the paper that John writes in *s*.

Quantitative tropes:

- (60) a. ?? The number of people John might invite exceeds the number of people Mary might invite.
- b. The number of people that can fit into the bus exceeds the number of people that fit into the car

in (60b): all the relevant number tropes will be exactly similar

Condition on trope inheritance:

A variable embodiment can inherit a trope from its manifestations in case the trope of the manifestations are exactly similar.

I.e. an individual concept can inherit a trope from its values in case the values bear exactly similar tropes.

Tropes of variable embodiments subject to the same constraints (determinate, not determinable) as tropes of ‘ordinary objects’.

Tropes with ‘intensional bearers’ are possible either if

- the bearer is in fact an intentional object (*the originality of the paper John wants to write*)
- or
- the values of the individual concept bear exactly similar tropes of the relevant sort (*the number of people that fit into the car*)

Otherwise:

Functional use of trope terms: reference to variable embodiments with tropes as manifestations in other circumstances

The problem:

How to get such an interpretation compositionally?

(61) a. the originality of the paper John needs to write

b. the  $e_f$  John needs to write a paper that is e original

even more difficult:

(62) a. the number of paper that John might write

b. the  $e_f$  [John might write an e-number of papers]

(63) a. the weight of the statue that John might buy

b. the  $e_f$  [John might buy an e-heavy statue]

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