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The Possibility of Onion Worlds: Rebutting an argument for structural universals[1]

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Some argue that theories of universals should incorporate structural universals, in order to allow for the metaphysical possibility of worlds of 'infinite descending complexity' ('onion worlds'). I argue that the possibility of such worlds does not establish the need for structural universals. So long as we admit the metaphysical possibility of emergent universals, there is an attractive alternative description of such cases.

Some properties seem 'natural' to us: *being a human*, *being a person*; *being square*; *being of positive charge*. Others seem 'unnatural' by comparison: *being such that there are squares in existence*; *being thought of by me on a Tuesday*; *being green and first observed before the year 2000, or blue and first observed before the year 2000*. Call a theory which draws some sort of objective distinction between 'natural' and 'unnatural' properties *inegalitarian*. Otherwise, call it *egalitarian*.[2]

David Lewis famously argues against egalitarian theories of properties. He does so primarily on the grounds of the *philosophical utility* of inegalitarianism. For Lewis [1999b (1983)], the natural/non-natural property distinction is crucial in saying what it is for one thing to be a perfect *duplicate* of another, which in turn is invoked by accounts of intrinsicality, supervenience, and the notion of 'diverging' worlds utilized in his theory of counterfactuals. Further downstream, Lewis relies on inegalitarianism when formulating a minimal thesis of materialism; he deploys it within a Humean analysis of laws of nature; and invokes it within his counterfactual theory of causation via an account of the conditions for something's counting as an *event*. Finally, Lewis calls on the distinction in the attempt to avoid indeterminacy problems for his favoured foundational theory of the content of thought and language.[3]

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[1] This material was developed during my time at *Arché: the AHRC centre for the philosophy of logic, language, mathematics and mind* at the University of St Andrews, and I presented a version of the material to the *Centre for Metaphysics and Mind* at the University of Leeds. Thanks to all those with whom I have discussed this material, and especially to Ross Cameron and Josh Parsons.

[2] I take the terminology from Hirsch [1993]. I count theories which allow objective *degrees* or *orderings* of naturalness as inegalitarian. A note on terminology: I shall reserve the term 'properties' for the 'abundant' sense in which it is right to say that even tremendously 'unnatural' predicates such as 'is thought of by me on a Tuesday' express a property. For the utility of drawing a distinction between abundant and sparse usages of the word 'property' (and the adoption of a convention to use the word 'property' for the former sense) see [Lewis 1983].

[3] Duplication (for simple objects) is defined to be the sharing of all perfectly natural properties. For compound objects, A is a duplicate of B if the parts of A and B can be put into a correspondence whereby

If one is not to be an egalitarian, what inegalitarian theory of properties should one adopt? Lewis [1999a (1983)] gives three options. We can label them the way of Primitive Similarity, the way of Primitive Naturalness, and the way of Additional Ontology. The way of Primitive Similarity is a form of resemblance nominalism, based on a highly complex 'multigrade and contrastive' metaphysical primitive: $x_1,\ldots x_i,\ldots$ resemble each other and do not likewise resemble $y_1,\ldots,y_i,\ldots$.[4] The way of Primitive Naturalness can simply take the distinction between those properties that count as 'natural' and those which do not as a basic piece of ideology. In the same spirit, one might take a more complex piece of ideology as primitive: for example, a ranking of properties by degrees of naturalness. In each case, the position is characterized by its refusal to give further analysis of the notion at hand.[5]

I mention these only to set them to one side, for my concern here is with the way of Additional Ontology. We have resolved to use 'property' in a somewhat pleonastic sense, so that any (logically coherent) predicate will correspond to a property. But there is another traditional usage of the term 'property' where they correspond to only a privileged few predicates.

One theory of such 'sparse properties' is described by Armstrong [1978b]. He calls his sparse properties *Universals*: to avoid terminological confusion, I will henceforth use this name and reserve 'property' for the abundant sense alone. The way of Additional Ontology endorses something like an Armstrongian theory of Universals, and uses this to draw a distinction between natural and relatively non-natural properties. A property P will be natural if and only if there is some universal U such that (necessarily) something has P if and only if it instantiates U.[6]

Is an inegalitarianism based on universals acceptable? Here is an short argument drawn from [Lewis 1999b (1986), p.80] that suggests not:

1. A theory of universals is committed to at least the possibility of there being *structural universals*. [Armstrong, 1978b]
2. Structural universals are incoherent. [Lewis, 1999b (1986)]

Clearly, if the two premises are accepted, the theory of universals must be rejected.

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corresponding parts have the same perfectly natural properties and stand in the same perfectly natural relations [Lewis, 1986a, p.61] (For present purposes, I will not distinguish between 'natural' and 'perfectly natural' properties, though it might become important if ones inegalitarian framework is formulated in terms of orderings or degrees of naturalness.) For details of how to use duplication to handle the other projects, see Lewis [1999 (1983), passim].

[4] For criticism of resemblance nominalism, see [Armstrong 1978a] passim. For a potential simplification, see [Hirsch 1993, ch.3].

[5] For an attack on Primitivism, in the context of the kind of set-theoretic treatment of properties and relations favoured by Lewis, see [Sider 1996].

[6] Lewis later considers an additional competitor involving which combines primitive ontology with 'similarity' ideology. This is a theory of 'sparse' Tropes + primitive "perfect trope duplication" discussed in [Lewis 1999b (1986)].

1 Structural Universals

What are Armstrongian structural universals? First, they are Armstrongian universals - entities which are 'instantiated' by particulars, and wholly present wherever they are instantiated. Two objects that share a Universal *resemble* each other in that respect. They cannot exist without being instantiated (i.e. they are 'Aristotelian' rather than 'Platonic' universals). Armstrongian *structural* Universals are then complex entities 'formed out of' other, more basic universals. A basic example: consider the putative universal METHANE, molecules of which are composed of four hydrogen atoms bonded to a carbon atom. The story is that for something to be METHANE is for it to have parts in an appropriate structural formation that fall under HYDROGEN and CARBON respectively. Just as a methane molecule is composed of parts which are carbon and hydrogen atoms, so the universal METHANE is composed (somehow) by the universals CARBON and HYDROGEN. Or so the story goes.

To avoid invoking this 'constitution' in the very characterization of structural universals, Lewis suggests the following alternative, which I shall accept:

> Anything that instantiates [the structural universal] must have proper parts: and there is a necessary connection between the instantiating of the structural universal and the instantiating of other universals by the parts.
> [Lewis, 1999b (1986), p.81]

Let us call universals which are not structural *basic*.[7] Lewis [1999b (1986)], drawing on Armstrong [1978b, pp.67-68], considers an argument for structural universals:

> Why believe in them? Why not prefer a theory of universals even simpler than Armstrong's, which admits only [basic] universals? Such a theory is simple and elegant. Why not be content with it?
> ...
> Can we be sure that there *are* any [basic universals]? if not, then we cannot dispense with structural universals in favour of the [basic universals] they involve; because they don't involve [basic universals], just other structural universals. Take our previous example [i.e. that of METHANE]. We certainly didn't get down to [basic universals]: a carbon atom consists of electrons, protons and neutrons in a certain structure of bonding; protons and neutrons consist in turn of quarks; it is speculated that quarks in turn are composite... Maybe there is no end to this complexity. Maybe there are no [basic universals], just structures of structures *ad infinitum* ... Even if we believe in (enough) [basic universals], should we adopt a doctrine of universals that presupposes this, and leaves no room for even the possibility of infinite complexity?

[7] Lewis calls them instead 'simple', while distinguishing this kind of 'simplicity' from *mereological* simplicity. I regard this creating unnecessary confusion. I replace Lewis's terminology with my own in the quotation below.

> I take this last reason to be the weightiest by far. Infinite complexity does seem, offhand, to be a genuine possibility.
> [Lewis, 1999b (1986), pp.82, 85-6]

Call a world with infinitely many descending 'layers' of microscopic particles an 'onion world'. [8] In an onion world the descending chain from molecules to atoms to protons to quarks continues indefinitely. If one's metaphysics is formulated in terms of a theory of universals, then Lewis takes it that an onion world would have to involve structural universals. Since the onion world is possible, structural universals must be possible.[9]

Unfortunately, Lewis has an argument that structural universals (at least of the kind that could be present in an onion world) are incoherent. Lewis poses a trilemma for friends of structural universals. He thinks that either (a) structural universals are something like set-theoretic constructs out of basic universals, in which case they could not exist in a world with no basic universals; or (b) they are compound 'pictorial' entities, in which case they make appeal to an (allegedly) unacceptable non-mereological form of composition; or (c) they are non-compound 'magical' entities, in which case they have (allegedly) unacceptable necessary connections to the more basic universals from which they arise.

The latter two elements of Lewis' trilemma may be resisted; but I do not consider such moves here. I shall defend the coherence of a theory of universals whereby (necessarily) every universal is basic. I shall argue that this is compatible with the possibility-even the actuality-of onion worlds. If I am right, the friend of universals has no *need* to find fault in Lewis' trilemma.

2 A second reason for resisting structural universals in onion worlds.

Let me mention another reason to be interested in resisting the description of onion worlds as involving infinitely complex structural universals. Our interest in Universals, for present purposes, is as a way of making an inegalitarian account of properties. We wanted *this* because of the philosophical work that inegalitarianism does, of which we listed many examples above. But, at least in the versions given in [Lewis 1999a (1983)], these theories appeal to *perfectly natural* properties-an all-or-nothing divide between the 'elite' properties (corresponding to universals) and the rest. For example, the Humean account of laws of nature requires that competing theories' primitive vocabulary pick out

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[8] The name is due, I believe, to [Sider 1995].

[9] For discussion, see [Mellor 1992; Oliver 1992; Sider 1995; Schaffer 2004]. Some of this discussion (as the titles indicate) focuses on the possibility of *conjunctive universals* as opposed to *structural universals*. The discussion in [Armstrong, 1978b] takes this line. The generalization to the case of structural universals is fairly clear, however. Lewis translates the argument to this case without comment and later discussion often treats the two together. Though I have focussed on structural universals in this paper, the way of resisting the onion argument for structural universals can be transferred wholesale to the parallel debate over conjunctive universals.
Very similar "infinite complexity" arguments have been offered in support of the possibility of *atomless gunk*. I believe that the kind of considerations adduced below ultimately undermine these arguments too; but to extend them in this way raises several new issues and will not be discussed here.

such elite properties. I argue in [Williams 2006] that his account of content of language makes exactly the same assumption. The account of duplication is likewise formulated in terms of perfectly natural properties: two things are duplicates if they share each other's perfectly natural properties.

It is often assumed that only basic universals count as 'perfectly natural'. The basis for this is the principle that a structural universal is less natural than its structural parts: METHANE less natural than HYDROGEN, for example. As we decompose structural universals into their parts, we will find more and more natural universals. We only find a 'highest degree' of naturalness if at some point we come to basic universals. Or so the thought runs.

If the principle linking structural universals to decrease in naturalness is accepted, then an onion world, framed in terms of ever-embedded structural universals, is highly problematic. In a world having no basic universals, and so no deservers for the title of 'perfectly natural' properties, the theories of duplication, laws, content and so forth could not be formulated as they stand. That is a severe complaint against those theories, if sustained (especially so if, as [Schaffer 2003] argues, it is an epistemic possibility that the actual world is an onion world).[10]

3 The onion argument

The argument for structural universals to be considered is the following.[11] It is a familiar fact that atoms are structured entities, composed of certain arrangements of protons, neutrons and electrons. It is also a familiar fact that protons and neutrons are in turn composed of certain more basic entities: quarks. Have we any reason to think that the decomposition of pretty fundamental particulars into more fundamental ones stops there? Why not suppose that there are yet more particles: the *sub-quarks* which combine to form the quarks?

Perhaps fundamental physics gives us good reason to discard this hypothesis. But in any case, it should be a *metaphysical possibility* that there be a world macroscopically similar to our own, where quark-counterparts are composed of more basic entities. Like the

[10] This kind of concern is developed in [Sider 1995]. I am careful to hedge this second point. This is because it seems to me that we might be able to finesse the issue. In the setup of Lewis's theories of duplication, laws and content, replace 'perfectly natural' throughout with 'natural', where the natural properties are exactly those that correspond to universals (whether basic or structural). It seems to me that these modified versions of the above theories are as well motivated as the original. Indeed, I am not even sure that we can't read 'perfectly natural' (as used in the original formulation in [Lewis 1999a (1983)]) so that it coincides with 'natural' as here defined. That would be a reading of 'perfectly natural' on which the principle linking structural universals to decrease in naturalness would be denied.

[11] The argument is outlined in [Lewis 1999b (1986), p.85-6] and attributed to [Armstrong 1978b, p.67-8]. The argument in Armstrong is actually concerned with simple vs. complex universals, not (as in Lewis' presentation, and here) with basic vs. structural universals. But the debate, and in particular, my objection to the argument, makes sense in either setting.

layers of an onion, we can go on to posit yet further layers of more-and-more fundamental entities: each time, there will be a possible world where the scenario is realized.

At the limit, we might consider a world of *infinite* complexity. In such a world, for every layer of pretty-fundamental particles, there would be an underlying layer of yet-more-fundamental entities, just as the quarks underlay the protons which underlay the atoms. Call a world where this is realized an 'onion' world. In some onion worlds, there may be 'ultimate' particles lying beyond the whole infinite chain of more-and-more fundamental entities. But there seems no necessity for this. Call a world where the only fundamental particles are those in the infinite chain a *proper* onion world. The first move of the argument for structural universals is the claim that a proper onion world is a metaphysical possibility. Let us grant this *pro tem*.

The second move in the argument is the claim that for each kind of fundamental particle F, the universal F-HOOD is structural (if it exists at all). For the fundamental F-particles are composed of particles the more fundamental kind F′. And these particles stand to F particles just as HYDROGEN and CARBON stand to METHANE. So (the thought goes) if there is a universal F-HOOD, then it is structural.

Suppose there were no structural universals in the onion world. Then, by the considerations adduced above, the property *being an F* does not correspond to a universal. But F was arbitrary. So none of the kinds of particles correspond to a universal. Since that scenario is impossible, but the proper onion world a possibility, there must be structured universals around.

4 Attacking the argument

I shall not here attempt a detailed analysis of the moves in the argument from onion worlds to the metaphysical possibility of structural universals. Rather, I shall identify what I take to be a key strategic weak point: on any precisification, the argument will fall to the considerations below.

I start by noting that both Armstrong and Lewis allow for a kind of 'higher level' universal other than those composed structurally of more basic universals. These are the *emergent* universals.[12] A traditional example might be *being alive*, conceived as something that cannot be reductively characterized in terms of more basic properties.

[12] Armstrong endorses the possibility (though not actuality) of these on p.69 of *A Theory of Universals*:

> it seems possible that particulars might have *over-all* or *emergent* properties ... which were distinct from any property-structure possessed by the particulars having the emergent property. ... Unlike a structural property, such a property could be simple... . Characteristically, reductionists do not believe in the existence of properties of this sort, and I myself think that there are good methodological and scientific reasons for being sceptical about claims that such properties exist. But I cannot see that their existence is ruled out *a priori*.

Lewis' acceptance of the *possibility* of (alien) emergent properties is illustrated, for example, during his discussion of the contingency of materialism at [Lewis, 1999a (1983),p.35] and at [Lewis 1986b, p.x].

Given the supposition that it is impossible to structurally characterize the circumstances in which the property is instantiated, if there is a universal BEING ALIVE, it cannot be structural. Emergent properties in this sense would be *basic*, and would typically hold of relatively complex entities.

Another potential example of an emergent universal is CONSCIOUSNESS, as conceived by David Chalmers [1996]. This time, we focus on Chalmers' claim that the link between the high-level property of consciousness and the structural arrangements of physical properties is merely *nomological*: that there are metaphysically possible worlds which are physical duplicates of this one, where nothing is conscious (/instantiates the universal CONSCIOUSNESS). Given this, Chalmers' CONSCIOUSNESS cannot be a structural universal in Lewis's sense, since for something to be a structural universal there must be "a necessary connection between the instantiating of the structural universal and the instantiating of other universals by the parts".[13]

We can define what it is to be a emergent universal for present purposes as follows: (1) it is a universal that can hold of relatively high-level particulars without having to instantiate all the parts of that particular;[14] but (2) the relation between the instantiating of the high-level universal and the instantiating of universals by its parts is metaphysically *contingent*. By definition, then, an emergent universal is not a structural universal.
My first suggestion to the universals theorist is that, with Armstrong and Lewis, they allow that emergent universals so-characterized are metaphysically possible. One might still hope that the actual world does not contain any of them, as do Lewis and Armstrong. But ruling such alien properties *impossible* would take new arguments, since (for example) none of the problems that Lewis identifies for structural universals afflicts the friend of (the possibility of) emergent universals.

Let us now defend Lewis's 'simpler' version of a theory of universals, on which there structural universals are metaphysically impossible. Lewis holds an 'ultrasparse' conception of universals according to which, in the actual world, there are only universals for the most fundamental properties of microphysics: just enough to fully describe the most fundamental microphysical structure of the world (compare Schaffer [2004]). On this view, it might be that the assay of universals in the actual world includes QUARK, but if so it will not include PROTON or HYDROGEN or METHANE. Nevertheless, as just mentioned, Lewis allows that relatively high-level emergent universals are a metaphysical possibility. Like the putative emergent universal of Chalmersian CONSCIOUSNESS the pattern of instantiation of these emergent universals would not

[13] I set to one side for present purposes Chalmers' suggestion that consciousness might be a property possessed by organisms (ultimately) in virtue of their microscopic parts possessing *non-physical* properties. If this is right, person-level consciousness at might turn out to be a universal structured from non-physical components.
[14] That is, that they are *anomoeomerous* in Armstrong's sense [Armstrong, 1978b, p.169]

supervene with metaphysical necessity on the pattern of instantiation of the lower-level universals.[15]

Like the putative emergent universal ALIVE emergent universals *need not* stand in any systematically statable relationship to the patterns of instantiation of lower-level universals. But, as a matter of contingent happenstance, in a particular possible world they may end up constantly correlated with certain patterns of instantiation at lower-levels. Lewis therefore has no need to deny, and no grounds for denying, that there is possible world just like the actual one *except* for there being an emergent universal that instantiated by all and only protons. Call this PROTON*.
Given the conception of emergent universals sketched above, PROTON* has no (metaphysical) necessary connections to QUARK and the rest of the fundamental base. They can exist and be instantiated in relevant patterns without it existing; it can exist without them existing. If Lewis is right, the actual world witnesses the former scenario. An example of the latter scenario might be a world qualitatively like our own 'from the protons up', but where there are no correlates of our quarks, but where the things which play the proton-role are mereologically simple.

5 Describing onion worlds

With this possibility in mind, there is an obvious metaphysical description of an onion world that is acceptable on the Lewisian picture. It is one wherein the relation between PROTON* and QUARK is replicated 'all the way down'. In this scenario, there are infinitely many 'layers' to reality, but no metaphysically necessary connections tying the levels together. It is a contingent feature of the world that the universals instantiated at the various layers are in perfect harmony.

Onion worlds, therefore, can be ones where every universal is emergent. Each such universal will hold of particulars (e.g. the proton-counterparts, the quark counterparts, the sub-quark counterparts etc) which always decompose into parts instantiating further distinct universals; and there are no metaphysically necessary connections between the stages. Since we have already conceded the possibility of emergent universals, there seems no reason at all to reject the possibility of the scenario described.

The argument for structural universals from the possibility of onion-worlds therefore fails. The onion world may indeed require infinite complexity, but only in that it has infinite *layers* of universals. It takes further argument to show that the relevant universals would have to be *structural*. No such argument is in the offing.

6 Nomological connections

[15] If the patterns of instantiation did stand on relations of metaphysical supervenience, Lewis's objections to the 'magical' conception of structural universals would be applicable to them.

We have emphasized that there are no metaphysically necessary connections between the layers of universals in onion worlds. Nevertheless, there may be *nomologically* necessary connections between the layers of emergent universals. It may be nomologically necessary (a matter of physical law) that quarks, arranged thus-and-such, will form a proton*, just as on Chalmers' view consciousness stands in nomological relations to patterns of instantiation of physico-functional properties. On a theory of physical laws like Armstrong's , this would require a higher-order universal to hold between QUARK and PROTON*. There seems no reason to exclude such higher-order relations from obtaining between higher-level and lower-level universals. At the very least, the burden is on the Armstrongian Realist about laws to explain why such relations are metaphysically impossible.

Nomological connections are even cheaper if one adopted Lewis's Humean view of laws of nature. For nomologically connections to obtain between higher-level and lower-level universals would simply require that the best theory of the distribution of basic universals entail a sentence appropriately linking quark-hood to proton*-hood. Given that PROTON* *is* among the basic universals, accounting for facts about its pattern of instantiation is one of the constraints on best theory. Hence, a Humean account can be expected to include 'bridging principles' that allows us to derive facts about its co-location with patterns of lower-level universals.

All this can be argued even before we begin the consider onion worlds. The conclusion is general: there is no reason to resist nomic connections between emergent universals and patterns of lower-level universals. Transferred to the case of the onion world, this has the result that it might well be that each layer of the 'onion' supervenes with *nomic* necessity on the distribution of universals at lower levels.

Suppose, then, that such nomic connections are in place. Our emergent universals are very similar structural universals under the 'magical conception' described in [Lewis 1999b (1986)]. The *only* difference would be that the magical conception of structural universals postulates metaphysically necessary connections between simple high-level universals and their parts, whereas on the present conception such connections are merely nomic. Since it is the alleged mysterious nature of this metaphysically necessary connection that forms the basis of Lewis's objection to magical structured universals, Lewis's objections do not transfer to the present case.

If one wishes, one could describe the emergent universals to which I am appealing as 'nomically structured universals', and think of the considerations above as showing that there is a theory of structural universals to which Lewis should have no objection (even if he thinks that actuality isn't set up that way).[16] The decision whether to talk this way, or rather to stick with the original characterisation of structural universals and view the current argument as *defeating* the argument from onion worlds to structural universals is, I take it, merely terminological.

[16] Thanks to Josh Parsons for discussion of this point.

7 Conclusion

As Lewisians, we might not like emergent universals; but we should admit the *possibility* of their existence. We also should concede that it is *possible* for them to have nomological connections to the 'bottom-level' universals. Indeed, we need not stop at protons. There is a possible world where there are emergent basic universals of HYDROGEN*, METHANE* and the rest, nomically connected in appropriate ways. In short, the Lewisian need not deny the *metaphysical possibility* of the generous emergentism commended by Schaffer [2004], whereby every scientifically interesting property from any level of science (physics, chemistry, biology, psychology...) corresponds to a universal.[17] They simply deny that *actuality* is this way. Similarly, the Lewisian can concede the *possibility* of endless universals at lower and lower levels. As described above, this provides all the resources needed to make out the possibility of onion worlds. Again, she denies its *actuality*.

The Lewisian takes herself to have good reason to reject structural universals. She can thus put the burden of proof on friends of structural universals to describe scenarios which require we postulate them. As we have seen, onion worlds do not turn the trick.

Consider three characters. The first is friend of universals convinced by Lewis' argument against structural universals. She thought that she had to reject the possibility of onion worlds. She should be happy with the conclusion I have urged: for she is now spared the embarrassment of brutely excluding apparent metaphysical possibilities. The second character was initially attracted to a universals theory, but being convinced both by Lewis's considerations against structural universals, and the Lewis/Armstrong onion-world argument for them, had given it up. The current discussion shows them how to safely accept the possibility of onion worlds, reject structural universals, and endorse the universals-based accounts of duplication, intrinsicality, laws, content and the rest.[18] The final character was prepared to endorse Armstrongian Universals and resist Lewis's trilemma against them. But this was merely negative-she maintained they were coherent. She needed to be shown a positive case in favour of structural universals. Here, the Armstrong/Lewis onion world argument convinced her that at least in some possible worlds, there must be structural universals. If I am right, then such a character needs to look again at her motivations: for the possibility of onion worlds have no bearing on the existence or otherwise of structural universals.[19]

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[17] It is unclear to me whether [Schaffer 2004] endorses the existence of new 'disjunctive' forms of structural universals, or is arguing for emergent universals in my sense.

[18] The arguments given here transfer directly to the case of complex vs. simple universals (e.g. conjunctive *being positively charged and spin up* vs. 'atomic' universals *being positively charged*.) Onion-world-style considerations in favour of the existence of conjunctive universals can be handled using plentiful emergent universals.

[19] In particular, one could not use the worlds to establish the basic form of metaphysic endorsed by Forrest's abstractionist account of possible worlds as (often uninstantiated) structured universals.

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