

Copredication, Counting, and Criteria of Individuation: A Response to Gotham

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1 Introduction

Copredication is the phenomenon exhibited by sentences such as (1)-(3):

- (1) Lunch was delicious but lasted hours.
- (2) Three heavy books are informative.
- (3) The bank was vandalized after calling in Bob's debt.

The puzzle about copredication is that (1)-(3) ascribe two properties that, at least *prima facie*, can't be jointly instantiated, e.g. being delicious (a property of food items) and lasting hours (a property of events); being heavy (a property of physical objects) and being informative (a property of informational entities); being vandalised (a property of physical buildings) and calling in debts (a property of institutions). Nevertheless, it is easy to conceive of contexts where each of (1)-(3) seem to be true.

This problem has driven theorists to a variety of dramatic conclusions, most notably that referential semantics should be jettisoned altogether (Chomsky 2000, Pietroski 2005, Collins 2009, 2011, and forthcoming). Those who are moved by the puzzle but wish to preserve referential semantics have offered a range of complex semantic theories (Pustejovsky 1995, Luo 2012, Asher 2011, Gotham 2017). The details of these views vary considerably, but they share the common general idea: nouns involved in copredication (such as 'book') belong to a kind of complex semantic type (in this case, a type which in some manner combines being physical and being informational), and which (perhaps after some further syntactic and semantic footwork) allows the two conflicting properties or modifiers ('heavy' and 'informative' in this case), to apply.

However, pressure on such solutions is placed by issues concerning counting and individuation. Consider, for example, a context containing three copies of *War and Peace*. In one sense, it seems that the context involves three books (and thus that books are counted and individuated as if they were merely physical objects), and in another sense, it seems that the context involves just one book (and thus that books are counted and individuated as if they were merely

informational objects). To make things worse, we seem to never count books as if they were some kind of complex entities. Consider a view on which books are ordered-pairs of physical and informational objects, and take a context containing three physical volumes, each binding together *War and Peace* and *Anna Karenina*. While we seem to get either a reading on which there are three books involved (the ‘physical’ reading) and a reading on which there are two books involved (the ‘informational’ reading), we do not seem to get any reading on which there are six books involved, as a simple ordered-pair view would predict.¹

Some accounts of copredication do not directly address issues of counting and individuation. Thus, for example, Luo’s (2012) account handles copredication by utilising a type theory on which both modifiers with a domain of type *physical*→*t* (such as ‘heavy’) and those with a domain of type *informational*→*t* (such as ‘informative’) can apply to ‘book’. However, he does not address the issue how to count books, and in particular how to generate the various conflicting readings of such counting sentences.

Other accounts do address the issues of counting and individuation, but only at the price of accepting highly controversial assumptions about the metaphysics of objects and of identity. Thus according to Asher (2011), books are neither informational objects nor physical objects, but belong to a complex type P•I. Asher maintains that books have a ‘physical aspect’, and an ‘informational aspect’ but crucially, these aspects are not parts or components of books but rather ‘two conceptualizations, if you will, that are equally ‘true of’ or ‘faithful to’ the object” (Asher 2011: 130-1). With respect to counting and individuation, Asher suggests that: “we can count books as informational objects or as physical objects (though not coherently as both)... The counting criterion determines the cardinality of the model!... Does this mean that we have in effect two models with different sets of inhabitants for ‘book’, depending on which criterion of individuation is chosen? Not necessarily, but it does force us to the position that counting requires a criterion of identity and individuation, which is part of the doctrine of relative identity” (Asher 2011: 157). The problem, however, is that from a philosophical point of view it is not obvious how to make sense of this view: since Asher takes being a physical object and being an informational object as incompatible properties (p.139), it is hard to explain how both ‘conceptualizations’ can be ‘equally true’ of books, and the doctrine of relative identity on which Asher relies is widely rejected in the philosophical literature.²

Against this background, Gotham (2017) makes an important and welcome contribution to this debate. Gotham’s theory offers a compositional semantics which accounts both for the true readings of copredication sentences and for a wide range of intricate data concerning counting and individuation sentences. Moreover, it achieves these aims with completely standard metaphysical machinery. We think that Gotham’s discussion is insightful and his theory ingenious

¹Cf. Asher (2011): 140-141.

²For a discussion of some of the problems for relative identity, see Hawthorne (2006), §3.1, who concludes the section with the following: “In sum: it is no mere artefact of philosophical fashion that Geach’s relative identity approach has few adherents.” (p. 23).

and well-developed. Nevertheless, we argue that the theory ultimately suffers from significant flaws and thus ought to be rejected.

To put our cards on the table we are not neutral parties to this debate. In Liebesman and Magidor (2017), we develop and defend our own theory of copredication. Unlike previous accounts, we do not take books to be some kind of complex entities: on our view, there are (at least) two different kinds of books: informational books and physical books, where facts about counting and individuation are explained by quantifying over different kinds of books in different cases.³ It is hardly surprising that separating physical books and informational books addresses the issues of counting and individuation, but of course the challenge to this view is whether it can account for copredication. We argue, however, that the puzzles of copredication have been generated by false metaphysical assumptions: for example, that physical objects cannot be informative or that informational objects cannot be on shelves. Once these assumptions are rejected, there is nothing puzzling about how sentences such as (1)-(3) can be straightforwardly true.

Our purpose here is not to defend our positive view. This paper is intended purely as a critical discussion of Gotham’s theory. In section 2 we present Gotham’s theory, and in sections 3 and 4 raise objections. Despite the fact that our sole aim here is critical, we take it that showing that we ought to reject one of the most promising accounts of copredication to appear in recent years offers indirect support for our own view.⁴

2 Gotham’s theory summarised

Gotham’s theory begins with a rejection of the view that ‘book’ is ambiguous, with one sense designating informational books, and the other designating physical books. Rather, he holds that the extension of ‘book’ contains mereological sums of informational and physical objects. Consider p , for instance, a particular physical copy of *War and Peace* on the shelf. That very copy—a physical thing—is not in the extension of ‘book’. Similarly, i , the abstract informational object expressed by that copy is also not in the extension of ‘book’. However, the mereological sum of p and i , $p+i$, is in the extension of ‘book’. This sum is a complex with both a physical and an informational component. Similar remarks hold for ‘lunch’, ‘bank’ and other nouns that give rise to copredicational sentences. (We’ll focus solely on ‘book’ for the sake of discussion.) These sums inherit properties from their components. Gotham assumes “that any property that holds of p holds of $p+i$, and likewise that any property that holds of i also

³As it turns out, we argue that this is achieved by a contextual domain restriction rather than by postulating an ambiguity for ‘book’, but this aspect of our view is entirely inessential to our solution to the puzzles of copredication and counting.

⁴In Liebesman and Magidor (2017), §5.3 we question data that motivates some of the details of Gotham’s account. However, since that particular issue does not interact with the objections we raise in this piece, we will not elaborate on it here. In §6.2 of Liebesman and Magidor (2017) we briefly mention some of the considerations taken up in detail in this discussion.

holds of $p+i$ ” (Gotham 2017: 335).

Pursued flat-footedly, taking ‘book’ to designate such mereological sums runs the risk of generating incorrect truth-conditions for counting sentences, due to the existence of too many books. The problem is that a single physical book may express more than one informational book. Gotham considers two physical books, each of which expresses both Dostoyevsky’s *Notes from the Underground* and *The Gambler*. Imagine that both of these physical volumes are heavy, and nothing else is. If ‘book’ designates mereological sums, as suggested, then there are (at least) four sums: $v1+NFU$, $v2+NFU$, $v1+TG$, and $v2+TG$.⁵ Since each of sums these inherits the property of being heavy from its physical component, the result is a true reading of (4).

(4) Four books are heavy.

To avoid this unwanted result, Gotham revises his semantics of quantifiers and first-order predicates. The latter are taken to encode criteria of individuation, while the former are able to exploit these criteria to produce more discriminating counts. ‘Heavy’, for instance, encodes a physical criterion of individuation. It does not suffice for there to be two heavy things that there is a x that is heavy, and a y that is heavy, and that x is not identical to y . Rather, what’s required is that there is a x that is heavy, and a y that is heavy, and that x is *physically distinct* from y . Physical distinctness, in turn, is analyzed as non-identity of physical components. While there may be four sums, the maximal number of physically distinct sums is two.

To compositionally derive these truth-conditions, Gotham takes predicate meanings to involve product types of their familiar types and criteria of individuation. So, for instance, the revised (extensional) meaning of ‘heavy’ is given in (5):

(5) $[[\text{heavy}]] = \lambda x_e. \langle * \text{heavy}'(x_e), \text{PHYS} \rangle$

The semantic-value of ‘heavy’ is a function from entities of type e (which Gotham takes to include both individual entities as well as pluralities of individuals) to ordered pairs of truth-values and criteria of individuation. ‘*heavy’ designates the pluralized heaviness property (i.e. a function that yields the value t for a plurality iff each of its individual members is heavy). PHYS is the physical criterion of individuation, which is analyzed as a relation that holds between entities just in case their physical components are numerically identical.

(6) $\text{PHYS} = \lambda x. \lambda y. \text{phys-equiv}'(x,y)$

Note that this second component of the ordered-pair in (5) is constant across inputs into the function denoted.

Nouns that support copredication are assigned complex criteria of individuation that correspond to the multiple aspects of entities in their extensions. Since ‘book’ designates sums of informational and physical entities, its criterion is a

⁵If we can sum informational books freely, then we can generate additional books that are the sums of physical books with $NFU+TG$. This would yield eight!

conjunction of physical and informational criteria, as seen in (7). ‘ \sqcap ’ expresses generalized conjunction, defined in the familiar manner as in Partee and Rooth (1983) (‘ \sqcup ’ expresses generalized disjunction).

$$(7) \llbracket \text{books} \rrbracket = \lambda x_e. \langle * \text{book}'(x_e), \text{PHYS} \sqcap \text{INFO} \rangle$$

Though predicate meanings are now product types, we can easily recover familiar meanings by accessing projections using π , subscripted to the projection targeted.

$$(8) \lambda x_e. \pi_1(\llbracket \text{books} \rrbracket(x_e)) = \lambda x_e. \pi_1(\langle * \text{book}'(x_e), \text{PHYS} \sqcap \text{INFO} \rangle) = \lambda x_e. * \text{book}'(x_e)$$

Equally, the criterion of individuation for ‘book’ can be extracted as follows (with o being any entity of type e - recall that the value of the second element of the ordered pair is constant):⁶

$$(9) \pi_2(\llbracket \text{books} \rrbracket(o)) = \pi_2 \langle * \text{book}'(a), \text{PHYS} \sqcap \text{INFO} \rangle = \text{PHYS} \sqcap \text{INFO}$$

In order to derive his desired readings, Gotham gives a semantics for quantifiers that is sensitive to the criteria of individuation of their arguments. Here, for instance, is his proposal for quantifier ‘three’ (we omit the details for the second member of the relevant ordered-pair - namely the criterion of individuation carried over by the quantifier, as this will not play any role in our discussion):

$$(10) \lambda P. \lambda Q. \langle \exists x(|x| \geq 3 \wedge \pi_1(P(x)) \wedge \pi_1(Q(x))) \wedge \neg(\pi_2(P(x)) \sqcup \pi_2(Q(x))) \text{-comp}(x), \dots \rangle$$

(10) requires some clarification. P and Q range over the semantic-values of first-order predicates which are, as above, functions from entities to products of truth-values and criteria of individuation. x ranges over pluralities, and we can measure the cardinality of a given plurality using the absolute value function. ‘comp’ (compressibility) expresses a criterion-relative property of pluralities: if R is a criterion of individuation, a plurality x is R -compressible (denoted ‘ R -comp’) just in case there are two members of x that stand in R . So, for instance, if a plurality contains both $p1+i1$ and $p1+i2$ (where $p1$ is a physical part and $i1/i2$ are informational parts) then that plurality is PHYS -compressible because it contains two entities that are physically equivalent, but the plurality is not INFO -compressible.

Given all of this, we can see how Gotham generates the desired truth-conditions for (11), as (12)⁷:

$$(11) \text{Three books are heavy.}$$

⁶In his final theory, Gotham complicates the nature of criteria of individuation to account for the fact that meanings of higher types, e.g. those of transitive verbs, may impose different criteria on their different arguments. However, this complication will not concern us, so we will ignore it.

⁷Note that Gotham interprets the quantifiers on its *at least* reading, but it is obvious how to generalize this semantics for *exact* quantifiers.

(12) $\exists x(|x| \geq 3 \wedge \text{*book}'(x) \wedge \text{*heavy}'(x) \wedge \neg((\text{PHYS} \sqcap \text{INFO}) \sqcup \text{PHYS})\text{-comp}(x))$

We can simplify (12) to (13)), given that $((A \sqcap B) \sqcup B) = B$:

(13) $\exists x(|x| \geq 3 \wedge \text{*book}'(x) \wedge \text{*heavy}'(x) \wedge \neg(\text{PHYS-comp}(x)))$

The English gloss of (13) is that there is a plurality of three things, such that the plurality is heavy, it is some books, and no two of its members are physically equivalent. Importantly, note that this leaves out a constraint on the informational components of the plurality. As far as the generated truth-conditions go, all three members of the plurality may have the same informational part. This is as Gotham desires, since he takes (12) to be true when there are three copies of the same informational book.

Similarly, in the case discussed above involving two physical volumes each expressing two informational books (i.e. the case involving the books $v1+\text{NFU}$, $v2+\text{NFU}$, $v1+\text{TG}$, and $v2+\text{TG}$). Gotham derives his desired truth-conditions: ‘two books are heavy’ is true, but ‘three books are heavy’ is false: pluralities containing physically distinct books from this list can contain at most two members.

In sum, Gotham endorses a theory on which (i) nouns that support copredication designate sums, e.g. “book” designates sums of physical copies and informational books, (ii) these sums inherit properties from their components—the sum has all of the properties of its physical component, and all of the properties of its informational component, (iii) predicates are product types of their familiar types and criteria of individuation, and (iv) quantifiers are truth-conditionally sensitive to criteria of individuation, in the manner specified by the lexical entry for ‘three’. In the following, we’ll refer to this collection of views as GT.

GT, we’ll now argue, makes a number of false predictions. We’ll focus on two types of cases. In the first type, which we discuss in section 3, we seem to be designating purely informational or purely physical books. Given tenet (i), GT cannot easily accommodate this: all books have both physical and informational components. In the second type, which we discuss in section 4, we focus on the very sentences that motivate GT: counting sentences. Even though GT is an advancement on earlier theories of copredication (as Gotham (2017: §4) argues), we will argue that GT still makes false predictions in a number of central cases and that the theory cannot be easily amended to remedy this.

3 Is *War and Peace* a book?

Taking ‘book’ to designate sums of physical and informational books will run into problems whenever we seem to have a term that designates an entity in the extension of ‘book’ that is merely physical or merely informational. Book names, especially when uttered in a context in which there are no salient physical copies, provide plausible candidates:

(14) *War and Peace* is a book.

On GT, the only entities in the extension of ‘book’ (i.e. the only books) are sums of informational and physical entities. What, then, should the proponent of GT take ‘*War and Peace*’ to designate when (14) is uttered in absence of any physical copy? There are only two *prima facie* plausible options. The first option is to take ‘*War and Peace*’ in (14) to indeterminately designate every sum with an informational component that expresses *War and Peace*. The second option is to expand the extension of ‘book’ so that it includes, in addition to sums, the informational books themselves. Unfortunately, neither of these options is plausible.

3.1 Indeterminate Designation

The view that ‘*War and Peace*’ in (14) indeterminately designates every sum of a physical copy of *War and Peace* with the informational book gives rise to truth-conditional problems. Assume, for instance, that we take sentences containing ‘*War and Peace*’ to be true iff they are true on every resolution of indeterminacy. Such a view gives inadequate truth-conditions for sentences like (15).

(15) Every university library in Canada owns *War and Peace*.

(15) is intuitively true, but on the view under consideration it will be false. After all, consider a resolution of indeterminacy on which ‘*War and Peace*’ designates the sum of the informational book, and the physical copy owned by the University of Manitoba. It is not the case that every university library owns that sum. And, of course, this is hardly an isolated example. When we speak of books independently of their physical instances, we don’t take them to possess the properties of those physical instances—either determinately or indeterminately.

Of course one could give an alternate theory of indeterminate designation, but we know of no independently plausible theory that won’t give rise to similar truth-conditional issues. The reason is straightforward: when we speak of *War and Peace* independently of any of its copies, we ascribe it properties that are likewise independent of those copies. Any theory on which ‘*War and Peace*’ indeterminately designates sums containing copies will make faulty predictions in virtue of the fact that truth-conditions will be linked to copy-containing sums.

Another problem with the view that ‘*War and Peace*’ can indeterminately designate every sum of informational and physical ‘*War and Peace*’, is that we can truly ascribe properties to books even when no physical copies exist. Imagine, for instance, that just after Tolstoy finished his first complete draft of *War and Peace*, the manuscript was destroyed and he had to rewrite it from memory. (16) as uttered by Tolstoy is true, though there is no physical copy whatsoever.

(16) My only copy of *War and Peace* has been destroyed; I will just have to re-write it from memory!

3.2 The Informational Book is a Book

The second (and more plausible) option is to expand the extension of ‘book’ so that it includes informational books themselves. This option also faces truth-conditional problems. We can bring this out with a dilemma. Assume that there is a single copy of *War and Peace* (and no other books) on the shelf. Is the informational book *War and Peace* on the shelf as well? There are two options: yes, and no, and both yield truth-conditional problems for the view that ‘book’ has both mereological sums and informational books in its extension.

Assume that informational books are not on shelves. Consider the example of Emily Bronte, who has only written one book: *Wuthering Heights*. Suppose that the shelf contains a single copy of *Wuthering Heights*. Assuming informational books are the sort of things that can be written⁸ the following sentence is predicted to be false:

(17) Every book Emily Bronte wrote is on the shelf.

To see this, note that the truth-conditions GT assigns to sentences of the form ‘Every P is Q’ are entirely orthodox, with criteria of individuation playing no role (Gotham (2017): 353).⁹ Thus the sentence is true if every (contextually relevant) entity falling under the extension of ‘book Emily Bronte wrote’ is in the extension of ‘on the shelf’. But this is false: the (purely) informational book *Wuthering Heights* is in the extension of ‘book EB wrote’ (it is in the extension of ‘book’ which we are now assuming contains informational books, and also has the property of *having been written by Emily Bronte*), but the informational book is not (we are now assuming) in the extension of ‘on the shelf’. However, this prediction is incorrect: (17) is clearly true in the envisaged context.

If, on the other hand, the informational book is on the shelf, then (18) must be treated true on the envisioned scenario:

⁸This assumption is not crucial for the argument. As long as there is some property that the informational book uniquely instantiates, we can run a version of the argument with that property.

⁹Asher (2011): 133, 145 suggests that even quantifiers such as ‘Every’ should be sensitive to criteria of individuation, because of the contrast between ‘The student mastered every book in the library’ and ‘The student carried off every book in the library’ (on their most natural readings, the former is true if the student mastered one copy from each of multiple copies of *War and Peace*, but the latter requires the student to have carried off all copies of the book). Gotham (2016) §3.3.2 responds to this argument, claiming that this case is already handled by his semantics without needing to make the quantifier sensitive to criteria of individuation. His idea is that every sum $p+i$ is mastered iff i is mastered, and carried-off iff p is carried off — which is sufficient to generate the correct truth-conditions in this case. We note, however, that a variant of this example is not handled as well by Gotham’s semantics. For example, assume that the only book John ever read is *War and Peace*, which the library holds. In this scenario, ‘Every book John mastered is in the library’ should be true, but on Gotham’s semantics it is falsified by a second copy v of *War and Peace* which is not in the library ($v+WP$ will be a book John mastered which is not the library).

Note, however, that this objection has little to do with our discussion above. Presumably, even if in this case ‘every’ were somehow sensitive to criteria of individuation we would want it to be sensitive to an informational criterion, but if informational books cannot be on shelves then this does little to generate the true reading of (17).

(18) Two books are on the shelf.

Why is that? We will assume that (however this is compositionally derived), ‘on the shelf’ has a semantic value of the following form, and in particular it encodes a physical criterion of individuation:¹⁰

$$[[\text{on the shelf}]] = \lambda x_e. \langle * \text{on-the-shelf}'(x_e), \text{PHYS} \rangle$$

The semantic value of ‘books’ remains as above, with the only difference being that ‘book’ is also true as applied to purely informational books, as well as to sums:

$$[[\text{books}]] = \lambda x_e. \langle * \text{book}'(x_e), \text{PHYS} \sqcap \text{INFO} \rangle$$

Thus by GT’s semantics, (18) receives the following truth-conditions:

$$(19) \exists x(|x| \geq 2 \wedge * \text{book}(x) \wedge * \text{on the shelf}'(x) \wedge \neg(\text{PHYS-comp}(x)))$$

However, on the envisaged scenario (19) is true. For let p be the single physical copy on the shelf and i be the informational book *War and Peace*. The plurality containing both $p+i$ and i is a witness for (19): it contains two entities that fall under the extension of both ‘book’ and (we are assuming) ‘on the shelf’. Moreover the two members of this plurality are physically distinct because they don’t share a physical part. This, however, is an incorrect prediction: (18) is clearly false in the envisaged scenario.¹¹

3.3 The Properties of *War and Peace*

We’ve been focussing on sentences in which ‘*War and Peace*’ seems to designate a purely informational book and arguing that GT cannot provide satisfactory truth-conditions. We can further generalize this point by focussing on tenet (ii) of GT: that sums of informational and physical books inherit properties from their components—in particular, they inherit all of the properties of both the informational books and the physical books. This view is too liberal, given that it will lead to inconsistency. Each physical copy has the property of being *purely physical*, but no sum does. For GT to be consistent, it must revise (ii) with a more subtle account of property inheritance, one which restricts the inheritance in the case ‘pure’ properties that are not intended to carry over to books-qua-sums. The problem, though, is that that such a revision would not solve the

¹⁰At least assuming that ‘on the shelf’ is not ambiguous, this criterion will be needed in order to generate the reading of ‘Three books are on the shelf’ which is true on a scenario involving three copies of *War and Peace*. We discuss the possibility that ‘on the table’ and similar phrases are ambiguous below.

¹¹An anonymous reviewer has pointed out that one may attempt to escape this objection by adopting a ‘collapsed plural ontology’, on which the plurality of i and $i+p$ is identical to $i+p$. There are two reasons we won’t consider this in detail. The first is that we have a hard time understanding how to make coherent the underlying metaphysics of such an ontology. After all, i is one of the plurality of i and $i+p$, but i is not one of $i+p$. (Recall that one of the strengths of Gotham’s view is avoiding such controversial metaphysics.) The second reason is that a collapsed plural ontology doesn’t help the proponent of GT with any of the other problems we consider.

problem of inconsistency. This is so because some properties that we clearly do want to apply to ordinary books can still be inherited inconsistently.¹²

Consider the following sentences:

(20) Three brand new books are on the shelf.

(21) Two old books are on the shelf.

Imagine that there are three brand new copies of *War and Peace* on the shelf. (20) has a true reading. Since, on GT, ‘books’ ranges over sums of physical and informational entities, we must take those sums to, at least sometimes, inherit their age from their physical components.

However, imagine that the shelf contains a brand new copy of *War and Peace* and brand new copy of *The Bible*. (21) has a true reading. Since, on GT, ‘books’ ranges over sums of physical and informational entities, we must take those sums to, at least sometimes, inherit their age from their informational components.

So, we have a principled challenge for GT. It appears that the proponent of GT must sometimes take sums to inherit ages from their physical components and other times from their informational components. However, on pain of contradiction, they cannot always inherit both. It is worth stressing that natural alternative views do not face this challenge. If ‘book’ in (20) ranges over physical books, while in (21) ranges over informational books, there is simply no conflict.

There is a straightforward response for the proponent of GT: to claim that ‘old’ and ‘new’ are ambiguous as between expressing informational and physical properties. On one sense ‘old’ expresses the property of having an old *physical* component and on another sense, ‘old’ expresses the property of having an old *informational* component. This proposal will lead to a proliferation of ambiguity, and, in addition, won’t be able to account for sentences like (22):¹³

(22) ‘*War and Peace*’ is quite old, but this copy of it isn’t.

In §4.2 we’ll return to the possibility of defending GT by appeal to ambiguity in more detail, arguing that it doesn’t help. For now, we’ll set additional counterexamples aside.

4 Multiple readings of counting sentences

The main motivation for GT comes from counting sentences like (23). However, as we’ll now argue, GT cannot provide adequate truth-conditions for such sentences. The key problem is that counting sentences admit to multiple readings and GT is only designed to capture one of these. Furthermore, attempting to solve the problem by positing ambiguity or additional ontology does not help.

¹²The inconsistency of (ii) in the case of ‘pure’ properties such as ‘being physical’ is mentioned in fn. 38 of Liebesman and Magidor (2017), and (in a slightly different context) in Asher (2011: 138ff). But as we explain above, the problem of inconsistency goes deeper than this.

¹³Cf. Zwicky and Sadock (1975) for discussion of this sort of test.

To see that ordinary counting sentences admit multiple readings, imagine a scenario in which there are three copies of *War and Peace* (and nothing else) on the table. (23) has two readings: one true and the other false. (The numerical quantifiers in all our examples below are taken with an ‘exact’ rather than an ‘at least’ reading):

(23) Three books are on the table.¹⁴

On the true reading, we focus on physical books. GT has no problem generating this reading. If, as we have assumed so far, ‘on the table’ encodes a physical criterion of individuation, then GT generates a reading on which (23) is true just in case three physically distinct physical books are on the table.

However, (23) also has a false reading, one where we focus on informational books. We can generate the false reading by focusing on the true reading of (24):

(24) One book is on the table: *War and Peace*.

Given that Gotham associates a physical criteria of identity with ‘on the table’, it is hard to see how we can generate this reading. Moreover, it would not help to instead posit an alternative criterion of individuation for ‘on the table’: what we need is a theory that predicts both the true reading of (23) and the true reading of (24). If ‘on the table’ merely has a single criterion of individuation we fail to predict that (23) has two conflicting readings.

4.1 Yet More Multiplicity

A salient option for the proponent of GT is to take ‘on the table’ to be ambiguous, with one meaning encoding the PHYS criterion and the other encoding the INFO criterion. However, positing this two-way ambiguity is insufficient to solve the problem because there are more than two ways to individuate books. To see this, imagine that there are three copies of *War and Peace* on the table: two copies of the French translation of *War and Peace*, and one copy of the English translation. Now consider the following three sentences, each of which has a true reading in this scenario:

(25) One book is on the table. (Namely, *War and Peace*.)

(26) Two books are on the table. (Namely, the French translation of *War and Peace* and the English translation.)

(27) Three books are on the table. (Namely, the three copies of *War and Peace*.)

¹⁴Throughout our discussion we use sentences containing the predicate ‘on the table’ because we (and those we’ve consulted) have clear judgments about them that support our conclusions. However, as an anonymous referee rightly stressed, a wide variety of predicates would support our arguments (e.g. ‘in the shop’) and, insofar as one has trouble accessing all of our readings, one can feel free to substitute other predicates.

One might hope that this can be accommodated without multiplying ambiguities, simply by expanding the ontology of informational books. Suppose that in addition to the general informational book War and Peace ('WP'), we also recognize two additional informational books 'FV' and 'EV', denoting the French version and the English version respectively. Taking p1-p3 to be the three physical volumes, GT will now recognize six composite objects: p1+WP, p2+WP, p3+WP, p1+FV, p2+FV, and p3+EV.

But this mere expansion of the ontology does not solve the problem because it does not afford a reading on which (26) is true. Even worse, it does not generate a reading on which (25) is true. However 'on the table' is interpreted the result will be that there are three books on the table (if 'on the table' is interpreted using the PHYS criterion, then this will be made true by the plurality consisting of p1+WP, p2+WP, p3+WP; and if it is interpreted using the INFO criterion it will be made true by the plurality consisting of p3+WP, p1+FV, and p3+EV no two members of which share an informational component). Nor will it help to reject the existence of WP and recognize only the more fine-grained informational books FV and EV. If we do that then (25) would still be false (the maximal plurality of informationally distinct books will include two books).

The upshot is that in order to accommodate (25)-(27), GT would have to postulate at least a three-way ambiguity for 'on the table'—with one meaning encoding a PHYS criterion of individuation, a second encoding a criterion on which all versions of War and Peace count as the same book ('INFO_{COARSE}'), and a third encoding a criterion according to which to which different translations count as different books ('INFO_{FINE}').

4.2 The Failure of the Ambiguity Approach

So, can the proponent of GT solve the problem by taking 'on the table' to be three-ways ambiguous? No. First, it does not suffice to add ambiguity to 'on the table': we would also need to revise the semantic-value of 'book' so that it encodes the new criteria of individuation: $\text{PHYS} \sqcap \text{INFO}_{\text{GENERAL}} \sqcap \text{INFO}_{\text{FINE}}$. Second, reflection shows that there are in fact many more than three ways of individuating books (do we distinguish different editions? Different printings? And so forth). Thus 'on the table' will have to be very multiply ambiguous, and 'book' receive a multiply conjunctive criterion of individuation.

But even if we are happy to concede such massive ambiguity the problem is nevertheless not resolved. To see this, note that there are other nouns that can be individuated in multiple ways, none of which are informational. Suppose for example that our shop sells pens. Consider the following sentence:

(28) There are two pens on the display table.

This sentence has at least two readings: on the first reading, the sentence is true on a scenario where the display table contains two qualitatively identical pens and is false on a scenario where the display table contain ten (physical) pens. On the second reading, the sentence is false on the scenario containing two qualitatively identical pens, but is true in a scenario containing ten physical pens

where five of them are Parker Jotter pens, and five of them Uniball Jetstream pens.

The first reading involves a physical criterion of individuation. But what about the second reading? It cannot involve an informational criterion: unlike physical books, there is no information expressed by the pens. What we are looking for is something like an artefactual criterion ('ART').¹⁵ This, however, causes serious problems for GT, even if we allow for as many ambiguities as one wishes for 'on the table'. This is so because we can combine disjoint criteria of different nouns with a single use of 'on the table'.

To see this, suppose that our book-and-pen shop has six physical objects on the display table: two copies of *War and Peace*, two Parker Jotter pens, and two Uniball Jetstream pens. On this scenario there is clearly a true reading of the following sentence:

(29) One book and two pens are on the table.

However, no single (simple) interpretation of 'on the table' generates these truth-conditions. Suppose first that 'on the table' is interpreted with an 'INFO' criterion. In this case (30) would be true (as per GT's usual semantics), but (31) would be false:

(30) One book is on the table.

(31) Two pens are on the table.

To see this, note in order to account for the two readings of (28), 'pens' must encode the conjunctive criterion of individuation $\text{PHYS} \sqcap \text{ART}$:

$$[[\text{pens}]] = \lambda x_e. \langle * \text{pen}'(x_e), \text{PHYS} \sqcap \text{ART} \rangle$$

As we are now assuming 'on the table' has the INFO criterion, it receives the following semantic-value (again, ignoring the details of how it is compositionally derived):

$$(32) [[\text{on the table}]] = \lambda x_e. \langle * \text{on-the-table}'(x_e), \text{INFO} \rangle$$

Putting these together (and given the 'exact' reading of the quantifier), (31) receives the following truth-conditions:

$$(33) \exists x|x|(\geq 2 \wedge * \text{pens}'(x) \wedge * \text{on-the-table}'(x) \wedge \neg(\text{PHYS} \sqcap \text{ART}) \sqcup \text{INFO-comp}(x)) \wedge \neg(\exists x|x| \geq 3 \wedge * \text{pens}'(x) \wedge * \text{on-the-table}'(x) \wedge \neg(\text{PHYS} \sqcap \text{ART}) \sqcup \text{INFO-comp}(x))$$

Now consider our four physical pens p_1, \dots, p_4 and the two 'type'-pens PJ, and UJ. Together they generate a plurality x consisting of four sums: p_1+PJ , p_2+PJ , p_3+UJ , p_4+UJ . This plurality satisfies the complex criterion $\neg(\text{PHYS}$

¹⁵Can we subsume both the informational criterion and the artefactual criterion under one general criterion (call it 'TYPE')? No. As we have learnt from the discussion above, both pens and books can be individuated in multiple conflicting non-physical manners: criteria of individuation need to be more discriminating than merely type/token.

\sqcap ART) \sqcup INFO-comp(x). For take any two sums in the plurality. They are trivially not INFO equivalent, as they do not have informational components. Moreover, they are also not PHYS \sqcap ART-equivalent as each is distinct from the other by either its physical part or its artefactual component. The upshot is that if ‘on the table’ receives the interpretation suggesting in (32), then ‘There are four pens on the table’ is true, and (31) is false.

Conversely, if ‘on the table’ receives an ART criterion of individuation, then (30) will be false. On this interpretation, (30) will receive the following truth-conditions:

$$(34) \exists x(|x| \geq 1 \wedge *books'(x) \wedge *on-the-table'(x) \wedge \neg(\text{PHYS} \sqcap \text{INFO}) \sqcup \text{ART-comp}(x)) \wedge \neg(\exists x(|x| \geq 2 \wedge *books'(x) \wedge *on-the-table'(x) \wedge \neg(\text{PHYS} \sqcap \text{INFO}) \sqcup \text{ART-comp}(x)))$$

But letting WP be the informational book war and peace and v1, v2 the two physical copies, we have a plurality x consisting of two sums v1+WP, v2+WP. This plurality satisfies the complex criterion $\neg(\text{PHYS} \sqcap \text{INFO}) \sqcup \text{ART-comp}(x)$. For take any two sums in the plurality. They are trivially not ART equivalent, as they do not have artefactual components. Moreover, they are also not PHYS \sqcap INFO equivalent as each is distinct from the other by either its physical part or its informational component. The upshot is that on this interpretation ‘Two books are on the table’ is true and (30) is false. In fact, we can now see that the problem is not only that we do not get the interpretation which counts the books according to an informational criterion. The truth-conditions (34) actually express a very odd interpretation, one which the sentence cannot receive in any context. To see this, consider a slightly different scenario where the table contains two physical volumes: one, v1, binding together War and Peace and Anna Karenina (AK) and one, v2, expressing only War and Peace. This scenario involves a plurality of three sums: v1+WP, v1+AK, and v2+WP. Interestingly, even this plurality is not $(\text{PHYS} \sqcap \text{INFO}) \sqcup \text{ART-comp}$, entailing that in this scenario the sentence ‘Three books are on the table’ is predicted to be true. But this prediction is incorrect: there are clearly no readings of this sentence that are true on the envisaged scenario.

We conclude that the multiple readings of counting sentences undermines GT, which does not allow for such multiple readings. And amending GT to allow for ambiguity not only requires massive ambiguity but also fails in cases where different subject terms require different individuation conditions.¹⁶

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