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Slots in Universals

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Abstract: Slot theory, as I use the term, is the view that (i) there exist such entities as *argument places*, or ‘slots’, in universals, and that (ii) a universal u is n-adic if and only if there are n slots in u. I argue that those who take properties and relations to be abundant, fine-grained, non-set-theoretical entities face pressure to be slot theorists. I note that slots permit a natural account of the notion of adicy. I then consider a series of ‘slot-free’ accounts of that notion and argue that each of them has significant drawbacks.

1. Introduction

I am attracted to a pair of theses about universals. One of them is popular, though controversial. The other is rarely discussed, so its popularity is hard to gauge. The popular thesis is

> **Platonism**: Properties and relations are abstract (non-spatiotemporal) entities and are not sets or ordered sequences. They are abundant, in the sense that almost[1] every open sentence expresses one, and they are hyperintensionally individuated, in the sense that necessarily equivalent properties and relations are sometimes non-identical. (<u>Being a triangle</u> ≠ <u>being a trilateral</u>.) There are haecceitistic properties and relations (<u>being Socrates</u> and <u>being introduced to Socrates by</u>), there are uninstantiated properties and relations (<u>being a golden mountain</u> and <u>having given a golden mountain to</u>), and there are necessarily uninstantiated properties and relations (<u>being a round square</u> and <u>being both larger and smaller than</u>).[2]

The other thesis is

> **Slot Theory**: There are such things as argument places, or ‘slots’, in universals; in particular, for any universal u and number n, u is n-adic if and only if there are n slots in

[1] ‘Almost’ to avoid a commitment to such universals as <u>being a thing that does not instantiate itself</u>.
[2] See, e.g., van Inwagen (2006) for a defense of this view. van Inwagen uses ‘platonism’ for the weaker thesis that there are some abstract objects. However, he argues not merely for that weak view but also for the stronger view that I am calling ‘Platonism’. Other Platonists (give or take a bit) include Bealer (1982), Carmichael (2009), Horwich (1998), Jubien (1997 and 2009), Menzel (1993), Wetzel (2009), and Zalta (1988).

u. Slots are presumably *abstract* entities, and they are perhaps *ontologically dependent upon the universals that host them*, but this does not entail that *there are no such things*.[3]

In this chapter I note that slots are invoked by a natural account of the notion of the *adicy* of a universal: for a universal to be n-adic just is for it to have exactly n slots in it. I then consider a series of 'slot-free' accounts of adicy and argue that each of them has significant drawbacks, at least given a sufficiently abundant ontology of hyperintensionally individuated universals. For those of us who accept such a theory of universals, this is a prima facie motivation for realism about slots.

My goal, then, is limited: it's to show that slot theory has a certain virtue, one that has so far gone unmentioned and perhaps unnoticed. I do not try to tally up all the virtues and vices of slot theory and argue that former outweigh the latter.

The plan is as follows. In Section 2 I briefly discuss a direct argument for slots, along the lines of familiar arguments for numbers, properties, holes, fictional characters, and so on. Section 3, which constitutes the bulk of the paper, develops a less direct argument: it presents an account of adicy in terms of slots and goes on it criticize the ten most natural slot-free accounts. Section 4 responds to an objection to slot theory – namely, that it's in tension with the existence of multigrade universals.

2. Explicit quantification over slots

Here is one very simple and direct route to slot theory. In discourse about properties and relations, we often speak as if we believed in slots. We might say that there are three argument places in the relation of being between, two argument places in the relation of loving, and just one in the property of roundness. On its face, such talk is ontologically committing. The relevant sentences seem to express propositions that entail that slots exist. Cast as an argument, the thought goes like this:

[3] Many philosophers apparently find slot theory natural and put it to work in a larger theoretical apparatus, though typically without stopping to spell out the adverse effects of rejecting slots. See my (forthcoming), Jeffrey King (2007: 41), Thomas McKay (2006: 13), Andrew Newman (2002: 148), Byeong-Uk Yi (1999: 168 ff.), Chris Swoyer (1998: 302), David Armstrong (1997: 121), Christopher Menzel (1993: 82), Edward Zalta (1988: 52), Timothy Williamson (1985: 257), and especially Mark Crimmins (1992: 99-140) and Reinhardt Grossmann (1983: 200), (1992: 57). (Crimmins accepts both slots – which he calls 'arguments' – in universals, and associated entities that he calls 'roles' in propositions.)

In 'Propositions: what they are and how they mean' (1956: 286, originally published in 1919) Russell speaks of positions in facts, and in 'Compound Thoughts' (1984: 398-399, originally published in 1923), Frege speaks of positions in senses. Paul Horwich (1998: 91) speaks of positions in *propositional structures* (which he apparently takes to be *sui generis* abstract entities). Linda Wetzel (2009: 134) accepts even such *sui generis* abstract entities as *places in flag types* (e.g., the position in the flag type Old Glory occupied by the third red stripe from the bottom).

(1) There are three slots in the relation of being between.

(2) Therefore, there are slots.

Thus, at first glance, we have an analogy between an argument for slots on the one hand and familiar arguments for numbers, properties, holes, and fictional characters, on the other.

Numbers	Properties	Holes	Fictional Characters
There are prime numbers.	There are properties that you and I share.	There are remarkably many holes in this piece [of Gruyere] (Lewis and Lewis 1970: 206).	There are characters in some nineteenth century novels who are presented with a greater wealth of physical detail than is any character in any eighteenth-century novel (van Inwagen 2001: 43).
Therefore, there are numbers (Schaffer 2009: 357)	Therefore, there are properties. (Schaffer 2009: 358)	Therefore, there are holes.	Therefore, there are characters.

As far as I am aware, however, no one has advanced an argument of this sort for slots. A frequent assumption, I suspect, is that any apparent commitment to slots can be 'paraphrased away' much more easily than can commitment to holes, fictional characters, and the like.

The opponent of slots can say that what's obvious is not that (1) is *true*, but rather that it's 'in the vicinity' of a truth, and that it's better-with-respect-to-truth than such sentences as

(3) There is exactly one slot in the relation of being between;

1 at least gestures in the direction of a truth, whereas (3) does not even do that. In particular, the opponent of slots can say that (1), though false, gestures in the direction of

(1*) The relation of being between is triadic,

which is true (and does not entail (2)), whereas (3) gestures in the direction of

(3*) The relation of being between is monadic,

which is also false. Thus one can respect the Moorean fact that (1) is better than (3) without incurring any commitment to (2) or existence of slots. Further, it's hard to see what is lost when the friend of universals drops ontically-loaded slot-talk in favor of ontically-less-loaded adicy talk. When we do indulge in slot-talk, its only purpose seems to be that of specifying – in a picturesque and perhaps metaphorical way – the adicy of universals. This suggests that any Moorean truths that can be expressed or gestured toward by sentences that explicitly quantify over slots can also be expressed by sentences that use adicy predicates and do not explicitly quantify over slots. So, anyway, the opponent of slots will be inclined to argue. (Presumably the arguments for numbers, properties, holes, and fictional characters cannot be dealt with quite so easily, since satisfying paraphrases of their premises are harder to formulate.)

3. Accounts of Adicy

The above argument for slots takes, as its starting point, a sentence that explicitly quantifies over slots. This limits its appeal. There are Platonists who are antecedently skeptical of slots and who exhibit no tendency to accept such sentences in the first place. Other things being equal, a better strategy would be to start with something closer to the core of Platonism, acceptable even to skeptics about slots, and argue that this generates pressure toward slots.

I think that certain facts about adicy fit the bill. Some universals are monadic, others are dyadic, still others are triadic, and so on. These and related facts lie at the heart of any form of realism about universals, not merely the Platonist's extreme realism.[4] What is it for a universal to be, say, dyadic? As I mentioned earlier, the slot theorist will find it natural to answer: for a universal u to be dyadic is for there to be exactly two slots in u and, more generally, for a universal u to be n-adic for there to be exactly n slots in u.

If we could show that this is the *best* answer to the question, we would have a promising new argument for slot theory. I won't attempt anything so ambitious. What I will do is argue that the leading slot-free answers have some significant – and heretofore unmentioned – drawbacks, which the slot theorist's answer avoids. I leave the weighing of costs and benefits to others.

3.1 First slot-free account: fundamental one-place adicy predicates

One can give an account of something without giving an analysis. Accordingly, the first slot-free account takes 'is dyadic' to be a primitive one-place predicate that expresses a fundamental, unanalyzable property, <u>being dyadic</u>. Parallel treatment is given to 'is monadic', 'is triadic', and so on.

[4] Thanks to Ted Sider for suggesting that I frame the issue this way.

This avoids any commitment to slots, but it faces three problems.[5] First, it leads to an unwelcome inflation of our ideology. We get a new fundamental adicy predicate for each number that specifies the adicy of a universal. Second, it apparently prevents us from offering any explanation of the fact that necessarily, for any universal u, if u is monadic then it is not dyadic. Without an analysis of the relevant properties, we seem forced to accept all such incompatibility facts as brute.

Third, the present account makes it a complete mystery why our *predicates* for adicy properties incorporate number prefixes such as 'mon', 'dy', 'tri' and so on. To borrow some language from Sider (which he uses in the context of making a different point), the prefix 'dy' would be *semantically inert* in 'dyadic', "like the occurrence of 'nine' in 'canine'" (2009: 389-90). Given the fundamentality and unanalyzability of the relevant properties, we might just as well have coined a bunch of syntactically simple predicates ('blorgs', 'fooms', 'kibs', . . .) for those properties! Relatedly, in the case of certain apparent truths about adicy that are not simple ascriptions of determinate adicy properties, the present account leaves us with no way even to *express* these truths. For example:

(4) The number that specifies the adicy of loving is greater than the number that specifies the adicy of being triangular.

(5) The number that specifies the adicy of loving is equal to the number of characters in the paper 'Holes'.

(6) For any u, x, and n, if x is an ordered n-tuple and x instantiates u, then u is n-adic.

(7) For any u, x, and n, if x is an ordered n-tuple and there is an atomic proposition that predicates u of the 1^{st} item in x, . . ., and the nth item in x, in that order, then u is n-adic.

The fundamental language of the first account includes one-place predicates for determinate adicies ('is monadic', 'is dyadic', . . .). Thus it can be used to formulate sentences like 'if u is monadic, then it is not dyadic'. But that language does not include any two-place predicate such as '__ specifies the adicy of . . .' or '. . . is __-adic' that are satisfied by ordered pairs whose members are universals and numbers. And there doesn't appear to be any satisfactory way to define these predicates in terms of the fundamental language of the first account. Thus the first account is left with no way to express (4) – (7). Perhaps the friend of the first account can bite the bullet on (4) and (5). They may not seem especially fundamental, and they don't obviously do work in a Platonist theory of universals. But (6) and (7) do seem relatively fundamental and most

[5] These three problems are analogous to those facing the corresponding account of perforatedness properties in Lewis and Lewis (1970).

Platonists presumably will see them as doing work in a theory of universals. At least in some cases, the reason why there is no proposition that predicates a certain universal u of some things in a certain order, is that *the adicy of the universal rules it out*. To make this style of explanation explicit, we need (7) and its association of numbers with adicy properties. I suspect that similar remarks apply to (6).

The slot theorist has none of these problems. Concerning the first, his account invokes just one distinctively 'adicy-related' piece of fundamental ideology: the two-place predicate 'is a slot in'. Each one-place adicy predicate gets defined in terms of 'is a slot in' together with further general purpose fundamental ideology that everyone already employs: 'u is monadic' gets defined as 'there is exactly one slot in u', 'u is dyadic' as 'there are exactly two slots in u' and, more generally, 'u is n-adic' as 'there are exactly n slots in u'. (Alternatively, the slot theorist might define 'u is n-adic' as 'n numbers the slots in u' or as 'n is the cardinality of the set {x: x is a slot in u}'.) Concerning the *second* problem, the slot theorist sees each of the relevant 'incompatibility facts' as an instance of the following general schema, already accepted by everyone on independent grounds:

> necessarily, for any u, any n, and any n*, if n≠n*, then if there are exactly n entities that R u, it's not the case that there are exactly n* entities that R u.

Finally, concerning the third problem, the number prefixes in 'monadic', 'dyadic', etc., are obviously not semantically inert for the slot theorist; rather, they have the same numerical content in those words as they do elsewhere. And the slot theorist's language, with its fundamental 'is a slot in' predicate, permits natural definitions of '__ specifies the adicy of . . .' and '. . . is __-adic', which allow him to express (6) and (7) more or less as written.

3.2 Second slot-free account: a primitive two-place 'specifies-the-adicy-of' predicate

A second strategy for the opponent of slots is to take '__ specifies the adicy of . . .' or '. . . is __-adic' as primitive and fundamental, rather than as being analyzed in terms of 'is a slot in'. Again we avoid any commitment to slots, and this time we economize on fundamental adicy predicates, making do with just one ('__ specifies the adicy of . . .') where the first account required a great many ('is monadic', 'is dyadic', 'is triadic', . . .). Moreover, the friend of the second account can express (4) – (7) in his fundamental language just as easily as the slot theorist can. The key feature of those sentences is just that they use a two-place adicy predicate expressing a relation that holds between universals and numbers. The second account is tailor-made for these sentences. This account faces two potential problems of its own, however.

3.2.1 First problem: brute facts

Advocates of the second account will apparently be forced to take it as a brute fact that

(8) necessarily $\forall x \forall y \forall z$[(x specifies the adicy of z and y specifies the adicy of z) $\rightarrow$ x=y]

and that

(9) necessarily $\forall x \forall y$[x specifies the adicy of y $\rightarrow$ x is a cardinal number].

According to (8), nothing can have its adicy specified by more than one thing. (Or, if you like, nothing can bear the adicifying relation to more than one thing.) According to (9), the only entities that can specify the adicies of things are cardinal numbers. (In other words, nothing can bear the adicifying relation to anything but a cardinal number.) Thus, while there might be a universal whose adicy is specified by 6 or even $\aleph_0$, there couldn't be a universal whose adicy is specified by 2.5, π, or the Eiffel Tower.

If, as the slot theorist is free to claim, the adicy of a universal is just the number of slots in the universal, then (8) and (9) are easy to explain. In speaking of the number of slots in a universal, we are speaking of the cardinality of the set of those slots, and it is *independently* known that, necessarily, each set has only one cardinality (thus explaining (8)), and that, necessarily, only cardinal numbers can be cardinalities of sets (thus explaining (9)).[6] Everyone –

[6] Alternatively, the slot theorist is free to avoid talk of sets and instead paraphrase 'there are two slots in loving' in plural terms, as '2 numbers the slots in loving'. In that case, he could explain (8) by appeal to the general principle that (8*) necessarily, for any y, any z, and any X, if y numbers X and z numbers X, then y=z, and he could explain (9) by appeal to the general principle that (9*) necessarily, for any y and any X, if y numbers X, then y is a cardinal number.

Raul Saucedo has suggested a potential counterexample to this latter principle, (9*). Yesterday I ran exactly 1.5 miles. So 1.5 numbers the miles that I ran yesterday. But 1.5 is not a cardinal number. In response, I want to suggest that the sentence

(R) 1.5 numbers the miles that I ran yesterday

is either false or irrelevant to (9*). On a reading that makes it relevant to (9*), (R) entails

(R.1) $\exists X$ [1.5 numbers X & the miles that I ran yesterday = X],

where '=' expresses plural identity. But (R.1) is implausible. Surely it is not the case that there are some things such that 1.5 numbers them. (If 1.5 numbers them, then there is more than one of them, but fewer than two of them. If there is more than one of them, then

(R.2) $\exists x_1 \exists x_2$[x_1 is one of them & x_2 is one of them & $x_1 \neq x_2$],

but if there are fewer than two of them, then

(R.3) $\neg \exists x_1 \exists x_2$[$x_1$ is one of them & x_2 is one of them & $x_1 \neq x_2$],

which contradicts (R.2). There may be a reading on which (R) is true, but on such a reading (R) is just a stilted variant of 'I ran 1.5 miles yesterday', which, I take it, attributes a certain determinate length property, denoted by '1.5 miles' to my run. So understood, it does not entail (R.1) or generate a counterexample to (9*).

slot theorists and their opponents alike – *already* accepts these latter necessities, so, although they may be brute, the slot theorist is at no disadvantage vis-à-vis his opponent in appealing to them.

On the other hand, if ‘specifies the adicy of’ is fundamental and sentences like ‘2 specifies the adicy of loving’ incur no commitment to slots, then the foregoing explanation is no longer available. Why then *couldn’t* more than one thing specify the adicy of a given universal?[7] And why *couldn’t* the Eiffel Tower or π specify the adicy of a universal? As far as I can tell, the friend of the second account strategy has no answer, and must take the facts in question as rock-bottom, admitting of no explanation at all. Whereas the slot theorist derives (8) and (9) from necessities that everyone already accepts, the opponent of slots (if he opts for the second account) sees (8) and (9) as *additional* brute necessities. This is not an automatic disqualification, but surely it is a vice.

Objection. True, the slot theorist can explain (8) and (9) whereas the friend of the second account must take them as brute. But presumably the slot theorist must posit brute necessities of his own governing ‘is a slot in’. For example:

(10) necessarily $\forall x \forall y[x \text{ is a slot in } y \rightarrow \neg\, y \text{ is a slot in } x]$ Asymmetry of slot-in

So it hasn’t been shown that the friend of the second account is any worse off with regard to positing brute necessities than is the slot theorist.

Reply. In the end this objection may be correct. But there are two points in response to it that deserve to be aired.

First point. For what it’s worth, there are a number of other arguments to which a very similar objection can be made. Consider a ‘van Inwagen-esque’ argument for fictional characters. van Inwagen considers the sentence

(11) there are characters in some nineteenth century novels who are presented with a greater wealth of physical detail than is any character in any eighteenth-century novel (2001: 43),

which, taken at face value, is committed to characters. He then notes that one might paraphrase away this commitment by introducing a primitive two-place predicate, ‘dwelphs’, that is satisfied by an ordered ⟨x, y⟩ pair just in case: x and y are classes of novels and, as we might intuitively put

[7] It is no answer to say that ‘specifies the adicy of’ is properly symbolized as a functor rather a predicate. True, if we opted for this, then our formalization of ‘If x specifies the adicy of z and y specifies the adicy of z then x=y’ would be a logical truth (it would be ‘[x=adicy(z) & y=adicy(z)] → x=y’), but what justifies the assumption that ‘specifies the adicy of’ is properly symbolized as a functor? This seems just to presuppose, rather to explain, the fact in question. Moreover, the ‘functor’ suggestion leaves (9) untouched.

it, ‘there are characters in some member of x who are presented with a greater wealth of physical detail than is any character in any member of y’, so that

(12) the class of nineteenth century novels dwelphs the class of eighteenth century novels

turns out to be necessarily equivalent to (11) but is understood in such a way that it does not entail that there are characters. So far, so good for the opponent of characters. But regardless of whether one accepts characters, one will agree that the relation of dwelphing is transitive:

(13) Necessarily, for any x, y, and z, if x dwelphs y and y dwelphs z, then x dwelphs z.[8]

If one rejects characters and takes ‘dwelphs’ as primitive, one will see (13) as a brute fact. If on the other hand one is a realist about characters and defines ‘dwelphs’ in terms of them in the natural way, then one can derive (13) from logic plus the transitivity of being-presented-with-a-greater-wealth-of-physical-detail-than, which is independently plausible. This would seem to speak in favor of realism about characters.

However, just as the realist about slots has her primitive ‘is a slot in’ predicate, governed by certain brute facts such as the Asymmetry of slot-in, the realist about characters has his own primitive predicate. For van Inwagen, it’s the three-place ‘ - - - is ascribed to ___ in . . .’, which he takes to be satisfied only by ordered ⟨property, character, work-of-fiction-or-part-of-a-work-of-fiction⟩ triples. And this predicate is, no doubt, governed by its own group of unexplained necessary truths. So the realist about characters, like the realist about slots, avoids brute necessities in one place only by positing them in another. Perhaps this point undermines both arguments. But perhaps there is room to claim that certain principles are more appropriately taken as brute than others.

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[8] van Inwagen himself does not discuss (13). Instead, he claims that

(11*) every female character in any eighteenth-century novel is such that there is some character in some nineteenth-century novel who is presented with a greater wealth of physical detail than she is (2001: 46)

is a logical consequence of (11) and argues that the anti-realist about characters who takes ‘dwelphs’ as primitive will be unable to explain this fact. An analogous argument for slots runs as follows. Start with the apparent truth that

(A1) there are exactly two slots in the relation expressed by ‘is one of’,

which the friend of the second account will paraphrase as

(A2) 2 specifies the adicy of the relation expressed by ‘is one of’.

Then note that

(A3) if only one of the slots in the relation expressed by ‘is one of’ is singular, then there is a slot in the relation expressed by ‘is one of’ that is not singular.

is a logical consequence of (A1), and argue that if we take ‘specifies the adicy of’ as primitive and paraphrase (A1) as (A2) we cannot explain this fact.

Second point. In a very different vein, the slot theorist might try to argue that the fundamental relation expressed by ‘is a slot in’, and the brute principles governing it, are things that we already have reason to accept, even apart from considerations about universals and their adicies. In that case, though the principles would be brute, the slot theorist would be at no disadvantage vis-à-vis her opponent in positing them, whereas the *opponent* of slots in universals *would* be at a disadvantage when he takes (8) and (9) as brute.

What might be the independent motivation for accepting such a fundamental relation and its associated principles? Here’s the idea. First, one might think that holes (e.g., holes in pieces of cheese) can neither be eliminated nor reduced to more familiar entities, such as material ‘hole-lining’ objects or regions of space or spacetime. (See Casati and Varzi 1994.) In that case, one is likely to take the predicate ‘is a hole in’ as a primitive that expresses a fundamental relation holding between holes and their hosts. Second, one might take this relation to be *topic-neutral*, much like identity and – according to some – parthood. (The identity relation that material objects bear to themselves is the same as the identity relation that abstract objects bear to themselves; the fundamental part-whole relation that holds between my hand and my body is the same, some say, as the fundamental part-whole that holds (a) between the property <u>being a hydrogen atom</u> and the property <u>being a methane molecule</u> and (b) between the semantic content of ‘John’ and the semantic content of ‘John loves Mary’.) Third, on grounds of parsimony, one might simply identify the fundamental relation expressed by ‘is a slot in’ with the fundamental relation expressed by ‘is a hole in’. A less misleading predicate for such a topic neutral relation would be ‘is hosted by’. (Similar language is already used by Casati and Varzi 1994.) When a ‘hosted’ entity is hosted by a concrete particular, we call it a hole (or a depression, indentation, crack, tunnel, etc.). When a hosted entity is hosted by a universal or concept, we call it a slot (argument place, argument position, etc.). But the fundamental relation between hosted entity and host is the same in both cases. Or so one might be tempted to claim.

In any event, this would open up the possibility that the slot theorist’s crucial relation, and the bruteness of the principles governing its behavior, are independently motivated and therefore do not count against slot theory in the way that the bruteness of (8) and (9) would count against the second slot-free account of adicy.

3.2.2 Second problem: ungrounded numeric adicy facts

Here is a second problem for the proposal that ‘__ specifies the adicy of . . .’ is primitive and fundamental. Presumably, any adicy fact about a given universal should be grounded in non-numeric facts about that universal, facts that are not about numbers.[9] [10] The slot theorist can respect this. Admittedly, the slot theorist does say that the property being dyadic is a numeric property: it is the property <u>λx[2 is the cardinality of {y: y is a slot in x}]</u>, that is, the property <u>being an x such that 2 is the cardinality of the set of slots in x</u>.[11] This directly involves the number 2. Hence any atomic fact to the effect that a certain universal is dyadic will itself be a fact about a number. However, any such fact will be grounded in a fact that is not about any number. For example, the slot theorist will say that

(F1) the fact that loving is an x such that 2 is the cardinality of the set of slots in x

which is about the number 2, is grounded in

(F2) the fact that loving is an x such that $\exists y \exists z[y$ is a slot in x & z is a slot in x & $y \neq z$ & $\forall w[w$ is a slot in x $\rightarrow (w=y \vee w=z)]]$,[12]

which is not about 2 or any number. The friend of the second account has no comparable story to tell. He will posit

(F3) the fact that loving is an x such that 2 specifies the adicy of x,

which is a numeric fact about the number 2. But given that <u>specifying the adicy of</u> is taken as fundamental and unanalyzable, it's hard to see what non-numeric fact about loving might ground (F3).

3.3 Third slot-free account: define 'specifies the adicy of' in terms of a non-distributive instantiation predicate

So let us consider a third slot-free account of adicy. As with account two, we employ the predicate 'specifies the adicy of', but now, instead of taking it as primitive and fundamental, we define it. An initial thought is that 'n specifies the adicy of u' means something like 'u can be instantiated by n things'. If we treat 'instantiate' as a non-distributive predicate, we can sharpen this suggestion with the following definition:

(D0) x specifies the adicy of y =df. y is a universal[13] & $\forall Z[Z$ instantiates y $\rightarrow$ x numbers Z].

[9] Together, perhaps, with general principles that are not about the universal in question.
[10] Thanks to Ted Sider for this point.
[11] Alternatively, the slot theorist may say that it is the property <u>being an x such that 2 numbers the slots in x</u>.
[12] Together, perhaps, with general principles, not about loving, that link non-set-theoretical, non-numerical, purely quantificational claims (like those in (F2)) to set-theoretical and/or numerical claims (like those in (F1)).

The idea is that for one entity, n, to be the adicy of another, u, is for u to be a universal that is instantiated only by 'n-membered pluralities'. Thus redness has 1 as its adicy because, for any Z, if they instantiate redness then 1 numbers them (there is exactly one of them); and being taller than has 2 as its adicy because, for any Z, if they instantiate it then 2 numbers them (there are exactly two of them).[14]

One obvious problem for (D0) arises from non-asymmetric dyadic relations, such as identity (symmetric) and being at least as tall as (non-symmetric). Identity is dyadic but is only ever instantiated by *one*-membered 'pluralities'. Being at least as tall as is dyadic but is in some cases instantiated by two-membered pluralities, in other cases by one-membered pluralities. It is in part because of examples like these that we speak of an n-adic universal as being instantiated by an *ordered n-tuple of entities* or, alternatively, by some entities *in a given order* (where the order is 'of length n'). This suggests a natural improvement on the third account.

3.4 Fourth slot-free account: define 'n is the adicy of u' as 'u is instantiated only by n-tuples'

Again we define 'specifies the adicy of' partly in terms of 'instantiates', but now we eliminate the plural quantifier and variable and treat 'instantiates' as a distributive predicate that is satisfied only by ordered ⟨ordered -tuple, universal⟩ pairs, and we appeal to another two-place predicate, '. . . is an ordered ___-tuple', understood as being satisfied only by ⟨ordered n-tuple s, positive integer n⟩ pairs:

(D1) x specifies the adicy of y =df. y is a universal & ∀z[z instantiates y → z is an ordered x-tuple].[15]

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[13] Without this clause, (D0) would count any non-universal (e.g., this computer) as having everything as its adicy. Nothing instantiates this computer and, *a fortiori*, nothing instantiates this computer *that is not a seven-membered plurality*.

[14] Here 'instantiates' needs to understood in such a way that 'a instantiates u' and 'b instantiates u' do not jointly entail 'a and b instantiate u'. Otherwise redness (D0) would fail to count redness as monadic, given that that stop sign instantiates it, this book instantiates it, and that stop sign ≠ this book. Likewise 'instantiates' needs to be understood in such a way that (ii) 'a and b instantiate u' entails neither 'a instantiates u' nor 'b instantiates u'. Otherwise (D0) would fail to count being taller than as dyadic.

[15] Those who wish to avoid talk of n-adic universals being instantiated by *n-tuples* can replace (D1) with

(D1*) x is the adicy of y =df. y is a universal & ∀w∀Z[Z instantiate y in order w → w is of length x],

provided that they are able to make sense of the somewhat mysterious-sounding predicates involved. Intuitively, the thought underlying (D1) is that instantiation might be a three-place relation that can hold

Again we get the result that 1 specifies the adicy of redness, since redness is instantiated only by 1-tuples, and that 2 specifies the adicy of being taller than, since it is instantiated only by 2-tuples. But now identity is correctly classified as dyadic, since it is instantiated only by 2-tuples. Likewise for being at least as tall as.

Whatever its virtues may be, this strategy obviously has limited appeal. In particular, it will be rejected by those who believe that there are *uninstantiated* universals, such as the relation having given a golden mountain to (or R, for short). Intuitively, the only entity that specifies the adicy of R is the number two: R is dyadic. According to (D1), however, R has *everything* as its adicy. After all, nothing instantiates R, and so it is vacuously true that every x is such that, for any z, either z does not instantiate R or z is an x-tuple. Of course this poses no problem for those (e.g., Armstrong 1997) who reject uninstantiated universals, but the rest of us will want to find an alternative to (D1).

3.5 Fifth slot-free account: define 'n specifies the adicy of u' as 'u *can* be instantiated only by n-tuples'

One potential fix is to say that what it is for a universal u to be n-adic is for u to be such that, not merely in fact, but as a matter of necessity, the only things that instantiate it are n-tuples. This gives us:

(D2) x specifies the adicy of y =df. y is a universal and necessarily, for any z, if z instantiates y, then z is an x-tuple.

The uninstantiated dyadic relation R is no problem for (D2). For R is a universal, and although it is in fact uninstantiated, it is not necessarily so: it is possible for someone to have been given a golden mountain by someone. Moreover, it is plausible that the number 2 is the one and only entity that satisfies the open sentence 'necessarily, for any z, if z instantiates R then z is an x-tuple'. For it is possible that there be an ordered pair that instantiates R, and it is natural to think that is not possible that there be anything *other* than an ordered pair that instantiates R. In that case (D2) yields the intuitively correct result that 2 is the one and only entity that R has as its adicy. (D2) does face an obvious problem, however.

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between (i) some things, (ii) an n-adic universal, and (iii) an entity – call it an 'order' – that *specifies an order of length n in which the given things can be 'taken'*. Thus a given plurality, say, the surviving Beatles, might instantiate loving in w but not in order w*, where w specifies that Ringo comes first, Paul second, and w* specifies that Paul comes first, Ringo second. Orders will need to bear some 'length' relation to entities, and presumably it will need to turn out that (a) if w is an order, then w bears the length relation to exactly one thing, and that (b) if w bears the length relation to y, then y is a cardinal number.

Just as (D1) falters on the case of uninstant*iated* universals whose adicies are specified by exactly one entity, (D2) falters on the case of uninstant*iable* universals whose adicies are specified exactly one entity. Here I have in mind things like the monadic property <u>being both round and square</u> or the dyadic relation <u>being both larger and smaller than</u>. Since these are necessarily uninstantiated, (D2) tells us that they have everything as their adicy. But this is incorrect: there are many things, such as the number 12 and the Eiffel Tower, that do not specify the adicy of either of the universals mentioned above.[16]

There is a further problem for (D2) that arises even if there are no uninstantiable universals. Consider the fact, concerning a given universal u and number n, that u cannot be instantiated by anything other than n-tuples. This is a de re modal fact about u. Prima facie, it may seem desirable to treat the de re modal facts about universals as being *grounded* in non-modal facts about those universals. In particular, some may have found it plausible that the modal fact that u cannot be instantiated by anything other than n-tuples is grounded in (among other things, perhaps) the non-modal fact that u is n-adic. That is, it may seem plausible that the given modal fact obtains *because* u is n-adic. According to (D2), however, the fact that u is n-adic *just is* the given de re modal fact, and so cannot ground it. In somewhat different terms, if adicy facts are metaphysically prior to de re modal facts about instantiation, then the former cannot simply be defined as a species of the latter. Call this the 'priority problem'.

(Consider an analogy. Suppose that one thinks that a certain statue, Goliath, cannot survive being squashed. Further, suppose that Goliath cannot survive being squashed *because* Goliath is a statue. In that case one must not define 'is a statue' as 'is a thing that cannot survive being squashed'.)

3.6 Sixth slot-free account: adicies of uninstantiable universals explained by appeal to facts about the universals in terms of which they are analyzed

One might claim that uninstantiable universals are always *analyzable* in terms of instantiable universals. One might then suggest that the facts about the adicy of an instantiable universal can be explained by appeal to something like (D2), and that the facts about the adicy of an

[16] There is a second objection against (D2) that deserve a brief mention, though I do not endorse it. Just as one might say that some universals have certain of their *causal powers* accidentally, one might wish to hold that some universals have even their *adicies* accidentally. Thus, e.g., one might say that there is a universal U that is in fact dyadic but that could be triadic (and instantiated). (D2) rules this out. For if U could be triadic and instantiated, then presumably it could be instantiated by a 3-tuple. But in that case U is not *necessarily* such that the only things that instantiate it are 2-tuples, and hence (D2) denies that U is in fact dyadic. Of course, this objection disappears if (as most philosophers seem to think, and as I tend to agree) universals have their adicies essentially.

uninstantiable universal u can be explained by appeal to facts about the adicies of the instantiable universals in terms of which it is analyzed, together with facts about the *manner* in which those universals are combined in u.[17]

Consider the uninstantiable universal being both round and square. It is natural to think that this universal results from applying a certain logical operation, call it *conjunction*, to two instantiable universals, namely being round and being square.[18] Since being round is instantiable, the present strategy tells us that the facts about its adicy can be explained by appeal to (D2); and since being round can be instantiated by 1-tuples only, (D2) tells us that 1 is the adicy of being round. Likewise for being square. Finally, it is presumably a truth about the conjunction operation that for any x, any y, and any z, if y is monadic, z is monadic, and x=conjunction(y, z), then x is itself monadic.[19] This yields the desired result: being both round and square is monadic.[20] Of

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[17] Alternatively, rather than applying (D2) directly to any instantiable universal, one might prefer to apply it only to 'simple' or unanalyzable universals (which according to the present suggestion will all be instantiable). The variant proposal suffers from the same problems that I raise for the fifth strategy, plus one further problem of its own: it fails if all universals are analyzable into further universals (a possibility that some philosophers – notably Armstrong – have been unwilling to rule out).

[18] The basic conjunction operation is often regarded as one that takes in an m-adic universal U and an n-adic universal U* as arguments and yields an m+n-adic universal U** as value. See Menzel (1993), Swoyer (1998), and note 19. Accordingly, in the main text, when I use the term 'conjunction', I do not refer to that basic operation, but rather to one that takes being round and being square as arguments and yields being both round and square as value.

[19] Menzel (1993) develops a formal language that uses lambda abstracts as singular terms that refer to properties, relations, and propositions (PRPs): thus '[λx(x is round)]' is a singular term, in the same grammatical category as 'John', that refers to being red, '[λx(x is round & x is square)]' is a singular term that refers to being both round and square, etc. In sketching the semantics for this language, Menzel employs notions for various logical operations – e.g., reflection, conjunction – by means of which PRPs can be 'combined'. In the closely related terminology of Swoyer (1998: 303), the $\text{reflection}_{1,2}$ operation takes in an n-adic universal ($n \geq 2$) U as argument and yields an n-1 adic universal U* as value, where, intuitively, U* is what results from 'identifying the first and second argument places of U'. To illustrate, being self-identical is the $\text{reflection}_{1,2}$ of identity: [λx(x=x)]=$\text{reflection}_{1,2}$([λxy(x=y)]). The conjunction operation takes in an m-adic universal U and an n-adic universal U* as arguments and yields and yields an m+n-adic universal U** as value. The dyadic relation being an x and a y such that x is red and y is blue is the conjunction of being red and being blue: [λxy(x is red & y is blue)]=conjunction([λx(x is red)], [λx(x is blue)]). With these notions in hand, we can say, first, that [λx(x is round & x is square)]=$\text{reflection}_{1,2}$([λxy(x is round & y is square)]), and second, that [λxy(x is round & y is square)]=conjunction([λx(x is round)], [λx(x is square)]). Hence we get the result that [λx(x is round & x is square)]=$\text{reflection}_{1,2}$(conjunction([λx(x is round)], [λx(x is square)])). Since, for any x, y, z, if y is 1-adic, z is 1-adic, and x=$\text{reflection}_{1,2}$(conjunction(y, z)), x is 1-adic, and since [λx(x is round)] and [λx(x is square)] are both 1-adic (according to (D2)), we get the result that [λx(x is round & x is square)] is 1-adic too. Menzel's and Swoyer's treatment of the given operations is based on that of Bealer (1982). Bealer mentions some analogies between his operations and the predicate functors discussed by Quine (1995, originally published in 1960).

[20] One way to make this line of thought a bit more precise and general is via the following trio, the first two of which are definitions and the third of which is a definition schema:

(D3.1) x specifies is the **adicy** of y =df. either (i) y is an uninstantiable universal and x specifies the adicy_u of y or (ii) y is an instantiable universal and x is the adicy_i of y.

(D3.2) x is the **adicy_i** of y =df. (i) y is instantiable and (ii) necessarily, for any z, if z instantiates y, then z is an x-tuple.

course, no help has been offered with the priority problem that afflicts the simple, purely modal approach of the previous strategy. But the sixth account also generates three additional complaints. (We should also note that so far, sixth account merely gestures in the direction of a definition of 'is the adicy of', rather than actually giving one.)

First, the sixth account strikes me as being analogous to the definition of 'is red' as 'is either scarlet or crimson or . . .'. To oversimplify, the sixth account says something like this:

> for a universal u to be such that its adicy is specified by (say) the number 2 is for either (i) u to be instantiable but only by 2-tuples, or (ii) u to result from applying operation o_1 to a universal of type A, or (iii) u to result from applying operation o_2 to a pair of universals of types B and C, or (iv) u to result from applying operation o_3 to a universal of type D, or . . . .

I find both definitions implausible, and for similar reasons. Just as redness is intuitively a relatively simple property (unlike the property of <u>being either scarlet or crimson or . . .</u>), adicy seems relatively simple as well – in any case it seems much simpler than the sixth account makes it.

Second, it is preferable, other things being equal, to give a fully *uniform* account of adicy, rather than making its definition into a disjunctive affair, with a modal part that applies to instantiable universals, and a very different non-modal part that applies to uninstantiable universals. After all, <u>being dyadic</u> is, I take it, a relatively natural, non-gerrymandered, non-disjunctive property of universals: when two universals both have the given property, they will genuinely *resemble* each other in at least one respect, even if one of them is instantiable and the other is not. A disjunctive definition such as the one suggested above makes a mystery out of this evident fact.

(D3.3) x is the **adicy$_u$** of y =df. (i) y is uninstantiable and (ii) ______ ,
where the blank will be filled in roughly as follows:

> There is an n-tuple of instantiable universals $\langle u_1, \ldots, u_n \rangle$ of adicies$_i$ $a(u_1), \ldots, a(u_n)$ respectively, and either
>
> - y is formed by performing operation $\mathbf{o_1}$ on the given universals in the given order and x results from performing operation $\mathbf{o^*_1}$ to $\langle a(u_1), \ldots, a(u_n) \rangle$, or
> - y is formed by performing operation $\mathbf{o_2}$ on the given universals in the given order and x results from performing $\mathbf{o^*_2}$ on $\langle a(u_1), \ldots, a(u_n) \rangle$, or . . .

The basic idea, of course, is just that (D2) works for instantiable universals and that some other account can be given for the uninstantiable ones.

Third, it is unclear how much weight we (as lovers of abundant, hyperintensionally individuated universals) should be willing to rest on the hope that all uninstantiable universals are analyzable. True, no one has produced a very persuasive *example* of an uninstantiable universal that appears to be unanalyzable,[21] but the non-existence of such universals is not the only plausible explanation for this. One might think, e.g., that the only universals that we can grasp or refer to are (i) those whose instances have affected us, or (ii) those that are sufficiently similar to the universals in group (i) as to be graspable by something like ‘extrapolation’, or (iii) those that are analyzed in terms of the universals in (i) or (iii). On the assumption that any universal that bears the relevant degree of similarity to an instantiated universal must itself be instantiable, this view would predict that we do not grasp any uninstantiable unanalyzable universals, whether or not there are any.[22]

3.7 Seventh slot-free account: counterfactual definitions of ‘specifies the adicy of’

Accounts five and six attempted to define ‘specifies the adicy of’ by appeal to the necessity operator, together with the notion of instantiation, the notion of an n-tuple, and, in the case of the sixth strategy, notions for a variety of logical operations, such as conjunction. Perhaps the necessity operator is too blunt an instrument for the task at hand. A natural alternative is to appeal to the *counterfactual conditional* operator, perhaps as follows:

(D4) x specifies the adicy of y =df. (i) y is a universal,[23] (ii) if y were instantiated by something, it would be instantiated by an ordered x-tuple.[24]

[21] Though here are a few tries. (1) Perhaps it is impossible that there be a unicorn (as argued by Kripke 1980), and yet there is such a thing as <u>being a unicorn</u>, where this is not merely uninstantiable but also unanalyzable (as typical examples of properties corresponding to species appear to be) and monadic (i.e., monadic only, not dyadic, etc.). (2) Perhaps eliminativist theories of color [or value or morality] are necessarily true, so that necessarily, nothing *instantiates* any color [or value or moral] properties. It might still be the case that there is a such an entity as (e.g.) the property of redness [or wrongness or goodness], and that is monadic (only) despite being unanalyzable and uninstantiable. Indeed, we might even be acquainted with it in experience, perhaps by standing in a certain relation to a proposition that (falsely) *predicates* redness of some object in our visual field. (3) Perhaps some version of presentism that entails that *nothing is earlier than anything* is a necessary truth, and yet the relation <u>earlier than</u> exists and is dyadic (only) despite being unanalyzable and uninstantiable. Again we might be acquainted with such a relation in experience. (4) Perhaps some version of the B-theory of time that entails that *nothing instantiates any A-properties* is necessarily true, and yet there is an unanalyzable monadic property of presentness with which we are acquainted by standing in certain relations to propositions that (falsely) *predicate* this property of certain events.

[22] We might also add that (D3) is no improvement over (D2) with respect to the ‘problem’ of universals that have a single adicy accidentally.

[23] Without this clause, we might get the result that I am (say) monadic.

The thought here is that even if a universal is uninstantiable, it can still be non-vacuously true that if it *were* instantiated, it *would be* instantiated by, say, an ordered pair.[25] Consider <u>being both larger and smaller than</u>. Now, although it is impossible for this universal to be instantiated, it nevertheless seems true that if it were instantiated, it would be instantiated by an ordered pair, i.e., by a 2-tuple. According to (D4), then, the universal in question is dyadic: it bears the adicifying relation to the number 2. This provides a uniform, non-disjunctive account of the adicies of *all* universals, instantiable and uninstantiable alike.

It may, however, be vulnerable to counterexamples. Suppose that there is such a universal as <u>being an x such that: x is round and x is such that anything that is instantiated is instantiated only by ordered 2-tuples</u>,[26] and call it U_4 for short. Intuitively, U_4 is monadic and uninstantiable, much like <u>being an x such that: x is round and x is square</u>. It is not dyadic or triadic or . . . . But in order for (D4) to yield the intuitively correct verdict that U_4 is not 2-adic, it needs to turn out that

(14) it's not the case that: if U_4 were instantiated, it would be instantiated by an ordered 2-tuple.

But it's not clear to me that (14) is true. For suppose that, *per impossibile*, U_4 were instantiated. Then, given the nature of U_4, everything that is instantiated, including U_4 itself, would be instantiated by an ordered 2-tuple. So U_4 would be instantiated by a 2-tuple. This makes me doubt (14).[27]

Now, since U_4 is uninstantiable, (14) is the negation of a counter*possible*. Perhaps, even if some counterpossibles are non-vacuously true and others non-vacuously false, there is something distinctive about them that undermines my case against (14). Alternatively, perhaps even friends of abundant, hyperintensionally individuated universals have independent reason for denying the existence of U_4 and other universals that would generate counterexamples to (D4).

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[24] Those who want to avoid speaking of n-adic universals being instantiated by n-tuples, this definition can be restated in the manner suggested in note 15. The discussion below would then need to be restated accordingly.

[25] Contrary to Lewis (1973) and Stalnaker (1968), both of whom say that counterfactual conditionals with impossible antecedents are either vacuously true or vacuously false. For opposition to Lewis and Stalnaker on this point, see, e.g., Daniel Nolan (1997), Seahwa Kim and Cei Maslen (2006), and Cian Dorr (2008).

[26] In the language of Menzel (1993), we could refer to U_4 with the expression '[λx(x is round & $\forall y \forall z$ (z instantiates y $\rightarrow$ z is a 2-tuple)))]'.

[27] Similar problems arise if we define 'n specifies the adicy of u' as 'u is a universal, and if u were instantiated, it would be instantiated only by n-tuples' or 'u is a universal, and n is the one and only entity that is such that: if u were instantiated, it would be instantiated by n-tuples'.

Maybe – but for the moment I am unable to see how to fill out these replies, and accordingly I am persuaded by the argument against these definitions.[28]

Finally, we should note that counterfactual definitions of 'specifies the adicy of' make no progress on the priority problem. Suppose that one thinks that facts of the form *u cannot be instantiated by anything other than n-tuples* are grounded in facts of the form *u is n-adic*. Further, suppose that one takes it to be non-vacuously true that

(C) if <u>being both larger and smaller than</u> were instantiated, it would be instantiated by a 2-tuple.

In that case, one ought to find it plausible as well that the relevant *counterfactual fact* is grounded in the fact that given universal is dyadic, and one ought to take this latter fact to be non-modal and non-counterfactual. This is in tension with counterfactual definitions of 'specifies the adicy of'.

3.8 Eighth account: defining 'specifies the adicy of' in terms of essence

If the necessity operator is too blunt, perhaps the right response is to appeal to a notion of essence that is not analyzed in modal or counterfactual terms (Fine 1994).[29] We might try using such a notion alone or in combination with those expressed by modal and/or counterfactual operators. The simplest definition along these lines runs as follows:

(D5) x specifies the adicy of y =df. it is essential to y that: for any z, if z instantiates y, then z is an x-tuple.[30]

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[28] A very different counterfactual definition of 'x specifies the adicy of y' runs roughly as follows:

(D4c) x specifies the adicy of y =df. if there were such things as slots in universals, then x would number the slots in y.

But if one were willing to paraphrase away 'slot talk' in terms of 'counterfactualized slot talk', presumably one should also be willing to paraphrase away 'property and relation talk' in terms of 'counterfactualized property and relation talk' in the manner advocated by Dorr (2008). (For example, Dorr paraphrases 'spiders and insects share some anatomical properties' as 'if there were abstract objects and the concrete world were just as it actually is, then spiders and insects would share some anatomical properties'. He says that the former is true, taken superficially, iff the latter is true, taken fundamentally.) My target audience in this paper is confined to Platonists, who I take it have some reason for being dissatisfied with Dorr-style paraphrases of property and relation talk. I assume that any such reason will apply with equal force to (D4c).

[29] Thanks to Brad Skow for suggesting something in this neighborhood.

[30] As before, those who want to avoid talk of n-adic universals being instantiated by n-tuples can restate this definition, and the discussion that follows, in the manner suggested in note 15.

On a related point, some might be tempted to object to (D5) on the grounds that, quite generally, no non-logical truth concerning sets or ordered n-tuples is part of the essence of anything but sets or n-tuples themselves. One might take this to be the lesson of Fine's example concerning Socrates and {Socrates}: although it is necessary that if Socrates exists he belongs to {Socrates} exists, it is not essential to Socrates that he belongs to {Socrates} (or that if he exists then he so belongs). Likewise, the objection

To see why such a definition might seem promising, consider the following schema. (Italicized expressions are to be understood as schematic.)

U-Essence Necessarily, for any u, if u=[$\lambda x_1 \ldots x_n \varphi$], then it is essential to u that: $\forall$y [y instantiates u if and only if $\exists y_1 \ldots \exists y_n$

(i) y=$\langle y_1, \ldots, y_n \rangle$, and

(ii) ${}^{x1 \ldots xn}\varphi_{y1 \ldots yn}$][31]

Here is an instance of the schema:

U-Essence$_1$ Necessarily, for any u, if u=[$\lambda x_1 x_2$(x_1 is larger than x_2 & x_1 is smaller than x_2)], then it is essential to u that: $\forall$y [y instantiates u if and only if $\exists y_1 \exists y_2$

(i) y=$\langle y_1, y_2 \rangle$, and

(ii) y_1 is larger than y_2 & y_1 is smaller than y_2].

This says, roughly, that it belongs to the essence of the universal being both larger and smaller than that it's instantiated by a thing just in case that thing is an ordered pair whose first member is both larger and smaller than the thing's second member.[32] It is natural to think that parallel remarks apply to other universals, and indeed that every instance of the given schema is true.

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runs, it may be necessary that if being taller than is instantiated, it is instantiated only by 2-tuples, but it is not part essential to being taller than that if it's instantiated, it's instantiated only by 2-tuples.

Two points are worth making in response. First, I suspect that the principle driving the objection overgeneralizes on Fine's example. The property being a unit set is not itself a set or an ordered n-tuple, but it would be surprising if its essence didn't somehow involve set-theoretical notions. Further, it *might* turn out that for *each* property and relation, its essence involves some notion concerning n-tuples, though admittedly this would be a surprise. Second, since (D5) can be restated in the manner suggested above, one gets the feeling the objection turns on an idiosyncrasy of my *formulation* of the underlying idea, rather than on any core feature of the idea itself. Accordingly, I will not pursue the objection any further.

[31] Instances of U-Essence are formed as follows. There is a variable v_{x1} such that each occurrence of 'x_1' is to be replaced by an occurrence of v_{x1}, . . . , and there is a variable v_{xn} such that each occurrence of 'x_n' is to be replaced by an occurrence of v_{xn}; there is a variable v_{y1} such that each occurrence of 'y_1' is to be replaced by an occurrence of v_{y1}, . . ., and there is a variable v_{yn} such that each occurrence of 'y_n' is to be replaced by an occurrence of v_{yn}, where v_{x1}, . . ., v_{xn}, v_{y1}, . . ., and v_{yn} are 2n pairwise non-identical variables. Further, 'φ' is to be replaced by some formula f_φ in which no variables other than v_{x1}, . . ., and v_{xn} occur free, and in which v_{y1}, . . ., and v_{yn} do not occur at all. Finally, '${}^{x1 \ldots xn}\varphi_{y1 \ldots yn}$' is to be replaced with the formula f_ψ that results from replacing each free occurrence of v_{x1} in f_φ with an occurrence of v_{y1}, . . ., and replacing each free occurrence of v_{xn} in f_ψ with an occurrence of v_{yn}. Thanks to Linda Wetzel for catching some mistakes in an earlier formulation of the schema.

[32] I suspect U-Essence and its instances could be restated so that they do not take instantiation as a relation that holds between an n-adic universal and an n-tuple, but rather take it to hold between (i) some things, (ii) an n-adic universal, and (iii) an *order*, where the order is 'of length n', as suggested in note 15.

Further, this might seem to harmonize with (D5). Let S be an instance of U-Essence, and suppose that the lambda abstract A in S contains n variables bound by the initial occurrence of 'λ'. This lets us make two further claims. (i) The universal U of which A is a 'canonical name' will be intuitively n-adic, and (ii) it is essential to U that U be instantiated by something y only if there are things $y_1 \ldots y_n$ such that $y=\langle y_1, \ldots, y_n\rangle$. [33] And of course it will be at least *necessary* that $\langle y_1, \ldots, y_n\rangle$ here be an n-tuple. This makes it natural to think that for any instance of U-Essence, if the lambda abstract in that instance refers to a universal u that is intuitively n-adic, then the instance will tell us that it's essential to u that it be instantiated only by n-tuples, as predicted by (D5). (There is conceptual space to grant (i) and (ii) while still denying that it will always be *essential to* U that it be instantiated only by *n-tuples*,[34] but the motivation for such a denial is unclear.)

However, (D5) may run into trouble with U_4, the same universal that generated apparent counterexamples to the counterfactual definition. U_4, recall, is the universal <u>being an x such that: x is round and anything that is instantiated is instantiated by ordered 2-tuples</u>. Using machinery from Menzel (1993), we can refer to it with the lambda abstract '$[\lambda x(x \text{ is round } \& \forall y \forall z\ (z \text{ instantiates } y \rightarrow z \text{ is a 2-tuple}))]$', which is grammatically a singular term. Now, to see why this universal might pose a problem for (D5), consider the following instance of U-Essence:

U_4-Essence Necessarily, for any u, if $u=[\lambda x(x \text{ is round } \& \forall y \forall z\ (z \text{ instantiates } y \rightarrow z \text{ is a 2-tuple}))]$, then it is essential to u that:

(E_4) $\forall v$ [v instantiates u if and only if $\exists v_1$

(i) $v=\langle v_1\rangle$, and

[33] I temporarily assume that 'essential properties are closed under logical consequence': if the proposition that ψ is a logical consequence of the proposition that φ and it is part of the essence of x that φ, then it is also part of the essence of x that ψ. More on this below.

[34] There is conceptual space to grant, e.g., that

(2*) it is essential to U that, for any y, if y instantiates U, then $\exists y_1 \exists y_2\ y=\langle y_1, y_2\rangle$,

while denying that

(3*) It is part of the essence of U that, for any y, if y instantiates U, then OrderedTuple(y, 2), where 'OrderedTuple(,)' is a two-place predicate that is satisfied by an <x, z> pair just in case x is an ordered n-tuple and z=n. For it might be doubted that 'OrderedTuple(y, 2)' is a *logical* consequence of '$\exists y_1 \exists y_2\ y=\langle y_1, y_2\rangle$', even together with definitions.

(ii) v_1 is round & ∀y∀z (z instantiates y → z is a 2-tuple)].

If essential properties are closed under logical consequence, then U_4-Essence causes trouble for (D5) right away. For it is a logical consequence of (E_4) that

(E_4.1) ∀v [v instantiates u → ∀y∀z (z instantiates y → z is 2-tuple)]

and hence that

(E_4.2) ∀v [v instantiates u → v is a 2-tuple].

So, if essential properties are closed under logical consequence, then U_4-Essence tells us that it is part of the essence of U_4 that for any z, if z instantiates U_4 then z is a 2-tuple. And in that case (D5) incorrectly declares that 2 is the adicy U_4. (Intuitively U_4 is monadic and not dyadic.)[35]

Admittedly, those who embrace of Fine's notion of essence will be likely to deny that essential properties are closed under logical consequence. It is essential to me that I am human; the proposition that either snow is white or snow is not white is a logical consequence of the proposition that I am human; but, plausibly, it is *not* essential to me that I am such that either snow is white or snow is not white.

So not all the logical consequences of a thing's essence themselves belong to its essence. But it doesn't follow that none of them are, or that we shouldn't expect some of the more direct and obvious ones to be. Suppose that it is essential to *a* that: *a* is F & *a* is G. Then it seems that, other things being equal, we should expect it to be essential to *a* that: *a* is F. Or, suppose that it is essential to *b* that: all Fs are Gs & *b* is F. Then it seems that, other things being equal, we should expect it to be essential to *b* that: *b* is G.

Now one might think that the case of U_4 is more similar to these simple cases than it is to the case involving me and snow's being either white or not white. That is, even if there is no closure principle in place to guarantee that it is essential to U_4 to be instantiated only by 2-tuples, it still seems natural expect that this belongs to U_4's essence, given what else we know about its essence (via U_4-Essence). Its essence involves the relation of instantiation, the relation of being an ordered __-tuple, and the number 2 (or the associated concepts). So it's not as if we are pulling extraneous concepts into its essence willy-nilly by the use of logical trickery. Rather, in the manner of the simple examples from the previous paragraph, we're drawing straightforward

[35] To be sure, one can accept all of this and at the same time argue (again by appeal to U_4-Essence) that it is *also* part of the essence of U_4 that it be instantiated only by *1-tuples*. In that case one would say that, according to (D5), U_4's adicy is specified by both 1 and 2. This is cold comfort to the friend of (D5). I take it to be intuitively clear not merely that 1 does specify the adicy of U_4 but also that 2 does not. Again, even lovers of abundant fine-grained universals might have independent reason to deny the existence of U_4.

consequences from U_4-Essence while working exclusively with the concepts that are already invoked by that principle. This far from a knock-down argument. But it does show, I think, that if (D5) has an advantage over (D4) vis-à-vis U_4, the advantage is not clear-cut.

Further, (D5) sheds no light on the apparent fact that adicies are intrinsic properties.[36] Essences need not be intrinsic:[37] why then think that <u>being an x such that it is essential to x that x is instantiated only by 2-tuples</u> should turn out to be intrinsic? There is no obvious reason. (More on the intrinsicness of adicies later on.)[38]

As I mentioned earlier, (D5) is just the simplest and most naïve attempt to define 'specifies the adicy of' in terms of essence. Perhaps some other definition of its kind would fare better. But since no alternative 'essentialist' definition suggests itself as especially promising, and since a broad survey would be tedious and probably not very illuminating, these brief remarks will have to suffice.

3.9 Ninth slot-free account: define 'specifies the adicy of' in terms of canonical names

In my discussion of the previous strategy, I made use of the notion of a *canonical name* of a universal.[39] I said that if a given universal had, as a canonical name, a lambda abstract containing n variables bound by the initial occurrence of the lambda operator, 'λ', then the universal would be intuitively n-adic. Christopher Menzel describes these lambda abstracts as follows:

> The more formal counterpart to the property denoting form above is ⌜being an object ν such that φ ⌝ where (typically, but not necessarily) φ contains a free occurrence of the variable ν. We will symbolize this expression more concisely with the term ⌜$[\lambda\nu\varphi]$⌝. Thus, for instance, 'being something such that someone desires it' translates into '$[\lambda x \exists y Dyx]$'. (So in this context 'λx' plays the role of the variable binding operator 'being an object x such that'.) The form of expressions

[36] In section 2.10, I offer two considerations in favor of the view that adicies are intrinsic. The second of these (the only consideration remotely resembling an argument) is that the view plays a role in a natural explanation of the fact that for each universal u, if u is n-adic, then necessarily, if u exists, it's n-adic. But those who embrace U-Essence seem to have an alternative explanation of the given fact: if being n-adic just is being an x such that is essential to x that it is instantiated only by n-tuples, then presumably if a thing is in fact n-adic, it is essentially n-adic. (I assume that if a thing x is essentially F, then necessarily, if x exists, it's essentially F.) No appeal is made to the intrinsicality of adicies in this explanation. So friends of U-Essence may be under less pressure than the rest of us to treat adicies as intrinsic. Thanks to Carrie Ichikawa Jenkins for pointing this out to me.

[37] I have the property <u>being an x such that it is part of the essence of x that: Gene Gilmore is a parent of x</u>. But I perhaps I could have an intrinsic duplicate who has different parents and so lacks this property. If so, then the relevant essence property is extrinsic.

[38] Perhaps there is also room to raise a version of the priority problem for (D5). One might think that, if it is part of the essence of u that it be instantiated only by n-tuples, then this is *because* u is n-adic.

[39] See van Inwagen (2006b) for an extensive discussion of the notion of canonical names for properties, relations, and propositions.

> denoting n-place relations generally, then, is ⌜being objects $v_1, \ldots, v_n$ such that φ⌝ (e.g., 'being objects x, y, and z, such that x loves y but not z'), which we symbolize with the term ⌜[$\lambda v_1 \ldots v_n$ φ⌝ (e.g., '[λxyz(Lxy ∧ ~Lxz)]'). Where n≥0, this is the general form of all PRP denoting expressions. Such expressions will also be known as complex terms, or lambda abstracts (1993: 67-68).

Given that our intuitions about the adicy of a given universal are so closely tied to the facts about the number of variables bound by the initial lambda operator in its canonical name, why make a detour through counterfactuals about instantiation, or through claims about essence? Why not just define 'is the adicy of' directly in terms of facts about lambda abstracts?[40]

As a first try, we might say that n specifies the adicy of u just in case there are n variables bound by the initial occurrence of the lambda operator in the lambda abstract that names u. But of course we want to leave open the possibility that (i) some universals that have an adicy are named by more than one lambda abstract and that (ii) other universals that have an adicy are not named by any lambda abstracts. So, to leave these possibilities open without making any overly controversial claims about the modal profiles of lambda abstracts, we can offer the following definition:

(D6) x specifies the adicy of y =df. (i) y is a universal and (ii) necessarily, ∀z [(z is a lambda abstract & z names y) → x numbers the variables bound by the initial occurrence of the lambda operator in z][41]

What does it mean to say, e.g., that 1 specifies the adicy of U_4? According to (D6), it means that U_4 is a universal that can be named by a lambda abstract only if the initial occurrence of the lambda operator in that abstract binds exactly one variable. I find it plausible that U_4 could not be the referent (as determined by the appropriate kind of compositional semantics) of a lambda abstract of any other sort. So it seems to me that (D6), unlike *any* of our previous definitions, delivers the right verdict in this case. Indeed, it is easy to see that (D6) handles a wide range of cases successfully.

Still, if my own reaction to (D6) is any guide, most philosophers – especially those with Platonist leanings – will find (D6) bizarre, though perhaps for reasons that are not easy to

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[40] Thanks to Brad Skow for suggesting this.

[41] Is it possible that a lambda abstract whose initial 'λ' binds two or more variables (say '[λxy(x is larger than y)]', names a monadic universal? (Perhaps this would be so if, in addition to being a lambda abstract in some language that allows the formation of such complex terms, the expression were also used as an idiom.) If such a situation is possible, presumably we could fix (D6) by requiring that the lambda abstract name the relevant universal *in virtue of an appropriate sort of compositional semantics* governing the complex terms of the language to which the lambda abstract belongs.

articulate immediately. For what it's worth, (D6) initially seems to just change the subject. It takes us from talk about universals themselves and the things that have them – a broad and fundamental topic, even by metaphysical standards – to talk about linguistic expression types, their syntax, and their semantic properties – a rather narrow and superficial corner of reality. It's natural to think that the syntax of a given lambda abstract is a *guide* to the adicy of the universal (if any) that it names, but this is a far cry from saying that facts about the syntax of linguistic expressions are in any way *constitutive* of that universal's adicy!

Let me try to sharpen all this up a little, by casting it in the form of three distinct objections. First, (D6) is incompatible with the plausible view that adicy properties, such as <u>being dyadic</u>, are extra-linguistic properties: they do not 'constitutively depend' upon facts about languages, expressions, words, etc. Second, (D6) yields implausible counterpossibles. This objection can be framed as follows:

The Counterpossible Argument

C1 If any version of the Ninth Account is true, then if it were impossible that there be linguistic expressions, there wouldn't be any exclusively monadic universals (or exclusively dyadic universals or . . . .).

C2 It's not the case that: if it were impossible that there be linguistic expressions, there wouldn't be any exclusively monadic universals.

C3 Therefore, no version of the Ninth Account is true.

According to (D6), to say that n specifies the adicy of u is to say that u is universal that can be named only by lambda abstracts that have n variables bound by the initial occurrence of the lambda operator. Suppose (D6) were true and that, surprisingly, linguistic expressions were *impossible*. What else would then be true? In particular, which entity or entities would specify the adicy of roundness?

Well, presumably roundness would still be a universal. But since it would be impossible for there to be expression types, it would also be impossible for there to be lambda abstracts, and hence it would turn out that: for *every* x, it is necessarily such that for any z, if z is a lambda abstract (which nothing could be) and z names roundness, then x numbers the variables bound by the initial occurrence of the lambda operator in z. In other words, roundness would turn out to have its adicy specified by *each and every* entity. Accordingly, roundness would not be 'exclusively monadic' (in the sense of having its adicy specified by 1 and only 1). Since this argument doesn't turn on any special features of roundness, we can generalize: there would, given the above suppositions, be no exclusively monadic universals or exclusively dyadic universal, or universals of any fixed, exclusive adicy. I assume that parallel remarks could be applied to other versions of the Ninth Account. This gives us C1.

Of those who take counterpossibles seriously,[42] most I suspect will want to reject the claim that if linguistic expression types had been impossible, there would be no exclusively monadic universals. Granted, it would be strange if there couldn't be linguistic expressions. But on its face, this would have relatively little bearing on the world of universals. Maybe it would result in the non-existence of haecceitistic universals such as <u>being identical with a</u>, where a is the word 'the'. But most universals would survive unscathed. And in particular, there would still be such things as roundness and <u>being taller than</u>, and the facts about their adicies would still be just as they actually are. There would still be monadic universals, there would still be dyadic universals, and so on. For this reason, it seems false that if linguistic expressions were impossible, there wouldn't be any monadic universals. So the Counterpossible Argument looks sound.

Now let me turn to a third objection to (D6) and the Ninth Account: it faces an especially serious priority problem. Consider some universal u, and suppose that necessarily, it is not named by any lambda abstract that doesn't contain n variables bound in the right way. Surely this is the wrong place for a brute fact about u! To take this as brute would be like taking it as brute that I cannot be expressed by a predicate. Although it is hard to say exactly why, I take it to be relatively uncontroversial this latter fact cries out for explanation along the following lines: (i) I am a particular, (ii) all particulars are essentially particulars, and (iii) necessarily, predicates do not express particulars. The facts corresponding to (i) – (iii) *ground* the fact that I cannot be expressed by predicate.

Similarly, the fact that u cannot be named by any lambda abstract that doesn't contain n variables – call it *u-fact* – cries out for explanation, and grounding, in terms that mention u, certain non-linguistic properties that are essential to u, and certain de dicto necessities about how the syntactic properties of a lambda abstract must be mirrored by certain non-linguistic properties of any entity it names. In particular, I assume that the explanation ought to run as follows: (i) u is an n-adic universal, (ii) all n-adic universals are essentially n-adic universals, and (iii) necessarily, lambda abstracts that contain exactly n variables bound in the right way (compositionally) name only n-adic universals. These facts ground u-fact. So, contrary to (D6), u-fact must not be *identified* with the fact corresponding to (i).

[42] I.e., of those who think that some counterpossibles are true and that some are false.

3.10 Tenth slot-free account: saturation

One might wish to define 'specifies the adicy of' not in terms of 'instantiates' or via the notion of a canonical name, but rather in terms of 'saturates', roughly as follows:

(D7) x is the adicy of y =df. (i) there is at least one x-tuple that saturates y, and (ii) anything that saturates y is an x-tuple.[43] [44]

Loosely put, whereas the n-tuple $\langle a_1, \ldots, a_n \rangle$ *instantiates* the universal R just in case the proposition that $Ra_1, \ldots, a_n$ is true, that n-tuple *saturates* the given universal just in case *there is such a thing* as the proposition that $Ra_1, \ldots, a_n$, regardless of whether it's true.

This approach, like the canonical names approach, fares well in terms of its verdicts on cases. It has no apparent trouble, for example, even with the universal U_4, <u>being an x such that: x is round and anything that is instantiated is instantiated only by 2-tuples</u>. Presumably this is saturated by 1-tuples and 1-tuples only. Take the 1-tuple ⟨Obama⟩. Since there is such a thing as the (false) proposition *that Obama is round and such that anything that is instantiated is instantiated only by 2-tuples*, the given 1-tuple intuitively does saturate the given universal. It should be easy to convince oneself, by appeal to related considerations, that *nothing but* 1-tuples saturate this universal.

Further, the saturation approach may do better with respect to the priority problem than do some of the other strategies. Consider some universal u, and suppose that

s-fact u is saturated by n-tuples and only by n-tuples.

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[43] Just as one might prefer to avoid talk of n-adic universals being *instantiated* by n-tuples, one might wish to avoid talk of such universals being *saturated* by n-tuples. One might therefore prefer to replace (D7) with

(D7*) x is the adicy of y =df. (i) $\exists$Z[Z saturate y & x numbers Z] and (ii) $\forall$Z[Z saturate y $\rightarrow$ x numbers Z].

But this gets the adicy of identity wrong. Identity has 2 as its only adicy, but it's not the case that identity is saturated only by 2-membered pluralities. This problem could be avoided if clause (ii) were omitted, but then we would have no explanation of the fact that being monadic and being dyadic, e.g., are incompatible.

To deal with these problems without taking universals to be saturated by n-tuples, the friend of the saturation approach could appeal to a three-place saturation predicate, 'Z saturate y in order w' and a two-place *length* predicate 'w is an order of length x'. The idea would be to give a treatment of saturation that mirrors the treatment of instantiation sketched in note 15. (D7) could then be restated accordingly.

I suspect that none of these variant definitions does much to help with the central problems for (D7) discussed in the main text below.

[44] Why no modal operators in this definition? The reason is that just that we don't need them. For most universals, whether or not the given universal is *instantiated* (by a given n-tuple, or by anything at all) is a contingent matter. But *saturation* is different. Suppose that u is n-adic. Then, intuitively, it is a necessary truth that if u exists, u is saturated by *every* n-tuple. And I assume that, for every positive integer n, it is a necessary truth that there is at least one n-tuple. (I assume that pure sets, numbers, and many – though perhaps not all – universals and propositions exist necessarily.) So I don't think that there will be any 'variation from world to world' in the facts about which sorts of n-tuples a given universal is saturated by.

Is s-fact grounded in the fact that u is n-adic? For what it's worth, although I do find this plausible,[45] I see nothing absurd in its denial. Saturation facts strike me as relatively fundamental, certainly more fundamental than facts about 'de re modal instantiation profiles' or than facts about canonical names. Given the absence of modal operators from (D7), one cannot accuse the saturation strategy of treating adicy properties as modal properties. Thus it leaves space to ground the de re modal properties of universals in their non-modal properties. This is good.

What then is not to like about the saturation strategy? First, the approach introduces what appears to be a new primitive, fundamental predicate, 'saturates', and so it incurs some cost in ideology.[46] Second, and more significantly, it's in tension with the principle that adicy properties are intrinsic properties of universals. In other words, friends of the saturation approach face pressure to deny that

Intrinsicality of Adicy (IA) for any n, if there is such a thing as the property being n-adic, then that property is intrinsic.

Let me start by saying something about how I understand intrinsicality.

In the first place, I won't offer any precise definition of the notion. I assume that the notion is fairly easily grasped, at least with the help of some examples together with a rough gloss. This assumption is standard in the literature on defining 'intrinsic'. The participants in that literature are not offering stipulative definitions of technical terms. Rather, they are trying to analyze an intuitive notion that we grasp pre-analytically. Even before one arrives at a settled view on the analysis of intrinsicality, e.g., one is in a position to know that being an x such that x and its parts are the only contingent objects that exist is not intrinsic, and hence one is in a position to know that any analysis that calls the given property intrinsic is incorrect (Lewis 1999: 11-115).

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[45] Those who take counterpossibles seriously may think that the following argument for this carries some weight: if there hadn't been any 2-tuples, being taller than wouldn't have been saturated by any 2-tuples but it still would have been dyadic; so being dyadic is not the same thing as being saturated by 2-tuples and only 2-tuples.

[46] As Chad Carmichael pointed out to me, the friend of saturation might define it in terms of a primitive functor, 'pred', as follows:

(D7) x saturates y =df. ∃z z=pred(y, x)

Intuitively, the predication of a given universal to a given ordered –tuple is the proposition that predicates that universal *of* the members of that –tuple, in the order specified by that –tuple. E.g., the predication of being taller than to <Obama, Putin> is the proposition that Obama is taller than Putin. In symbols: pred(being taller than, <Obama, Putin>)=the proposition that Obama is taller than Putin. The slot theorist will be tempted to gloss 'pred' roughly as follows: the predication of a universal u to an n-tuple $\langle a_1, \ldots, a_n \rangle$ = the proposition that results from plugging a_1 into the first slot in u, . . ., and plugging a_n into the nth slot in u. But the friend of the saturation strategy who endorses (D7) will say that 'pred' is well-understood even without being defined in slot-theoretic terms. My criticism of the 'saturation strategy' applies equally to this variant.

The notion of intrinsicality invoked by IA is the same one that serves as the target of most of the literature on defining 'intrinsic'. Here is a standard informal characterization of that notion: to say that a property F is intrinsic is to say that whether or not a thing o has F depends only on what o is like in itself ('internally') and is independent of how o is related to things outside of (or 'external to') itself. It is an open question as to which, if any, familiar properties of material objects will ultimately turn out to be intrinsic, but prima facie, it is natural to think that shapes and masses are intrinsic, as are the mereological properties being simple and being composite. Being two miles from a lake, by contrast, is *extrinsic* (non-intrinsic).

So understood, IA is plausible on its face. If the notion of intrinsicality can *ever* be sensibly applied to properties that are instantiated only by abstract entities, surely it ought to turn out that adicies are intrinsic. Consider the property being either red or round. This property has many other properties. Some of these seem to be extrinsic (non-intrinsic): being used as an example by philosophers, being such that 2+2=4, being instantiated by more than one thing. Others seem to be intrinsic: being self-identical, being identical to *being either red or round*, being a universal, being logically complex (i.e., having an analysis), being disjunctive, being unnatural, involving a shape and a color.

One further property of being either red or round is being monadic. With which group does this property belong? I submit that it belongs with the latter. It's intrinsic.

I find the above considerations persuasive by themselves. But if an argument for IA is wanted, one option would be to cite it, in conjunction with the fact that *universals are abstract objects* and the fact that *abstract objects have their intrinsic properties essentially*,[47] as constituting the best explanation of the relatively uncontroversial fact that *universals have their adicies essentially*.[48] So let us agree that IA is true.

Now let me say why I think the saturation strategy is in tension with IA. I'll start with an analogy. The saturation strategy tells us that the property being dyadic is the property being saturated by a 2-tuple and nothing other than 2-tuples. Intuitively, this latter property is like being

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[47] This view figures prominently in Jubien (2009: 93).

[48] More carefully, the thought is that IA, together with

(i) universals are not possibly concrete, and

(ii) for any x, if x is not possibly concrete, then for any property F, if x has F and if F is intrinsic, then necessarily: if x exists, then x has F

constitutes the best explanation of the fact that

(iii) for any n and any universal u, if u has being n-adic, then necessarily: if u exists, u has being n-adic.

It is an interesting question whether adicies (or perhaps all intrinsic properties of not-possibly-concrete objects) are essential in Fine's stronger sense, but I take no stand on that here. Further, I take no stand on the question of whether there are contingently non-concrete entities. For arguments that there are such entities, see Linsky and Zalta (1996) and Williamson (2002).

an egg carton that is completely filled by some 6-membered set of eggs, and by no set of eggs that has a cardinality other than 6. Call this *fullness* for short. It is obviously extrinsic. The egg carton in my refridgerator is a piece of packaging. It is made out of recycled paper products. This piece of packaging does not become any less massive, e.g., as the eggs are used up. Whether or not a given carton has the property fullness is a matter of how the carton is related to things that are, in the relevant sense, 'external' to itself – namely, eggs and sets of them. A carton that had the given property wouldn't change intrinsically if it lost that property. It would go from being full to being empty, but this would be an extrinsic change.

According to the slot theorist, by contrast, the property being dyadic is the property being an x such that there are exactly two slots in x.[49] In terms of the egg carton analogy, this is like being something that has exactly six holes in it. This seems intrinsic. Whether or not a given egg carton has this property is a matter of how it is related to things – holes – that are suitably 'internal' to itself. A carton that had this property would change intrinsically if it lost it.

3.10.1 Inward-looking relations

This analogy points toward an explanation of why the saturation approach is in tension with IA, and of why slot theory harmonizes with that principle. Some intrinsic properties are *non-relational*: roughly, no relations are involved in their analysis. Perhaps the maximally determinate masses are examples of non-relational intrinsic properties. But other intrinsic properties are clearly relational. Being composite, for example, is just being an x such that for some y: ~y=x and y is a part of x. This involves the relation of parthood and the relation of identity, but the given property still seems intrinsic. Of course, not all relational properties are intrinsic. The paradigm examples of extrinsic properties are relational: being exactly two miles away from Barack Obama is both extrinsic and relational. It involves the spatial relation being exactly two miles from.

There is a general lesson that we can extract from these examples. Consider some intrinsic property F, and suppose that F is a relational property of the form

- *being an x such that Rxa*
  (e.g., being an x such that x=Obama)
- *being an x such that for some y, Rxy*
  (e.g., having a hole)
- *being an x such that for all y, if Rxy then Gy*

[49] Or perhaps being an x such that 2 numbers the slots in x, or being an x such that the cardinality of {y: y is a slot in x} is 2.

(e.g., being such that all of one's parts are negatively charged)

- *being an x such that for exactly n y, Rxy*

  (e.g., having exactly 5 holes)

- *being an x such that for some y and z, Rxy & Rxz & R*yz*

  (e.g., having parts that are exactly two feet away from each other)

or something along these lines. Informally, suppose that having F is a matter of bearing relation R to some particular thing, or to at least one thing, or only to things of a certain kind, or to exactly 5 things, etc. In that case, R had better be the *right sort* of relation. Not just any relation can be used as the 'primary relational ingredient' in the construction of an intrinsic relational property. Only certain special relations will do.

Roughly, any such relation must be one that a given thing can bear only to entities that are suitably 'internal' to that thing. I will call such relations *inward-looking*. I won't try to list all the inward-looking relations or give a definition of 'inward-looking'. But I will set out a pair of plausible principles that state necessary conditions on inward-lookingness. Schematically, they are:

IL1 If $[\lambda xy\mathcal{R}xy]$ is an inward-looking dyadic relation and $[\lambda x\mathcal{F}x]$ is an intrinsic property, then the property $[\lambda x\exists y(\mathcal{R}xy\ \&\ \mathcal{F}y)]$ is intrinsic.[50]

IL2 If $[\lambda xy\mathcal{R}xy]$ is an inward-looking dyadic relation, then, for any cardinal number n, the property [λx there are exactly n things y such that: $\mathcal{R}xy$] is intrinsic.[51]

The following are instances of IL1 and IL2, respectively:[52]

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[50] Instances of IL1 are formed by finding some dyadic predicate R* and some monadic predicate F* and replacing each occurrence of '$\mathcal{R}$' with an occurrence of R* and each occurrence of '$\mathcal{F}$' with an occurrence of F*.

Roughly put, IL1 is a generalized version of what Sider calls the Inheritance of Intrinsicality: 'if property P is intrinsic, then the property having a part that has P is also intrinsic' (2007:70). Sider's principle concerns parthood only. IL1 concerns inward-looking relations (of which having as a part is an example) more generally. Other plausible candidates for being inward-looking are being an x and a y such that y is a hole in x, i.e., having as hole, perhaps identity, perhaps having as a member. For discussion of Sider's principle, see Gilmore (2010). Weatherson's (2001: 373) principle (M) is also closely related to both IL1 and IL2.

[51] Instances of IL2 are formed by finding some dyadic predicate R* and replacing each occurrence of '$\mathcal{R}$' with an occurrence of R*.

[52] More formally:

$IL1_1$ If [λxy y is a part of x] is an inward-looking dyadic relation and [λx x is round] is an intrinsic property, then the property [λx∃y(y is a part of x & y is round)] is intrinsic.

$IL2_1$ If [λxy y is a part of x] is an inward-looking dyadic relation, then, for any cardinal number n, the property [λx there are exactly n things y such that: y is a part of x] is intrinsic.

$IL1_1$ If having as a part is an inward-looking dyadic relation and being round is an intrinsic property, then the property having a round part is intrinsic.

$IL2_1$ If having as a part is an inward-looking dyadic relation, then for any cardinal number n, the property having exactly n parts is intrinsic.

There are other plausible necessary conditions on inward-lookingness, but these are the only two that we'll need here. Informally, IL1 says that if I bear an inward-looking relation to a thing y, then y's intrinsic nature is reflected somehow in my intrinsic nature; and IL2 says that if R is an inward-looking relation, then the facts about *how many* things I bear R to are relevant to my intrinsic nature.

IL1 and IL2 can serve as tests for inward-lookingness. If the intrinsic nature of the things that I bear R to is not relevant to my intrinsic nature, then R is not an inward-looking relation. Likewise, if the facts about how many things I bear R to are not relevant to my intrinsic nature, then again R is not inward-looking. (In the other direction, if a relation R passes both tests, this is some evidence that R is inward-looking.)

Since they can serve as tests for inward-lookingness, IL1 and IL2 can also serve, indirectly, as tests for intrinsicality. For let F be a relational property, and suppose that we want to find out whether or not F is intrinsic. Further, suppose that the 'primary relational ingredient' in F is the dyadic relation R. Finally, suppose that R flunks one or both of the above tests for inward-lookingness. Then we can conclude that F, the relational property built up from R, is not intrinsic. (And in the other direction, if R *passes* both tests, that's some evidence that R is inward-looking. Hence it's some evidence that if F is built up from R in an appropriate way, then F is intrinsic.)

3.10.2 Applying the test to being saturated by a 2-tuple and only by 2-tuples

I suggest that we apply this test to the property being saturated by a 2-tuple and only by 2-tuples. If we let 'Sxy' abbreviate 'x is saturated by y' and let 'TTz' abbreviate 'z is a 2-tuple', then we can refer to the given property with the following lambda abstract:

$$[\lambda x \exists y(Sxy \;\&\; \forall z(Sxz \rightarrow TTz))]$$

I assume that the 'primary relational ingredient' in the given property is the dyadic relation being saturated by, i.e, [λxySxy]. Having the given property is a matter of bearing the given relation to at least one thing of a certain kind, and only to things of that kind.

Is being saturated by an inward-looking relation? If it is, then (i) we should expect the intrinsic nature of the things that saturate a given universal to be somehow reflected in the intrinsic nature of the universal itself (by IL1), and (ii) we should expect the facts about *how* *many* things saturate a given universal to be relevant to the intrinsic nature of that universal (by IL2). But it seems to me that the *second* prediction, at least, is false. (I have serious doubts about the first prediction as well.[53])

Consider the universal loving. It is *instantiated* by ordered 2-tuples and only by 2-tuples. How many 2-tuples is it instantiated by? Equivalently, how many ⟨x, y⟩ pairs are there such that x loves y? Some fairly large finite number, probably. Maybe it's between ten and twenty trillion. Call this number n. So loving has the property being instantiated by exactly n things. But this is clearly a contingent fact about loving. It could have been instantiated by more things, or by fewer, and if it had, it wouldn't have been any different intrinsically. It's a platonic entity, after all, and it has exactly the same intrinsic properties in every possible world in which it exists. So being instantiated by exactly n things is an extrinsic property, and being instantiated by is not an inward-looking relation.

Similar remarks apply to being saturated by. Loving is saturated by 2-tuples and only by 2-tuples. How many 2-tuples is it saturated by? This depends on how many 2-tuples there are. Some very large infinite number, probably. Call it n*. So loving has the property being saturated by exactly n* things. Admittedly, this may be a non-contingent fact about loving. Whatever n* is, it may well be a necessary truth that there are exactly n* 2-tuples. But it's still clearly a fact 'external' to loving. The intrinsic nature of loving in no way depends upon how many 2-tuples

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[53] The first prediction is that:

IL1$_P$ If [λxFx] is intrinsic, then [λx∃y(Sxy & Fy)] is intrinsic.

This says that if being an F is intrinsic, then being saturated by an F is intrinsic. To see why this might seem doubtful, consider:

Saturationists need to say that for any positive integer n, the property being an n-tuple is intrinsic. (If these properties were *not* intrinsic, then being saturated by a 2-tuple and only by 2-tuples would be like having a part that is two miles from a lake, and being such that each of one's parts is two miles from a lake, i.e., obviously extrinsic.)

But if the given properties are intrinsic, that's presumably because n-tuples bear some inward-looking relation to their members. And in that case, the intrinsic properties of the members of an n-tuple are relevant to the intrinsic nature of n-tuple itself. So, e.g., the 2-tuple ⟨Plato, Shaquille O'Neal⟩ differs intrinsically from the 2-tuple ⟨Plato, Aristotle⟩: the former but not the latter has the property being such that its second member is over 7 feet tall (F_{s1} for short), which on the current view would be intrinsic.

From here it is a short step to the view that IL1$_P$ is false. In the actual world, loving has the property being saturated by something whose second member is over 7 feet tall (F_{s2} for short). There are other possible worlds in which nothing is over 7 feet tall. In those worlds, there are no 2-tuples whose second member is over 7 feet tall. Accordingly, in those worlds, loving lacks the property being saturated by something whose second member is over 7 feet tall; it lacks F_{s2}. Since loving has exactly the same intrinsic properties in all possible worlds but has F_{s2} in some possible worlds and not in others, it follows that F_{s2} is extrinsic. But F_{s1} is intrinsic. This yields a counterexample to IL1$_P$.

If being saturated by is either a dyadic relation that holds between a universal and some things ('a plurality') or a triadic relation that holds between a universal, some things, and an order, this argument would need to be restated, but I suspect that some version of it would still go through.

there are, even if it is necessary that there are exactly n* 2-tuples. Suppose (*per impossibile* perhaps) that there were fewer 2-tuples, but things were otherwise largely as they actually are. In particular, suppose that it were still true that loving was saturated by infinitely many 2-tuples and only by 2-tuples. In that case, loving wouldn't have been any different intrinsically; it wouldn't have had any intrinsic property that it actually lacks. It's just that there would have been fewer things out there for it to be saturated by. Intuitively, just as the facts about how many 2-tuples a dyadic universal is *instantiated by* are not relevant to its intrinsic nature, the facts about how many 2-tuples it's *saturated by* are likewise irrelevant to its intrinsic nature.

One might initially think that *what kinds* of –tuples a universal is saturated by is relevant to the universal's intrinsic nature. But surely one ought to admit that *how many* –tuples of that kind the universal is saturated by is not relevant. So it seems to me that being saturated by exactly n* 2-tuples is an extrinsic property, and hence that being saturated by is not an inward-looking relation.[54] Accordingly, being saturated by a 2-tuple and only by 2-tuples fails our test for intrinsicality.

3.10.3 Applying the test to having exactly 2 slots

How does the slot theorist's proposal fare by the lights of this test? I think it fares well. For each cardinal number n, the slot theorist identifies the property being n-adic with the property having exactly n slots.[55] So, like the saturationist, he takes adicies to be relational properties. According to the slot theorist, however, the primary relational ingredient in adicy properties is the relation having as a slot (i.e., the converse of being a slot in). And this relation passes the tests for inward-lookingness.

Consider the first test. It's plausible that for any cardinal number n, the property having exactly n slots is intrinsic. This confirmed by reflecting on the appropriate counterpossibles. Suppose that loving is dyadic, i.e., that it has two slots in it. It seems to me that if, *per impossibile*, loving were to lose one of its slots, it would change intrinsically. We might also compare the principle about slots with the analogous principle about holes: for any cardinal number n, the property having exactly n holes is intrinsic. This too is plausible. Objects with

[54] As indicated in note 43, if being saturated by is either a dyadic relation that holds between a universal and some things ('a plurality') or a triadic relation that holds between a universal, some things, and an order, this argument will need to be restated. Intuitively, the thought would be that the facts about how many 'n-membered pluralities' a given n-adic universal is saturated by are irrelevant to that universal's intrinsic nature.

[55] Or perhaps being an x such that n numbers the slots in x, or being an x such that the cardinality of {y: y is a slot in x} is n.

different numbers of holes in them will be differently shaped, and so will have different intrinsic properties.

Now consider the second test. It's plausible that if being an F is an intrinsic property, then having a slot that is an F is an intrinsic property too. Byeong-Uk Yi suggests that certain relations have multiple slots some of which are *singular* and others of which are *plural*.

> Call an argument place of a relation plural if it admits of many objects as such; singular otherwise. Accordingly, call a relation singular if all of its argument places are singular; plural otherwise. (1999: 169)

According to Yi, the predicate 'is one of' expresses a dyadic relation (being one of) whose first slot is singular and whose second slot is plural. If one embraces something like Yi's view, one might think, further, that being a plural slot and being a singular slot are intrinsic properties of slots. In particular, one might think that if a certain slot s 'admits of many objects as such', that's *because* it has a certain intrinsic property, being a plural slot.

Assume that this view is correct. In that case, if having as a slot is inward-looking, then it should turn out that

(Y) having a plural slot and having a singular slot are themselves intrinsic properties.

Is (Y) true? I don't know how to prove that it is, but I do find (Y) highly plausible, and I can't think of any reason to doubt it. It seems to me that any two universals that have plural slots are thereby intrinsically similar in that respect; likewise for those that have singular slots. (The analogy with holes might again be helpful: being large and triangular is intrinsic, and so is having a large, triangular hole. Any two objects that have large triangular holes in them are thereby intrinsically similar in that respect.) Further, it seems to me that if, *per impossibile*, one of the slots in loving became plural, loving would change intrinsically.

In sum, then, all signs point to the conclusion that having as a slot is inward-looking, and that properties of the form having exactly n slots are intrinsic. Slot theory harmonizes with IA, the principle that adicies are intrinsic properties. [56]

[56] At this point one might reply the following slot-free explanation of why adicy properties are intrinsic. If it works, it is equally available to any of the ten slot-free accounts of adicity.

> A property is intrinsic if and only if it never differs between possible duplicates. This is a very well-entrenched principle in discussions of intrinsicality; call it *ID*. Now suppose, as some believe, that universals have no possible duplicates (aside from themselves): if universal u in possible world w is a duplicate of u* in possible world w*, then u=u*. Then ID tells us that every property that can be possessed only by universals, and that is possessed necessarily by any universal that possesses it, is intrinsic. Further, since adicy properties can be possessed only by universals, and since they are had necessarily by anything that has them, ID tells us that they are intrinsic. So there is our explanation of the relevant fact, and it has nothing to do with slots.

4. A problem for slots?

Kit Fine (2000) has raised a number of worries for views in the vicinity of slot theory. I cannot discuss them all here.[57] Nor is it the goal of this paper to give a comprehensive defense of slots. But there is one consideration that I would like to address before concluding. Fine puts it thus:

> The antipositionalist view has another, related, advantage over the positionalist view. For it is able to account for the possibility of variable polyadicity. It is plausible to suppose that certain relations are variably polyadic in the sense that they can relate different numbers of objects (and not merely through some of those objects occurring several times as a relatum). There should, for example, be a relation of supporting that holds between any positive number of supporting objects a_1, a_2, . . . and a single supported object b just when a_1, a_2, . . . are collectively supporting b.
>
> Under the positional view, it is hard to see how any relation could be variably polyadic, for the number of argument places belonging to a relation will fix the number of relata that may occupy them. Under the antipositionalist view, however, there is no impediment to a relation being variably polyadic, since there are no preordained positions by which the number of arguments might be constrained (2000: 22).

Two responses are available. The *singularist* response takes <u>supporting</u> to be a dyadic relation that holds between, on the one hand, the *sum*, or *aggregate*, or *set*, or . . . of supporting objects and, on the other hand, the supported object. (See McKay (2006) for a survey of these views.) This is consistent with the view that <u>supporting</u> is a dyadic relation with exactly two slots in it, each of them singular. The *pluralist* response, by contrast, takes <u>supporting</u> to be a relation that holds between, on the one hand, *some things* (the supporting objects) and, on the other hand, the supported object. This view is also consistent with the view that <u>supporting</u> has exactly two slots in it. Indeed, the most natural way of explaining this view is to say, following Yi (1999: 169) and McKay (2006: 13), that <u>supporting</u> has two slots in it, but that these slots are qualitatively different from each other: the first is plural, the second is singular.[58] On this view, when we give the logical form of a universal, it is not enough to say that it is monadic, dyadic, etc. To give a

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The problem with this explanation is that relies on ID. ID may seem plausible when one restricts one's attention to concrete particulars and the properties thereof (though see (Eddon 2011) for a convincing criticism that applies even there), but it quickly loses its appeal when one turns to the realm of abstracta. For example, ID tells us that <u>being an x such that necessarily, x is instantiated by ⟨2, 1⟩</u> is an intrinsic property. Intuitively, however, the given property is clearly extrinsic. It is had by <u>being less than</u>, and necessarily so, but it is not an *intrinsic* property of that relation.

[57] See also MacBride (2005: 588-589) and (2007), Fine (2007), Wieland (2010), and Orilia (2011).

[58] Suppose that a_1, a_2, and a_3 support b, and that <u>supporting</u> has two slots, the first plural, the second singular. In that case, what instantiates <u>supporting</u>? Presumably, if we *initially* took instantiation to be a dyadic relation between an n-adic universal u and an n-tuple of things that 'stand in' u, then we should now say that $\langle\{a_1, a_2, a_3\}, \{b\}\rangle$ instantiates s<u>upporting</u>. So we should now think of instantiation as a dyadic relation between an n-adic universal u and n-tuple of *sets* of things whose members 'stand' in u. If u is singular with respect to its ith slot, then it will be instantiated only by n-tuples whose ith members are singleton sets. See MacBride (2005).

more complete and fine-grained characterization, we should say that it is, e.g., dyadic and plural-with-respect-to-its-first-slot but singular-with-respect-to-its-second-slot. Not only is such a view compatible with the existence of slots, the view is very hard to understand without them![59]

5. Conclusion

There are further slot-free accounts of adicy, but those that I've discussed are probably the ones that have the most *prima facie* appeal.[60] In light of the problems with these accounts, it seems increasingly likely that Platonists face real pressure to be slot theorists. Whether these pressures override the equally real countervailing motivations to reject slots is a difficult question, and one that I have not tried to answer here.[61]

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[59] In the following passage, Fraser MacBride considers a view like Yi's and McKay's. He then goes on to argue that there may be universals that are variably polyadic in a way that is more radical:

> From this point of view each universal has a fixed number of argument places: *form a circle* has one argument place, causation has two argument places, and so on. But even though the number of places is fixed, different numbers of individuals may occupy each place. . . . However, it does not follow from the fact that some universals have a fixed degree (in the sense of having a fixed number of argument positions) that all universals have a fixed degree. . . .The multiple relation of belief applies differentially to different numbers of objects, properties, and relations. For example, Iago may believe that Roderigo loves Desdemona whilst not believing that Desdemona loves Roderigo. It follows that the objects, properties, and relations the belief relation relates cannot fall within a single undiscriminating position. Rather to account for the differential application of the belief relation, the related items must be slotted into different argument positions of the relation. Then since the number of objects, properties, and relations related by belief varies – Iago may simply believe that Roderigo is a fool – it follows that he number of argument positions in the belief relation must vary too. (2005b: 588-589).

Might this suggestion constitute a problem for slot theory? I think not. In the first place, I doubt that there are any varigrade universals. But even if there are, I don't see why this poses a threat to slot theory. After all, the most natural way to describe the scenario that MacBride has in mind is to say that believing has different numbers of slots in it relative to different propositions in which it occurs. Far from undermining slots, this description presupposes them.

[60] Further accounts are given by Bealer (1982: 83) and Hossack (2007: 67). I hope to discuss these in future work.

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