How to Count Situations
(Notes Towards a User's Manual)

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First Draft: May 1997 (seminar notes)
Second Draft: July 2005 (minimal clean-up)

Author's Note

These notes expand on remarks in my paper "A Minimal Theory of Adverbial Quantification" about the difficulties with counting situations. In May 1997, I talked about this topic in an MIT seminar on events co-taught with Irene Heim. These are the slightly updated class notes from that seminar. I have no new thoughts on the issues, but perhaps these notes are still useful. [References still to be added – for now I just appended an old list of references from some class notes.]

1 Situations

Following Berman and Heim, I adopted in my dissertation and in my paper "A Minimal Theory of Adverbial Quantification" the situation-based semantics proposed by Kratzer. The crucial assumptions are:

1. Sentences denote propositions.
2. Propositions are sets of situations.
3. Situations are parts of worlds.
4. Worlds are maximal situations, situations that are not a proper part of any other situation.
5. The proprositions expressed by natural language sentences are persistent: if a situation is in the proposition, then any situation it is part of is also in the proposition.
6. Any two situations can form a mereological sum that gives another situation that has the two original situation as parts (as well as anything that they have as parts).

Counting situations is made quite hard by the part-whole structure of the domain of situations (note the parallel with the semantics of mass terms). This can already be illustrated with cardinal frequency adverbs:

(1) John climbed Mt. Holyoke twice.

This sentence should obviously not be true in a world where John only climbed Mt. Holyoke once. But clearly, even if John climbed Mt. Holyoke only once, there will be many situations in which John climbed Mt. Holyoke. For example, there is the situation that contains John's climbing Mt. Holyoke and the celebratory dinner he had afterwards. To correctly count Mt. Holyoke-climbing situations, we have to get rid of all sorts of irrelevant junk. What we want is to retrieve the truth-makers[1], the situations that make the proposition that John climbed Mt. Holyoke true.

The move made by Berman and everyone else since is to count minimal situations in which John climbed Mt. Holyoke, situations that have no proper parts in which John also climbed Mt. Holyoke. The minimal situations in a set of situations, i.e. in a proposition, are those that do not have proper parts that are also in the set. They are the ones that contain just enough parts to support the proposition, they have no parts that can be removed such that the stripped down situation still supports the proposition. Berman and Heim show that this independently needed device will nicely take care of the notorious sage plant example.

But there are further problems. First, though a remark on free fusion.

2 Free Fusion

Our conception of the structure of situations is a standard mereological one.[2] Situations are parts of worlds. The usual axioms of classic mereology apply.[3] What I called mereological sum above is also called mereological fusion. With classic mereology, I assume two properties of fusion: (i) the fusion of a and b contains nothing beyond what is already in a and b, (ii) for any a and b, there always is a fusion. The first property is a definitional property of fusion.[4] David Lewis writes in his book *Parts of Classes* (1991: 73):

(2) Something is a *fusion* of some things iff it has all of them as parts and has no part that is distinct from each of them.

[1] Minimality is also appealed to in some philosophical work on "truth-makers" (Mulligan, Simons, and Smith 1984; Fox 1987). See Oliver (1996) for discussion.

[2] This section comes from my "Minimal Replies" to comments on my "Minimal" paper, especially the section replying Paul Dekker's comments. These are now all published in the volume edited by Hans Kamp and Barbara Partee.

[3] The classic references are Lesniewski (1983 [1927-1931]) and Goodman & Leonard (1940). For a recent survey, see Simons (1987).

[4] Within the wider realm of lattice theory, we can see fusion as a loaded version of the join operation. If one doesn't like mereology, there are weaker theories available.

Or we could define fusion by using the notion of overlap, see Simons (1987: 14):

(3) The mereological fusion of two individuals x and y, $x \oplus y$, is that individual which something overlaps iff it overlaps at least one of x and y.

The other central tenet of classic mereology is that any two individuals possess a fusion. Simons writes: "Since individuals may be disjoint, spatiotemporally widely separated, and of quite different kinds, this assumption is very implausible." Lewis calls this prima facie implausible tenet of mereology Unrestricted Composition and gives the following longish defense (1991: 79-81):

> I say that whenever there are some things, they have a fusion. *Whenever*! It doesn't matter how many or disparate or scattered or unrelated they are. It doesn't matter whether they are all and only the satisfiers of some description. It doesn't matter whether there is any set, or even any class, of them. [...] There is still a fusion. So I am committed to all manner of unheard-of things: trout-turkeys, fusions of individuals and classes, all the world's styrofoam, and many, many more. We are not accustomed to speak or think about such things. How is it done? Do we really have to?
>
> It is done with the greatest of ease. It is no problem to describe an unheard-of fusion. It is nothing over and above its parts, so to describe it you need only describe the parts. Describe the character of the parts, describe their interrelation, and you have *ipso facto* described the fusion. The trout-turkey in no way defies description. It is neither fish nor fowl, but it is nothing else: it is part fish and part fowl. It is neither here nor there, so where is it? – Partly here, partly there. That much we can say, and that's enough. Its character is exhausted by the character and relations of its parts.
>
> I never said, of course, that a trout-turkey is no different from an ordinary, much-heard-of thing. It is inhomogeneous, disconnected, and not in contrast with its surroundings. (Not along some of its borders.) It is not cohesive, not causallly integrated, not a causal unit in its impact on the rest of the world. It is not carved at the joints. But none of that has any bearing on whether it exists.
>
> If you wish to ignore it, of course you may. Only if you speak with your quantifiers wide open must you affirm the trout-turkey's existence. If, like most of us all the time and all of us most of the time, you quantify subject to restrictions, then you can leave it out. You can declare that there just does not exist any such thing – *except*, of course, among the things you're ignoring.

> Doing away with queer fusions by restricting composition cannot succeed, unless we do away with too much else besides. For many respects of queerness are matters of degree. But existence cannot be a matter of degree. If you say there is something that exists to a diminished degree, once you've said 'there is' your game is up. Existence is not some special distinction that befalls some of the things there are. Existence just means being one of the things there are, nothing else. The fuzzy line between less queer and more queer fusions cannot possibly coincide with the sharp edge where existence gives out and nothing lies beyond. A restriction on your quantifiers, on the other hand, may be as fuzzy as you please.[5]

[The distinction between what we admit in our ontology and what natural language quantifies over is important and should be kept in mind. These are two very different matters.]

Any a priori restriction on summation would be an unwarranted restraint on the plenitude of logical space. Thus, there is a situation that contains all and only my left earlobe, the square root of 2, and Brutus stabbing Caesar.

Paul Dekker, in comments on my "Minimal" paper, draws attention to the point that adopting mereological fusion appears incompatible with one assumption of Kratzerian situation semantics. There, worlds are defined as the maximal elements with respect to the part-whole relation. If we have free fusion however, there will only be one maximal element, the fusion of all the possible situations there are, something that fuses elements of all possible worlds into one big piece of gunk. Worlds as we know them have to be defined in a different manner. Lewis' alternative is to define worlds as the maximal sums of spatiotemporally related parts. But there may be other ways out of the tension between free fusion and the existence of separate possible worlds. We could also take worlds as primitive.

3 Minimal Worries

Do all propositions that we need to deal with have minimal situations in which they are true? Perhaps not. As pointed out to me by Angelika Kratzer (pc, in 1994 or 1995), there are in fact propositions that do not seem to have minimal situations. This is similar to what may happen in the domain of entities with mass nouns which have the subdividability property: any part of water is arguably still water. In the domain of situations, we have imperfective or atelic propositions: any running situation has a proper part which arguably is still a running situation.

[5] [Lewis' footnote:] For a fuller statement of this argument against restricting composition, see Lewis, *On the Plurality of Worlds*, pp. 212–213. For a rejoinder, see Peter van Inwagen, "When are Objects Parts?", *Philosophical Perspectives*, 1 (1987), pp. 21–47, especially pp. 40–5.

But then again, maybe not. Perhaps, we shouldn't give in. Is it really true that any part of a running situation is still a running situation?[6]

Let's assume that we can in fact assume that any proposition (expressed by natural language) has minimal situations. But then we have to recognize that even if we are lucky and end up with some very small undividable running situations, those will not be what we are counting:

(4) Often, when John runs, he wears his old tennis shoes.

Apparently, (4) counts situations in which John starts to run, runs, and stops. See Bach (1981: 74) for a similar observation.

So, we need something bigger than minimal situations, but that still excludes irrelevant, extraneous parts. In other words, we need to do two things:

(i) Eliminate irrelevant parts

(ii) Count chunks (maximal?)

4 Situations that Exemplify a Proposition

Kratzer introduces an additional notion to the toolbox: situations that exemplify a proposition (in earlier work by her, there were "situations that make a proposition true" – I forget whether the definition was the same).

(5) A situation s exemplifies a proposition p iff p is true in s, and any subsituation of s in which p is not true can be extended to a subsituation of s that is a minimal situation in which p is true.

This lets in more situations than the minimal situations in a proposition. It corresponds to the intuitive notion of excluding all situations that contain irrelevant stuff.

Situations that exemplify a proposition will still form a part-whole structure. Two situations that exemplify a proposition can always be summed to give yet another, bigger situation that exemplifies a proposition.

One might have thought that one could just take the situations that exemplify a proposition and then identify among them the maximal ones and then count those. But free fusion means that there will be only one maximal situation that exemplifies a proposition. So, nothing ever happens twice. Not true.

[6] [There should be some references here to the grain problem with mass terms and imperfective event descriptions.]

5 No Interruptions!

In my "Minimal" paper, I suggested tentatively that we want to quantify over maximally uninterrupted situations. Putting this together with what we said before, we seem to have to go through these steps:

(i) Eliminate irrelevant parts by restricting a proposition to those situations that exemplify the proposition

(ii) Identify the uninterrupted, internally coherent, situations from the first step

(iii) Single out the maximal elements in the set from the second step

So, for John's running, we would count those situations that contain only him running (step (i)) that are furthermore uninterrupted (step (ii)) and that are maximally uninterrupted (step (iii)).

Just to have a fancy looking formula:

(6) Given a proposition p (a set of situations), we count:
$\max(\mathrm{coh}(\downarrow p))$

Here, $\downarrow p$ takes p and gives us the situations that exemplify p, *coh* filters out the coherent situations, and then we get the maximal ones among those.

What do I mean by "uninterrupted" or "internally coherent"? Not just spatio-temporal contiguity. We need to be able to count two situations as separate even if they coincide in the same spatio-temporal location (the literature on events abounds with examples). So, it is necessary to also to carve up situations into parts that have some other kind of integrity or coherence. Please read the passage below from Bennett, who identifies some ways other than spatio-temporal contiguity that may matter.

6 Context-Dependency

It should be noted that especially the notion of "uninterrupted" or "internally coherent" might be very much context-dependent.[7]

Imagine that Jones sip some water from his cup, and again without putting the glas down, and then a minute later one more sips. How often did Jones sip water? Probably not once, either twice or three times, and seems up to us how we want to count. Do we count the two immediately adjacent sips as one sipping situation or not?

[7]Berman already stressed that what counts as "minimal" might depend on context. I am extending his point to our fancier system.

Now, zoom out from the scene and scan Jones' entire day. As his doctor, who has told him that he should drink a lot of water, you want to know how often during the day Jones drank water. The intutive answer now seems to be *once* (at least, it's a legitimate answer).

7 Bennett

I end these notes with a long quote from Jonathan Bennett's book *Event and their Names*, pp. 123ff., where he distinguishes between two kinds of criteria of coherence: spatiotemporal contiguity and relational coherence. On top of that he recognizes maximality.

> If a sizable region contains a fire, then it contains many: there is a fire in this bush, and in that, and in that other – the whole forest is raging. So we cannot count fires in a determinate way. To give [the] sentence ["There have been two forest fires in the state this month"] a determinate enough sense to make it worth asserting, we must take a single fire to be a *zonally maximal fire* – one that fills a fiery zone entirely surrounded by coolness. By that standard, two synchronous fires must be separated by space that is not fiery at that time; and two fires in the same place must be separated by time when that place is not fiery. Here is how, in general, to count fires: *There are n fires in zone z if and only if z contains n zones such that: something burns at each of them, and every spatiotemporal track between any two of them runs through a zone at which nothing burns.* That is a general pattern of counting uproars, traffic jams, storms, invasions, and many other kinds of event. [...]
>
> The counting of conferences, weddings, games of chess, etc. is [...] not of [the same] type [as counting fires] because here zonal separation is not part of the story. It is not *needed*, because a proper part of a conference (wedding, etc.) is not itself a conference (wedding, etc.), and sometimes it is not *present*. For example, two conferences can overlap in space-time: a roomful of people discussing philosophical logic may all be participating, there and then, in the annual conferences of the ASL and of the APA. Two chess games could coincide exactly. Have a pair of masters play two games at once, not using physical pieces, and using a code – it is easy to devise – in which each signal conveys two moves but not because one part of the signal indicates one move and the rest of it indicates the other. And, on the other hand, many events of these kinds can be temporally discontinuous: a single conference, unlike a single forest fire, can occur half last month and the rest next week.

> How, then, do we count conferences? Well, there is at least one conference in the hotel today if and only if people there relate to one another in a certain complex manner R, which has to do with overlap of interest and concern and with a relevantly shared causal history (so that R relates them not only to one another but also to things outside the hotel now). That there is a conference going on in the hotel now may follow from facts about how people are behaving and interrelating in rooms A,B, and C, and it may also follow from facts about the goings on in rooms D, E, and F. The question of whether those two trios of rooms are the scenes of different parts of one conference or of two conferences depends on how the people in one set of rooms relate to those in the other set; specifically, it depends upon whether the relation R holds across the sets of rooms as well as among the rooms within each set. In short, how many conferences a zone contains depends on *how many sets of people it contains that are closed under a certain relation R*. The broad outlines of that account apply to the counting of weddings, football games, and many other kinds of event [...].

8 Conclusion

It should be emphasized that what is happening here in a situation-based framework is not really the fault of the framework. One might have thought that using events instead of situations would evade these issues. But as Bennett shows, with events as well we need to answer the question of individuation in order to count and quantify. There is nothing special in the situation-based account, it just makes it more obvious that we have issues to address.

It would be very interesting to see further work done on this.

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