Clouds and Blood.
More on Vagueness and the Mass/Count Distinction.

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1. Introduction.

Liebesman (2015) – henceforth, L - argues that the proposal in Chierchia (2010) – henceforth, C - of understanding the mass-count distinction in terms of vagueness is flawed, by leveling four arguments against it. He furthermore tries to make a case that regardless of the details of C's proposal no vagueness-based account of the distinction is viable. In this paper I show that Liebesman's arguments against C don't go through and that a line of investigation on the mass count contrast in terms of vagueness is not only viable but also perhaps a source of insight. The outcome of the present discussion is of interest beyond the question of who is right in this debate, as it puts into sharper focus several issues pertaining to mass vs. count, plural vs. singular, and the role of vagueness in natural language semantics.

C's main contention is that even though the mass-count distinction has important connections with and repercussions on the metaphysics of objects vs. substances, its grounding is in grammar (viewed here as a cognitive endowment of humans), and in the way grammar shapes the inferential system associated with semantic composition. More specifically, what constrains the way we count is how singularities ('ones') vs. pluralities ('many') and vagueness are coded in natural language. This view is the target of L's criticisms and the present paper follows the layout of his argumentation. In the remainder of this section, I provide the relevant background. In section 2 I go over L's four arguments against C in the order in which he develops them. Brief conclusions follow.

1.1. Background.

In the context of the present paper, a 'natural property' is the denotation of any basic common noun, whether mass (like *flour*, *water*, *blood*, etc.) or count (like *table*, *cat*, etc.). C follows the widespread practice of modeling properties as functions from worlds/contexts into partial characteristic functions over a (pragmatically determined) domain U of individuals.[1] Partiality is exploited in this connection in order to represent

[1] Strictly speaking, C adheres to the classical bidimensional Kaplanian view according to which worlds play distinct roles when they fix the value of indexicals vs. when they are used to model propositional content. So, the arguments that follow should be couched in terms of 'natural characters' rather than 'natural properties/contents'. However, the Kaplanian distinction between character and content is particularly relevant to issues, such as the interpretation of demonstratives within attitude reports or conditionals, that are largely orthogonal to the present concerns. It is therefore appropriate (and arguably safe) to follow the ways of classical Montague semantics (e.g. Montague 1970) and bypass such distinction within the present discussion, as it will greatly simplify our

the vagueness of natural properties (while trying to stay neutral on the thorny issue of to what extent vagueness is ignorance vs. indeterminacy). The (highly preliminary) way in which partiality may capture vagueness is as follows. Take the cat-property. For any world w and any x, if x is my cat, then $cat_w(x) = 1$; if x is my dog, then $cat_w(x) = 0$; if x is a one hour old cat-fetus, $c_w(x)$ may be 0, 1 or # (undefined), depending on the conventions/choices prevailing in w.[2] As is evident from this example, C assumes that (almost) every natural property (i.e. the interpretation of every noun or verb in a naturalistic setting) is vague. Furthermore, C adopts the view that while there clearly are indexical expressions that are context dependent but not (particularly) vague (like, e.g., the first person pronoun 'I'), the boundaries of the vagueness band of words like *cat* is resolved by the context, in the sense that whether e.g. the cat-property is (un)defined for cat-fetuses in w depends in part on the conventions (and choices) prevailing among the illocutionary agents in w. Consequently, there is a degree of context dependency in every vague expression. This is a very far cry from a complete story of vagueness. But C claims that even this minimal take suffices to shed light on what makes 'counting with mass nouns' systematically awkward.

The key to C's proposal lies in a further semantic distinction that is orthogonal to the mass/count one but crucial to its understanding, namely the contrast between singular and plural, a complex topic in its own right. C's proposal is couched within a widely shared approach to plurality vs. singularity that for the sake of argument we shall regard here as uncontroversial (as L does). Such an approach assumes that the domain U of individuals is closed under a plurality forming operation $\cup_w$ (in any world w), in terms of which a 'part-of' relation $\leq_w$ is defined in the usual way.[3] The $\cup_w$ -operation is at the basis of the difference between singular and plural properties. If, for instance, we are in a world w

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exposition. Cf. fn. 2 for a way of translating the present proposal into a Kaplanian bi-dimensional framework.

[2] Here is a more explicit way of restating the semantics of the English word 'cat', in a more or less standard Kaplanian mold. For any context c, world w and individual, u, the English word /kæt/ denotes a function **cat**, such that **cat**(c)(w)(u) = 1 if u is a cat in w according to the conventions prevailing among the English speaking community in c; **cat**(c)(w)(u) = 0, if u is not a cat according to the conventions prevailing among the English speaking community in c; and **cat**(c)(w)(u) is undefined, otherwise. The English sentence *that is a cat* is true relative to a context c iff whatever *that* refers to in c (say u) is a cat relatively to the world of the context w_c (i.e. iff **cat**(c)(w_c)(u) = 1). The formula $cat_w(x)$ in the text can be taken as an abbreviation for **cat**(c)(w_c)(x), and all of the examples in this paper can straightforwardly be restated along similar lines.

For the notions of 'world of the context' and 'conventions prevailing in a community of speakers' cf., e.g., Chierchia and McConnell-Ginet (2000), Ch 4, .Ch. 6.2 and references therein.

[3] $a \leq_w b =_{df} a \cup_w b = b$. See Link (1983) for a classic formulation. The present discussion could be readily re-couched, with no modifications of substance, within set-theoretic approaches to plurality, such as, e.g., Schwarzschild (1996). For general introductions to the issues discussed here, cf., e.g., Pelletier and Schubert (1989) or Krifka (1994).

with only three cats, a, b, and c, then U will contain, among other things, the following individuals, structured as shown:

(1) $a \cup_W b \cup_W c$

$a \cup_W b \quad b \cup_W c \quad a \cup_W c$

$a \quad b \quad c$

The minimal elements in (1) are cat-singularities (or cat-atoms) and constitute the positive extension in w of the (singular) cat-property $\lambda w.cat_W$. The whole of the structure in (1) constitutes the positive extension of the plural cat-property $\lambda w.CAT_W$.[4] The cat a is part of the plurality $a \cup_W b$ (i.e., $a \leq_W a \cup_W b$), and so is, of course, the cat b. The part-of relation $\leq_W$ is not to be understood mereologically, for cats are complex and a cat-paw is as much a singularity as the cat to which it belongs.

The main intuition upon which C's proposal is based is the following. If the approach to plurality and singularity sketched above is on the right track, any count noun, no matter how vague, has the structure in (1), with singularities and pluralities divided 'clearly enough'. For any natural context w, the positive extension of any count noun P will differentiate the 'ones' (singularities) from the 'many' (pluralities). And no way of sharpening our criteria for being P in w can change that initial choice, for vagueness resolution only affects the entities for which P is undefined in w (i.e. P's vagueness band). In contrast with this, when it comes to ('prototypical') mass nouns, the difference between pluralities and singularities is never clearly defined. Take a single grain of rice; we readily see in it many smaller sized rice amounts; similarly for drops of water, etc. C's conjecture is that when it comes to candidates for epistemically reliable rice-atoms or rice singularities, the property of being rice is left undefined, either because there isn't a natural way of grounding rice samples into singularities, or because speakers don't care to find one. According to this proposal, the reason for the existence of mass nouns is a mix of formal/grammatical factors (how plurality, singularity and vagueness is encoded in grammar) and perceptual, and socio-ecological ones. The interaction of these factors results in putting all the rice atom candidates or water atom candidates, etc., in the vagueness band of the rice/water property.

[4] The plural property $\lambda w.CAT_W$ includes singularities in its positive extension to ensure that that sentences like *there are no cats on the mat* comes out false if there is even a single cat on the mat. The intuition that *there are cats on the mat* is either false or infelicitous if there is just one cat on the mat is generally attributed to a scalar implicature triggered by the existence of an alternative (*there is a cat on the mat*) better suited to the context at hand. Cf. e.g. Sauerland (2003), Spector (2007), Mayr (2015) for discussion and implementations.

1.2. The role of vagueness.

C tries to make the above intuition precise enough to be tested, in terms of vagueness structures of the form $<W, \propto, U_{\leq}>$, where U is a set of individuals ordered by $\leq_w$ in each world w, and $\propto$ is a partial order on the set of worlds/contexts W, such that $w \propto w'$ is to be understood as "w' is a precisification of w":

(2) $w \propto w' =_{df}$ For any (natural) property P and any u if $P_w(u)$ is defined, so is $P_{w'}(u)$ and moreover $P_w(u) = P_{w'}(u)$.

Total precisifications of w are precisifications of w in which every property is total. By definition (2), precisifications are monotonic: if w' is a precisification of w, then all of what was settled in w remains settled in the same way in w'. C defines a 'ground' context as a context that is $\propto$-minimal.[5] Intuitively, ground contexts are normal communicative situations where the criteria for having the relevant properties are sufficiently defined for successful communication, but no more. Given our limited cognitive resources there are always many different worlds that qualify as reasonable candidates for being the actual ground one. C defines furthermore an admittedly weak 'definiteness' operator *D*, useful in spelling out his proposal on mass vs count. For any world w and proposition $\lambda w'.\phi_{w'}$, $D_w\, \lambda w'.\phi_{w'}$ holds iff $\lambda w'.\phi_{w'}$ is true in every precisification of w:

(3) $D_w\, \lambda w'\phi_{w'} = \forall w'[\, w \propto w' \rightarrow \phi_{w'}]$ [abbreviated as $D\phi$]

D is what C uses to characterize the notion of 'stable atom'. A property P has stable atoms (and is, therefore, stably atomic) if for any ground context w, the $\leq$-minimal entities in P's extension remain minimal in every precisification of w.[6] The D-operator is meant to be fairly weak. A possible gloss for it, in the spirit of supervaluationism, might be 'it is fairly sure on the basis of the linguistic conventions prevailing in w that ϕ'. There are many ways of fleshing this out further in terms of your favourite way of testing conventions (from polling speaker's judgements to some other way of probing truth value

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[5] w is $\propto$-minimal $=_{df}$ $\forall w'[\, w' \propto w \rightarrow w' = w]$

[6] Here are the relevant definitions. For any natural property P,

(i) $AT(P_w)(u) =_{df} P_w(u) \wedge \forall u'[\, P_w(u') \wedge u' \leq_w u \rightarrow u' = u]$.
In prose: u is $\leq$-minimal in P at w (i.e. a P-atom in w) iff u is a $\leq$-smallest member of P's extension in w

(ii) $\mathbf{AT}(P_w)(u) =_{df} D_w\, \lambda w'.\, AT(P_{w'})(u)$
In prose: u is stably minimal in P at w (= a stable P-atom in w) iff u is $\leq$-minimal in P at every precisification of w.

For any natural property P, we only count stable P-atoms (i.e. objects in P whose atomicity ('one-ness') we are reasonably sure of on the basis of the prevailing conventions.

judgments).[7] On this view, a property is stably atomic iff we are fairly sure that it holds of singularities (even if we may be unable to identify them), which looks like a reasonable pre-condition for counting Ps. Something like "those are three cats" holds in w (i.e. $3(CAT_w)(x) = 1$) iff x is the sum of 3 distinct things that are cat-atoms in w and any precisification thereof. In contrast with this, the set of minimal entities of which a mass noun (say, *rice*) is true in a ground context (say, whole rice-grains), systematically turn out to be composed of 'smaller' Ps (rice amounts smaller than whole grains) in precisifications of w.

It is important to bear in mind (for reasons having to do with L's criticisms) that, like all modal adverbs, *surely* or *definitely* is graded. We can sensibly say things like (4a-b)

(4) a. It is fairly sure that it will rain tomorrow, but there is a slight chance that it won't
b. It is almost certain that p, but there is a remote possibility that not p

This has been known since Kratzer's (1981) seminal work on modals, and discussed in much of the subsequent literature. From this point of view, the D operator proposed by C, is certainly not the strongest conceivable one. A stronger 'definitely' operator would be, for example, one that requires ϕ to be true in (the precisifications of) every world indistinguishable from the actual one (i.e. every world that, for all we know, might be the actual one):

(5) $!D_W\, \lambda w'\phi_{w'} = \forall w'\forall w''\, [[S_W(w'') \wedge w'' \propto w'] \rightarrow \phi_{w'}]$ [abbreviated as $!D\phi$]

The S-relation in (5) is simply the similarity relation familiar from work on conditionals. The formula $S_W(w'')$ in (5) is to be interpreted as *w'' is similar to w*. According to (5), 'Definitely ϕ' is true in w iff ϕ is true in any precisification of any world similar to w. Together, D ('it is fairly sure that') and !D ('it is definitely the case that'), and their duals $P =_{df} \neg D \neg$ and $!P =_{df} \neg\, !D \neg$ are useful in capturing the graded character of our reasoning with explicit commitments to precision, as shown by the following patterns of entailment to which D and !D give rise:

(6) a. i. "It's definitely the case that ϕ" entails " It's (fairly) sure that ϕ"
(but not the other way around)
ii. $!D\phi \rightarrow D\phi$
b. i. "It's fairly sure that ϕ but there is a slight chance that not ϕ" is consistent
ii. $D\phi \wedge !P\neg\phi = D\phi \wedge \neg!D\neg\neg\phi = D\phi \wedge \neg!D\phi$
c. i. "It's definitely the case that ϕ but there is a slight chance that not ϕ" is *not* consistent
ii. $!D\phi \wedge !P\neg\phi$
d. i. "It must be the case that p" entails "it is likely that p is the case"
ii. "It is likely that p is the case but there is a slight chance that not p" is consistent

[7] An interpretation of D more in line with an epistemicist stance should also be possible if '$\propto$' is reinterpreted as ordering epistemic states.

iii. "It must be the case that p but there is a slight chance that not p" is not consistent

The paradigm in (6a-c) is fully parallel to that in (6d), familiar from Kratzer (1981), and receives a similar account under the present treatment. Notice that the addition of definition (6) to C changes nothing of his original proposal. It merely draws out the fact that talk of 'definiteness' must be properly graded, as that is relevant to some of L's criticisms.

The following characterizations of mass and count properties embody C's stance on the matter:

(7) a. With count properties we are '(reasonably) sure' of atomicity:

i. P is count = $\forall x\ [AT_{w0}(P)(x) \rightarrow D_{w0}\ \lambda w'.\ AT_{w'}(P)(x)]$,
where w_0 is understood as ranging over ground worlds.

ii. In prose: P is count iff all of its atoms are stable (= we are fairly sure that every P-sample is grounded on singularities – cf. fn. 6 for the definition of AT)

b. With mass properties we are never '(sufficiently) sure' of atomicity:

i. P is mass = $\forall x\ [AT_{w0}(P)(x) \rightarrow \exists w'\ [w_0 \propto w' \wedge \neg AT_{w'}(P)(x)]$

ii. In prose: No P-sample has stable atoms (= any P-sample in a ground context may turn out to be an aggregate of simpler P-units).[8]

2. L's criticisms.

Liebesman (2015) identifies 4 major problems for C, which we will discuss (and dispel) in turn.

2.1. The problem of the 'many'.

This is a widely discussed issue and it will be impossible to do justice to it within the limits of the present paper (for a thorough characterization of the problem, cf. Weatherson (2015) and references therein). We will stay as close as possible to L's formulation of the problem of the many and address his critique to C.

We look out into the sky and we see that it is blue and beautiful, except for one pretty cloud. But what *is* that cloud, actually? Is that little puff of white to the right part of it? And those light stripes on the top? Hmm, there are many "cloud candidates" out there… (where 'cloud-candidates' are objects – in the case at hands aggregates of water vapour- that for all we know might qualify as clouds).

The problem of the many seeks to reconcile the 'counting judgement' in (8a), with the 'parity principle' in (8b):

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[8] Definition (7b) has as a consequence that 'that H_2O molecule is water' must be false or undefined for any ground context. I think this is plausible: the term 'that H_2O molecule' is hardly part of English, and its intended referent (a particular molecule) would have none of the properties native speakers impute to water samples in a naturalistic setting.

(8) a. Counting Judgment: there is exactly one cloud in the sky.
b. Parity Principle: there is a multitude of equally good cloud candidates in the sky.

L's allegation is that C's stance is incompatible with a popular and desirable supervaluationist way of upholding both (8a) and (8b), which we will presently review.[9] My contention is that if there is a disagreement between C and supervaluationism on this matter it is not one of substance, but one of form, having to do with relatively minor differences on how to formalize (8a) and (8b).

A supervaluationist might want to say that (α) nothing out there is definitely a cloud but (β) it is 'supertrue' that there is exactly one cloud. One way of fleshing this out in the present framework is to maintain that $cloud_W(x)$ is undefined for any possible value of x in the ground context w, even though for any (total) precisification w' of w, it is true in w' that there is exactly one u that makes $cloud_{W'}(x)$ true. The witnesses for such x will be different ones in different precisifications. However, one counterintuitive consequence of this way of stating the problem is that $\exists x[cloud_W(x)]$ (i.e. *there is a cloud out there*) would come out undefined in the ground context w. But within any reasonable conception of the role of ground contexts (i.e. adopting a fairly uncontroversial characterization of what clouds are), nobody doubts for a minute that *there is a cloud in the sky* is definitely true, even if we may be unable to identify/agree on the identity of the object in question.

An approach to the problem of the many compatible with both C's approach and a supervaluationist take is to maintain that (α) is too strong (for something out there must surely be a cloud) and to render (β) as in (9i):

(9) i. $\exists x[\ D_W\lambda w'.\ cloud_{W'}(x)]$[10]
In prose: there is something that is a cloud in every precisification of w =
there is something of which we are reasonably sure that it is a cloud.
ii. $\exists x[\ !D_W\lambda w'.\ cloud_{W'}(x)]$
In prose: there is something that in every precisification of every world w' indistinguishable from the actual one is a cloud =
There is something that is definitely a cloud

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[9] One might wonder: So what if C's proposal is incompatible with a particular version of supervaluationism? The real question is whether C's proposal is right! However, C clearly engages supervaluationism and views his proposal as a development of that line of thinking, and so discussing how C's proposal might fit with a supervaluationist take on the problem of the many can be enlightening. L also claims that C's approach is incompatible with a second popular approach to the problem of the many, namely Lewis's (1993) 'counting solution'. However, figuring out whether C's take is also compatible with Lewis's, while interesting in its own right, appears to be totally orthogonal to C's stated goals.

[10] The actual rendering of 'there is exactly one cloud' would be:
(i) $\exists x\ [\mathbf{AT}(P_w)(x) \wedge \forall y\ [\mathbf{AT}(P_w)(y) \rightarrow y = x]$
Formula (i) entails (9i) in the text in virtue of the definition of **AT** (cf. fn. 6).

The truth of formula (9i) is warranted by the fact that there is surely some object in w, which has got to be a cloud-atom in every precisification of w, even if we are unable to identify such an object. The stronger formula (9ii), on the other hand, is *not* warranted, for w is indistinguishable from many other ground worlds w', w'',… in which the cloud we are looking at might be witnessed by slightly different aggregates of water vapour.

Now, L finds (9i) too strong to be compatible with supervaluationism. Is he right? Here is a relevant quote from Weatherson, who illustrates very lucidly the tenets of supervaluationism in this very connection:

> Imagine I point cloudwards and say, "That is a cloud". Intuitively, what I have said is true, even though 'cloud' is vague, and so is my demonstrative 'that'. (To see this, note that there's no determinate answer as to which of the o_i it picks out.) On different precisifications, 'that' picks out different o_i. But on every precisification it picks out the o_i that is in the extension of 'cloud', so "That is a cloud" comes out true as desired. Similarly, if I named the cloud 'Edgar', then a similar trick lets it be true that "Edgar" is vague, while "Edgar is a cloud" is **determinately true**. (Weatherson (2015) 7.3, emphasis added)

According to Weatherson, a supervaluationist would want a sentence like 'that is a cloud' to come out as 'determinately true' in the context under consideration. I.e., in the present formalism, $D_w(\lambda w'.cloud_{w'}(that))$ must hold. But since the demonstrative *that* (or the proper name *Edgar*) refers rigidly (relatively to the ground context), this is equivalent to $\lambda x[D_w(\lambda w'.cloud_{w'}(x))](that)$. Which is entails (9i), i.e. C's rendering of (β). Vagueness remains because there are of course many undistinguishable ground contexts w, w',… sufficiently similar to the actual one and many different u's such that $cloud_W(u) = cloud_{W'}(u') = \ldots 1$. To put it in slightly different terms, the proposition $\lambda w.D_w(\lambda w'.cloud_{w'}(that))$ applied to any ground world w will come out true in the above scenario, but it will be true of different objects, depending on what *that* 'hits' in w.

Thus, C's framework seems in condition of providing a formal machine explicit enough to test our intuitions about counting and (lack of) identifiability. There are other ways one might want to account for the relevant judgements. But that's just fine: regardless of the details of the present formalization, the point is that there are approaches to the problem of the many close in spirit to supervaluationism available to C, if one does not impute to the rather weak D-operator an excess of "definiteness", which was never there in the first place.

2.2. C's counts are both too precise and not precise enough.

L's second criticism is that C gets counting judgments wrong. In particular, he offers a couple of cases where they appear to be too strict. [11] I will discuss here only one of the two examples offered by L, as they are isomorphic to each other.

We are flying over a mountain chain. Below us there are two things that are definitely mountains and a third peak; it is unclear whether this third peak is a mountain

[11] The 'not strict enough' part of the allegation refers to the fact that C does not discuss sentences like "I own one and a half cars". But it is completely orthogonal to the mass count issue how to add fractions to a system of integers. If one relies on a notion of atom or singularity, one can clearly avail oneself of the notion of one half, one third, etc. of an atom/singularity.

of its own or whether it is part of one of the two uncontroversial mountains. We are invited to assume/stipulate that there is no fact of the matter that could determine whether the peak in question is a mountain or not. Consider against this scenario sentence (10a) and its semantics on C's theory in (10b):

(10) a. Three mountains are covered with snow

b. $\exists x[3(\mathbf{AT}(\text{mountains}_w))(x) \wedge \text{snow-covered}_W(x)]$

c. $\exists x\ \text{mountains}_W(x) \wedge \forall w'[\ w \propto w' \rightarrow 3(\text{mountains}_{w'})(x) \wedge \text{snow-covered}_{W'}(x)]$

L points out that (10b), which entails (10c), is expected to be 'definitely false' on C's theory, in the stipulated context, which L finds counterintuitive: in the situation at hand, we are sure that there are two snow-covered mountains, but we should retain some uncertainty as to whether there might turn out to be more than two mountains. The semantics of (10a) should come out undefined rather than false. Whence the allegation of "excess of precision".

This example is very close to one discussed in C (cf. p. 122) and in what follows I paraphrase and elucidate his proposal. [12] Consider the proposition in question, namely $\lambda w.\exists x[3(\mathbf{AT}(\text{mountains}_w))(x) \wedge \text{snow-covered}_W(x)]$. Applied to a ground context w_1 where the third peak falls in the vagueness band, the proposition in question yields indeed 'false' (because the third peak will end up in the positive extension of *mountain* in some precisifications of w_1 and in the negative extension in others). But in the scenario L is entertaining, where deciding whether the third peak is a mountain is beyond our reach, there will surely be other ground contexts w_2 quite similar to the one we are in in which the third peak falls in the positive extension of *mountain* (for it is clearly conceivable that the third peak may be a mountain after all). In such a ground context w_2, the proposition in question would turn out to be true. If the property of ground contexts that would help us settle the matter is cognitively inaccessible, there is no way for us to decide whether the proposition under discussion is true or not. By hypothesis, we are not in condition of deciding the truth-value of our proposition, in any of the stipulated ground contexts. And so we just cannot update our knowledge state directly with the proposition in question. We are stuck with conditionals of the form: if we are in a world in which the third peak is a mountain, then there are three snow-covered mountains; otherwise, there are only two.[13] Allegations of 'excess of precision' appear, therefore, to be misguided.

2.3. C's dilemma.

The texture of this third argument against C is somewhat less analytic than the previous two. L sets it up as a dilemma, which I will try to reproduce as best as I can. The first horn of the dilemma is the following. A supervaluationist would like to maintain that there are ground contexts and nouns that (i) give rise to non-zero counts and (ii) lack

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[12] With the help of one of the anonymous referees, who pointed out to me this particular way of addressing L's concerns.

[13] This idea can be developed further in a dynamic semantics framework. But doing so here would take us too far afield.

stable atoms. C denies this. Which leads to the second horn of the dilemma. Denying that (i) and (ii) hold, as C does, requires treating clouds or heaps as stable atoms, in spite of the fact that the nature of clouds or heaps is (i) not fully determined by our usage, (ii) "epistemically recalcitrant" and (iii) ultimately "metaphysically arbitrary" (L's terms). Surely, mass nouns are better off.

The key questions here can be couched, in slightly different terms, as follows: What is the difference between clouds and blood? Aren't these natural properties at least equally vague? If so, how can one maintain that vagueness plays any role in understanding the mass/count distinction?

My line of reply is that vagueness is not a night in which all cows are black. Clouds and blood are both pretty vague. But the way in which the cloud-property is vague is systematically different from the way in which the blood-property is. I lay out two simple criteria. First we have (and *must* have) clear enough intuitions about the 'one-ness' or singularity of samples of any count-property (about which we are competent).[14] There are plenty of contexts in which we are sure that there is a single table (i.e. something which is not an aggregate or set of tables) in front of us. And the same holds for heaps or clouds or lines or walls. In indefinitely many contexts, we are totally sure that there is one cloud or one heap of sand out there, and not several. With mass nouns there just is no natural context in which this is so. There is no context in which a certain blood sample is clearly and uncontroversially a minimal instance of the blood-property. This is so regardless of whether we can agree on whether the drawer is part of the table or those three grains of sand on the right of the main sand heap are part of the heap. Second, and relatedly, there are indefinitely many situations in which we are sure that there are n tables or n heaps of sand in front of us. There are no such contexts when it comes to sand *as such*, or water or blood. There can, of course, be three puddles of blood on the floor, i.e. three maximal, self-connected amounts of blood instances. But in each of those puddles, we will see many blood samples that make them up.

One might not like the way in which modern semantics deals with the one-many contrast, namely in terms of an ordering $\leq_W$ where one counts things in the positive extension of a natural property that are reliably $\leq_W$ -minimal. There certainly are many interesting metaphysical problems lurking behind such a notion. But if one adopts any variant whatsoever of such a view of singularities and pluralities, then there is little choice, it seems. The notion of heap-atom or heap-singularity has to be there. And it has to be stable enough to sustain our counting judgements, which in so many cases are totally clear.

And so C's story goes here as on the problem of the many. In presence of an uncontroversially single heap of flour on the table, there will be many different aggregates of the relevant protein that would qualify as good enough heap-singularities. This means that there are a host of epistemically undistinguishable worlds/contexts w in which the denotation of x in *heap-of-flour*$_W$*(x)* is set (slightly) differently. Still, in each precisification of each of those epistemically equivalent worlds this initial setting does

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[14] As one anonymous referee points out, if one has no clue as to what beeches are, one cannot know what it is to be one beech; if I know that beeches are trees I can at best analogize with what it is to be one tree.

not change, and this is both necessary and sufficient for ‘naturalistic’ counting. In going from flour-*heaps* to *flour*, matters change. Mass properties do not come with criteria that determine what may qualify as ‘one’ vs. ‘many’ flour(s), blood(s), etc.: the positive extension of the flour-property only includes relatively large samples of flour-candidates. And for any ground context, there are always a variety of ways of sharpening the criteria for being flour, water, rice, etc. according to which a given flour sample turns out to be an aggregate of more minimal flour instances.

Until otherwise proven, the resulting approach seems to be consistent: it has simple models (the vagueness structures laid out above). It uses conceptual tools that, in some form or other, seem really necessary to make sense of semantic composition: the plurality-singularity distinction and the idea that partiality can be used to model vagueness. And it provides an arguably natural explanation for *why* we tend to be unable/unwilling to count minimal samples of mass-properties: candidates for such minimal samples systematically fall in the vagueness band of such properties. The present approach even provides plausible reasons for why names of substances[15] tend so robustly to be mass across languages. Some of the reasons are simply perceptual: candidates for potentially minimal water samples are not accessible to perception. Some of the reasons are socio-ecological: the electromagnetic waves that might constitute smallest water samples are not very water-like and generally have socio-ecological features not particularly useful in day to day communication.

None of the above says anything about identifying things across contexts. It is a well-known fact that *any* natural property has its own problems when it comes to identifying its particular samples. There are problems of identification across contexts for any sort of entity: ships whose parts are gradually replaced, papers whose paragraphs are rewritten to address referees, recurrent earthquakes in Umbria, heaps of sands battered by the wind, and so on. Issues of identification of particulars completely cut across all sort of properties and are obviously independent of what one makes of mass vs. count.

In conclusion, there is no dilemma. Heaps and clouds are vague in ways that doesn’t impact our capacity to count them: their ‘atoms’ have got to be stable enough to sustain counting judgements; and blood and water are vague in ways that *does* affect counting. There is a fairly explicit, prima facie sound, and possibly true thesis on the ground that details how and why this is so.

2.4. Bad luck.

The fourth and final argument overtly brings metaphysics into the question of mass vs. count. As for the dilemma-argument, I can only try to reproduce L’s main point to the best of my understanding. Let us begin with a quote from L:

> Every mass noun may be such that it seems that there is no non- arbitrary way to identify its atoms. Note, though, that if this generalization holds there is a sense in which it is lucky. It is lucky because the metaphysical facts—which are not up to us!—determine that it holds. *Whether some sub- quantity of a quantity of rice has the relevant nutritional value, color, etc. to count as rice is a matter of the metaphysical nature of that sub-quantity*. (L, 3.4; emphasis added)

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[15] I use the term “substance” here in the sense familiar from much work in cognitive psychology. See, e.g., Carey (1985), Carey and Spelke (1996).

Here, L seems to state fairly unequivocally that whether something has stable atoms is a metaphysical matter: it depends on how 'the world' is. In particular, it may seem that there is no arbitrary way of identifying minimal rice samples; but in fact there may turn out to be some way of so doing. The circumstance that speakers of English are unable/unwilling to do so could be just their 'bad luck'. Even if some natural substance is 'psychologically' perceived as lacking stable atoms, we are not thereby guaranteed that such a substance has the structure required by C's theory, for that will depend on the world, not just on our psychological set up. In fact, L elaborates, there must be *possible* ground contexts where this happens, i.e. where rice is atomized as much as people and chairs, for the realm of the possible is pretty vast and we humans, in spite of our psychological limitations, can certainly conceive of states of affairs where rice is treated/conceptualized like beans. Although L's criticism doesn't quite go that far, one might even conclude that C's requirement that for *every* possible ground context mass nouns lack stable atoms is incompatible with a normal understanding of possibility and counterfactuality.

There are many difficult questions behind this criticism. I detect a couple of main points in it that can be addressed within the limits of a self contained and preliminary reply. The first concerns the metaphysical commitment of the notion of 'stable atom'; the second the notions of 'possible ground context' and counterfactuality. Let's consider them in turn.

Is it a matter of metaphysics whether noun denotations have/lack stable atoms? I wish I could have as clear intuitions on this matter as L seems to. Take John, Mary and Bill, as they are waiting outside your office to discuss their academic summer plans with you. Talking about them, we can say, 'those three students are loud', where we are regarding them as the sum of three student-atoms. But we can also use the singular noun phrase 'the group constituted by John, Mary, and Bill', or more simply, we can point to them and say 'that group is really loud', where the group in question must, at some level, be categorized as a singularity (i.e. a stable atom in its own right). The compositional semantics of language seems to distinguish between pluralities and groups and how such a distinction should be understood is a matter of much discussion. But is the contrast between groups and pluralities a matter of metaphysics? Is this, for example, what Russell had in mind in talking about 'classes as many' vs. 'classes as one'? More than appeal to intuitions is needed to address this question, it seems.

Another example. We have four pieces of chocolate in front of us. I can say 'I want that chocolate' or 'I want those four pieces of chocolate'. And this is almost always the case: we have typically the option of referring to some substance as "that chocolate, blood,…" or "those n pieces of chocolate/n quantities of blood,…". NPs like *pieces of chocolate* are count and plural. [16] On the present theory of plurality, noun phrases of this sort have to denote (stable) atoms (in any world in which they have a denotation).[17] No

[16] Following much work in syntax, I say that the constituent *pieces of chocolate* (which is part of the larger constituent *those pieces of chocolate*) is a Noun Phrase (NP), while *those pieces of chocolate* or *every piece of chocolate* is a Determiner Phrase (as it includes the determiners *that* and *every*).

[17] See, e.g., C section 5.2 for one way of analyzing these structures.

ifs or buts. This is a typical issue of semantic composition. How much metaphysical weight do we want it to carry?

The main moral one might want to draw from these simple observations is that it is not as self evident as L makes it to be that it is a metaphysical matter whether an NP denotation is mass or count. Like with many modern relationships, what one can say about the one between natural language semantics and metaphysics is that "it's complicated". These days, semantic hypotheses on how languages work are assessed on the basis of how well they account for the relevant linguistic facts, not on the basis of metaphysical intuitions.

Similar considerations apply to C's notion of "ground context", the second main target of L's fourth criticism. As is the case with accessibility relations involved in modal reasoning, "being a ground context" is a primitive notion, with some intuitive content informally specified. A possible world w constitutes a ground context if vagueness is resolved in w in as much as to give every day communication a chance, and no more. To illustrate further, observe that we tend to say things like "many people here smoke" in contexts where the vaguely specified number (or proportion) of smokers is such that (i) makes our audience understand what we mean and (ii) hopefully, will lead one to accept our statement. In ground contexts, the determiner 'many' will tend to range over numbers that are likely to be perceived as 'big enough' by the illocutionary agents. To the extent we can, we stay away from controversial borders. This is typical of ground contexts: vagueness is resolved to some extent, but with a range of possibilities left open. Similarly, when we say 'I piled the snow in one heap', we chose some standard for what constitutes a single heap of snow that hopefully won't give raise to objection. And by the very same token, one can set (and adhere to) norms for effective uses of nouns, without having to decide at all what qualifies as *one* sample or instantiation of the relevant natural property. We can happily leave candidates for singularities fall in the vagueness band (and stick to 'large enough' instantiations as our standard-setting samples). This is, however, going to prevent us from counting and pluralizing through such nouns, for the distinction relevant to counting and pluralization will remain too elusive to warrant success. So, no: in no world which is a reasonable candidate for qualifying as ground context *rice* can be atomic in the relevant sense, nor can we counterfactually imagine a ground context where that happens. That is not the kind of thing that can be discovered or imagined; it would have to be stipulated (collectively by the community of speakers).

Here is one of several possible alternatives to L's assertion that the atomic texture of a property, qua denotation of an English NP, is for metaphysics to decide. C's conditions on mass vs. count, namely (7a-b) above, are to be viewed as part of Universal Grammar (UG), as characterized within the generative enterprise (construed as broadly and ecumenically as possible). The notion of 'vague atom' has the same status that the notion of 'atom' has; and the same, of course, goes for any other semantic notion (e.g. the notion of similarity involved in counterfactual constructions, event structures, and so on and so forth). Falling within a certain semantic-grammatical category (like, plural or mass) has logical consequences. Specifically, falling within the mass or the count category has consequences that affect combining numbers with nouns, pluralisation, and other compositional processes depending on what else is happening in the grammar of particular languages (which is subject to parametric variation). Broadly speaking, semantic components of grammar can be viewed as giving rise to a natural logic, i.e. a set of natural operations and compositional/inferential schemata that grow spontaneously in humans, much like syntactic devices do).[18] This is in so far as grammar goes.

Then, there is an issue of mapping: How are natural properties, whatever they may be, grammatically categorized? How are they selected, for example, as N denotations of the mass or the count sort? Here conditions on use and various non-strictly linguistic factors enter into play. Candidates for noun denotations vary quite a bit in their make up (= there are many subtypes of common nouns and common NPs). Some natural properties come with clear enough units. *Cat* and *heap* are cases in point. Neither the cat- nor the heap-property has natural mass counterparts in the prevailing linguistic eco-system: cat-meat is not popular, and 'heap-stuff' makes little sense. Other properties (like *blood* or *flour*) do not have natural count uses.[19] C's conjecture is that this is so because reasonable candidates to the role of blood- or flour-singularity are perceptually elusive and not very blood- or flour-like, and hence speakers keep it vague whether a single red blood cell counts as blood or a single minimal protein with the appropriate structure (if there is such a thing) counts as flour in normal communicative situations (= 'ground contexts'). Yet other properties have fairly natural dual uses. *Rock* can be thought of as applying to maximal, self-connected portions of mineral aggregates ("there are three rocks over there") or as arbitrary parts thereof, non necessarily maximal ("there isn't much rock on the coast of Rimini"). By the same token, properties of things with a salient granularity can be thought of as applying to their natural grains (beans) or to any arbitrary part of their grains (rice). From this general viewpoint, one would expect fairly limited cross-linguistic variation with nouns like *heap* or *cat* (modulo, e.g., the (non) existence of cultures where cat-meat becomes a popular food) or *flour/blood* (modulo the (non) existence of cultures in which blood might come in standard servings as a drink, like tea or beer). One would expect, on the other hand, more variation when it comes to properties that can be readily conceptualized on the basis of some natural subsample or not, like, rocks or granular substances. Which is, more or less, what happens: there are no reports of systematic uses of *cat* or *heap* as mass nouns in the literature, but there is variation for granular properties et similia: *hair* is predominantly mass in English, but count in Italian, Miskito Coast Creole chooses to treat *piyz* 'bean' as mass (cf. e.g. Holm (2000, 135)), and so on.

One does not have to buy into every aspect of the view just sketched. The above remarks are meant as a way of showing that one cannot argue away a substantive linguistic hypothesis on metaphysical grounds.

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[18] For one way of spelling out the notion of 'natural logic', cf., e.g., Chierchia (2013, Ch. 1) and references therein.

[19] Of course, as is well known, mass-nouns generally admit count uses on the 'type' reading:

(a) I like only two wines: chianti and prosecco.

Also count nouns have 'type' readings:

(b) Two whales are seriously endangered: sperm whales and humpback whales.

3. Conclusions

L sees four fundamental problems with the very basics of C's proposal. He then goes on to argue that there is no way of modifying C's stance that would avoid such problems (or related ones), and gives some indications for where to look in order to find a better grounding for the mass/count distinction. We have shown here that L's concerns are misplaced: upon close scrutiny, none of his four arguments against C goes through. Therefore, at least one coherent model for a fairly explicit vagueness based theory of the mass-count distinction exists. If this is so, it follows logically that the claim "no vagueness based theory of mass vs. count is possible" is false. In fact, the above considerations suggest that a vagueness based theory can be quite explanatory in offering insight not only on why mass nouns in English do not combine directly with numerals, but also on some general trends relating to how natural properties will be coded across languages. Ultimately, this is how semantics hypotheses on the compositional systems of the languages of the world are to be assessed: how well do they account for linguistic generalizations and language variation? In the case at hand, how well does vagueness explain variants and invariants in the grammar of counting, vis-à-vis theories that posit a different source for mass vs. count? There is much work that addresses these questions we couldn't discuss here, including intriguing puzzles as to why some languages, like English, allow nouns like *furniture, footwear, jewellery* to be mass while others (like Modern Greek) don't,[20] or why some languages freely allow to say things that sound like *I found three bloods on the floor*, with any notionally mass noun.[21] And more. Explaining these paradigms stands a chance at leading to progress in our understanding of language, and a vagueness-based theory might well provide us with a useful basis for this enterprise.

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[20] Cf., e.g., Barner and Snedeker (2005) for some differences between mass nouns like *furniture* and canonical ones like *water* in English. See C, section 6.1, for an account of nouns like *furniture*.

[21] See on this topic, Darlymple and Morfu (2012), Lima (2014), Chierchia (2015), among others.

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