Counting and measuring – a reply to Liebesman

David Nicolas

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Introduction

In a recent paper, Liebesman (2014) claims that we do not "count by identity". Counting some objects by identity is giving the cardinality of the plurality that has these objects as members. Under this conception, some objects are two just in case these objects comprise one object distinct from another and no other object. Liebesman presents two arguments for his claim: the bagel argument and the liter argument.

In my reply, I focus on the bagel argument, which is the most important. Liebesman first purports to show that in (1) *Two and a half bagels are on the table*, we do not count by identity. In particular he rejects possibilities like the following: the expression *two and a half bagels* would really be *two bagels and a half bagel*. He then argues that in (2) *Exactly two bagels are on the table*, we do not count by identity either. Taking a uniform semantics to be preferable, he concludes that we never count by identity.

As I explain below, I agree that in some cases, we do not count directly and use some kind of measurement instead. But contra Liebesman, I argue that this is the exception rather than the rule. In normal cases, we just count ("by identity"). Moreover, I provide an explicit semantics of the relevant sentences. Finally, I argue that even when we measure, this involves genuine counting.

1) What is the semantics of *two bagels* and *two and a half bagels*?

The starting point of Liebesman is the following observation. With some count nouns, like *bagel*, we understand expressions like *a half bagel* and *(a) half of a bagel*, and sentences like this one:

(1) *Two and a half bagels are on the table.*

This is true, for instance, if on the table there are two bagels and a half bagel (half of a bagel).

If instead of *two and a half* we use a simple cardinal like *two*, the truth conditions of a similar sentence can be stated like this:

(3) *Two bagels are on the table*

is true iff $\exists x$ (bagel(x) $\wedge$ card(x) = 2 $\wedge$ on_the_table(x)) {"at least" semantics}

where bagel() applies to one or more bagels and card() counts the number of bagels.

The sentence is true just in case there is a plurality x of bagels on the table whose cardinality is two. This "at least" semantics of cardinals just asserts the existence of two things. An "exact semantics" would assert the existence of exactly two things and no more (Spector 2013).

Whether one adopts an "at least" semantics or an "exact" semantics, these kind of truth conditions are inadequate for (1) for two reasons (Salmon 1997, Liebesman 2014):

- Intuitively, half a bagel is not in the denotation of *bagels*, so it cannot be in the denotation of *two and a half bagels* if *two and a half* just restricts the denotation of *bagels*.
- The function card() returns the cardinality of a plurality, which can never be a fractional number.

So what are the truth conditions of the sentence and how do we get them? Liebesman says that it involves a kind of measurement, but he does not provide an explicit semantics for the relevant sentences. In the next section, I present a first type of account, which Liebesman rejects. Then I put forward my own, positive account, in which measurement is involved only in special sentences, like (1).

2) Against analyzing *two and a half bagels* as *two bagels and a half bagel*

Ionin & Matushansky (2006) claim that complex numerals "compose". Syntactically, due to something akin to ellipsis, *twenty-two bagels* is really *twenty bagels and two bagels*. Semantically:

[*twenty-two bagels*] = $\lambda x\ \exists y\ \exists z\ (x=y+z \wedge$ [*twenty bagels*](y) $\wedge$ [*two bagels*](z))

twenty-two bagels applies to a plurality x just in case x is the sum of a plurality y of twenty bagels and a plurality z of two bagels.

One could propose the same for *two and a half bagels*. Or more directly, one could suppose that (1) should be analyzed as (4) or a variant like (4'):

(4) *Two bagels and a half bagel are on the table.*

(4') *Two bagels are on the table and a half bagel is on the table.*

But this kind of account has the following problems:[1]

a) It does not explain why we can refer anaphorically to *two and a half* as a number:

(5) *Two and a half bagels are on the kitchen table. Twice as many onions as <u>that</u> are on the dining room table.* (Liebesman 2014: 7)

However, this argument is not as strong as it seems. In (5') below, one seems able to refer anaphorically to five things (two bagels and three bialys), and something similar could be happening in (5) itself:

(5') *Two bagels were on the side table, three bialys were in the bread box, and twice as many kaiser rolls as <u>that</u> were on the counter.*

b) The account predicts that (1) *Two and a half bagels are on the table* is false if there are five half bagels, insofar as (3) *Two bagels are on the table* is false if there are four half bagels from four different bagels.

It also predicts that (1) is false if there are two bagels and two quarters from two different bagels, insofar as (6) *A half bagel is on the table* is false if there are two quarters from two different bagels (Liebesman 2014: 7).

3) My proposal: *bagels* receives a novel meaning in special contexts

Consider (1) again:

(1) *Two and a half bagels are on the table*.

The idea is that in this sentence, the meaning of *two and a half* clashes with that of *bagels*, which demands to combine with a cardinal number. To avoid this, a new meaning is constructed (partly analogous to the meaning of a measure expression like *two and a half*

1 The account of Ionin & Matushansky faces another challenge. The semantics given for *twenty-two bagels* allows overlap between the twenty bagels and the two bagels. Overlap is ruled out pragmatically. So there should be contexts where overlap is possible. But it is never the case when we describe something as *twenty-two bagels*.

pounds of chocolates):[2]
[*two and a half bagels*] = λx (bagel'(x) ∧ amount-bagel(x) = 2.5)

Within this construction, *bagels* receives this novel meaning (which I abbreviate as Q):
[*bagels*] = Q = λn λx (bagel'(x) ∧ amount-bagel(x) = n)

bagel'() is the crucial element in fixing the novel denotation of *bagels*. Plausibly, what bagel'() applies to depends on context. In the most typical context, bagel'() applies only to whole bagels and half bagels. But in other contexts, it may also apply to other fractions, like a quarter of a bagel.

amount-bagel() is a partial, additive function, i. e. for any things to which it applies:
If x and y do not overlap, amount-bagel(x+y) = amount-bagel(x) + amount-bagel(y).
The function is defined in terms of the units whole bagel and half bagel, and possibly further units. Whenever x is a whole bagel, amount-bagel(x) = 1. And whenever x is a half bagel, amount-bagel(x) = 0.5. In some contexts, further units may also be defined, e. g. if x is a quarter of a bagel, amount-bagel(x) = 0.25. Then in a given context, one uses the units defined in that context to find out whether amount-bagel() associates a number to a plurality of things. amount-bagel() returns a number just in case this plurality can be divided into subpluralities that correspond to the available units, e. g. one bagel here, two half bagels there, and three quarters from three different bagels there.

The novel meaning Q is available only in special contexts. One context is when *bagels* is combined with an expression like *two and a half*. Another is when we judge the following sentence false if on the table there are two bagels and a half bagel:[3]
(2) *Exactly two bagels on the table.*
What we see or know makes half bagels relevant. Then in this special context, *bagels* receives the novel meaning Q and *two* stands in competition with *two and a half*. Demanding the most precise answer, *exactly* rules out *two*. By contrast, in normal contexts halves are not relevant, *two* just stands in competition with other cardinal numbers like *three*, and (2) excludes these alternatives: it says that there are two bagels, not three, nor more.

4) This is really a novel meaning

An alternative proposal would be that the meaning of *bagels* is always Q. Liebesman is not explicit about what semantics *bagels* should receive. But this view might be congenial to his overall position.

However, the intuitions concerning the interpretation of the following sentences make a strong case against this view:
(7) *There are some bagels on the table.*
(8) *Some bagels are on the table.*
(9) *What there is on the table are bagels.*
Intuitively, these sentences assert the existence of a cardinal number of whole bagels. This

2 On measure expressions, see Krifka (1989), Rothstein (2011), Partee & Borschev (2012).
3 Both Salmon (1997) and Liebesman (2014) claim that the sentence is false under these circumstances. Several native speakers I have consulted accept both this interpretation and another one under which the sentence is true since on the table there are two bagels and not three.

would be completely unexpected if Q were the usual denotation of *bagels*. The sentences should be true if several halves of bagels were on the table. But that is not the case. Moreover, intuitively, the sentence (3) *Two bagels are on the table* says that two whole bagels are on the table. If Q were the denotation of *bagels*, then the sentence should be true if on the table there were four halves from four different bagels. Again, this is not the case.

So in sentence (3) and in sentences (7) to (9), *bagels* has just its normal meaning. Inspired by Krifka (1989) and Bale (2006), we can suppose, for concreteness, that the normal denotation of *bagels* is this (nothing important depends on this particular choice):
[*bagels*] = λn λx (bagel(x) ∧ card(x) = n)
where bagel() applies to one or more bagels and card() counts the number of bagels.

5) Even when using *half*, counting is involved

By contrast, in sentences like the following one, *bagels* receives the novel meaning Q:
(10) *One and a half bagels are on the table.*
In the most typical context, the partial, additive function amount-bagel() is defined in terms of two units: whole bagel and half bagel. So any number it outputs must be derivable from counting and a simple calculation based on these units.[4] Then two kinds of situation make (10) true:
- Situation 1: one counts one bagel and one half bagel and calculates thus (where *x* is the multiplication sign):
amount-bagel(x) = 1*x*1 + 1*x*(0.5) = 1.5
- Situation 2: one counts three half bagels and calculates thus:
amount-bagel(x) = 3*x*(0.5) = 1.5

In general, for each unit available in the context, one counts how many things correspond to (or instantiate) that unit. And the rest of the calculation proceeds similarly.

Liebesman claims that when we interpret sentences like (10), we do not count ("by identity"). What precedes shows that the interpretation involves genuine counting and multiplication, based on the units bagel and half bagel (and further units such as quarters if these are given in the context).

Conclusion

Following Salmon (1997), Liebesman argues that in sentences like (1) *Two and a half bagels are on the table*, we do not count "by identity". He concludes from this that we never do. This second step, however, is not warranted. There is another account, which is plausible and attractive. We genuinely count in sentences like (3) *Two bagels are on the table*. It is only in special cases, like (1), that we use some kind of measurement. And moreover, even when we do measure, this involves genuine counting.

4 See Wiese (2003: 28) for a similar view concerning extensive measurement more generally.

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