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LOCATING GUNKY WATER AND WINE

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Abstract

Can material objects be weakly located at regions of spacetime and yet fail to be exactly located anywhere? In this paper, I discuss a case which, at least according to one interpretation, answers affirmatively: the case of blending gunky water and wine, in gunky space. Perhaps after such a blend, the water and wine aren't exactly located anywhere while being weakly located at the location of the blend and any region which overlaps it. I show that the case is interesting and complicated, and has consequences for some ideas found in papers by Daniel Nolan and Josh Parsons.[1]

You and I are located at all sorts of regions of spacetime, though in different ways.[2] At the moment, I am in a very loose sense located in California, in my office, and in the hallway as I stick my arm through the door frame. And yet in a very strict sense, I am located at a region of spacetime which has the same size and shape as I do, and stands in all the same spatiotemporal relations to other objects that I do. For the moment, let's say that I am *weakly* located anywhere that is not completely free of me.[3] And let's say that I am *exactly* located at the region that is my "shadow" in substantival spacetime.[4] Now for the underlying question of the

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[2] I'll write in terms of spacetime, but for the purposes of this paper feel free to ignore this commitment. It will suffice to replace this talk with talk of spatial regions.

[3] This gloss of weak location is taken from Josh Parsons, "Theories of Location," in *Oxford Studies in Metaphysics Vol 3*, ed. Dean W. Zimmerman (Oxford: Oxford University Press, 2007).

[4] I take 'exact location' to mean what Varzi (2007) means by 'exact location', what Gilmore (2007) and Hudson (2001) mean by 'exactly occupies', what Donnelly (2010) means by 'is exactly located at', what Sattig (2006) means by 'occupies', and what Hawthorne (2008) means by 'is wholly located at'. See Achille Varzi, "Spatial Reasoning and Ontology: Parts, Wholes, and Locations," in *Handbook of Spatial Logics*, ed. Marco Aiello et al. (Dordrecht: Springer, 2007); Cody Gilmore, "Time Travel, Coinciding Objects, and Persistence," in *Oxford Studies in Metaphysics Vol 3*, ed. Dean W. Zimmerman, (Oxford: Oxford University Press, 2007); Hud Hudson, *A Materialist Metaphysics of the Human Person* (Ithaca: Cornell University Press, 2001); Maureen Donnelly, "Parthood and

paper: *is it possible for a material object to be weakly located at some regions of spacetime, and yet fail to be exactly located anywhere?* In this paper, I want to dissect a case which both Daniel Nolan and Josh Parsons discuss, whereby some gunky water is mixed with some gunky wine, in a gunky space containing only continuous regions, where an object is *gunky* just in case all of its parts have proper parts.[5] According to the case, the resulting gunky mix has an exact location, though the original substances, i.e., the gunky water and the gunky wine, fail to have exact locations while retaining weak locations post-blend. If such a case is possible, then the water and wine, for instance, fail to have exact locations while having weak locations.

You might think that this case is possible or you might think that this case is flat-out incoherent. I do not attempt to settle this dispute. However, I'll point out that *if* you think that the case is possible, it comes with a price. In particular, I'll show that you are forced to posit a costly ideology and some brute metaphysical necessities. This, of course, doesn't show that the case is impossible, but it does show that there is a price in accepting the case to be possible.

In what follows, I'll do a few things. First, I'll briefly review both the case and Nolan's important claim about it. Second, I'll introduce some formal theories of location provided by Achille Varzi and Josh Parsons, and mention why the case is *prima facie* problematic for Parsons' theory of location. Third, I'll show that given these theories of location, we do not actually possess the resources to make the claim Nolan wants to make about the case. Lastly, I'll discuss the morals of the case. The theories formulated by Varzi and Parsons are ideologically parsimonious: they only posit one primitive location relation. I'll consider one possible way of reviving Nolan's claim about the case by introducing multiple primitive location relations, but then show that this comes with a price: not only is this route ideologically costly, but we won't have enough constraint on our theory of location, unless we posit some

Multi-location," in *Oxford Studies in Metaphysics Vol 5*, ed. Dean W. Zimmerman (Oxford: Oxford University Press, 2010); Thomas Sattig, *The Language and Reality of Time* (Oxford: Clarendon Press, 2006); John Hawthorne, "Three-Dimensionalism vs. Four-Dimensionalism," in *Contemporary Debates in Metaphysics*, ed. Ted Sider, John Hawthorne, and Dean Zimmerman (Oxford: Blackwell, 2008).

[5] See Daniel Nolan, "Stoic Gunk," *Phronesis* 51(2): pg. 162–183, 2006, and Josh Parsons, "Theories of Location." As Parsons mentions in a footnote in his "Theories of Location," it should be noted that Shieva Kleinschmidt first raised this case in the context of contemporary location theories.

brute metaphysical necessities. It will then become obvious that the case isn't really problematic for Parsons' theory of location, after all.

1. Nolan on Blending

The Stoics, Chrysippus in particular, had a fascinating theory of mixture. Suppose I took a liter of water and poured it into a liter of wine. Chrysippus thought that the water and wine mix *through and through*. After I mix the two, you could take a little sample of it, as small as you'd like, and you'd find both water and wine. The blend would never bottom out. In contemporary jargon, the Stoics believed in gunk![6]

It might be best to explain the nature of this Stoic mix by first describing what sort of mix it is not. First, the water and the wine do not mix so as to be merely *juxtaposed*. The mix of water and wine is altogether different from a mix of, say, wheat and lentils. Mixes like this are such that blobs of wheat rub against blobs of lentils and, at some point, the mix bottoms out. Second, the water and wine do not mix in such a way so as to be *transformed*. After I pour the one into the other, the water and the wine do not change in substance whatsoever. Rather, mixes of water and wine are such that the water and wine mix *through and through*. We'll call these sorts of mixes *blends*.[7] Following Nolan and Parsons, we'll say that x and y are *blended* iff every subregion of the exact location of the fusion of x and y, is such that x and y are weakly located at it. The Stoic claim is that the water and wine are *blended*. For any subregion of the blend's exact location, the water and wine will be weakly located at it. In this sense, the water and wine, unlike the mix of wheat and lentils, will never bottom out.

Both classical and contemporary commentators have found this Stoic theory of mixture troubling. One of the most prevalent objections to the theory is that it seems to commit Chrysippus to positing "two bodies in the same place." One of Nolan's central tenets (Nolan "Stoic Gunk") is that Chrysippus is not, in fact, committed to the co-location of the water and wine. Nolan offers an additional explanation as to what might be going on. On this second view, the water and wine post-blend fail to have "strict"

[6] See Nolan, "Stoic Gunk," pgs. 164–172.
[7] The names of these mixes are taken from Nolan, "Stoic Gunk."

locations, while retaining "loose" locations. On this view, the water and the wine themselves are not exactly located at any region within the blend, since any region in which they might be located also contains parts of the other blended substance. Nolan (rightly) mentions that very little indeed follows from the claim that the gunky mixture itself is exactly located. Without further principles about location, very little deductively follows about the status of the gunky water and wine post-blend. Letting '*O*' denote an object like our gunky mix, and '*Q*' and '*Q*′' denote our gunky water and wine, Nolan writes:

> . . .[W]e might assign locations to only some of the objects out there – for instance, for well-behaved objects like *O*, but none for strange objects like *Q* and *Q*′. . . . *Q* and *Q*′ will not be located anywhere at all (though we may still say that they are in a loose sense, since they will retain an important connection to the place where *O* is). If we do this, then we are not forced to say that the mixed substances are in the same place – the mixture is in a specific location, true enough, but while they remain mixed the components are not in a place at all (at least in the strict sense) (Nolan "Stoic Gunk," p. 174).

It is important to see that this is not a case of juxtaposition; each region within the blend is such that both the water and wine are weakly located at it (p. 172). Chrysippus, then, is not forced to admit that the gunky water and wine are co-located; he might, in fact, claim that though the gunky blend itself has an exact location, the two gunky liquids themselves fail to have exact locations. Nolan himself doesn't take a stand on which option to take, but importantly shows that we now have (at least) two options from which to choose. If you don't like co-location, you are free to claim that the water and wine post-blend aren't exactly located anywhere.

2. Theories of Location and Stoic Gunk

Nolan discusses the above case in terms of "strict" and "loose" location, and these two notions correspond to the intuitive notions of "exact" and "weak" location I mentioned above, respectively. When we talk about location with a failure of precision, things get messy. We've already differentiated between an object's *weak* location and its *exact* location. But objects are located in spacetime in even more ways. I am *entirely* located in California but not in my office because my hand is protruding the doorframe. In

another sense, I am *pervasively located* at places that are parts of my exact location.[8] I pervade the region at which my toe is exactly located, the region at which the upper half of my body is exactly located, but I do not pervade my living room. In offering formal theories of location, Varzi and Parsons have shown how we can be much more precise about the nature of such location relations.[9] Let's say that x is located at spacetime region r in the following ways:

$x@_{o}r$	**Weak Location**
$x@_{<}r$	**Entire Location**
$x@_{>}r$	**Pervasive Location**
$x@r$	**Exact Location**

Varzi offers a theory of location (Varzi, "Spatial Reasoning and Ontology") whereby we take exact location as primitive and define the other notions in terms of it and mereology. Interestingly, Parsons has proven (Parsons, "Theories of Location") that there are (at least) two ways of defining the above location relations. In addition to the Varzi route, we can take weak location as primitive and define the other location relations in terms of it. I'll briefly review each proposal. As mentioned above, we can take '@' (exact location) to have the following intuitive gloss: x is exactly located at r iff x is the same shape and size as r and stands in all the same spatiotemporal relations as r. Let '$\leq$' express the parthood relation, let 'o' express the overlap relation,[10] and we can formulate Varzi's method of defining location relations as follows:

(1) $x@_{<}r =_{df} \exists s(x@s \wedge s \leq r)$	**Entire Location**
(2) $x@_{>}r =_{df} \exists s(x@s \wedge r \leq s)$	**Pervasive Location**
(3) $x@_{o}r =_{df} \exists s(x@s \wedge r \circ r)$	**Weak Location**

Parsons has demonstrated that this method of defining location relations entails an interesting principle: namely, everything that has a weak location has an exact location.[11] The following principle is entailed by (3):

$\exists r(x@_{o}r) \rightarrow \exists r(x@r)$ **Exactness**

[8] I take these names from Parsons, "Theories of Location."

[9] See Achille Varzi, "Spatial Reasoning and Ontology: Parts, Wholes, and Locations," Roberto Casati and Achille Varzi, *Parts and Places: The Structures of Spatial Representation* (Cambridge: MIT Press, 1999), and Josh Parsons "Theories of Location."

[10] $x \circ y =_{df} \exists z(z \leq x \wedge z \leq y)$.

[11] See Parsons, "Theories of Location," pg. 205.

Exactness commits us to answering negatively to what I called the underlying question of this paper. However, Parsons has also demonstrated that we aren't forced to take exact location as the primitive of our theory. We can also take weak location as the primitive of our theory and define the other location relations as follows:

(4) $x@_{<}r =_{df} x@_{o}r \wedge \forall s(x@_{o}s \rightarrow r \circ s)$ **Entire Location**
(5) $x@_{>}r =_{df} \forall s(r \circ s \rightarrow x@_{o}s)$ **Pervasive Location**
(6) $x@r =_{df} \forall s(r \circ s \leftrightarrow x@_{o}s)$ **Exact Location**

As Parsons notes, this method also entails an interesting principle: namely, that exact location is a function. The following principle is entailed by (6):[12]

$(x@y \wedge x@z) \rightarrow y = z$ **Functionality**

You might imagine someone thinking that one of either **Exactness** or **Functionality** is false, and in this case, such a person would be forced to reject one set (or both sets) of definitions. But Parsons thinks that **Functionality** and **Exactness** are good principles, and thereby thinks that both methods are equally good.

The Stoic gunk case, then, has important consequences for the second method of defining location relations. If we accept Nolan's second explanation (and thereby insist that the water and wine post-blend lack exact locations), we claim that the wine, post-blend, is weakly and entirely located at the exact location of the blend though not pervasively nor exactly located at the exact location of the blend. Parsons is interested in the case because it seems to count as a counterexample to **Exactness**. Parsons writes:

> A blend of water and wine is such that every subregion of the region in which the blend is exactly located contains some water and some wine . . . It follows from this that after blending, the wine is weakly located in all the regions that the blend is weakly located in, but has no exact location. The wine is so scattered and discontinuous that it will not exactly fit any of the continuous regions of Nolanian space (Parsons "Theories of Location," p. 208).

[12] More precisely, Parsons claims that (6) entails **Functionality**, together with some very basic assumptions about the overlap relation.

However, in the next section, I'll show that we don't even have the resources to formulate the case.

3. Locating the Water and Wine

In what follows, I'll show that there is something interesting about this particular counterexample to **Exactness**; namely, we don't in fact possess the resources to make Nolan's claim that the water and wine post-blend have weak but not exact locations, given these two methods of defining location relations.

For simplicity, in what follows let 'b' name the blend, let 'R_b' name the exact location of the blend, and let 'w' name the wine, post-blend. Let's take the easy case first. It should be obvious that we cannot take exact location as our primitive to define the other relations, if we want to make Nolan's claim about the case. As I mentioned above, Parsons has proven that this method entails **Exactness**, which is at odds with the claim itself that the water and wine have weak but not exact locations.[13]

So surely, you might think, we must take weak location as the primitive to make Nolan's claim. As it turns out, somewhat shockingly, the water and wine are weakly, entirely, pervasively and exactly located at the exact location of the blend, on this method. It should be obvious that the water and wine are weakly and entirely located at the location of the blend. But it is quite shocking that they turn out to be pervasively and exactly located there, as well. Here are the proofs. First, and most uncontroversially, the wine is weakly located at the exact location of the blend. We don't have a definition of weak location but it seems pretty natural to claim that it is. The intended meaning, as I've said above, is the following: w is weakly located at R_b just in case R_b is not completely free of w. Second, unsurprisingly as well, the wine is entirely located at the exact location of the blend. To say that the wine is entirely located at the exact location of the blend is just to say: $w@_o R_b \wedge (\forall s)\,(w@_o s \rightarrow R_b \circ s)$. The first conjunct is true by the first step, above. Next we show that the second conjunct is true. Recall that b is the fusion of the water and wine, and that b has an exact

[13] Hud Hudson also introduces a theory of location by taking exact location as primitive, and thus, his theory entails **Exactness**, as well. See Hud Hudson, *The Metaphysics of Hyperspace* (Oxford: Oxford University Press, 2005), pgs. 99–103. See Shieva Kleinschmidt, "Placement Permissivism and the Logics of Location," unpublished manuscript, for similar problems with taking exact location as primitive.

location, R_b. Let 'R_t' be the mereological complement of R_b; in other words, R_t is the fusion of regions disjoint from R_b. To show that $(\forall s)(w@_o s \rightarrow R_b \text{ o } s)$, suppose that there exists some region s, such that w is weakly located at it. Now, w is not weakly located at R_t (the complement of R_b) because R_t is completely free of w. Since s is discrete from R_t, s isn't a part of R_t. But every region either overlaps R_b or R_t, so it follows that s overlaps R_b, because s must overlap the complement of R_t. Thus, the wine is entirely located at the exact location of the blend. Third, surprisingly, it turns out that the wine pervades the exact location of the blend. To say that the wine pervades the exact location of the blend is to say that: $\forall s(R_b \text{ o } s \rightarrow w@_o s)$. This says that any region which overlaps R_b is a region at which the wine is weakly located. Suppose that there exists some region s which overlaps R_b. Then, by the definition of overlap, there is some x such that x is a part of both R_b and s. But recall the definition of a blend: for any subregion of R_b, it contains some water and some wine.[14] In particular, x contains some wine. Thus, s, which has x as a part, is not completely free of w, and hence is a region at which w is weakly located. Thus, the wine pervades the exact location of the blend. Fourth, surprisingly as well, it turns out that the wine is exactly located at the exact location of the blend. To say that the wine is exactly located at the exact location of the blend is to say that: $\forall s(R_b \text{ o } s \leftrightarrow w@_o s)$. But we've already proven this. We derived the right-to-left direction in the second proof and we derived the left-to-right direction in the third proof. Thus, since the wine is both entirely and pervasively located at the exact location of the blend, it follows that the wine is exactly located at the exact location of the blend. It turns out that the water and wine are co-located, after all, on this approach.

But this is quite shocking! Though we might want to make the Nolanian claim that the water and wine are weakly and entirely located, though not pervasively nor exactly located at the exact location of the blend, we simply do not possess the resources to make this claim.

4. The Price of Unlocated Stoic Gunk

On the face of it, it is perfectly coherent to make the Nolanian claim that the water and wine have weak but not exact locations.

[14] By "x contains y," I mean "y is weakly located at x."

However, given the theories of location offered in the literature, we simply fail to have the resources to make this claim. Given the theories of location mentioned above, the only way to retain the Nolanian claim (that I can think of) would be to insist that *both* weak and exact location should be taken as primitive, and insist that the blend is a legitimate metaphysical possibility. In this final section, I'll note one problem with this route.

If we take this route, we're forced to introduce multiple primitives and we're forced to start removing constraints on location, unless we introduce some brute metaphysical necessities.[15] The majority of us would rightly insist that the following case is flat-out impossible:

A. I am exactly located at region *r*, but fail to have any weak locations.

One virtue of both Varzi's and Parsons' methods is that they immediately ban cases like this. Let me briefly show how this works. Consider Case A. Suppose that I am exactly located at region *r*. On Varzi's method, this means that *r* is the same shape and size as me, and stands in all the same spatiotemporal relations as I do. And on Varzi's method, to be weakly located at some region *s* is just to have an exact location that overlaps *s*. But my exact location *r* overlaps itself, and so I am weakly located at my exact location *r*, as well, and hence have a weak location. Now, let's check Parsons' method. Suppose that I am exactly located at *r*, and name my body 'I'. For Parsons, this means that $\forall s(r \text{ o } s \leftrightarrow I@_{o}s)$. It is quite easy to see that if I have an exact location, then I have a weak location. Since $\forall s(r \text{ o } s \leftrightarrow I@_{o}s)$, let $s = r$. By the reflexivity of parthood and the definition of overlap, *r* overlaps *r*. But then it follows that $I@_{o}r$ because the biconditional must be true for all *s*. Hence, I am weakly located at *r*, too. Thus, for both Varzi's and Parsons' accounts, it is impossible for me to be exactly located at *r* and yet fail to have any weak locations. The virtue of Parsons' and Varzi's methods is that Case A is banned by the definitions of location themselves.

However, if we take *both* exact location and weak location as primitive, this case is up in the air: it's not obvious what would rule out impossible cases like (A). If we introduce a theory of location with multiple primitives, impossible cases like (A) wouldn't be

[15] Thanks to Josh Parsons for helpful discussion here.

ruled out by definitions themselves. In other words, the negation of (A) doesn't follow from logic, definitions, and mereology. Given the Varzi or Parsons method, the negation of (A) is ruled out. Given the definition of exact location in terms of weak location, the negation of (A) follows from the reflexivity of parthood, the definition of overlap, and the definition of exact location. Given the definition of weak location in terms of exact location, the negation of (A) follows from logic and the definition of weak location.[16]

Introducing a theory of location with two primitives would require introducing brute necessities to rule out problematic cases like (A). If we take two location primitives, we'd need to introduce an axiom like the following to rule out the case:

$\exists r(x@r) \rightarrow \exists r(x@_{o}r)$ **Exact-Weak**

Or: If something has an exact location, then it has a weak location. If we take the Varzi or Parsons route, as shown above, it counts as a conceptual and necessary truth that Case (A) is ruled out.

Hence, there are two overarching morals to the story. First, Parsons need not even worry about this case being a genuine counterexample to **Exactness**. For given what Parsons himself means by weak and exact location, we don't even have the resources to formulate the counterexample. Second, though Nolan has indeed shown that Chrysippus need not accept that the water and wine are co-located by insisting that they fail to have exact locations (while retaining weak locations), he is forced to introduce some brute metaphysical necessities expressed by principles like **Exact-Weak** to rule out impossible cases like (A) above. Though we are no longer forced to claim that the water and wine are co-located, we are forced to pay a price by positing such brute metaphysical necessities.

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