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Second-order relations and nomic regularities

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Abstract Bird's Ultimate Argument sought to show that Armstrong's N relationships involving categorical universals can't entail nomic regularities. In N's place Bird offered the non-categorical SR relation. Two kinds of objection have been raised: either Bird's own alternative metaphysics fails in just the same way as Armstrong's or the target of Bird's argument may anyway have a way out of the problem. My aim is to reclaim the victory for Bird. I argue that the responses in defence of Armstong's N relationships fail to acknowledge that Bird was explicitly concerned with Armstrong's commitment to a categoricalist view of universals. Moreover, Bird's alternative account does not suffer the same problem since his metaphysics of properties is essentialist. Nevertheless, Bird's account does need elaborating on to explain *why* SR relationships entail their regularities. I offer Schaffer's Axiomatic Solution as a candidate for this purpose.

Keywords Nomic necessitation · Dispositional essentialism · Laws · Inference problem · Second-order relations · Axiom choice

1 Introduction

A 'realist', for the sake of what follows, takes any strict regularity to be the inclusion of the extension of one universal within that of another.[1] But not all regularities are created equal for such a realist. Some are a result of mere

[1] The realism here is specifically one about natural properties. By casting it explicitly in terms of universals I mean to obviate the need to discuss tropes.

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happenstance, without need for any deep explanation, whereas others are lawlike. To explain the distinction a number of realists have proposed the existence of second-order nomic relations between those universals involved in lawlike regularities. Though the details vary, it is generally accepted by those who propose them that second-order relations can only fully explain a regularity if they also entail it. If they didn't, so the thought goes, the realist would have to either accept that the relation and regularity both hold, when they do, as a matter of happenstance, or else propose some further (third-order) relation to support the explanation. Both options undermine the realist programme for explaining lawlike regularities with second-order relationships.

Bird (2005) has presented an 'Ultimate Argument' showing that Armstrong's proposal of a categorical nomic relation (N) between universals cannot confer this entailment. Consequently, N cannot explain the difference between a lawlike regularity and a happenstantial one. Bird therefore suggests an alternative, non-categoricalist 'manifestation' (Bird 2007a, 139) or 'stimulus-response' (SR) relation (Barker & Smart 2012) which essentially individuates the related universals and which, Bird claims, does entail the regularity. It seems that Armstrong himself was impressed with the force of Bird's argument and amended his view in a similar manner (Armstrong, 2005).

Since Bird's argument, and Armstrong's reply, a number of arguments have been provided which aim to complicate the victory for Bird's SR relation over Armstrong's N relation. First, some have suggested that Bird's argument, or the closely related 'inference problem', are insufficient to undermine Armstrong's account. Barker and Smart suggest Armstrong might make appeal to brute necessities to avoid the problem, Coates (2019) suggests that Bird ignores the possibility that categorical properties might have a qualitative nature which determines the regularities, and Schaffer (2016) has suggested that Armstrong might simply stipulate an axiom that N relationships imply their corresponding regularities. Second, Barker and Smart (2012) claim that in providing his alternative view, Bird confuses the constitutive role played by SR with the necessitating role he claimed N can't confer. As a consequence, they claim Bird's SR 'faces precisely the same objection' (p.717) Bird foisted on Armstrong's N. As a consequence, some have considered Bird's alternative in as much need of 'rescuing' as Armstrong's (Tugby, 2012; Kimpton-Nye, 2021).

My aim in what follows is to re-establish the superiority for Bird's SR relation, at least with respect to the criticisms just cited. First, the proffered responses on behalf of Armstrong are not, I claim, available to him, given the specific position of his which was the target of Bird's argument. Second, Bird's substitution of SR for N is in no need of 'rescuing' from the Ultimate Argument. I begin (Sect. 2) by rehearsing Bird's Ultimate Argument against the explanatory power of N. I'll then (Sect. 3) describe each of Barker and Smart's, Coates's and Schaffer's suggestions for how Armstrong's N relationships might circumvent the Ultimate Argument. I'll then (Sect. 5) move on to consider Barker and Smart's argument that Bird's SR relationships suffer the Ultimate Argument too. I'll explain (Sect. 6) why this argument is false. Where the Ultimate Argument proves that N relationships *cannot* entail regularities without changing Armstrong's specific view of universals, which was Bird's explicit target, Barker and Smart's argument shows only that Bird has not provided an account of *why* SR relationships entail their regularities. I'll

consider (Sect. 7) whether any of the foregoing responses on behalf of Armstrong can be appropriated by Bird to address this issue and will suggest that the most promising is Schaffer's Axiomatic Solution. I'll suggest (Sect. 8) that this solution can be made palatable for the defender of SR relations as it also supplies a solution to another issue the realist faces, of explaining the entailment from second-order determination relations to their regularities. Section 9 concludes.

2 Bird's ultimate argument

For any two universals F and G related by a lawlike regularity, Armstrong posited a second-order 'relation of non-logical or contingent necessitation', 'N(F,G)', to explain it (Armstrong, 1983, 85). Let's consider an example. Particles with half-integer intrinsic angular momentum, or 'spin', can be deflected in inhomogeneous magnetic fields. In realist terms this amounts to the extensional inclusion of things instantiating a universal $\frac{1}{2}$-SPIN among those which instantiate the universal DEFLECT, where the former is the universal instantiated by all particulars with half-integer spin, and the latter by all particulars which accelerate in inhomogenous magnetic fields. Crucially, the regularity is lawlike, rather than accidental (although it is also heavily idealised).[2] Under Armstrong's proposal, therefore, there is a second-order relationship N($\frac{1}{2}$-SPIN, DEFLECT): the state of affairs or fact of $\frac{1}{2}$-SPIN nomically necessitating DEFLECT.

As others have pointed out, the label 'necessitation' for such relations masks a highly contentious aspect of the account, and Armstrong struggled to satisfactorily explain how the second-order relationship entails the regularity (Armstrong, 1983; Lewis, 1983; Van Fraassen, 1989). Following van Fraassen, this has come to be known as the 'inference problem'. Bird's Ultimate Argument is not quite the inference problem. But it shows, in effect, that so long as N and its relata are categorical, the inference problem cannot be solved.

There is plenty of debate over the details of what it means to be categorical, but for our purposes we need only go by the details which were important to Armstrong at the time. At its core, a categorical property is one individuated in contrast to dispositional properties. Where dispositional properties have 'a nature that is exhausted by their possible [...] manifestations' (1997,76), categorical properties 'are self-contained things, keeping themselves to themselves, not pointing beyond themselves to further effects brought about in virtue of such properties' (ibid. 80). In Bird's terminology, this difference amounts to a matter of whether or not a property has an essential, nontrivial modal character. Dispositional properties have essential non-trivial modal characters, whereas categorical properties do not.

[2] The suggestion of extensional inclusion masks the detail of the necessary background conditions. It may also not be obvious how complex relations as we might expect to hold among the multiple variables of a dynamical law should be presented in terms of mere extensional exclusion. Nevertheless, I'll assume as Armstrong and fellow discussants seem happy to, that these details are only a complication to the logical form of regularities as opposed to something that should seriously influence our ontological distinction between laws and accidents.

As it turns out, however, Bird's use of 'categorical' in his Ultimate Argument is broader than this. As Bird uses the term, categorical properties are ones which,

> have no essential *or other* nontrivial modal character. For example, and in particular, properties do not, essentially *or necessarily*, have or confer any dispositional character or power. (2005, 147, my emphasis)

This broader conception of categorical properties, which Bird attributes to Armstrong, not only denies that they have any essential nontrivial modal character (as does the narrower conception) but also denies they have any *necessary* nontrivial modal character. To believe that there is such a distinction between broad and narrow conceptions is to buy into the now-popular idea that essence is *hyperintensional*, going beyond mere specifications of necessity (Fine, 1994; Nolan, 2002). Although Bird has signalled awareness of the distinction, the relevance of it to his Ultimate Argument is perhaps not as clear as it could have been (but see Bird, 2007a, fn.64). Nevertheless, the distinction is requisite for Bird's argument to go through. It also bears emphasising (since it will be important later on) that in requiring this broad conception Bird did not present a straw-man argument. Armstrong made clear in numerous texts that he held the broader conception of categorical properties (Armstrong 1978, 1989, 1997, 1999).

Although Bird's full expression of the argument goes through a number of manoeuvres, the basic structure is very simple. Begin by noting that, given the commitment to categorical properties (conceived broadly, as above), the instantiation of universals, like $\frac{1}{2}$-SPIN, cannot entail the instantiation of any others, such as DEFLECT.[3] As a consequence, the extension of $\frac{1}{2}$-SPIN will not necessarily fall within the extension of DEFLECT. But now notice that the extension of $\frac{1}{2}$-SPIN cannot necessarily fall within the extension of DEFLECT even *in worlds where* N($\frac{1}{2}$-SPIN, DEFLECT) *holds*. For N also cannot have any essential or necessary nontrivial modal character. Specifically it is not, by Armstrong's own standards, a relation such that *if* it relates F and G, then the available possibilities are further restricted to those in which F is extensionally included within G.[4] Consequently, any entailment of the same form as (1) (relating distinct universals) must be false.

> (1) Necessarily, if N($\frac{1}{2}$-SPIN, DEFLECT) then all particles with $\frac{1}{2}$-integer spin accelerate in inhomogenous magnetic fields.

The antecedent N relationship can't entail the consequent regularity because that would mean at least one of the involved universals (i.e. N, $\frac{1}{2}$-SPIN or DEFLECT)

[3] As Armstrong and Bird have separately noted, things would be different if the involved universals were complex and related by inclusion somehow, e.g. if $\frac{1}{2}$-SPIN *contained* DEFLECT or DEFLECT was a disjunctive universal involving $\frac{1}{2}$-SPIN (Armstrong, 1983, 86, Bird, 2005, Sect. 5). I assume for the sake of this discussion that neither option is acceptable. In particular, they are precluded by Armstrong since they render nomic necessitation relations redundant and their regularities necessary. Bird argues also that such relationships would fail to eradicate regularities from the explanans, since the regular occurrence of the parts of the complex universal would need explaining.

[4] Bird captures this in terms of an entailment of the 'extensional inclusion relation' $R(F, G)$. I think this muddies the waters by introducing a further, potentially spurious, relation into the argument.

has a necessary non-trivial modal character which, according to Armstrong's commitment to the categorical nature of universals, it does not. Consequently, under the assumption that N($\frac{1}{2}$-SPIN, DEFLECT) must entail the regularity in order to explain it (see Sect. 1), this result shows that the N relationship cannot explain its corresponding regularity.[5]

Armstrong was clearly sympathetic with Bird's conclusion.

> Bird has pointed to a real difficulty in my view of laws of nature, or at any rate the position I held in 1997 [...] My properties are universals, and if some universals taken pair-wise sustain such nomic relations then it appears that this sustaining is a [necessary] non-trivial modal character of these universals. (2005, 264)

Armstrong's only defence was that he had already (since 1999) persuaded himself of the need to abandon nomic relations' categorical nature (Armstrong, 2004, 2005) and by the time of Bird's presentation of the argument had come to favour an alternative view of laws more like Bird's own. According to this alternative view, the second-order nomic relationship between two lawfully related universals is an internal and metaphysically necessary relation concerning the very natures, essences or 'partial identities', of the involved universals (see also Swoyer, 1982; Shoemaker, 1997; Chakravartty, 2003; Mumford, 2004; Bird, 2007a). Nevertheless Armstrong's capitulation on behalf of his former position hasn't stopped others attempting to defend his original position.

3 Three responses for Armstrong

The following three responses have been proffered on behalf of Armstrong's original view of laws to Bird's Ultimate Argument. We begin with Barker and Smart's.

> [O]ne option for Armstrong that Bird does not explicitly contemplate is that the necessary connection between N(F,G) and the fact that *Every F is G* is a brute one, so that it's just a basic fact about the nature of metaphysically possible worlds that there is a kind of transworld regularity [...] If we accept this response then Bird's argument is diffused. (2012, 716)

According to the solution, entailments like (1) may be true, though not as a consequence of the essential nature of N, $\frac{1}{2}$-SPIN or DEFLECT, but instead because there simply are *as a matter of brute fact* no worlds in which N($\frac{1}{2}$-SPIN,DEFLECT) holds and the associated regularity does not (and similarly for other universals related by N). Barker and Smart admit that

> Armstrong does not like brute necessary connections between distinct existences, but that dislike does not exclude Armstrong appealing to brute

[5] Quite plausibly, the conditions on explanation should be much higher. Not only should necessitation relation and regularity be necessarily correlated, but the latter should be a *consequence of* the former.

> necessary connections if that is what is required to maintain his necessitarianism. Has Bird provided the ultimate argument against Armstrong's necessitarianism? No. All that's been shown is that Armstrongians are committed to brute necessary connections between distinct existences. (Ibid., 716–7).

A second line of response on behalf of Armstrong comes from Schaffer (2016), who advocates an 'Axiomatic Solution' to the inference problem about how to make sense of entailments like (1) within Armstrong's metaphysics. Shaffer maintains that 'the Inference Problem is based on a confusion,' and argues for this in the following way. Consider first an analogous problem of the 'modalist', who accepts primitive modal facts expressed with the operator '□'. Obviously, the modalist must supply some axioms for how to employ '□' if the operator is to have any meaning, and one plausible axiom (of which there are likely to be more) is the axiom *T* (for truth).

T $\quad \Box p \rightarrow p.$

Evidently, if someone wonders of the modalist's position how it could be impossible to have □ *p* but not *p*, then they have 'simply not understood that the modalist has posited something whose work includes underwriting this very inference via *T*' (ibid., 580).

Something similar can be said for someone who holds a 'knowledge-first' epistemology who accepts primitive facts about knowledge expressed with the operator 'knows that'. Again, they will have to supply some axioms for how to employ the operator, if only to give it some meaning, and one plausible axiom would be *B* (for belief).

B $\quad$ *S* knows that $p \rightarrow$ *S* believes that *p*.

Such axioms are perfectly legitimate and moreover essential in order to define a posit. The modalist simply insists that *T* is one of the axioms for her posit; the knowledge-first epistemologist insists that *B* is one of the axioms for hers. Analogously, so argues Schaffer, the defender of Armstrong's view of laws can simply stipulate that underwriting inferences of the form of (1) are just an axiomatic feature of the operator 'N', e.g.,

Inference for N $\quad \mathrm{N(F,G)} \rightarrow \forall \mathrm{x(Fx} \rightarrow \mathrm{Gx)}.$

So, Schaffer argues,

> when Lewis (1983, 366) says to Armstrong: "I cannot see how it could be absolutely impossible to have N(F, G) and Fa without Ga", I reply that Lewis has not understood that Armstrong can and should stipulate that N is a relation such that Inference for DTA holds. (Ibid., 580)

It can be tempting to object that an insistence on axioms is all too easy. After all, simply stipulating an axiom is not in and of itself a way to say anything significant about the contents of the world. So why believe in relationships of the form N(F,G) which satisfy the axiom *Inference for N* any more than some other kind of

relationship N'(F,G) which doesn't? Schaffer argues that theorists who endorse relations axiomatised in the above ways have a reason for their belief: that it is an inference to the best explanation of certain regularities (Schaffer, 2016, 583–4). For instance, belief in relationships like N(F,G) are justified over belief in relationships like N'(F,G) by the fact that the former only entail their regularities, which is arguably a good indication that they explain those regularities, and at the very least a necessary condition of their ability to explain (we are assuming). Indeed, an inference to the best explanation is just how Armstrong seems to have thought about his N relationships all along (e.g. Armstrong, 1983, 83).

Although Schaffer doesn't mention Bird's Ultimate Argument, it's safe to assume that his 'Axiomatic Solution' would supply a response to that too. The Ultimate Argument is, after all, an attempt to validate the tension revealed by Lewis's and van Fraassen's original inference problems by showing that any solution would result in a contradiction (Bird, 2005, 148–9).

Finally, Coates (2019) acknowledges both Barker and Smart's and Shaffer's responses, but also considers a third. The response is to conceive of categorical properties as *qualities* (see, e.g. Jacobs, 2011; Smith, 2016).

> The key thought is that such properties could occupy their dispositional roles in virtue of having their qualitative essences. While this idea has the consequence that natural properties occupy their dispositional roles necessarily, the properties, nonetheless, are categorical properties just because they have purely qualitative essences that do not include their dispositional roles. (10)

Coates does not endorse this qualitative conception. He also points to sections of Armstrong's work that clearly suggest a thinner conception (Armstrong, 1997, viz. 168-9). Nevertheless, Coates maintains that 'it seems possible for the Armstrongian conception of the laws of nature to be conjoined with the qualitative view' (2019, 9). As a consequence, he argues that 'Bird's own argument that this problem is fatal for David Armstrong's influential theory of the laws of nature but not for dispositional essentialism is seriously flawed' (ibid., 1).[6] For as with the other responses, if this qualitative conception of categorical properties can be endorsed by Bird's target then it would permit entailments of the form of (1).

Summing up, we've considered three responses on behalf of Armstrong to the Ultimate Argument. Their success obviously depends on what one takes their goal to be. I will not here dispute that any of the responses are plausible routes to ensuring entailments of the form (1). And if that is all the responses are put forward for, then for all I will say, they are successful. However, in all three cases, the respondents aim to show more than this. In each case, the respondents want to show that their suggestions undermine the kind of reasoning involved in Bird's Ultimate Argument. In the first and third solutions this is quite explicit. Barker and Smart

[6] Coates is specifically interested in an interpretation of the inference problem called the 'validation problem', as opposed to the 'explanation problem' (see Pagès, 2002 for the original demarcation). The focus seems to be also that of Bird's in critiquing Armstrong, and I agree with Coates that Barker and Smart's criticism of Bird may be a result of a failure to acknowledge the distinction.

suggest that Armstrong has available an option 'Bird doesn't contemplate', and Coates suggests that Bird's argument is 'flawed' due to its failure to consider the thicker conception of qualitative properties. Schaffer's own suggestion is not made in direct response to Bird, but his suggestion that Armstrong had a ready response to Lewis's objection to the entailment from N relationships to regularities clearly has import to Bird's argument. In the following section I'll argue that this is *not* something any of the respondents achieve.

4 Bird's ultimate argument sustained

Bird's Ultimate Argument is not an attempt to show that there is some reasonable metaphysics of laws taking departure from Armstrong's own according to which entailments of the form (1) are true. As the first line of Bird's (2005) abstract indicates, his intention was to 'show that Armstrong's view of laws as second-order contingent relations of 'necessitation' *among categorical properties* faces a dilemma' (my emphasis).[7] As I've already emphasised, for the sake of Bird's argument being *categorical* is to be 'understood in the following sense: they have no essential or other nontrivial modal character (Armstrong, 1997, 80–83)'. Bird's Ultimate Argument is, therefore, an attempt to show that there is no reasonable metaphysics of laws according to which (1) is true which maintains that specific understanding of properties. It's also clear that this is a conception of properties Armstrong at one time endorsed.

It's straightforward to show that two of the considered responses fail to undermine this. Barker and Smart suggested that Armstrong endorse brute necessities to restrict the worlds to those in which, wherever N(F,G), also *all Fs are Gs*. And Schaffer suggests that Armstrong endorse an axiom which stipulates that N support the corresponding regularities. But either view is clearly inconsistent with the broad conception of categorical properties constitutive of the target of Bird's argument, since it permits N to have a necessary nontrivial modal character.

Coates' suggestion is only a little less stark in its inconsistency with Bird's target. His suggestion is that Armstrong endorse a qualitative conception of categorical universals, yet specifically one infused with the idea of Jacobs and Smith (among others) that 'has the consequence that natural properties occupy their dispositional roles necessarily'. Coates may be right that such a conception of categorical properties is coherent, even tempting. But it is explicitly not the understanding of categorical properties Bird has within his sights. The sense Bird says he means by 'categorical', and (rightly) understands Armstrong to have meant by it as well, is that of a property which has 'no essential or other nontrivial modal character'. Under Coates' suggestion, categorical properties would not satisfy this constraint, since they would exactly have some (non-essential) nontrivial modal character. So,

[7] The dilemma being, specifically, that between opting for contingent laws, and so facing a failure of entailment, or rejecting contingent laws, and so facing incompatibility with Armstrong's favoured view of properties. In my rendition of Bird's argument I simply put this in terms of the first horn: *given* the view of properties and the contingency of laws, the entailment cannot follow.

despite Coates' suggestion that Bird's argument is 'seriously flawed', it is in fact implausible that the target of Bird's argument could endorse Coates' solution.

Of course, none of this shows that the proffered solutions aren't coherent or even promising moves for someone starting out from Armstrong's initial position on laws. For all I will argue, Barker and Smart might well be right when they claim that, while Armstrong didn't 'like brute necessary connections' that doesn't exclude 'Armstrongian necessitarians' from appealing to them to avoid Bird's argument. Coates makes the analogous remark that despite Armstrong preferring a thinner conception of properties, 'it seems possible for the Armstrongian conception of the laws of nature to be conjoined with the qualitative view'. But there's a difference between finding reasonable ways to avoid an argument and showing that the argument itself is flawed. And the reference to what an 'Armstrongian' might chose to say is clearly too vague to establish the latter aim with respect to Bird's Ultimate Argument. What really seems to matter to all of the respondents considered above is not whether some view or metaphysician deserving the relatively unconstrained title 'Armstrongian' can endorse entailments like (1), but whether the target of Bird's Ultimate Argument can—a target which Armstrong himself conceded his views fell into at one time. I think it's fairly clear that none of the respondents have succeeded in achieving this.

To reiterate, Bird's argument aimed to attack 'Armstrong's view of laws as second-order contingent relations of 'necessitation' *among categorical properties*' specifically understood in the sense of 'having no essential or other nontrivial modal character'. It was not to attack some alternative view which takes laws to be second-order relations but only in a weaker or different categorical sense than Armstrong in fact wanted to defend. Given that none of the responses mentioned in Sect. 3 are consistent with this target of Bird's Ultimate Argument then, for all they have shown, his argument is successful.

As we've seen Armstrong himself was sympathetic to Bird's Ultimate Argument and indicated that it was only via a rather radical overhaul of his metaphysics that he was able to avoid it. In particular, his later 'partial identity' view of particulars and universals gave up on the idea of contingency of laws (Armstrong, 2004, 146). That is something advised under Coates's response, but Armstrong's later view was not one of introducing a qualitative conception of categorical universals. In effect, it was to give up on categoricalism entirely. In these respects, the resulting picture is similar to that developed by Bird. But as we're about to see, Bird's own view has been charged with suffering from the Ultimate Argument too.

5 Barker and Smart's Ultimate Argument

Aside from their invitation for 'Armstrongians' to posit brute necessities, Barker and Smart (2012) otherwise grant the success of Bird's argument. However, they are not fans of Bird's alternative view either, and they present what appears to be the embarrassing result that it faces exactly the same issues as Armstrong's.

Barker and Smart describe Bird's alternative view (correctly as I see it) as the idea that any two nomically related universals F and G are *essentially* related by a

second-order 'stimulus-response' (SR) relation. Because SR is, for Bird, really a relation which helps to characterise dispositional universals Barker and Smart treat it as a triadic relation between stimulus, disposition and manifestation (hence, SR(S,D,M)). However, this is a complication which can be ignored, since nothing in either Bird's or Barker and Smart's argumentation is lost if we continue treating SR as diadic; hence, SR(F, G).[8] Barker and Smart also draw attention to Bird's ingenious solution to how a distribution of SR relationships can constitutively individuate universals by forming an asymmetric structure in which there are no non-trivial automorphisms. Again, however, this is not crucial to the argumentation on either side. All that is required is that we understand that for Bird, universals are not categorical in either narrow or broad sense, since their very natures are constitutively identified by their SR relationships with other universals.

It is the existence of SR between two universals which Bird thinks renders the corresponding regularity among the universals' instances nomic. Moreover, because the SR relationship determines the essential constitutive nature of the first-order universals being related, Bird hopes to improve on Armstrong's account by permitting the analogous entailments, e.g. (2).

(2) Necessarily, if SR($\frac{1}{2}$-SPIN, DEFLECT) then all particles with $\frac{1}{2}$-integer spin accelerate in inhomogenous magnetic fields.

However, as Barker and Smart emphasise, the mere fact that some necessary second-order relation exists between first-order universals is by itself no reason to think that there must be the corresponding regularity. In Barker and Smart's terminology, we may grant that SR plays a 'constituting role' in determining the identity of the universals it relates, but that is not alone sufficient to entail that it also plays the 'governing role' required if one relatum's instances are to be accompanied by the other's in a lawlike way.

The failure to show how SR relationships play this governing role is, for Barker and Smart, tantamount to making exactly the same error Armstrong did. Armstrong used 'necessitation' to denote his second-order relationships, Bird uses 'manifestation' (2007a, 139–46). But in neither case is that relationship being called as it is enough to make it do what is posited of it (cf. Lewis, 1983, 366). It makes no difference that the relation Bird posits plays a role in individuating universals, for universals' identity is an independent issue from whether those universals are able to explain any regularities. In sum, where Bird claims to have provided the Ultimate Argument against Armstrong's categoricalist account, Barker and Smart claim he has also effectively brought about the failure of his own account.

As I'll now demonstrate, Barker and Smart have not in fact shown that Bird's account fails for the same reasons Bird attributes to Armstrong. Nevertheless, it does raise an issue worth addressing.

[8] Indeed, Bird's own solution to the Ultimate Argument does not advise change to the adicity of the relation. Moreover, the adicity of dispositions' characterising relations is anyway up for debate (Vetter 2015).

6 Barker and Smart's Ultimate Argument is not an ultimate argument

Barker and Smart present their criticism of Bird as a repackaged version of the Ultimate Argument Bird used against Armstrong. For example, they claim that 'precisely the same regress afflicts Bird's [...] theory' (2012, 714), and that he is 'hoist by his own petard' (ibid., 720). This is plainly false (see Coates, 2019 for a related argument to the same conclusion). Bird's Ultimate Argument makes essential use of the reference to Armstrong's categoricalist ontology: it is because Armstrong refuses to admit non-trivial modal ties among properties that he cannot account for an entailment from any relationship of the form N(F,G) to the corresponding inclusion of Fs among the Gs. But Barker and Smart's objection makes no suggestion that Bird's ontology is really categoricalist (broad or otherwise). Indeed, they grant that SR relationships confer constitutive identification of the involved first-order universals.

There is evidently something similar about Bird's complaint with Armstrong and Barker and Smart's complaint with Bird. For example, both invoke a regress by suggesting that what closes the gap between second-order facts and the regularities they are supposed to govern is some further third-order relationship, thereby raising the question of how the third-order relationship governs the regularity between the second-order relationship and regularity, etc. But here Barker and Smart again reveal their misappropriation of 'Ultimate Argument' when they observe that 'Bird might claim that SR has its governing role built into its essence,' and go on to protest rhetorically that 'if Bird can say this, why not Armstrong?' (ibid., 271). I will shortly suggest that building in a governing role to SR is something Bird might very well wish to endorse. But the whole point behind Bird's Ultimate Argument (as we have seen above) is that Armstrong certainly *cannot* say as much for N, for his view of universals (including N and everything it may relate) is that they have no necessary nontrivial modal character. Insofar as Armstrong's universals have essences at all, they are modally powerless.

As we have seen, Bird didn't consider explicitly the possibility that Armstrong could establish entailments like (1) by endorsing brute necessary connections. Nor did he consider the possibility that Armstrong might have endorsed a qualitative conception of universals which would enable them to determine the requisite regularities. That such options might be available to Armstrong led Barker and Smart (at least in the first case) to claim that Bird's argument is not after all 'ultimate'. But we also now know that this misses the point. The very fact that the only way out for an Armstrongian is via methods which contradict the broad conception of categorical properties which Bird made his explicit target simply reveals how decisive—how *ultimate*—Bird's argument is.

To sum up. We have a first step in defending Bird's proposal of SR in place of Armstrong's N. *Pace* Barker and Smart, in no way is Bird's proposal 'hoist by his own petard', i.e. by the Ultimate Argument. True, Bird has not shown how regularities are entailed by second-order relations. But that is not what the Ultimate Argument aims to show. The Ultimate Argument aims to show only that some non-trivial modal connections between properties are required to get the entailment. At

least a substitution of SR for N is an improvement in that regard. It is plainly wrong, therefore, for commentators to agree with Barker and Smart that Bird's view 'has no significant advantage over Armstrong's categoricalist view where the Ultimate Argument is concerned' (Tugby, 2012, 731).

Nevertheless, Barker and Smart do identify an issue with Bird's account which he might well wish to address: *why do* the regularities get entailed by SR relationships? This is, in effect, to present the inference problem again, only applied to Bird's account. Now, however, there is at least the possibility of a solution.

7 The wrong response for SR theorists

Let's take stock of the discussion so far. I began by rehearsing Bird's Ultimate Argument which aimed to show that one cannot provide a way to validate entailments of the form (1) if one is committed (as Armstrong once was) to universals' lack of necessary nontrivial modal character. I discussed three responses which suggest that one can, after all, have the relevant entailments given certain posits (brute necessities, qualitative natures, or new axioms). I went on to argue, however, that such posits could never be endorsed by someone with the commitments Bird defines his target as having. Consequently, Bird's Ultimate Argument is sustained. I then moved on to consider Barker and Smart's claim that Bird's Ultimate Argument in fact takes out Bird's own alternative view of laws as collateral damage. I just argued that it does not, since the Ultimate Argument specifically establishes that it is a commitment to universals' non-modal character which precludes laws built from second-order relations from entailing regularities. Since Bird denies that universals must be like that, he does not suffer the argument.

Nevertheless, Barker and Smart have revealed an issue facing Bird's SR relations: that of accounting for *why* the entailments hold. That is a problem that the responses on behalf of Armstrong aimed to answer; responses which, I argued, Armstrong couldn't have accepted and maintained a commitment to categorical properties with no nontrivial modal character. But that doesn't mean Bird couldn't appropriate them for his own account. For example, Barker and Smart are explicit (2012, 721) in suggesting that Bird might make use of brute necessities to establish entailments like (2). Similarly, Tugby (2012) offers a solution analogous to Coates's by advocating a 'Qualitative Dispositional Essentialism' (QDE) which imbues universals with an intrinsic quality that can determine regularities (see also Jacobs, 2011; Smith, 2016; Coates, 2019). Lastly, one might suppose that Schaffer's Axiomatic Solution could be used to stipulate that SR is a relation which ensures that the needed entailments hold. In what remains of this section, I'll suggest that fans of the SR relation should certainly have reservations about the first and second solution. In the next section I'll develop some justification for why the latter solution may retain some appeal.

One reason fans of the view of laws developed by Bird are unlikely to endorse brute necessities stems from a more general optimism among dispositionalists for 'modal dispositionalism'. This is the view that the nature of dispositions and how they are instanced can ground all (or some large portion of) modal claims (Bird,

2007a, 218; Bird, 2018; Borghini and Williams, 2008; Jacobs, 2010; Vetter, 2015). Such a view takes necessities and possibilities (particularly those concerning physical ongoings) to have their source in the essential natures of dispositional universals. Endorsing brute necessities for linking laws to regularities would therefore severely undermine that view.

Another, more general reason for dispositionalists to have a distaste for brute necessities would be simply that they don't satisfy the sort of explanatory role that a metaphysical posit is expected to provide. Whether or not fans of dispositions see a need to endorse other metaphysical posits alongside dispositions, they are unlikely to want to endorse one so unforthcoming in explanatory depth (e.g. Bird, 2007a, 197–8).

So much for appropriation of Barker and Smart's proffered response. What about Tugby's QDE? Tugby clearly motivates his view to contrast with what Tugby calls Bird's 'dispositional monism', according to which the 'natures of properties are exhausted by the second-order modal relations which fix their dispositional roles' (2012, 723). This suggests that adopting QDE would not be in line with the latter metaphysics. However, one might think those tempted by SR relations could be persuaded that Tugby's qualitative approach is a justifiable alternative. Here I give some reasons why they probably should not be so tempted.

An initial cause for SR theorists to find the alternative proposal underwhelming is that it may not be entirely clear what QDE offers that isn't already present in the framework developed by Bird. Obviously, it's crucial to the distinctness of QDE that qualities themselves can be modally determining. Yet, to parallel Tugby's own query of dispositional monism (ibid., 725), we are entitled to ask what precisely it is about the natures of different kinds of quality which allows them to determine different regularities. Tugby's response is an appeal to obviousness: it is 'an obvious explanation' of such determinations to say that 'different properties have different inherent or intrinsic natures' (ibid., 725). An appropriate and commonly used example might be that of a *sphericity*, the quality of having all points on its surface equidistant from a central point. Tugby might therefore proclaim that an 'obvious explanation' of why a ball rolls is that it has the quality of being spherical (cf. Heil, 2005; Mumford and Anjum, 2011). Admittedly, such a quality doesn't seem on the face of it to be identified by its relations with any behavioural properties, and yet we might think its instances necessarily roll (when co-instanced with the right material and environment). By contrast, so Tugby claims, on the monist view 'the nature of a disposition is fixed relationally [via SR] rather than intrinsically: the nature of a disposition consists entirely in what manifestation it is a disposition for' (ibid., 725).

Bird has elsewhere taken a sceptical approach to examples like *sphericity*. There may, he suggests, be multiple ways of referring to the same universal, some which are overtly dispositional (e.g. 'can roll'), others which are not (e.g. 'is spherical') (Bird, 2007b, 2009, 2012; see also Shoemaker, 1997). For all the obviousness of the example, it may just be that we're appealing to a dispositional essence of one and the same universal when we intuit that something spherical can roll. If that were the case then sphericity does not present an example in which qualitatively defined properties are distinct from those individuated by their place in an SR structure. Bird rightly admits, however, that 'one drawback for this approach is that it does not

demonstrate that the dispositional monist is correct [...] at most only that it is an option' (2009, 223).

There are other ways to query whether QDE really offers a genuine alternative to dispositional monism. Specifically, we might wonder whether the fact that some universals have their natures 'fixed' entirely intrinsically is after all something the monist must deny. Since SR relationships constitutively individuate their relata, they must at least be *internal* to their relata (as Tugby admits, 2012, 724).[9] Moreover, since universals are necessary existents under monism, the SR relationships any specific universal is involved in will be independent of accompaniment by contingent entities, therefore legitimating its intrinsicness under at least one popular, if flawed, definition of intrinsicness (Lewis and Langton, 1998). Granting all this, it can be hard to see why monists aren't in some sense already endorsing the existence of intrinsic qualities (cf. Taylor, 2018).[10]

But the most important reason why those who find Bird's dispositional monism initially plausible should be weary of adopting QDE in its place is that it gives up on one of the fundamental benefits of the former view. As already remarked on, SR relations can seem to provide a principled way for universals to be individuated via the graph-theoretic idea of structure with no non-trivial automorphisms. The idea is that each universal will occupy a node in the structure of SR relations and, due to the structure's asymmetry, will be uniquely identifiable (Bird, 2007a, ch.6). The suggestion is controversial to be sure (Barker, 2009, 2013), but if successful it promises to isolate a way of individuating universals which avoids the problems of reference (Bird, 2007a), abundance (Black, 2000) and epistemic access (Shoemaker, 1997) more familiar to categoricalist views of properties. Bird is explicit that, along with their ability to underlie laws and provide a basis for modal dispositionalism, SR relations warrant our inference to them partly on these grounds (Bird, 2018). Substituting QDE for this dispositional monist framework abandons this benefit of a powers metaphysics, since it is explicitly opposed to understanding universals to be individuated by the second-order relationships they have to other universals. Indeed, QDE supplies no principled reason why two qualitatively distinct universals couldn't give rise to the same regularities among their instances. As a consequence, one might wonder whether some of the very same concerns about reference which Bird raises against traditional categoricalist views wouldn't carry over to such a view.

If neither brute necessities nor qualities with necessary entailments should be appropriated by the fan of SR relations in order to respond to Barker and Smart, that leaves us only with the Axiomatic Solution from Schaffer. As I'll now suggest, I think this may indeed be something which is entirely consistent with these nomic relations and with realism in general.

[9] The relevant sense of internal here is what Barker (2009) refers to as 'Bradleyan' internal, to be contrasted with 'Leibnizian' internal relations which hold in virtue of monadic properties of the relata. SR relations must therefore be additions to being beyond the monadic features of their relata.

[10] Similar reasoning would also show that 'powerful qualities' views of properties may be insufficiently unique too.

8 The right response for SR theorists?

Schaffer didn't explicitly consider the SR relation, but it is clear how the corresponding solution would go. It would require us to endorse the following as an axiom of the theory of SR relations.

Inference for SR $\quad SR(F,G) \rightarrow \forall x\ (Fx \rightarrow Gx)$

The defender of SR will thereby stipulate that the SR relation is 'in the business' of establishing the required regularities. As we have already seen from Schaffer, the Axiomatic Solution requires that it is legitimate to advance axioms on explanatory grounds. The following from Baker in the context of mathematics shows that this is not in general an unreasonable thought.

> Mathematicians—and philosophers—have gradually moved away from the Euclidan conception of axioms as fundamental, "self-evident" truths. [...] One popular view, sometimes associated with Bertrand Russell , is that axioms are justified by their consequences. On this view, a mathematical theory such as arithmetic has various core claims [...] A given set of axioms is judged [...] by the extent to which it allows the core claims of the theory to be deduced [...] There is a clear analogy here with the use of inference to the best explanation . (Baker, 2009, 152)

SR theorists are in good company, then, if they employ their axiom as an inference to the best explanation for the lawlikeness of certain regularities. As we have seen, like those who favour Armstrong's N relations, SR theorists are already liable to justify the inference to SR relations on these kinds of grounds. Specifically, SR relations are mooted to explain lawlikeness, the individuation of properties and even, potentially, modality in general. What we learn from considering Barker and Smart's follow up to Bird, however, is that something more is needed than the relation alone if they are to explain lawlikeness. Failing any other response, theorists must additionally posit an axiom of inference as well. Of course, the stipulation of this axiom comes at an ideological cost. But the defender of SR will say that it is a cost worth paying in order to get the most plausible explanation for nomic regularities.

Still, having recourse to this kind of solution might seem ad hoc in isolation. If further issues in the general realist outlook could be found in which the axiomatic solution is also a promising solution then its employment here will be part of a unified strategy to improve the general realists' programme. As we've seen, Schaffer points to a number of cases in which recourse to the axiomatic nature of certain kinds of entailment may hold. Nevertheless, someone tempted by realism about universals may have no inclination to endorse of Schaffer's particular examples (including the modalist's operator '$\Box$' and the knowledge-first epistemologist's operator 'knows that'). A case which may bear more relevance, mentioned only in passing by Schaffer, is the determination operator, 'D', between determinate and determinable universals.

As a matter of necessity, all particles with $\frac{1}{2}$-integer spin have spin. The regularity is not typically thought of as nomic, but rather one of *determination*: having spin is the relative *determinable* of having $\frac{1}{2}$-integer spin, and having $\frac{1}{2}$-integer spin a relative *determinate* of having spin.[11] Realists have often tried to do without positing determinable universals (Armstrong, 1978; Massin, 2013). Increasingly, however, realists are finding a need to include determinable universals alongside their determinates. One reason is in order to supply a plausible account of the modal characteristics of functional laws (Armstrong, 1997, 247; Wilson, 2012). It is, after all, the variable for spin, and not any specific values of spin, which features in quantum-mechanical formulae for describing the dynamics of quantum systems. Moreover, quantum systems can be in *superpositions* of spin. Wilson (2013) has proposed that we treat this as a case of metaphysical indeterminacy, where the system instantiates a genuine determinable property for spin but not any corresponding determinate (though see Wolff, 2015).

So, there exist good, if not unshakeable, reasons to endorse the existence of a determinable universal SPIN (the universal shared by all and only objects which have intrinsic angular momentum) alongside its determinates (e.g. $\frac{1}{2}$-SPIN). Accordingly, the regularity of determination will be one of the extensional inclusion of all the things instantiating $\frac{1}{2}$-SPIN among all the things instantiating SPIN. Due to its necessity, however, the realist will want to explain what distinguishes it from accidental regularities, and it seems reasonable to introduce for this purpose a second-order relation 'D' which holds between determinates and their determinables. Hence, (3).

(3) Necessarily, if D($\frac{1}{2}$-SPIN, SPIN) then all particles with $\frac{1}{2}$-integer spin will have spin.

The realist who has followed the inferences this far will see evident parallels between N, SR and D. All are second-order relations which relate first order universals. Moreover, each is supposed to entail certain regularities. In analogy with Bird's Ultimate Argument against N, we can surmise that D cannot be categorical, since that would preclude the possibility of such entailments. But in analogy with Barker and Smart against SR, we can also ask how exactly this entailment is supposed to work in the case of D relationships.

I have suggested that in the case of SR the Axiomatic Solution is feasibly the most promising of three considered strategies for addressing this issue. Similar remarks hold for D. After all, I take it that in the case of D, brute necessities will have no more appeal than in the case of SR: it is surely something about the universals themselves and how they are related that means the determination regularities follow. It may also be hard to see how the answer to the entailment lies

[11] Wolff (2020) has suggested that capturing the relationship between quantitative variables and their quantities in terms of determinable-determinate relations misses some of the crucial aspects of the former, including the lack of nested determinables and the distance and ordering relations among values. I doubt, however, that the differences make significant impact on the claims made here. If necessary, we may substitute D for Q, the relation which holds between quantitative variables and their specific quantities.

in the qualitative nature of the universals, which would seem to preclude any sort of constitutive relationship between determinates and their determinables.

By contrast, an axiomatic solution can seem entirely reasonable (cf. Schaffer, 2016, 587). The idea would be to stipulate that the operator 'D' satisfies an axiom according to which entailments like (3) will follow without fail, such as the following (where 'F_i' denotes a determinate universal and 'F' its respective determinable).

Inference for D $\quad D(F_i,F) \rightarrow \forall\, x\, (F_i x \rightarrow Fx).$

As with SR, an axiomatic solution in this case is not without its ideological costs. But its defenders can defend it as an inference to the best explanation of determinate-determinable relationships. As we have seen, in the case of spin, D's defenders have reasons to believe that both $\frac{1}{2}$-SPIN *and* SPIN should be countenanced as real universals. Since reasonable alternative solutions aren't forthcoming, the *Inference for D* axiom seems well-justified.

In sum, the advocate of SR as a second-order nomic relation introduced to explain nomic regularities can rest confident that in drawing on the Axiomatic Solution to explain why SR relationships entail their associated regularities they have not drawn on something entirely alien to a general realist position. For not only might it be relevant to answering the question Barker and Smart raise for the entailment of nomic regularities, it may also be relevant for the analogous issue of entailment of determination regularities. The Axiomatic Solution therefore represents a unified solution to at least two issues facing the realist. Of course, that's not to say one can only accept one axiom if one accepts the other. The two are independent. But at least the availability and plausibility of both axioms shows that in either case the Axiomatic Solution should not be dismissed as ad hoc.

9 Conclusion

Bird's self-proclaimed 'Ultimate Argument' sought to show that Armstrong's N relationships involving categorical universals couldn't entail their corresponding nomic regularities. In its place Bird advised a non-categorical SR relation to do the job instead. Since the argument's first presentation a number of philosophers have tried to undermine its conclusions. It's been argued that either Armstrong had a way out of the argument or Bird's own alternative metaphysics makes a similar error as that supposedly located with Armstrong. Here I've tried to reclaim the victory for Bird. The proposed responses on behalf of Armstrong from Barker and Smart, Schaffer and Coates are insufficient, since they fail to acknowledge that the explicit target of Bird's argument was the broad conception of categorical properties Armstrong once defended. Moreover, Bird's own alternative account does *not* suffer the same problem since his is an essentialist view of properties. However, Bird's alternative proposal is in need of elaborating on in order to explain *why* SR relationships entail their regularities. I suggested that Schaffer's Axiomatic Solution might be appropriated for this purpose. The solution bears plausibility since the

relevant axiom is justified, along with SR relations themselves, as an inference to the best explanation of lawlikeness. Moreover, axiomatic solutions may anyway be required to assist in other problems facing realists, e.g. that of linking second-order determination relations to their regularities.

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