

THE SUPERSUBSTANTIVALIST RESPONSE TO THE ARGUMENT FROM
VAGUENESS

by

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ABSTRACT
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Unrestricted Composition is the axiom of classical extensional mereology according to which any objects, the x s, compose some y . Perhaps the most powerful argument for Unrestricted Composition is the Argument from Vagueness, which purports to secure Unrestricted Composition on the grounds of a few plausible theses about composition, vagueness, and the number of objects. Here I present Theodore Sider's (2001) formulation of the Argument from Vagueness. I show that given *supersubstantialism*—the thesis that material objects are identical to spacetime regions—we are in a position to consider the Argument from Vagueness unsound. I then consider supersubstantialist responses from Andrew Wake (2010) and Nikk Effingham (2009) and argue that both are inferior to my own.

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0 Introduction

One highly controversial axiom of classical extensional mereology is Unrestricted Composition:

Unrestricted Composition: For any objects the x s, there is some object y such that the x s compose y .

Unrestricted Composition has surprising and pretheoretically implausible consequences. For example, it follows from Unrestricted Composition that there's a further object composed of all the cats in Wisconsin and the Sun. Perhaps the most powerful argument for Unrestricted Composition is the Argument from Vagueness, first given by David Lewis (1986: 212-213) in *On the Plurality of Worlds* and forcefully articulated and defended by Theodore Sider (2001: 120-132) in *Four-Dimensionalism*.¹ Very roughly, the Argument from Vagueness goes something like this: if composition is restricted (that is, if Unrestricted Composition is false), then it may be indeterminate whether some objects compose another object. But it's never indeterminate whether some objects compose another object. So, composition is unrestricted. In §1, I present and explain Sider's formulation of the Argument from Vagueness. I then argue in §2 that proponents of *supersubstantivalism*—the thesis that material objects are identical to regions of spacetime—have the resources at their disposal to regard the Argument from Vagueness unsound. Supersubstantivalists may hold that there are instances of 'the x s compose some y ' that are neither determinately true nor determinately false and thus deny a crucial premise of Sider's argument. Two

¹ The Argument from Vagueness has generated much critical discussion. For responses to Argument from Vagueness, see Carmichael (2011), Effingham (2009), Elder (2008), Korman (2007), Markosian (1998), Nolan (2006), and Wake (2012). For a comprehensive introduction to the argument, see Korman (2010).

other authors have independently responded to the Argument from Vagueness on behalf of supersubstantialists. However, both responses are inadequate. In §3, I consider Andrew Wake's (2011) supersubstantialist response, and in §4 I consider that of Nikk Effingham (2009).

1 The Argument from Vagueness

Before we can understand Sider's formulation of the Argument from Vagueness, we need some terminological tools. Let a *case of composition* ("case", for short) be a possible situation involving some objects that have certain properties and stand in certain relations relevant to whether those objects compose. Sider (2001: 123) cites a few putative examples of such properties and relations: qualitative homogeneity, spatial proximity, unity of action, comprehensiveness of causal relations, etc. Consider two distinct cases. One case, C_1 , is the possible situation involving the subatomic particles that presently compose the Moon, related to each other in the way that they actually are at present. Suppose then that an asteroid collides with the Moon and scatters the particles that previously composed it across the galaxy. Another case, C_n , is the possible situation involving those particles, related to each other as they are when they're scattered across the galaxy. Intuitively, it seems that the particles in C_n don't compose.

We can imagine an ordered series of cases, each ever so slightly different from any case that's adjacent to it in the series. Let a *continuous series* be a series with the following features: First, every member of the series is a distinct case. Second, the series is ordered in terms of similarity: for any three distinct cases x , y , and z in the series, if x is adjacent to y and y is adjacent to z , then x is more similar (with respect to those properties and relations relevant to whether some objects compose) to y , than x is to z , and z is more

similar to y than z is to x .² Third, every member of the series is extremely similar to any case that's adjacent to it. Imagine a continuous series connecting C_1 on one end to C_n on the other. C_2 , the second case in the series (the case adjacent to C_1), is ever so slightly different from C_1 . C_3 is ever so slightly different from C_2 , and so on, all the way to C_n .

With these terminological tools in hand, we may now consider the Argument from Vagueness. Sider (2001: 123-125) formulates the argument explicitly:

- (1) If not every class has a fusion [(that is, if it's not the case that the members of every class compose)], then there must be a pair of cases connected by a continuous series such that in one, composition occurs, but in the other, composition does not occur.
- (2) In no continuous series is there a sharp cut-off in whether composition occurs.
- (3) In any case, either composition definitely occurs, or composition definitely does not occur.

From (1), (2), and (3) we are supposed to conclude that Unrestricted Composition is true.

According to (1), if not every class has a fusion, then there's a class that actually doesn't have a fusion, and thus, there's a case in which some objects don't actually compose. But presumably it's possible that some objects compose, and so, since a case is a possible situation, there's a case in which some objects compose. (Perhaps the case wherein some objects compose includes all of the same objects as the case wherein some objects don't compose; perhaps not. Nothing Sider says precludes there being a continuous series connecting a case including some objects, o_1 - o_n , to a case lacking some or all of o_1 - o_n .) Furthermore, there are presumably many other cases with varying

² The first and second features of a continuous series that I mention here are only implicit in Sider's (2001) discussion.

degrees of similarity to these two cases, so many that there's a continuous series connecting the case in which some objects compose to the case in which some objects don't compose. I take it that only mereological nihilists—those who believe that necessarily, *no* objects compose—will disagree with (1). Sider (2001: 176-180) argues against nihilism elsewhere, and for present purposes I grant that he's right to reject it.³

A sharp cut-off is a pair of adjacent cases in a continuous series, such that the objects in one member of the pair definitely compose but the objects in the other member of the pair definitely don't compose. Motivated by skepticism about metaphysical arbitrariness, (2) denies the existence of sharp cut-offs. If in some continuous series there were a sharp cut-off, the exact location of that cut-off in the series would be unacceptably arbitrary. The differences between any two cases in a continuous series may be extremely minute. For instance, the only difference between a pair of cases in the continuous series connecting C_1 - C_n might be that in one member of the pair, some particles are displaced only a fraction of a nanometer from the locations that those particles occupy in the other member of the pair. It seems implausible that such minute differences between two cases could make a difference with respect to whether some objects compose. Therefore, there's no sharp cut-off in any continuous series.⁴

³ Here I also ignore that Sider (2013) has recently defended mereological nihilism.

⁴ Proponents of at least one theory of linguistic vagueness will likely be inclined to reject (2). *Epistemicists* about vagueness like Williamson (1994) hold that every vague expression has a determinate meaning and that an expression's vagueness consists in our ignorance of what that meaning is. For example, according to epistemicists, a particular set of objects is the meaning (or, *extension*) of the vague predicate 'sand-heap': the set of heap-like objects composed of n grains or more, though we don't know what n is. Imagine a sorites series of putative candidates for heap-hood. On our far left we have a candidate with one grain of sand, and on our far right we have a candidate with one billion grains, where every member differs from any member that's adjacent to it by one grain. Epistemicism famously implies that there's a sharp cut-off in every sorites series. In our heap example, a sharp cut-off would be a pair of adjacent heap-candidates that differ by a single grain, one of which is a heap, the other of which isn't. I take it that epistemicists would grant that there's a sharp cut-off in every continuous series of cases as well.

However, showing that there are no sharp cut-offs isn't enough to show that the objects in every case of a continuous series compose. For if we admit truth value gaps, we might think that for some range of cases it's indeterminate whether the objects in each member of that range compose, just as we might think that it's indeterminate whether some things are heaps and whether some people are bald. But (3) denies that it can be indeterminate whether some objects compose.

There are roughly two ways of responding to (3). The first appeals to metaphysical, or ontic vagueness.⁵ One might think that there's no matter of fact about whether some objects compose in a given case and that there would be this indeterminacy even if our languages and concepts were completely precise. However, with Lewis (1986: 212), Sider (2001: 125) finds the notion of metaphysical vagueness unintelligible and subscribes to the linguistic theory of vagueness, the theory that vagueness is only a feature of language, thought, and concepts, not of the concrete world. Since I would like to respond to the Argument from Vagueness on Sider's own terms, I won't consider appeal to metaphysical vagueness a viable option.

The second way of responding to (3) is in keeping with the linguistic theory of vagueness, and it's this strategy that will concern us from here on out. Perhaps it's due to the vagueness of the predicates 'heap' and 'bald' that it's indeterminate whether some objects are heaps and whether some individuals are bald. Similarly, we might think that it's indeterminate whether some objects compose due to vagueness in the expression "the *xs* compose".

Since Sider rejects epistemicism, I won't consider it further, but see Sider (2001: 130-132) for an argument that even epistemicists should accept (2).

⁵ One believer in metaphysical vagueness is van Inwagen (1990). For a recent theory of metaphysical vagueness, see Barnes and Williams (2011).

However, Sider (2001: 123) tells us that the Argument from Vagueness isn't just "another sorites". Indeterminacy about the truth value of 'xs compose' would entail *count-indeterminacy*, indeterminacy about the number of objects that exist. And count-indeterminacy is implausible.

Let a *numerical sentence* be a sentence asserting only that for some finite number n , exactly n concrete objects exist. Sider (2001: 125-132) gives the following argument, which I call the Argument for the Determinacy of Composition:

(4) If in some case it were indeterminate whether some objects compose, then some numerical sentence would be indeterminate in truth value.

(5) If some numerical sentence were indeterminate in truth value, then that numerical sentence would contain a vague expression.

(6) No numerical sentence contains a vague expression.

(7) Therefore, in no case is it indeterminate whether some objects compose.

And (7) is equivalent to (3), the claim that in any case either composition definitely occurs or definitely doesn't occur.

(4) is motivated by the claim that whether the objects in a given case compose determines the number of objects in that case. Consider a case in which there are two simples and nothing else. Now consider a second case that differs from the first case in only one respect: the simples compose. In the first case there are only two objects: the two simples. In the second case there are three objects: the two simples plus their fusion, the object that the simples compose. If in a third case it were indeterminate whether the simples compose, it would be indeterminate whether there are two or three objects in that third case. Because numerical sentences assert exactly how many objects exist, both the

truth value of the numerical sentence asserting that there are exactly two objects and the truth value of the numerical sentence asserting that there are exactly three objects would be indeterminate in that third case.

(5) claims that a numerical sentence is indeterminate in truth value only if that sentence contains a vague expression. It seems that familiar claims about semantic compositionality are supposed to justify (5). The truth value of a sentence is a function of the meanings of its parts. Therefore, if the truth value of a sentence is indeterminate, then the meaning of at least one of its parts must be indeterminate as well.⁶

But (6) has it that numerical sentences don't contain vague expressions. Notice that we may express any numerical sentence using a language that's arguably free from vagueness: the vocabulary of pure first-order predicate logic with identity and the predicate 'concrete'. For example, the following formula asserts that exactly two concrete objects exist:

$$(8) \exists x \exists y [Cx \ \& \ Cy \ \& \ x \neq y \ \& \ \forall z (Cz \rightarrow (x = z \vee y = z))].$$

Sider needs to restrict the quantifiers of his numerical sentences with the concreteness predicate (C) because one might think that there are uncountably many abstract objects (like, for instance, the real numbers). If there are uncountably many abstract objects and the quantifiers of numerical sentences aren't restricted to concrete objects, then (4) will be false. There may be a case in which it's indeterminate whether some objects compose while in that case the truth value of every numerical sentence is determinate. Consider a case in which there are infinitely many abstract objects and some concrete

⁶ Sider doesn't explicitly give this argument from semantic compositionality, and I take it that not everyone will buy it. However, if (5) is false, then so much the worse for the Argument from Vagueness. Simply assuming that (5) is true for the sake of argument will serve my purposes here.

objects. Without a restriction to the concrete objects, a numerical sentence will be true in that case if and only if it asserts that there are infinitely many objects. But a numerical sentence asserting that there are infinitely many objects will be true in that case whether or not a given pair of concrete objects compose. And this is inconsistent with (4), since (4) claims that indeterminacy about whether some objects compose in a given case entails count-indeterminacy in that case.

Now, Sider (2003: 137-138) accepts a precisificational conception of vagueness: an expression *e* is vague only if *e* has multiple *precisifications*: multiple equally plausible precise meaning candidates (or perhaps, *extension* candidates).⁷ Given (5), if (8) is indeterminate in truth value, then (8) must contain a vague expression. But it seems that no expression in (8) has multiple precisifications. It's hard to see what the precisifications of the truth-functional operators or '=' could be. The concreteness predicate '*C*' doesn't seem to have precisifications either, since Sider defines it stipulatively using a list of predicates for fundamental ontological kinds: *x* is concrete if and only if *x* isn't a set, class, number, property, relation, universal, trope, possible world, or possible situation (or any other entity that your views regard abstract). And these predicates seem not to admit of borderline cases. That leaves us with the unrestricted quantifiers, and Sider (2001: 128-129) argues that they too are precise. If the unrestricted

⁷ Sider (2003: 138) holds that the precisificational conception of vagueness is consistent with many going theories of linguistic vagueness. However, just what it's supposed to be for an expression to have multiple precisifications depends on which theorist you ask. Both supervaluationists (Fine 1975, Keefe 2000) and certain nihilists about linguistic vagueness (Braun and Sider 2007) hold that no one of an expression's precisifications is that expression's unique meaning (or extension). Epistemicists (Williamson 1994) hold that every vague expression has some precisification as its unique meaning (or extension), but we don't (or can't!) know which. Others hold that which precisification an expression means (or has as its extension) is in some way a function of context (Raffman 1994, Shapiro 2008, Soames 1999) or our interests (Fara 2000). For all its plausibility, however, the precisificational conception has its critics. See Collins and Varzi (2000).

existential quantifier ‘ \exists ’ is vague, then ‘ \exists ’ has multiple precisifications, and it seems that if a quantifier has multiple precisifications, then those precisifications would have to have distinct domains. Let’s say that it’s indeterminate whether ‘ \exists ’ has as its domain d_1 or d_2 . Since d_1 and d_2 are distinct, there must be some object that’s a member of one domain but not the other. But if either d_1 or d_2 contains an object that the other doesn’t contain, then the domain lacking that object is restricted and an inadequate precisification of ‘ \exists ’, since by hypothesis, ‘ \exists ’ is unrestricted. Therefore, ‘ \exists ’ is not both vague and unrestricted.⁸

Let’s take a moment to recap by briefly summarizing the Argument from Vagueness. If composition is restricted, then there’s a continuous series connecting a case wherein some objects compose to a case wherein some objects fail to compose. There are no sharp cut-offs in any continuous series. Nor are there *vague cut-offs*: ranges of cases wherein it’s indeterminate whether the objects in each of those cases compose. For indeterminacy about whether some objects in any case compose entails count-indeterminacy in that case. But there’s no count-indeterminacy. So there’s no continuous series connecting a case wherein some objects compose to a case wherein some objects fail to compose. Composition is unrestricted.

2 Supersubstantivalism

Various philosophers, including Sider (2001: 110-114, Forthcoming: 32) himself, have been attracted to *supersubstantivalism*, the thesis that x is a material object only if x

⁸ For two more arguments that unrestricted quantifiers are precise (one of which is supposed to be a successor to the (2001) argument above), see Sider (2003).

is a region of spacetime.⁹ One consideration that proponents cite as a reason to believe that supersubstantivalism is true is its parsimony. A theory according to which material objects are numerically identical to regions is simpler than a theory according to which material objects occupy regions but are numerically distinct from the regions that they occupy. However, here I won't consider any arguments for supersubstantivalism, as here I'm just concerned to show that the supersubstantivalist has a natural response to the Argument from Vagueness in her bag.

My argument is this: supersubstantivalists are under pressure to include the monadic predicate 'is a material object' in their formulations of numerical sentences. But supersubstantivalists are also free to regard that predicate vague. It follows that supersubstantivalists are free to deny (6), the premise of the Argument for the Determinacy of Composition according to which no numerical sentence contains a vague expression. Supersubstantivalists may then regard some numerical sentences, and accordingly, some instances of 'the *x*s compose', indeterminate in truth value and deny (3). This section will proceed as follows: In §2.1 I'll argue that supersubstantivalists are committed to including a material object predicate in their formulations of numerical sentences. Then in §2.2 I'll show using an example that supersubstantivalists may intelligibly regard that material object predicate vague and blame indeterminacy of numerical sentences' truth values on that predicate. For ease of discussion, I'll henceforth assume that supersubstantivalism is true.

⁹ Though I should note that Sider (2001: 110-114) advances the conditional claim that if substantivalism (the thesis that points and spacetime regions exist) is true, then so is supersubstantivalism. Other philosophers friendly to supersubstantivalism include Field (1984), Heller (1990), Lewis (1986), and Quine (1976, 1995). See Skow (2005: 54-71) for an extended treatment. Schaffer (2009: 134) defends a stronger form of supersubstantivalism, according to which *x* is a material object *if* and only if *x* is a region of spacetime.

Before I proceed, however, a note about my commitments. The response to Sider I will put forth will be mereologically pluralist, in that on this proposal, the mereology of material objects and the mereology of spacetime pull apart. I will endorse a mereology of material objects according to which Unrestricted Composition is false, but I will endorse a mereology of spacetime regions according to which a principle analogous to Unrestricted Composition is true: Any regions the, r s, have a union.¹⁰ It follows that given any material objects, there is some region that those objects together exactly occupy. Thus, there are gerrymandered regions, all of whose subregions are occupied by material objects. Now, on supersubstantivalism, an object occupies a region if and only if the object is identical to that region. So, throw supersubstantivalism into this cocktail and the result is that all the subregions of a given region r may be identical to material objects, though r is not itself identical to a material object.

2.1 The material object predicate

Given supersubstantivalism, all material objects are spacetime regions, but not all spacetime regions are material objects.¹¹ So, it seems that ‘is a material object’ is a predicate that some spacetime regions satisfy and some spacetime regions fail to satisfy. Just as Sider was forced to include the concreteness predicate in his formulations of numerical sentences, we must include the material object predicate in our formulations of numerical sentences. It’s plausible that there are infinitely many spacetime regions. Furthermore, it’s plausible that all spacetime regions are concrete. (One plausible feature

¹⁰ To say that a region r is the union of r' and r'' is to say that r' and r'' are subregions of r , and anything else that’s a subregion of r has a subregion in common with r' or r'' .

¹¹ Here one might question the distinction between concrete objects that are also material (the material objects) and the concrete objects that aren’t also material (the regions that are not also material objects). For it might have seemed plausible that an object is concrete if and only if that object is material.

of concrete objects is that they causally interact with other concrete objects, and the results of relativistic physics seem to require that spacetime itself interacts causally with concrete objects.) But if the quantifiers of numerical sentences are allowed to range over everything that's concrete, then (4) will be false. There may be a case in which it's indeterminate whether some concrete objects compose while in that case the truth value of every numerical sentence is determinate.

Consider a case S in which there are infinitely many regions and two material simples. Suppose also that if there's any composite object in S, it's the object that the simples compose. Sider would claim that the following are correct formulations of numerical sentences and that one or the other expresses how many concrete objects exist in S:

$$(8) \exists x \exists y [Cx \ \& \ Cy \ \& \ x \neq y \ \& \ \forall z (Cz \rightarrow (x = z \vee y = z))]$$

$$(9) \exists w \exists x \exists y [Cw \ \& \ Cx \ \& \ Cy \ \& \ w \neq x \ \& \ x \neq y \ \& \ w \neq y \ \& \ \forall z (Cz \rightarrow (w = z \vee x = z \vee y = z))].$$

However, given supersubstantivalism, both (8) and (9) will be false in S. A numerical sentence will be true in S if and only if it asserts that there are infinitely many concrete objects. But a numerical sentence asserting that there are infinitely many concrete objects will be true in S whether or not our pair of material simples compose. And this is inconsistent with (4), since (4) claims that indeterminacy about whether some objects compose in a given case entails count-indeterminacy in that case.

The upshot here is that on pain of falsifying (4), we shouldn't agree that Sider has shown us the correct way to formulate numerical sentences. I suggest that we supplant (8) and (9), respectively, with the following formulas:

$$(10) \exists x \exists y [Cx \& Ox \& Cy \& Oy \& x \neq y \& \forall z ((Cz \& Oz) \rightarrow (x = z \vee y = z))]$$

$$(11) \exists w \exists x \exists y [Cw \& Ow \& Cx \& Ox \& Cy \& Oy \& w \neq x \& x \neq y \& w \neq y \& \forall z ((Cz \& Oz) \rightarrow (w = z \vee x = z \vee y = z))].$$

The only difference between (8) and (9) on one hand and (10) and (11) on the other is that the quantifiers of (10) and (11) are restricted to the material objects using the material object predicate, ‘*O*’. Neither (10) nor (11) cause trouble for (4), since indeterminacy about whether our two material simples compose *does* result in indeterminacy about whether (10) or (11) is true.

2.2 As a vague predicate

We now have the resources at our disposal to resist (3), the premise of the Argument from Vagueness according to which it can’t be indeterminate whether some objects compose. We may intelligibly regard the material object predicate vague, for we may consider it to have multiple precisifications. There are multiple sets of spacetime regions, all of which are equally plausible meaning (or extension) candidates for the material object predicate, though no one of which is that predicate’s determinate meaning (or extension). On one way of making ‘is a material object’ precise, its meaning (or extension) is a certain set of spacetime regions; on another way of making it precise, its meaning (or extension) is another set of spacetime regions. Therefore, we may hold that numerical sentences *do* include a vague expression, contra Sider’s Argument for the Determinacy of Composition.

I will illustrate how the material object predicate could be vague using an example similar to that of the two simples from the previous section. Again, suppose that there are at least two material objects—two simples—and at most three: two simples plus

their fusion. For simplicity, let's suppose, implausibly, that the only relation relevant to whether some objects compose is spatial proximity. When some objects are sufficiently close together, they compose, but when some objects are sufficiently far apart, they don't compose. Let S1 be a case in which two simples are close together, and let S5 be a case in which two simples are (relatively) far apart.

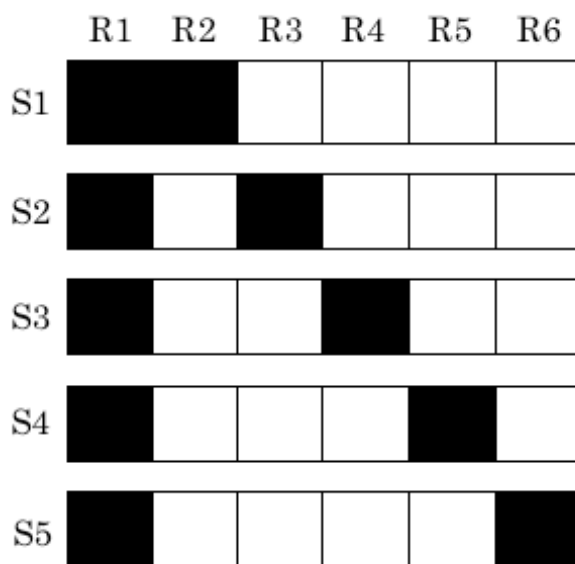


Figure 1: A continuous series connecting case S1 to case S5

Figure 1 represents a continuous series connecting S1 to S5.¹² Each square box is a spacetime region. R1 is continuous with R2; R2 is continuous with R3, and so on. Each square blackened region is a simple. Notice that a different pair of simples exists in every case. The simples in S1 are R1 and R2; the simples in S2 are R1 and R3, and so forth. The simples in S1 are touching and therefore compose a further object. Let's stipulate that the simples in S2 are close enough together that they compose as well. So,

¹² I realize that the fewer cases there are in a continuous series, the less implausible sharp cut-offs seem. After all, one might think that a natural cut-off in the series represented by Figure 1 is just the cut-off between S1 and S2! However, I take it that my strategy for dealing with the series that Figure 1 represents will generalize to more realistic examples.

in both S1 and S2, there are three objects: in each case two simples and the object the two simples compose.¹³ Let's also stipulate that the simples in both S4 and S5 are far enough apart that they don't compose. So, in both S4 and S5, there are only two objects: two simples in each case. That leaves us with the case in the middle. Suppose that it's indeterminate whether the simples in S3 compose.

With these stipulations, let's now take a look at precisifications for the objecthood predicate. Given that by hypothesis, the simples in S1 and the simples in S2 compose, the simples in S4 and the simples in S5 don't compose, and the simples in S3 neither compose nor don't compose, we may specify the precisifications of 'material object' extensionally with the following sets of regions:

$$(P1) \{R1^{S1}, R2^{S1}, (R1+R2)^{S1}, R1^{S2}, R3^{S2}, (R1+R3)^{S2}, R1^{S3}, R4^{S3}, (R1+R4)^{S3}, R1^{S4}, R5^{S4}, R1^{S5}, R6^{S5}\}$$

$$(P2) \{R1^{S1}, R2^{S1}, (R1+R2)^{S1}, R1^{S2}, R3^{S2}, (R1+R3)^{S2}, R1^{S3}, R4^{S3}, R1^{S4}, R5^{S4}, R1^{S5}, R6^{S5}\}$$

(P1) is one precisification for the predicate 'is a material object'; (P2) is another. My notation in (P1) and (P2) is a bit unusual. Where i, j , and k are variables ranging over the integers, ' $R_j^{S_i}$ ' denotes region R_j indexed to the case S_i . ' $R1^{S1}$ ' therefore denotes $R1$ in $S1$. ' $(R_j+R_k)^{S_i}$ ' denotes the region (R_j+R_k) , the region that is the union of R_j and R_k , also indexed to S_i . ' $(R1+R2)^{S1}$ ' therefore denotes the region $(R1+R2)$ in $S1$. $R1^{S1}$ is definitely a material object, since it's a member of every admissible precisification. So are $R2^{S1}$, $(R1+R2)^{S1}$, and so on. Some unions of regions are discontinuous. For example, the subregions of $(R1+R3)^{S2}$ are $R1$ and $R3$. However, $R1$ and $R3$ aren't continuous, so

¹³ Notice that since $R1$ and $R3$ are discontinuous in $S2$, my claim that there's an object in $S2$ with $R1$ and $R3$ as parts requires that I admit the existence of discontinuous regions, though this view isn't especially controversial.

the union of R1 and R3 is discontinuous. $(R1+R6)^{S5}$ is definitely not a material object since it's a member of no admissible precisification. Notice that it's indeterminate whether $(R1+R4)^{S3}$ is a material object, since $(R1+R4)^{S3}$ is a member of one but not all admissible precisifications.

Since the material object predicate is vague, sentences in which it occurs inherit its vagueness. Thus, (10) (the supersubstantialist's numerical sentence asserting that there are exactly two material objects) and (11) (the supersubstantialist's numerical sentence asserting that there are exactly three material objects) will both be indeterminate in S3. If 'material object' means (or has as its extension) (P1), then (11) will be true and (10) will be false in S3. If 'material object' means (or has as its extension) (P2), then (10) will be true and (11) will be false in S3. Since it's indeterminate whether 'material object' means (or has as its extension) (P1) or (P2), both (10) and (11) are indeterminate in S3.

Sider would have us believe that (8) and (9) are correct formulations of numerical sentences and that numerical sentences can't be indeterminate in truth-value because they contain no vague expressions. But as we've seen above, numerical sentences must contain the material object predicate. (10) and (11) do include the material object predicate. When asked to point to a vague expression in (10) and (11), there's an obvious candidate: the predicate '*O*' ('is a material object') is to blame.

3 Wake's supersubstantialist response

Andrew Wake (2011) also suggests that supersubstantialists have the resources to deny (3), the claim that it's never indeterminate whether some objects compose. However, while my strategy for responding to the Argument for the

Determinacy of Composition is to deny (6), the claim that no numerical sentence contains a vague expression, Wake's strategy is to deny (5), the claim that indeterminacy about composition entails count-indeterminacy. Wake (2011: 28) suggests that we employ the following vocabulary: 'exists', 'is a region', 'is a sub-region of', 'is a proper sub-region of', and 'is a proper part of'. And while I recommend that the supersubstantialist regard vague the monadic predicate 'material object', Wake (2010: 28) recommends that the supersubstantialist regard vague the dyadic predicate 'is a proper part of'.

Like me, Wake denies (3) and holds that with respect to our example, it may be indeterminate whether the simples in a given case compose. Given the stipulations that we made above about whether the simples in each of S1 through S5 compose, Wake would explain these facts about composition in terms of proper parthood. The simples in S1 compose, since the simples in S1 are proper parts of (R1+R2). The simples in S2 compose as well, since they're proper parts of (R1+R3). The simples in S4 aren't proper parts, and neither are the simples in S5. So neither the simples in S4 nor the simples in S5 compose. Finally, it's indeterminate whether the simples in S3 compose, since it's indeterminate whether those simples are proper parts. If the simples in S3 are proper parts, then they compose. If they're not proper parts, then they don't compose.

Unlike me, though, Wake denies (4) and contends that whether the simples in a given case compose does *not* entail count-indeterminacy in that case. According to Wake, the following numerical sentence is true in each of S1 through S5:

$$(9) \exists w \exists x \exists y [Cw \ \& \ Cx \ \& \ Cy \ \& \ w \neq x \ \& \ x \neq y \ \& \ w \neq y \ \& \\ \forall z (Cz \rightarrow (w = z \vee x = z \vee y = z))].$$

But it's not clear what Wake understands (9)'s quantifiers to range over in every case. Let's introduce a neutral term and say that those quantifiers range over the *entities* in each case. So, according to Wake there are three entities in S1 and three entities in S2: R1 and R2 are proper parts of (R1+R2) in S1, and R1 and R3 are proper parts of (R1+R3) in S2. But Wake thinks that there are three entities in S4 and three entities in S5 as well, even though no simples compose in either of those cases. In S4 neither R1 nor R5 are proper parts of any entity. Nevertheless, there's a third entity in S4: (R1+R5).¹⁴ Similarly, in S5, R1 and R6 aren't proper parts of any entity either. But there's a third entity in this case as well: (R1+R6). There are also three entities in S3 on both precisifications of the proper parthood predicate. On one precisification, R1 and R4 are proper parts of (R1+R4). On another precisification, R1 and R4 aren't proper parts of any other entity. But either way, there are three entities in S3.

Consider the cases wherein no entities compose: S4 and S5. There's supposed to be a third entity in each of these cases. (There's also supposed to be a third entity in S3 with respect to one precisification of 'proper part'.) That third entity in S4 is (R1+R5), and in S5 it's (R1+R6). (The third entity that exists in S3 with respect to one precisification is (R1+R4)^{S3}). It seems clear that the entities in S1 and S2 are all supposed to be material objects. In S1, R1 and R2 are material simples, and they're the only proper parts of (R1+R2). Similarly, in S2, R1 and R3 are material simples as well, and they're the only proper parts of (R1+R3). However, it's unclear whether Wake thinks that (R1+R5)^{S4} and (R1+R6)^{S5} are material or immaterial objects. If Wake

¹⁴ Wake (2011: 24) is also a mereological pluralist and states upfront that he rejects the following claim: Necessarily, if r is a proper subregion of r' , then r is a proper part of r' . In other words, there are pairs of regions (r, r') , such that r is a proper subregion of r' , but r isn't a proper part of r' .

understands $(R1+R5)^{S4}$ and $(R1+R6)^{S5}$ to be immaterial, presumably he understands them to be mere regions, regions that lack whatever property or properties regions have whenever they're also material objects. (Whatever we should say about $(R1+R5)^{S4}$ and $(R1+R6)^{S5}$ we should presumably also say about $(R1+R4)^{S3}$ with respect to one precisification of the proper parthood predicate.) Either way of understanding Wake's proposal leads to trouble, though, and my own supersubstantialist response is superior to both of them.

Suppose that Wake understands $(R1+R5)^{S4}$ and $(R1+R6)^{S5}$ to be material objects. Then according to Wake's view, $(R1+R5)^{S4}$ and $(R1+R6)^{S5}$ are discontinuous extended material simples, and in $S3$, one precisification of 'proper part' will have it that $(R1+R4)$ is a discontinuous extended material simple. Iterate the procedure represented in Figure 1 for displacing the simples until there's a case in which two simples are located trillions of light-years away from each other. Each of these simples is a particular region. Wake's response to the argument from vagueness would commit us to admitting the possibility of a discontinuous extended simple that is the union of these two regions. One motivation for attempting to resist the argument from vagueness is that its conclusion entails the existence of strange fusions, like the fusion of all the cats in Wisconsin and the Sun. But transgalactic material simples seem just as bizarre as the solar feline-fusions that we set out to avoid in the first place. Insofar as we're motivated to resist accepting strange fusions like these into our ontology, we should reject this first interpretation of Wake's proposal.

However, there's a second interpretation of Wake's proposal. We might think the third entity that exists in each case wherein some entities fail to compose is an immaterial

object—a mere region—rather than a region that’s also a material object. This second interpretation requires Wake to hold that for some cases in the series represented by Figure 1, the class of concrete entities that exists in those cases includes both material objects and mere regions. The entities in S1 and S2 are all material objects, and with respect to one precisification of ‘proper part’, the entities in S3 are all material objects as well. But the entities in S4 and the entities in S5 are diverse: $R1^{S4}$ and $R5^{S4}$ are material while $(R1+R5)^{S4}$ is immaterial, and $R1^{S5}$ and $R6^{S5}$ are material while $(R1+R6)^{S5}$ is immaterial. With respect to one precisification of ‘proper part’, the objects in S3 are also diverse: $R1^{S3}$ and $R4^{S3}$ are material while $(R1+R4)^{S3}$ is immaterial.

This second interpretation of Wake’s proposal has its own problems, though. Without revision, Wake’s proposal doesn’t allow him to make general claims about the *material* objects. Wake wants to say that in every case of the continuous series connecting S1 to S5, there are three objects. That is, in every case, (9) is true. If (9) is true in every case, then on my second interpretation of Wake’s proposal, in some cases (9)’s quantifiers range over a diverse bunch of objects. (9) tells us that there are exactly three concrete objects. But we may well want to know how many of those concrete objects are material. As it stands, Wake’s proposal has no way of making claims about all and only the material objects. This is a strange result. There seems to be an interesting difference between the material objects and the objects that are mere regions, and it’s unsatisfying that Wake’s proposal doesn’t countenance this difference.

In order to state precisely how many material objects exist, it seems that Wake will have to introduce a material object predicate. He then has two options: in introducing the

material object predicate he may either define it in terms of other vocabulary that he employs, or he may define it extensionally.

Wake can't define a material object predicate in terms of other vocabulary he employs, for he simply doesn't employ any suitable vocabulary. For example, Wake can't use either of the following definitions:

(*) x is a material object =df x is a proper part of some y

(**) x is a material object =df some y is a proper part of x .

(*) won't work because it doesn't recognize certain composite material objects that aren't themselves proper parts of anything. (**) is inadequate because it doesn't recognize material simples. Since the only other vocabulary that Wake (2010: 28) employs are the predicates 'exists', 'is a region', 'is a subregion of', and 'is a proper subregion of', it isn't clear how else he could try to define 'material object'.

If Wake introduces a material object predicate, he is of course free to define that predicate extensionally, just as I did when I introduced my material object predicate (of which (P1) and (P2) are precisifications). However, this way of introducing the material object predicate comes at a cost. If Wake introduces his material object predicate extensionally, it seems that he'll be unable to explain the connection between the vagueness of the material object predicate and the vagueness of 'proper part'. We saw above that Wake holds that 'proper part' is vague. But the vagueness of 'proper part' will presumably affect the number of material objects there are, *even if it doesn't affect the number of objects simpliciter*. Consider again the continuous series represented by Figure 1. According to Wake, though there are three objects in S3 on both precisifications of 'proper part', it's indeterminate whether there are two or three *material*

objects. On one precisification, all three of those objects are material. On another precisification, two of those objects are material, and the other, being a mere region, is immaterial. If Wake simply defines both ‘proper part’ and ‘material object’ extensionally, then no feature of his view will explain why the vagueness of ‘proper part’ and the vagueness of ‘material object’ are connected in this way.

I must also explain the connection between the vagueness of ‘proper part’ and the vagueness of ‘material object’, for on my view, if it’s indeterminate whether some region is a material object, then it will be indeterminate whether its subregions (if it has any) are proper parts of it. But I can easily explain this connection, since I can give the following intuitive definition of ‘proper part’:

Proper Parthood: x is a proper part of y =df x is a proper subregion of y and y is a material object.

I contend that the material object predicate is vague. Since the definiens of Proper Parthood contains ‘material object’, ‘proper part’ inherits the vagueness of ‘material object’. As a result, the claim that x is a proper part of y is indeterminate in truth value just in case it’s indeterminate whether y is a material object. For example, on my proposal, it’s indeterminate whether $R1^{S3}$ is a proper part of $(R1+R4)^{S3}$. Given Proper Parthood, to say that it’s indeterminate whether $R1^{S3}$ is a proper part of $(R1+R4)^{S3}$ is just to say that it’s indeterminate whether $R1^{S3}$ is both a proper subregion of $(R1+R4)^{S3}$ *and* that $(R1+R4)^{S3}$ is a material object. And, as we saw above, it *is* indeterminate whether $(R1+R4)^{S3}$ is a material object on my proposal. $(R1+R4)^{S3}$ is a material object on one precisification of ‘material object’, namely (P1), but not the other. Thus, it’s

indeterminate whether $R1^{S3}$ is a proper part of $(R1+R4)^{S3}$ *because* it's indeterminate whether $(R1+R4)^{S3}$ is a material object.

4 Effingham's supersubstantialist response

Nikk Effingham (2009) also has a supersubstantialist response to the Argument from Vagueness. According to Effingham, Sider is committed to a contradiction, given supersubstantialism: the affirmation and denial of the claim that all regions are concrete.

Typically, regions are all taken to be concrete or all taken to be non-concrete, but Effingham argues that insofar as one accepts both the Argument from Vagueness and supersubstantialism, one is committed to the claim that

(12) Some but not all regions are concrete.

Supersubstantialism precludes that all regions are non-concrete. If all regions are non-concrete and material objects just are spacetime regions, then material objects will also be non-concrete, which is implausible.

But it can't be that all regions are concrete either. Effingham's argument that not all regions are concrete runs exactly parallel to my own argument that we must include a material object predicate in our formulations of numerical sentences (as well as Sider's argument that his numerical sentences must include a concreteness predicate). Suppose that all regions are concrete. It's plausible that there are infinitely many regions. If so, then a numerical sentence will be true in a given case if and only if it asserts that infinitely many concrete objects exist. But then indeterminacy about whether some objects compose doesn't entail count-indeterminacy, and again we run afoul of (4).

Effingham (2009: 39) notes that one might be squeamish about (12), but then so much the worse for Sider's argument. Let's take a moment to compare my own proposal

to Effingham's. I presupposed that the supersubstantialist would either take every region to be concrete or take every region to be non-concrete, and I assumed that supersubstantialists would prefer the former. I then took the fact that accepting infinitely many concrete regions falsifies (4) to motivate restricting the quantifiers of numerical sentences. Effingham, on the other hand, takes the fact that accepting infinitely many concrete regions falsifies (4) to motivate a revisionary thesis about whether spacetime is concrete. Though I do consider it a virtue of my proposal that it isn't revisionary in this way, I will grant here that Effingham is right to say that supersubstantialists should consider some but not all regions concrete, on pain of falsifying (4).

At the same time, Effingham (2009: 40-41) thinks that given supersubstantialism, the proponent of the Argument from Vagueness is committed, against (12), to the claim that either all regions are concrete or no regions are concrete. Let a *case of concreteness* be a possible situation consisting of a region and the properties it instantiates. His argument runs exactly parallel to the Argument from Vagueness:

- (13) If not all regions are concrete (but some of them are), then there must be a pair of cases of concreteness connected by a continuous series such that in one, a region is concrete, but in the other, a region isn't concrete.
- (14) In no continuous series is there a sharp cut-off in whether a region is concrete or not.
- (15) In any case of concreteness, a region is either definitely concrete or definitely not concrete.
- (16) So, either all regions are concrete or none of them are.

Before we can appreciate this argument, we need a certain lemma:

(17) It's not the case that for any regions, the rs , if the rs are concrete, then the union of the rs is concrete.

To see why (17) is true, suppose that it's false; suppose that any concrete regions have a concrete union. Imagine again a case involving two simples. If there's any composite object in the case, it's the object that the simples compose. The simples have a union, given that the simples are identical to regions, and any regions have a union. But since the simples are concrete material objects, their union will also be concrete. Thus, there will definitely be three concrete objects whether the simples compose or not. Again, indeterminacy about whether some objects compose will fail to imply count-indeterminacy. So, in order to preserve the truth of (4), we should accept (17).

With this lemma in hand, let's now consider each of the premises of the argument in turn. Effingham explains (13) with an example:

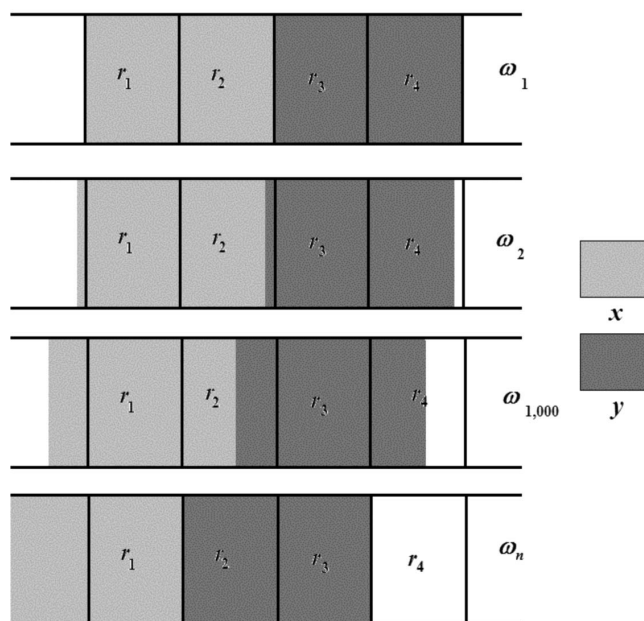


Figure 2: A continuous series connecting case w_1 to case w_n

Suppose that x and y are material objects. In case w_1 , x is identical to the union of regions r_1 and r_2 , while y is identical to the union of r_3 and r_4 . Furthermore, r_1 and r_2 are each proper parts of x , and r_3 and r_4 are each proper parts of y . Now, let R be the union of r_2 and r_3 . Assuming that composition is restricted, we can stipulate that r_2 and r_3 fail to compose. It follows that the region R isn't occupied by (i.e., isn't identical to) a material object. With our lemma (17) in place, we may also stipulate that though r_2 and r_3 are concrete, their union R isn't concrete.

Now consider continuous series of cases of concreteness. In case w_2 , x and y each occupy regions that are exceedingly similar to the regions that they occupy in w_1 : regions that have almost exactly the same subregions as the regions that they occupy in w_1 .^{15, 16} There are presumably many more cases in the series, in each of which x and y occupy exceedingly similar regions to the regions that they occupy in adjacent cases. In w_{1000} , x and y occupy regions that are quite different from the regions they occupy in w_2 . However, in w_{1000} , x and y occupy regions that are exceedingly similar to those that they occupy in both w_{999} and w_{1001} . Finally, we reach w_n , in which y occupies region R . Since, y is a concrete material object and is identical to R in w_n , R is concrete in w_n . Thus, we have a continuous series connecting a case in which a particular region is non-concrete to a case in which that region is concrete. (13) seems true.

We may be tempted to deny (14), and hold that there is a sharp cut-off in the continuous series represented by Figure 2. Claiming that there is a sharp cut-off in this

¹⁵ Note that on supersubstantialism, an object occupies a particular region if and only if that object is identical to that region. So, Effingham's example requires that we accept contingent identity. In w_1 , x occupies a particular region, the union of r_1 and r_2 , but there's a possible situation in which x occupies a distinct region. That is to say, it's possible that x is identical to a different region. So, the claim that x is identical to the union of r_1 and r_2 is contingently true in w_1 .

¹⁶ Also notice that Effingham's example requires that it's merely contingent which objects are concrete. This seems to be a somewhat strange result.

series would amount to claiming that there is some pair of cases in the series, such that a region is concrete in one member of the pair, but an exceedingly similar region is not concrete in the other member of the pair. But just as sharp cut-offs in a continuous series of cases of composition seemed implausible, so too do sharp cut-offs in the series represented by Figure 2. Precisely where the sharp cut-off occurs in the series would seem to be metaphysically arbitrary. It's unclear what could explain why the cut-off occurs at one place in the series rather than another. Furthermore, it would seem that if there were some explanation for why a sharp cut-off occurs here rather than there in a continuous series for concreteness, it's unclear why the same couldn't explain why a sharp cut-off occurs here rather than there in a continuous series for composition. Effingham (2009: 41) tells us that the only changes there are from case to case in the series represented by Figure 2 are changes in what natural properties point-sized subregions of *R* instantiate. If a region's instantiating a certain property explains why a region is definitely concrete (and thus explains a sharp cut-off with respect to concreteness), it's unclear why instantiating that property couldn't also explain why some objects compose (and thus explain a sharp cut-off with respect to composition).

One may wish to deny (15) and hold that "concrete" is vague, but then one will be forced to deny (6), the premise of the Argument for the Determinacy of Composition according to which no numerical sentence contains a vague expression. Thus, it seems that we are committed to holding that every region is concrete (or none of them are), and we have a contradiction with (12).

Yet, I think that Effingham hasn't given us a convincing response to the Argument from Vagueness. For Sider can embrace each of (13)-(15) and combine them

with the premises of his original Argument from Vagueness. The result is an argument that's exactly parallel to the Argument from Vagueness for Unrestricted Composition.

Call this the "Second Argument from Vagueness":

(18) If composition and concreteness are restricted, then there is a continuous series of cases, at one end of which composition occurs and a region is concrete, but at the other end neither composition occurs, nor is a region concrete.

(19) In no continuous series is there a sharp cut-off in whether composition occurs or in whether a region is concrete.

(20) In any case, composition either definitely occurs or definitely doesn't occur, and a region is either definitely concrete or definitely non-concrete.

(21) So, it's not the case that both composition and concreteness are restricted.

(21) is equivalent to the disjunctive thesis that

(22) Either composition is unrestricted, or concreteness is unrestricted, or both.

That is, either any concrete objects compose, or every region is concrete, or both. Before further discussing the Second Argument from Vagueness, let's note that Sider, insofar as he's a supersubstantialist, should find the following principle independently plausible:

(23) For any regions, the *rs*, the *rs* compose iff the union of the *rs* is concrete.

The left to right direction of the biconditional seems plausible for at least the following reason. The Argument from Vagueness depends on the success of the Argument for the Determinacy of Composition. According to the Argument for the Determinacy of Composition, there is no vague cut-off because indeterminacy about whether some concrete objects compose entails indeterminacy about the number of concrete objects,

and this kind of count-indeterminacy is impossible. Given supersubstantivalism, whenever some objects, the *rs*, compose, the resulting composite object will be the union of the *rs*. If the left to right direction is false and it's possible for some concrete objects to compose without the resulting composite object being concrete, then it's hard to see how indeterminacy about whether some concrete objects compose could entail count-indeterminacy. In a case where the *rs* don't compose, there are n concrete objects. But in a case where the *rs* compose and their union isn't concrete, there will also be n , rather than $n + 1$ concrete objects. If there are definitely n concrete objects whether the *rs* compose or not, indeterminacy about composition doesn't entail count-indeterminacy. (4) would again be false.

Furthermore, various authors have embraced "harmony" between the mereology of material objects and the mereology of space.¹⁷ If material objects and spacetime regions obey the same mereological principles, then (23) seems to follow, as long as we also accept the plausible principle that all material objects are concrete (and supersubstantivalism). There is no reason Sider cannot also hold that material objects and spacetime regions obey the same mereological principles, so there seems to be no reason he cannot also accept (23).

We may now see why Sider can happily accept the conclusion of the Second Argument from Vagueness in conjunction with (23). By endorsing both the Second Argument from Vagueness and (23), Sider can countenance all of the exotic and gerrymandered material objects that he would have countenanced by simply endorsing the first Argument from Vagueness. Consider the region exactly occupied by the Eiffel

¹⁷ See Schaffer (2009) and Uzquiano (2011).

Tower and the region exactly occupied by the Moon, and call these “Eiffel-region” and “Moon-region”, respectively. Eiffel-region and Moon-region have a union: there is a discontinuous region—call it “Eiffel-Moon-region”—that has as subregions Eiffel-region and Moon-region, where any subregion of Eiffel-Moon-region has a subregion in common with either Eiffel-region or Moon-region. Now, given supersubstantialism, Eiffel-region and Moon-region are identical to concrete objects: the Eiffel Tower and the Moon, respectively. Even though the Eiffel Tower and the Moon together exactly occupy Eiffel-Moon-region, we may wonder whether Eiffel-Moon-region is itself a concrete object. In other words, we may wonder whether there is a gerrymandered object that has as parts the Eiffel Tower and the Moon, where any part of that gerrymandered object overlaps with either the Eiffel Tower or the Moon.

Supplemented with (23), the Second Argument from Vagueness gives us an answer here. The left disjunct of (22)—Unrestricted Composition—implies by itself that the Eiffel Tower and the Moon compose something. The right disjunct of (22) implies that Eiffel-Moon-region is concrete. It then follows that the subregions of Eiffel-Moon-region compose it, from the right to left direction of (23) and *modus ponens*. Though the conclusion of the Second Argument from Vagueness is disjunctive, both disjuncts ensure Unrestricted Composition, given (23).

Anyone who wishes to deny both disjuncts of (22) must face the premises of the Second Argument from Vagueness. It’s unclear how Effingham could respond to these premises, since he rejects no premise of Sider’s original Argument from Vagueness, and the Second Argument from Vagueness includes his own argument for unrestricted concreteness. I conclude that Effingham hasn’t successfully responded to Sider, since

Sider can embrace Effingham's argument for unrestricted concreteness. Sider can then combine that argument with his original Argument from Vagueness for Unrestricted Composition, and together with (23), achieve the same ontology of concrete objects that one might have thought he did in the first place.

5 Conclusion

As Wake (2010: 35) and Effingham (2009: 42) correctly point out, the fact that supersubstantialists have the resources to respond to the Argument from Vagueness may strike some as one reason to endorse supersubstantialism. Moreover, because supersubstantialists can and should deny a premise of the Argument from Vagueness, Sider's argument for Unrestricted Composition is in tension with other claims he makes in *Four-Dimensionalism*. After all, Sider (2001: 110-114) is friendly to supersubstantialism there. Furthermore, I take it that my proposal suggests a general strategy for rejecting a premise of Sider's argument: find some precise expression in terms of which to state the precisifications of 'material object'. We may then consider 'material object' to be a vague predicate and hold that there are vague cut-offs in a continuous series (i.e., hold that there are instances of 'the *x*s compose' that are neither determinately true nor determinately false). If we find a suitable expression in terms of which to state the precisifications of 'material object', we're in a position to regard the argument from vagueness "just another sorites". As we've seen above, supersubstantialists are in this position.

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