Tooley's account of the necessary connection between law and regularity*

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Abstract

Fred Dretske, Michael Tooley, and David Armstrong accept a theory of governing laws of nature according to which laws are atomic states of affairs that necessitate corresponding natural regularities. Some philosophers object to the Dretske/Tooley/Armstrong theory on the grounds that there is no illuminating account of the necessary connection between governing law and natural regularity. In response, Michael Tooley has provided a reductive account of this necessary connection in his book *Causation* (1987). In this essay, I discuss an improved version of his account and argue that it fails. First, the account cannot be extended to explain the necessary connection between certain sorts of laws—namely, probabilistic laws and laws relating structural universals—and their corresponding regularities. Second, Tooley's account succeeds only by (very subtly) incorporating primitive necessity elsewhere, so the problem of avoiding primitive necessity is merely relocated.

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1 Introduction

I'll begin with a quick explanation of the Dretske/Tooley/Armstrong (henceforth, *DTA*) account of governing laws set forth in (Dretske 1977), (Tooley 1977, 1987), and (Armstrong 1983). According to this account, laws are atomic states of affairs consisting of irreducible second-order external relations between first-order universals. These nomic relations are

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special; they are such that their instantiation by a pair of universals necessitates a corresponding regularity among instances of those first-order universals. Consider the regularity that all Fs are Gs. We can explain this regularity by postulating a relation of nomic necessitation N between universals F and G, represented as $N(F,G)$. The crucial postulate of the theory is then

NN: For all F and G, $N(F,G)$ *necessitates* $\forall x(Fx \supset Gx)$.

N is defined as the irreducible second-order external relation that satisfies NN. It is NN that explains why $N(F,G)$ explains regularities. Similar postulates can be used to explain other types of basic laws if there are any, such as exclusion laws (no Fs are Gs) or probabilistic laws (for each F, the probability that it is G is P).

The DTA account is a specific version of a more general theory, and the objection that the DTA account incorporates irreducible necessity (as it is usually presented, for instance by (Bird 2005) and (van Fraassen 1989, Chapter 5)) is really an objection to this more general theory. First, distinguish laws that govern from those that merely describe:

Governing Laws: There are some governing laws, where governing laws are atomic states of affairs that necessitate natural regularities.

Descriptive Laws: There are no governing laws; if there are any laws at all, they reduce to or supervene on facts about regularities (or other facts unrelated to governing laws, such facts about bare dispositions).

Second, distinguish theories that hold that all necessity is analytic from those that do not:

Humeanism: a proposition is necessarily true (false) if and only if it is true (false) in virtue of its meaning or logical form—that is, if and only if it is *analytically* true (false).

Non-Humeanism: Humeanism is false; some synthetic propositions are necessarily true.

The DTA theory is a narrow account of Governing Laws. Armstrong and Tooley endorse something like Humeanism as well.[1] This is important, because the standard objection to the DTA theory is not really a forceful

[1] They wish to avoid (or minimize) modal primitives, but this is not to say that they endorse something like *Humean supervenience*.

objection to Governing Laws, but to the conjunction of Governing Laws and Humeanism. Taken as an objection to Governing Laws alone, it merely shows that the view involves some primitive not required for Descriptive Laws. But this won't trouble the Governing Law theorist who endorses Non-Humeanism, for she will think that the irreducible necessity involved is a useful primitive, and ultimately one that we cannot live without. Taken as an objection to the conjunction of Governing Laws and Humeanism (call this view *Governing Humeanism*), however, the objection is much more powerful; it attempts to show that there is no Humean-consistent account of the necessity involved in Governing Laws; that is, it attempts to identify a genuine contradiction.

This paper is organized as follows. In 2 I discuss an improved version of Tooley's (1987) reductive (that is, Humean-consistent) account of the entailment between governing laws and regularities. In 3, 4, and 5 I provide three objections to the improved account. In short, I argue that Tooley's attempt to avoid the purported inconsistency between Governing Laws and Humeanism fails.

2 Tooley's Account

In an effort to dispel the mystery of the necessitation holding between governing law and regularity, Tooley provides a speculative account of the intrinsic nature of nomic relations. For simplicity, I'll focus only on his speculative account of the relation of nomic necessitation, N (Tooley 1987, 123–129):

$SPEC_0$: $N(F,G)$ holds in world w if and only if in w, F exists only as a part of a conjunctive universal $F\&G$.

In order for this account to succeed, SPEC_0 must entail NN while avoiding any synthetic necessities. Some elaboration is required in order to see how the account accomplishes this. In *Causation* (1987), Tooley spoke as though F was a *universal*, but this is somewhat misleading. We also need an account of conjunctive universals and an account of the "exists only as a part of" relation. What follows is a speculative clarification of SPEC_0.[2]

The relevant interpretation of SPEC_0 involves drawing a distinction between *properties* and *universals* in the way specified by (1) through (5) below.

[2] I would like to thank Michael Tooley for graciously allowing me to discuss this speculative proposal here. He proposed an account of this sort in correspondence, but my development of it should not be taken to represent his views.

(1) There are transcendent universals that have non-spatial, non-temporal existence, and whose existence does not logically supervene upon spatiotemporal states of affairs.

(2) A particular can have a property only if a relevant universal is instantiated by the particular.

This is a Platonic rather than Aristotelian conception of universals. But this account does not entail that all properties are universals, because properties are understood as follows:

(3) Two things *a* and *b* share a property if and only if *a* and *b* are similar in some respect.

Thus properties are conceived as "similarities" or "resemblances," and, as is fashionable these days, we can say that universals *ground* the various resemblance relations among their instances. One way for two objects to resemble in respects *D*, *E*, and *F* is for them to instantiate distinct universals corresponding to each of *D*, *E*, and *F*, but that isn't the only way for universals to ground these three properties. This will be important for a number of reasons, but for present purposes it matters because it allows for the following type of scenario:

(4) Two things, *a* and *b*, are similar in two respects *F* and *G*, and thus share two properties, *F* and *G*, though neither *F* nor *G* is a transcendent universal. Instead, there is only a single universal giving rise to both properties.

In the case just described, we have objects resembling in multiple respects in virtue of their possession of a single universal. We are now in the position to say what a conjunctive universal is.

(5) A *conjunctive universal* is a universal such that any two objects instantiating it are similar, or resemble one another, in more than one respect. (This can be stated in a less cumbersome manner: a *conjunctive universal* makes all of its instances resemble in multiple respects.)

For example, we write *F&G* to denote the universal such that any objects instantiating it resemble one another in respects *F* and *G*.

The theory constituted by (1) through (5) suggests the following revision of SPEC_0, where 'property' and 'conjunctive universal' are as defined above:

SPEC$_1$: $N(F,G)$ holds in world w if and only if in w, property F exists only as a part of a conjunctive universal $F\&G$.

Now we can elaborate on the "exists only as a part of" relation. This has been the source of earlier criticism of Tooley's account. Sider's (1992) primary complaint is that Tooley hasn't carefully specified the nature of this mereological relation, and he argues that on no plausible specification does Tooley's speculative account succeed. However, we needn't engage Sider's critique here, because the relation need not be mereological in character. Let us analyze the "exists only as a part of" relation as follows:

(6) A property P *exists only as a part of* universal Q in world $w =_{df} Q$ is the only universal in w that makes its instances P.

Applying this analysis to SPEC$_1$ yields the following:

SPEC$_2$: $N(F,G)$ holds in world w if and only if in w, $F\&G$ is the only universal that makes its instances F.[3]

SPEC$_2$ is a fully-developed account of the necessary connection between law and regularity. As required, SPEC$_2$ entails NN. Suppose that the world is such that there are only two universals present in that world: G and $F\&G$. Suppose further that a has property F. Then there must be some universal instantiated by a in virtue of which it is F. In this world, that universal can only be $F\&G$. Accordingly, anything that has property F must (in this world) have property G, but it isn't the case that everything with property G must have property F since an object can have G by instantiating either universal G or universal $F\&G$.

Unfortunately, we're not quite finished. SPEC$_2$ is subject to a counterexample. Let w_1 be a world containing properties D, E, F, G, laws $N(F,G)$, $N(E,F)$, $N(D,F)$, and some Ds that are not Es. Intuitively, such a world is possible—in fact, our world may include this very nomological structure—but SPEC$_2$ rules it out.[4]

Because $N(F,G)$ is a law in w_1, SPEC$_2$ implies that $F\&G$ is the only universal in w_1 that makes its instances F. Because $N(E,F)$ is a law in w_1, SPEC$_2$ also implies that $E\&F$ is the only universal in w_1 that makes its instances E. However, $E\&F$ also makes all its instances F. Therefore, either $F\&G = E\&F$ or SPEC$_2$ must be revised. The first option is unsatisfactory.

[3] Note that by (5), $F\&G$ makes *all* of its instances resemble in both respects.

[4] I am indebted to an anonymous referee for discovering this shortcoming in SPEC$_2$ and for suggesting the resolution employed here.

Because $N(D,F)$ is a law in w_1, $SPEC_2$ implies that $D\&F$ makes its instances F. But we've already determined that $F\&G = E\&F$ is the only universal that makes its instances F. Thus we must add that $F\&G = E\&F = D\&F$. Putting these results together, $F\&G = E\&F = D\&F$ is the only universal that makes its instances D. This entails that all Ds are Es—because the only universal that makes its instances D is also a universal that makes its instances E—contrary to our initial description of the world. Therefore, $SPEC_2$ must be revised to accommodate w_1.[5]

The problem arises because $SPEC_2$ contains a uniqueness clause: $N(F,G)$ holds if and only if $F\&G$ is the *only* universal that makes its instances F. Fortunately, we can formulate a version of SPEC that entails NN without any such uniqueness clause. Tooley's original formulation includes the expression "a conjunctive universal $F\&G$." On a charitable reading, this expression is ambiguous between the following two precisifications:

(7) *the* conjunctive universal $F\&G$

(8) *every* conjunctive universal that makes all of its instances G, for example $F\&G$.

The second precisification suggests the following amendment to $SPEC_2$:

$SPEC_3$: $N(F,G)$ holds in world w if and only if in w, every universal that makes its instances F also makes all of its instances G.

Like $SPEC_2$, $SPEC_3$ entails NN. Unlike $SPEC_2$, $SPEC_3$ is not subject to the counterexample above. On the surface, this appears to be a plausible account of the necessary connection between law and regularity. We now have to determine whether $SPEC_3$ entails NN *without employing any synthetic necessity*.

In the following three sections, I'll discuss three different objections to $SPEC_3$. The first two objections assume that the solution just presented succeeds in its own right, but they show that the solution cannot be extended in other desirable directions. The third objection shows that the solution just presented does not succeed even for the simple case presented above—that it entails NN only if it introduces synthetic necessities, and thus that it is not a Humean-consistent theory.

[5] Another option is to introduce a "longer" conjunctive universal $D\&E\&F\&G$. Thus proposal is subject to exactly the same problem as the proposal that $F\&G = E\&F = D\&F$, so I won't consider it separately.

3 The Objection from Probabilistic Laws

$SPEC_3$ cannot be extended to explain the connection between probabilistic laws and regularities. At best, it shows that *deterministic* laws are Humean-consistent. Here is a quick explanation. The necessity that holds between law and regularity is, on this account, nothing more than necessity of identity. According to $SPEC_3$, the reason that $N(F, G)$ necessitates the regularity that all Fs are Gs is that a single universal is responsible for both the Fness and Gness of the individuals in question. In this respect, it is similar to the familiar cases of a posteriori necessities in which two *names* refer to a single property. On the standard view, it doesn't make sense to say that identity can be probabilistic; we can't say, for instance, that water = H_2O and that water is probably (but not necessarily) H_2O. Similarly, if properties F and G arise from the same universal, it isn't possible to claim that Fs are *probably* (but not necessarily) Gs. All things F must be G (in the world in question).

There are two potential reasons to worry about this limitation. First, it is common to interpret quantum mechanics as implying that the world contains genuinely indeterministic laws. If this account is incapable of explaining the connection between *actual* laws and their corresponding regularities, the account would fail to give us reason for thinking that Governing Humeanism is true of this world. (For the record, I don't fully endorse this argument, because I'm not convinced that quantum mechanics ought to be interpreted in this way. I don't know whether the Copenhagen interpretation is superior to the Bohm interpretation.)

Second, this limitation has important implications for the initial plausibility or a priori probability of the theory. If Governing Humeanism precludes probabilistic laws then it countenances fewer possibilities than its Non-Humean competitor. The Non-Humean competitor simply takes the connections between law and regularity as basic and therefore does not preclude probabilistic laws. This gives us some reason to think that the a priori probability of Governing Humeanism is less than the a priori probability of Governing Non-Humeanism.[6] Put in more familiar terms, other things equal we prefer a theory with fewer implications to one with lots of implications (unless of course those implications are directly related to the theory's explanatory power over some observation). Precluding probabilistic laws precludes lots of possibilities, and thus $SPEC_3$ has lots of

[6] Note that this relative "reduction" in the a priori probability of Governing Humeanism won't confer any explanatory advantages over Governing Non-Humeanism.

implications. Though I'm not convinced that any of the actual laws are probabilistic, I'd rather not rule them out.

4 The Objection from Laws Relating Structural Universals

$SPEC_3$ cannot provide a Humean-consistent explanation of laws relating structural universals, because the required account of structural universals involves primitive necessities. I'll introduce this objection under the assumption that there are laws relating such universals. I'll conclude this section by discussing reasons to think there could be such laws. As in the section above, I'm not convinced that there are any such laws, but I'd rather not rule them out.

What are structural universals? David Lewis (1986) explains them roughly as follows. First, they are universals: they can occur repeatedly, and so on. Second, anything that instantiates a structural universal has proper parts, and there is a necessary connection between the instantiation of the structural universal by the whole and the instantiation of other universals by the parts. We'll say that structural universals "involve" these other universals, and we'll say later what this involvement is in the context of specific theories of structural universals. For example,

> suppose we have monadic universals *carbon* and *hydrogen*, instantiated by atoms of those elements; and a dyadic universal *bonded*, instantiated by pairs of atoms between which there is a covalent bond. (I should really be talking about momentary stages, but let's leave time out of it for simplicity.) Then we have, for instance, a structural universal *methane*, which is instantiated by methane molecules. It relates the three previously mentioned universals as follows: necessarily, something instantiates *methane* if and only if it is divisible into five spatial parts c, h_1, h_2, h_3, h_4 such that c instantiates *carbon*, each of the h's instantiates *hydrogen*, and each of the c-h pairs instantiates *bonded*. (Lewis 1986, 27)

For present purposes, we need an account of structural universals that satisfies three desiderata: first, it explains the necessary connection between the instantiation of structural universals and the instantiation of other properties/universals by their parts; second, it is compatible with laws relating structural universals in accordance with $SPEC_3$; third, it is compatible with Humeanism. For example, suppose it is a fundamental, non-derived law that all methane is combustible. (Of course no one takes this law to be fundamental, but this example is just for illustrative purposes.) Our account of structural universals must explain the necessary connection between the instantiation of methane by a molecule and the instantiation of carbon, etc., by its parts; it must be compatible with SPEC_3's interpretation of the law $N(\textit{methane}, \textit{combustible})$: namely, that $N(\textit{methane}, \textit{combustible})$ holds in a world w if and only if in w all universals that make their instances methane make their instances combustible; and it must be compatible with Humeanism. I don't think any account of structural universals can satisfy all three desiderata.

Broadly speaking, there are two types of accounts of structural universals—two ways to satisfy the first desideratum. First, there are non-reductive accounts, which hold that the necessary connection between the instantiation of methane and the instantiation of its component properties is primitive. Lewis calls this kind of account the *magical account*, and describes it in more detail as follows:

> On the magical conception, a structural universal has no proper parts... A structural universal is never simple; it involves other, simpler, universals... But it is mereologically atomic. The other universals it involves are not present in it as parts. Nor are the other universals set-theoretic constituents of it; it is not a set but an individual. There is no way in which it is composed of them. (Lewis 1986, 41)

According to this account, the connection between a structural universal and the simpler universals (or properties) it involves—we might under other circumstances call these its "constituent properties"—is an unanalyzable primitive. But the connection is postulated to be a necessary one. As such, it is inconsistent with Humeanism.

Second, there are reductive accounts of the necessary connection between the instantiation of methane and the instantiation of component properties by its parts. This type of account reduces structural universals to simpler properties/universals plus certain relations. Since the account is reductive, the existence of structural universals isn't controversial, given that we have already accepted the simpler properties/universals and the relevant relations (see (Lewis 1986, 32)). Unfortunately, this account precludes an analysis of $N(\textit{methane}, \textit{combustible})$ in terms of SPEC_3. According to our analysis of the law $N(\textit{methane}, \textit{combustible})$, methane is a mere property—not a genuine universal—that can only be instantiated when a certain structural universal (or class of universals) is instantiated. For simplicity, let's suppose that there is exactly one such universal S. S must do a lot of work. It must make its instances methane, it must make its instances combustible, and it must make the parts of its instances have the relevant properties constitutive of methane (carbon, hydrogen, and so on). Here's the problem. According to $SPEC_3$, S is *more* primitive than the properties/universals carbon, hydrogen, and bonded; it says that S grounds these properties. But the reductive account of structural universals holds that S is *less* primitive than the properties/universals carbon, hydrogen, and bonded; it says that S is grounded by these properties. (It is important to note that, in order for S to make its instances methane, it must be a structural universal itself.) The result is contradictory, because one thing cannot be both more and less primitive than another. These problems generalize. Therefore, reductive accounts of structural universals are incompatible with $SPEC_3$.

(It should be noted that Lewis does not simply divide accounts of structural universals into non-reductive and reductive accounts. Instead, he considers the *magical* account (an explicitly non-reductive account), the *linguistic* account (an explicitly reductive account), and the *pictorial* account. The pictorial account holds that structural universals are isomorphic to their instances. This kind of isomorphism doesn't make sense to me if we interpret the account reductively, because I don't understand what it would mean for transcendental universals to stand in structural—for example, spatial or temporal—relations to one another.[7] Remember, $SPEC_3$ requires its universals to be transcendental (Tooley 1987, 125–128). On the other hand, if we interpret the account non-reductively, it's very difficult to see how the pictorial account differs from the magical account. Thus I think that the pictorial account fails to offer a genuine alternative to reductive and non-reductive accounts. It must be interpreted in one of those two ways, but then it simply inherits their problems.)

I have suggested that no account of structural universals can satisfy all three desiderata. How serious is this problem? That will depend on whether there are (or could be) laws relating structural universals. I'll make a fairly weak suggestion here: that, for all we know, there could be

[7] Lewis rejects the account for essentially this same reason, regardless of whether universals are Platonic or Aristotelian: "So if the structural universal *methane* is to be an isomorph of the molecules that are its instances, it must have the universal *hydrogen* as a part not just once, but four times over. Likewise for *bonded*, since each molecule has four bonded pairs of atoms. But what can it mean for something to have a part four times over? What are there four of? There are not four of the universal *hydrogen*, or of the universal *bonded*; there is only one. The pictorial conception as I have presented it has many virtues, but consistency is not among them." (Lewis 1986, 34)

laws of this sort. As in the case of probabilistic laws, I'm not convinced that there are laws of the relevant kinds. But again, I'd rather not endorse a metaphysics that rules them out.

First, there could be non-derived (that is, fundamental) laws of the special sciences—for example, fundamental laws of chemistry relating the interaction of different types of molecules. In the same vein, there could be fundamental laws in metaphysics—for example, fundamental laws describing mind-brain supervenience. Such laws would relate structural universals.

Second, there could be temporally extended laws (consider laws about the half-life of radioactive elements, or any account of causal laws according to which causes are earlier than their effects).[8] If perdurantism is correct, these laws will relate structural universals, and so cannot be accounted for by SPEC_3. Consider a law that says that the possession of P by an individual x at time t entails the possession of Q by x at $t+1$. For SPEC_3 to work, all universals S that make their instances P at t will have to make their instances Q at $t+1$. Any such universal S must be structural, for it must relate P to Q *in the specified way*; namely, it must account for the structural relation between the instantiation of P and the later instantiation of Q by having one part (the P part) at an earlier time and another part (the Q part) at a later time. Therefore, if perdurantism is correct, temporally extended laws relate structural universals.

Third, the laws of quantum mechanics could relate structural universals. Why? Consider an entangled system. The quantum state of that system cannot be described solely in terms of the properties of its proper parts. Information about the complete quantum state contains information beyond that provided by the descriptions of its parts. In order to apply the laws of quantum mechanics to make correct predictions, we require that extra information. My suggestion is that we interpret the quantum state as the instantiation of a structural universal. Thus there are two components to this suggestion: that the relevant quantum state instantiates a structural universal, and that the equations describing the laws are functions of the quantum state as a whole. Must we interpret quantum mechanics in this way? I don't know—I'm inclined to think that the latter component is less controversial than the former—but it is something to consider.[9]

[8] This is of particular relevance to Tooley (1987), since causal laws are temporally extended on his own account.

[9] See (Schaffer 2010, Section 2.2) and (Maudlin 2007, 53–61) for some relevant background on entangled systems. I should note that Maudlin's interpretation of these systems places independent pressure on Humeanism.

5 An Objection Concerning the Definition of Conjunctive Universals

We come now to what is in my opinion the most damaging objection to SPEC_3. The concept of a conjunctive universal needs to be specified more carefully. I'll argue that conjunctive universals are capable of explaining natural regularities only if they incorporate irreducibly modal elements. Compare the following two analyses:[10]

(9) A *conjunctive universal* is a universal such that, *contingently*, any two objects instantiating it are similar (resemble one another) in more than one respect.

(10) A *conjunctive universal* is a universal such that, *necessarily*, any two objects instantiating it are similar (resemble one another) in more than one respect.

Here we have a dilemma. (9) is consistent with Humeanism, but it precludes SPEC_3. (10) is compatible with SPEC_3, but it precludes Humeanism. These points require some elaboration.

(9) precludes SPEC_3 because it entails that worlds with accidental regularities and universals are worlds with conjunctive universals. Suppose that S and T are intuitively simple (that is, non-conjunctive) universals. Suppose further that everything which has S also has T, simply as a matter of accidental fact. According to (9), S is a conjunctive universal. But an object's having S does not entail that it has T, so laws of nature cannot be explained in terms of conjunctive universals if (9) is the correct analysis of conjunctive universals. The result is that a world with two universals G and $F\&G$ will not entail that everything with F has G; in this world, nothing precludes $F\&G$ from giving rise only to property F. We need the necessary connection between $F\&G$ and properties F and G, but the account doesn't provide that unless it incorporates necessity as in (10).

Why think that the necessity in (10) is inconsistent with Humeanism? If we took conjunctive universals to be structural universals with simpler universals as their parts, it would be easy to show that the possession of a structural universal entails that, necessarily, any two objects instantiating it are similar in multiple respects (that is, it would be easy to provide a Humean-consistent account of the necessity in (10)); objects instantiating the structural universal would resemble in multiple respects in virtue of instantiating the simpler universals which are parts (or whatever) of the

[10] I have returned to the more cumbersome version of the definition because it allows for precise placement of the relevant modal operators.

structural universal in question. Thus the necessary connection between a conjunctive universal and the properties to which it gives rise would be consistent with Humeanism. But the proponent of $SPEC_3$ cannot interpret conjunctive universals in this way, since this account entails that the simpler properties/universals are more primitive than the conjunctive universals—that they can exist without the conjunctive universals, and therefore do not "exist only as a part of" the conjunctive universals. On this Humean-consistent account of (10), $SPEC_3$ just doesn't work. We have (10) but not $SPEC_3$. That is, in making the necessity benign we lose $SPEC_3$. But how else are we to explain the necessity? If we opt for a different Humean-consistent account the worry will be (again) that $SPEC_3$ doesn't follow. If we just stipulate that (10) is correct, we require an account of the necessity; it's an open question whether the necessity can be reduced. I can't think of any Humean-consistent accounts which preserve $SPEC_3$, and for this reason I have serious doubts that $SPEC_3$ can succeed at all.

In sum, $SPEC_3$ requires (10), but it appears that we can't have both $SPEC_3$ and (10) if Humeanism is true. For this reason, I believe that Tooley's type of reductive type of account, though creative and resourceful, fails. That said, the problems raised in this essay only hold for Governing Humeanism. The failure to provide a reductive account of the necessary connection between law and regularity tells neither against Governing Laws nor against the view that laws are higher-order relations among universals.[11]

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