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Collective Powers

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It is natural to think there are higher-level powers, such as a screen's powers to display various images, and lower-level powers such as each pixel's powers to display various colours. Moreover, it is natural to think that higher-level powers depend in some way on lower-level powers. However, this appealing picture creates some philosophical puzzles. What are the bearers of higher-level powers? The obvious answer is that higher-level powers are instantiated by composite substances, but this answer creates difficulties. Some have also complained that higher-level powers create a causal exclusion problem. This chapter offers a new way to respond to these puzzles in a way that preserves ontological commitment to higher-level powers. The novel proposal of the theory is that higher-level powers are collective properties which are plurally instantiated by simple substances. The chapter also develops the idea that higher-level powers are grounded by the low-level powers of substances.

Some powers appear to be built out of others.¹ There are *higher-level* powers, such as a screen's powers to display various images, and *lower-level* powers, such as each pixel's powers to display various colours. It is natural to think that higher-level powers are grounded in, or even composed by, lower-level powers. Thus, the relationship between higher- and lower-level powers might well be a prime example of a relationship of composition between properties.

However, this appealing picture comes under pressure from three angles:

- (1) Is the very notion of a higher- and lower-level structure of powers coherent, or explanatorily useful?
- (2) What precisely is the relationship between higher- and lower-level powers?
- (3) What is it about the intrinsic natures of powers which make such structures possible?

Our chapter addresses these questions by exploring a novel theory of higher-level powers, according to which such powers are *collectively* grounded by lower-level powers. Moreover, it is argued that in order to accommodate higher-level powers in a satisfactory way, we might have to accept that some powers are *plurally instantiated*. This theory can solve various puzzles about higher-level powers and their bearers. However, while there has been some focus on plural *predication* (e.g. Oliver and Smiley 2001), the topic of plural *instantiation* and collective *properties* has to a large extent been neglected by powers theorists and metaphysicians generally.² We speculate that this is due in part to a widespread implicit commitment to an Aristotelian conception of instantiation, according to which a property can only be instantiated singularly by an individual.³ Our aim in this paper is to challenge this tradition and open up conceptual space for new ways of thinking about higher-level powers and their relationship to lower-level powers. Although it is too early to tell whether the theory proposed is the best, it is certainly one which is parsimonious in various respects: First, since collective plural predication is not systematically construable as singular predication on aggregates or sums (Lewis 1991, Oliver and Smiley 2001) our account's *ideology* does not imply a commitment to singular bearers of higher-level powers. Moreover, if we accept that higher-level powers are plurally instantiated by low-level entities, then there is no obvious *ontological* need to posit higher-level composite individuals as possessors of the higher-level powers. Thus, our account is able to bypass recent problems that Heil (2021) raises about composite substances.

The paper is structured as follows: In the next section, we introduce powers-based theories of properties and the notion of higher-level powers. In the third section, we introduce puzzles that arise in connection with composite property-bearers and higher-level powers, drawing on recent work by John Heil. In the fourth section, we begin to respond to Heilean scepticism about higher-level powers by introducing the idea that higher-level powers are genuine collective (non-distributive) properties which are plurally instantiated. We discuss preliminary arguments for thinking that some properties are irreducibly collective and plural. In the fifth section, we develop the idea further, focusing on the relationship between collective powers and the properties of the individuals which plurally instantiate those powers. We claim that this relationship is typically one of grounding and speculate that it is a species of composition. In the sixth section, we anticipate and address some objections that the proposal is likely to face. In the final section, we briefly address some

remaining metaphysical questions about the causal efficacy of higher-level powers and the ultimate source of the grounding of higher-level powers.

Powers and higher-level properties

In this chapter we assume from the start that there is an intimate metaphysical connection between properties and powers. Consider a snooker ball. It has the property of being spherical, which means it has the power to roll down an incline. Many of us do not think it is a contingent fact that this property confers this power. Properties are not inert but rather confer causal power(s) on their bearers as a matter of metaphysical necessity. Moreover, we take it that this metaphysical necessity is not a brute feature of the world. There are at least three possible sources of the necessary connection between properties and powers. This necessary connection might be a consequence of the fact that properties are essentially powerful (the theory of dispositional essentialism), that properties are identical with powers (identity theory), or that properties metaphysically ground powers (the grounding theory of powers). For the purposes of this chapter, we remain neutral about which of these three theories is correct.⁴ We take this issue to be a matter for in-house dispute between those who, unlike neo-Humean philosophers, take causal powers metaphysically seriously. What advocates of all these anti-Humean theories can agree on is that properties are not merely categorical: they confer genuine powers by their very natures.

If we follow powers theorists and accept that powers are part of the world's ontological furniture, questions quickly arise about how many or which types of power there are. All powers theorists can probably agree that the fundamental properties figuring in our best physics are genuine, such as charge and spin (indeed, an influential argument for the powers metaphysics is precisely that the theoretical properties of physics appear to be defined in exclusively dispositional terms). But beyond that, there is room for disagreement. For example, Mumford and Anjum (2011: 17) appear to take a liberal stance, accepting that there might be what Bird (2016: 342) calls 'macro-powers', which exist at higher (non-microscopic) levels of nature (see also McKittrick (2018), who proposes a particularly abundant conception of powers). Recently, however, Bird (2016, 2018) has questioned whether the powers theory should be extended beyond physics and certain parts of biology. Heil (2003, 2012) takes an even more sceptical line against higher-level powers and argues that there is no room in our ontology for properties of composite

objects, even though it is often useful to employ higher-level predicates for various purposes.

We are attracted to the idea that the world exhibits causally powerful properties other than those found in fundamental physical theory. As the world takes more complex forms, in the special sciences and everyday life, an array of further powers appears to play an ineliminable role in how we view, and theorise about, the world. These are what we are calling the 'higher-level' powers.⁵ For example, at the molecular level, we find chemical properties with distinctive dispositional profiles, which allow them to play important predictive and explanatory roles in chemical theory. The same could be said of biological properties, geological properties, economic properties, and so on.

Our everyday dealings with medium-sized dry goods also seem to reveal a wide range of higher-level causally powerful properties. I miss my alarm in the morning. (Damn.) *If I drive really fast, can I still get to work on time?* The concern here is with what is possible. On the powers ontology that we are assuming, it is a concern with what powers there are – specifically (albeit colloquially), what powers my car has. But it is *not*, directly, a concern about the powers that the *parts* of my car each have (the wheels can go round), nor is it a concern about any mere *conjunction* of those powers (the wheels can go round and the fuel can combust). The concern is *only* with what these lower-level powers jointly contribute to – namely the power to be driven at high speeds.

Note also that the power to be driven at high speeds is not the kind of property that a quark can have. It is a property that can only arise at a certain level of complexity. However, that is not to say that higher-level powers are metaphysically emergent. 'Emergent property' is a slippery term – even within academic philosophy – but the term is usually used to get at the idea that a property is basic and not fully explicable, even though it depends in some way on other properties. However, the power that a car has to be driven is surely not inexplicable in that way: we can explain why the car has this power with reference to the powers had by the car engine, the gearbox, the wheels, and so on. This point will be of importance later on.

Unfortunately, this very natural picture of higher-level powers raises some difficult philosophical questions. For example: What are the bearers of higher-level powers? What is the relationship between higher-level powers and the low-level powers on which they apparently depend? If higher-level powers are dependent entities, do we really need them

in our ontology? Is there not a danger that the alleged causal efficacy of higher-level powers is undermined by the low-level powers on which they depend?

In the discussion that follows, we shall use John Heil's work on substance and properties as a point of departure for thinking about some of these questions. This is a useful starting point insofar as Heil's work suggests reasons to be sceptical about the existence of higher-level powers. While we agree with some aspects of Heil's picture, it will become clear that we are more optimistic than him about the prospects of accommodating higher-level powers as genuine elements of ontology. More precisely, our speculative proposal is that paradigmatic higher-level powers can be regarded as genuine collective, or non-distributive,⁶ properties. A collective property is one which is jointly instantiated by some *things*, plural, rather than a singular thing. Our proposal thus clashes with the broadly Aristotelian tradition mentioned earlier, according to which a property is always instantiated by an individual. Importantly, in the fourth section, we shall see that it is far from clear that collective properties can be explained away.

Scepticism about composite substances and higher-level powers

Suppose you thought that only substances are the bearers of properties. Then, it would seem plausible that if there are higher-level properties, they are instantiated by mereologically complex substances. The idea would be that a property is a higher-level one precisely because it is instantiated by a complex particular rather than a simple one. Such complex particulars are what Lowe calls 'composite substances' (1998: 190).⁷ Aristotelians typically accept that there are composite substances but disagree on precisely which objects count as composite substances. This disagreement largely turns on what one thinks it takes for a bunch of parts to compose a substance, as opposed to a mere aggregate or collective such as a pile of stones (Lowe, 1998: 162). According to some Aristotelianhylomorphists (e.g. Koslicki 2008, 2018), a composite substance must be composed of parts of a certain kind and have an organisational or functional unity that is imposed by the natural kind (substantial form) that the substance exemplifies. Complex organisms are often given as paradigmatic examples of composite substances, but artefacts such as clocks (Lowe 1998: 164) or motorcycles (Koslicki 2018: 27) could also be examples. Details aside, the important point for current purposes is that once we have

Aristotelian composite substances in play, it is entirely natural to ascribe higher-level powers to them – powers which are not had by any of the composite substance's proper parts. For example, a clock as a unified whole has the power to convey time even though none of its simple parts has that power. This picture of complex particulars and higher-level powers is a very natural one and probably accords well with what Heil and others call the manifest image of the world. But unfortunately, this natural metaphysical picture is not without its problems.

Heil (2012, 2021), for one, has recently reiterated his scepticism about composite substances and their alleged properties. Heil (2003: Ch. 11) certainly embraces the notion of substance and accepts that only substances are the bearers of properties. And properties, for Heil, are identical with powers. However, Heil is sceptical of the notion of a composite substance, favouring a view on which all genuine substances – that is, property bearers – are *simple*. Simple substances, on Heil's definition, are substances which have no further substantial parts: they are mereologically simple (although they might nevertheless have a spatial or temporal extension). Obvious candidates for the simple substances are the subatomic particles (or perhaps fields) of physics.

Heil (2021: 58) argues that the postulation of complex substances and the higher-level powers they allegedly bear is unnecessary and implausible, involving a sort of metaphysical double-counting. For Heil, accepting composite substances (and their properties) is a bit like saying someone has three objects in their pocket because they possess two coins plus the sum of the two coins. The sum exists (in some sense), but one should not regard it as a third object that is additional to the two coins (ibid.:58). The same goes for a tomato. For Heil, a tomato might appear to be a complex substance bearing higher-level powers like redness or sphericity, but on closer metaphysical and scientific inspection, this appearance is deceptive. The tomato is nothing over and above simple substances dynamically arranged in a certain way. One does not need to accept that, *in addition*, there is a tomato or a property of redness. However, to be clear, Heil (2021: 45; 52) claims not to be an anti-realist, reductionist or eliminativist about tomatoes or their redness. On Heil's picture, we can truly say that there are tomatoes and that such things are red. The point is just that the deep *truthmaking* story about tomatoes need not involve complex substances bearing ontic macro-properties like redness. Tomatoes exist, then, but are not what they appear to be. If the simple substances are atomic then the truth that tomatoes are red is likely to be made true by a fleeting, dynamic arrangement of particles, none of which is itself red.

We see the attraction of Heil's rejection of complex substances. If we can do without them, and let the simple substances (or a monistic substance) do the truthmaking work, then we are left with a more parsimonious metaphysical picture.⁸ However, what is of interest for current purposes is the question of whether we should also jettison higher-level powers along with composite substances. Heil appears to infer that if there are no composite substances, then there can be no higher-level powers (ontologically speaking) such as redness or sphericity, mental properties, or the sorts of properties posited in the special sciences. Thus, Heil's picture jettisons a vast array of powers from our metaphysics. Heil's theory still permits us to speak truly of higher-level powers, but metaphysically speaking, such powers are redundant: the *ontology* of higher-level powers is just an ontology of low-level powers and nothing more. Insofar as we speak of higher-level properties, they are merely properties by courtesy, quasi-properties (Heil 2021: 58), or 'Episcopalian' properties (Heil 2012: 152).

Higher-level powers as collective properties: the case for plural instantiation

One of the aims of this chapter is to question Heil's sceptical conclusion regarding higher-level powers. We suggest that even if it is only simple substances that are the bearers of properties, there might still be metaphysical room for so-called higher-level powers. In particular, we explore the idea that higher-level powers like redness are irreducibly *collective* properties which are *plurally* instantiated by simple substances. This idea is compatible with Heil's rejection of complex substances. It merely requires us to be open-minded about the kinds of properties that simple substances instantiate. While a simple substance can instantiate a property on its own as the standard Aristotelian picture suggests, simple substances can also work together to instantiate certain properties *collectively*. What we call higher-level powers would be properties of this latter sort. Such powers – and their associated properties – would be *plurally* instantiated.

Why think that collective properties are needed in the metaphysical inventory? Presumably, those sympathetic with Heil's picture will say that even if there are predicates which truly apply to pluralities rather than singular subjects, the deep truthmaking story is not one that requires us to posit genuine collective properties – namely properties which are plurally rather than singularly instantiated.

Against this view, we now present an argument in favour of collective properties. While we do not intend our argument to settle every question, we do mean to put collective powers on the table as a live option. To this end, we first marshal some considerations in favour of irreducibly plural *predication*, before turning to plural *instantiation*.

Consider the wheels on a bus. For the wheels to go round and round is – all being well – nothing more or less than for *each* wheel to go round and round. The predicate *goes round and round* can apply to the wheels plurally, but its doing so is *equivalent* to its applying to each wheel individually. In such cases, where *the Fs are G* is equivalent to *each F is G*, we say that G occurs *distributively*.

We describe any predicate that is not distributive as *collective* or *non-distributive*. Consider the seats on a bus. The seats are arranged in rows. On pain of nonsense, this is *not* equivalent to their *each* being arranged in rows. The predicate *arranged in rows* applies to the seats (plural) but not to each seat; *a fortiori*, its applying to the seats (plural) cannot be equivalent to its applying to each seat.⁹

To attempt to reduce *all* apparently collective predicates to distributive ones is tempting. For logics admitting only singular predication are familiar, while plural logics have – until recently – remained little explored. However, a solid case has been made in the literature for the existence of irreducibly collective plural predicates (see e.g. Lewis 1991, Oliver and Smiley 2001, Yi 2002).

Two salient reduction strategies (Oliver and Smiley 2001) are Changing the Predicate (CTP) and Changing the Subject (CTS). Each strategy attempts to fully replace apparently plural apparatus with familiar, singular constructions: in the predicate place and the subject place, respectively.

Consider the collective statement *the premises entail the conclusion*. CTP proposes reducing this to: *each premise co-entails the conclusion*. But *co-entails* and *entails* are simply different predicates. What we have shown is that *the premises co-entail the conclusion* is distributive, but not that *the premises entail the conclusion* is. Adding that the premises entail the conclusion *iff* each premise co-entails the conclusion merely shows *the premises entail the conclusion* to be *equivalent* to a statement that is distributive – not that it *is* itself distributive. (Nor does this equivalence make any reductive moves available for CTP – for each premise co-entails the conclusion only *because* the premises entail the conclusion.) So as a strategy for showing that collective *predicates* are reducible to distributive ones, CTP falls flat.¹⁰

CTS offers a more sophisticated approach: replace the plural subject *the premises* with a singular aggregate such as *the set of premises*. Against this view, Oliver and Smiley (2001: 292f.) offer two lines of reply. The first is that replacing plural things with singular sets of things does not eliminate the collectivity of the example but merely buries it a little deeper. Since entailment is a matter of truth-preservation and sets are not truth-apt, no set can entail a conclusion. Rather, it is the *members* of a set of premises which entail a conclusion. But making this explicit shows up the set itself as redundant: the members of the set entail the conclusion *collectively*.

Oliver and Smiley offer a further, general argument against CTS which is schematic and aims to take down *any* version of CTS. (Lewis 1991: 68 makes the same case). Considered schematically, CTS licenses the replacement of *the Fs are G* with *the H of Fs is G* for some value of H, where H is some term standing for an aggregate of Fs. CTS will not work without committing, *in each case*, to some particular instance of the schema and, hence, *some specific aggregate kind* as a value of H. But problems arise when we consider any such instance.

Consider the example: *the forces are in equilibrium*. Waiving the previous argument, CTS recommends substituting: *the set {F} is in equilibrium*.¹¹ But once we are in the business of replacing plural talk with talk of sets, CTS forces us to be *all in*: plural talk is replaceable by set-talk *in general*. In particular, then, plural statements about sets¹² should be treatable by the same strategy. From here it is a short step to a Russellian paradox: there are plural truths about *the nonselfmembered sets*,¹³ and CTS forces us to treat these as singular truths about a set of the nonselfmembered sets.

We consider these arguments against CTP and CTS to be persuasive: some plural predicates are irreducibly collective. It does not automatically follow from this, however, that any *properties* are irreducibly collectively *instantiated*. The remainder of this section considers ways to bridge this gap. We assume that the existence of irreducibly collective predicates gives *pro tanto* reason to hold that there are corresponding collective properties, and consider strategies for blocking this move.¹⁴

In shifting focus from predicates to properties, the situation with CTP and CTS reverses.¹⁵ CTS becomes a straightforward non-starter, given that we are joining Heil in rejecting composite or higher-level substances: there is simply no room for apparently plural properties to be instantiated by singular but composite substances. CTP, however, becomes a live option. Since properties need not correspond with predicates, giving an

account of an apparently plural property in terms of *different* singularly instantiated properties is not – at least on the surface – a misguided idea.

To illustrate CTP for properties, consider two examples: *the lights make a pattern*, and *the jury members are unanimous*. In the first case, CTP substitutes a reduction base involving each light and its location.¹⁶ In the second case, the base includes each jury member and their respective belief. The objection will then be that our commitment to collective power properties is superfluous: given each light and its location (each jury member and their belief), the facts about patterns and unanimity are fixed: for the lights to make this pattern just *is* nothing more than for each light to be located thus-and-so (*mutatis mutandis* each jury member).

To this line of objection, we reply that CTP's attempt to reduce away the apparent collectivity of our examples simply fails. Recall that our proposal here includes three claims: an *existence claim* (there are higher-level powers), a *grounding claim* (higher-level powers are grounded collectively by low-level ones), and an *explanatory claim* (higher-level powers do distinctive explanatory work). CTP attempts to undermine this picture by arguing that the explanatory claim is false because the higher-level powers can be reduced to low-level properties.

In order for CTP's reductive move to work, it must be the case that our examples of apparent collectivity are fully explainable in terms of reductive bases *that do not themselves contain irreducible collectivity which plays the same explanatory role* as the collectivity in our examples themselves. Indeed, on the face of it, offering each light and its location as a reduction base for *the lights form a pattern* appears to do exactly this. But there is a problem here which parallels Oliver and Smiley's reply to CTS in the case of predicates. For each light and its location, taken singly, does not suffice for the lights to form a pattern. Rather, it is the *aggregate* which aggregates *all* of the lights and their respective locations which does so. For illustration, consider each light and its location as forming a fact *that light l is at place p* . Then the relevant aggregate will be the *conjunctive* fact: *that l_1 is at p_1 , that l_2 is at p_2 , and so on*. Now, recall that we are continuing to reject composite or higher-level entities, but this conjunctive fact is precisely such an entity. So, we cannot offer the conjunction itself as a reductive base for the fact that *the lights form a pattern*.¹⁷ This leaves us with only the conjuncts themselves. But the conjuncts – *that l_1 is at p_1 , that l_2 is at p_2 , and so on* – only *collectively* make it the case that the lights form a pattern.¹⁸

One may object here that if this line of argument is correct, then it proves too much: *all* plurals will turn out to be collective plurals. For suppose that *the Fs are G* is distributive. Then it is equivalent to *each F is G*. This, in turn, is equivalent to a conjunction of facts that F_n is G. But that conjunction will be true in virtue of the *collective* truth of its conjuncts. So goes the objection. But the objection fails to note a key feature of distributive plurals, whether involving properties or predicates: for a plural to be distributive, *the Fs are G* must be equivalent to *each F is G* where the occurrences of G on each side of the equivalence *stand for the same thing*. For example, *the philosophers are in the pub* is distributive because it is equivalent to *each philosopher is in the pub*. The conjuncts *philosopher A is in the pub*, *philosopher B is in the pub* . . . need only explain the emergence of the conjunction *philosopher A is in the pub and philosopher B is in the pub*. By contrast, in the example *the lights make a pattern*, the conjuncts *that l_1 is at p_1* , *that l_2 is at p_2* , and so on are jointly responsible for explaining not only the emergence of the conjunction but also the emergence of a *pattern* made by the lights. CTP fails in the case of *the lights make a pattern* because the reduction base that it offers does not do away with this collective element.

We close this section with some clarifications. Just because plural collective powers cannot be eliminated in favour of logical constructions of singular properties, this does not mean that collective powers are somehow strongly emergent properties which are not explicable or predictable in terms of the various non-relational and/or relational properties of the individuals which collectively instantiate those powers. On the contrary, we take it that plurally instantiated collective powers are typically *grounded* in various properties of the individuals which make up the plurality (see the next section). Indeed, we take this to be the right lesson to draw from the CTP strategy discussed earlier. The character of a collective power will typically depend on the characters of the individuals that plurally instantiate the collective power. However, note that in our view, *grounding does not entail ontological reduction*. As should be clear already, the prospects for *reducing* collective (non-distributive) properties to collections of singular properties are dim. As we conceive it, grounding implies the opposite status of reduction. Reduction trades on identity: if one thing is ontologically reducible to another, that is because the one *just is* the other. However, metaphysical grounding is not compatible with identity. For one thing, grounding is an asymmetric and metaphysically generative relation while identity is not (see e.g. Audi 2012; Tugby 2022a: Ch. 6.2).¹⁹

Before proceeding, we must also acknowledge the possibility that not all the higher-level powers that philosophers speak of will turn out to be collective, non-distributive properties. For example, macroscopic things have mass and this might well be a distributive property.²⁰ Heil may well be right that it is unnecessary to countenance higher-level powers like these in our ontology. To be clear, our endorsement of higher-level powers is restricted to the non-distributive collective properties. However, this will still capture many of the cases that are regarded as higher-level powers. Again, redness is likely to count as non-distributive because redness (or the light-reflectance disposition associated with redness) is arguably not a property had by any individuals in the relevant plurality.

Collective powers and their grounding

In everyday contexts, we freely ascribe higher-level powers, such as the power of a car to be driven at 70 miles per hour. As noted earlier, such talk seems to be justified by the fact that higher-level powers do important explanatory work, especially in the special sciences. On the account we are proposing, many of the so-called higher-level powers are indeed genuine ontic properties. More precisely, we have argued that some properties are irreducibly collective and cannot be explained away in terms of logical constructions of non-plural properties. In truthmaking parlance, it is difficult to see how truthmakers can be given for non-distributive plural truths which appeal *only* to non-plural properties. So, it seems the truthmakers for such truths must inevitably appeal to collective properties. As we have seen, this opens the ontological door for those so-called higher-level powers which can be interpreted as collective properties. We provide further examples in this section and consider the important question of how collective powers relate to the individual properties of the substances which plurally instantiate those powers.

To continue first with the car example, we might say that its power to be driven at 70mph is plurally instantiated by the engine, the wheels, the gearbox and so on. Neither the engine, the wheels nor the gearbox *individually* has the power to be driven at 70mph, but collectively, they do. Notice, however, that this still cannot be the ultimate metaphysical story, since wheels and engines are arguably not themselves simple substances and (if we agree with Heil) therefore not really the kinds of things that can instantiate properties – plural or otherwise. Whilst it is often perfectly fine for explanatory purposes to speak of non-fundamental pluralities as instantiating higher-level collective powers (such as the power to be driven), the ultimate metaphysical explanation will be one which appeals only

to pluralities of simple substances (whatever they may be). Thus, if an atomistic theory of substance is correct, the collective power to be driven is one that is collectively instantiated by a certain (large) plurality of particles.²¹

We can expect that different special sciences will also posit collective powers of varying complexity. Consider the following example from elementary chemistry: the dissolution of a portion of salt in water. H_2O molecules surround the dissolved Na^+ and Cl^- ions. And if enough salt is present, the dissolved ions may saturate the water. However, no individual water molecule surrounds a dissolved ion, and no individual ion saturates the water: they instantiate these properties collectively.

Let us now start to address in more detail an important question that this picture raises: How do collective powers relate to the individual lower-level properties (non-relational and relational) of the substances which plurally instantiate those collective powers? The first thing to note is that in the examples discussed, it is plausible that the collective powers are metaphysically determined by the properties of the individuals that plurally instantiate the powers. So, to repeat, we do not regard collective properties like the power to be driven as being metaphysically *emergent*.²² In the cases discussed in this chapter, we take it that the relationship between higher-level collective powers and low-level powers is best thought of as involving some form of metaphysical grounding. We employ the term 'grounding' in much the same way as Bennett (2017) employs 'building'. Grounding picks out a family of relations which each have three metaphysical features in common: they are asymmetric, necessitating, and generative. In the case of collective powers, the idea is that (i) they are grounded in the properties (non-relational and/or relational) of the individuals that plurally instantiate them, *rather than vice versa*; (ii) the instantiation of a collective power is necessitated by the properties (non-relational and/or relational) of the individuals that plurally instantiate that power; and (iii) the instantiation of a collective power is metaphysically generated by the properties (non-relational and/or relational) of the individuals that plurally instantiate that power. Again, in the cases we have examined, it seems overwhelmingly plausible that grounding is at work. The power of a car to be driven is collectively grounded by the powers instantiated by the engine, the gearbox, the wheels and so on. The power of some H_2O molecules to form solvation shells around Na^+ ions is collectively grounded by – inter alia – the power of each (electronegative) oxygen component to attract an (electropositive) Na^+ ion.

We said that talk of grounding refers to a family of finer-grained relations. These include relations such as composition, constitution, realization, set formation, and the relation of

determination between determinate and determinable properties. Which of these specific relations might apply in the case of collective powers and the properties of the individuals on which those powers depend? We are open-minded, but if we take a suitably liberal stance towards what can compose what, and allow that some property instances might compose others, then it seems to us that the notion of composition might fit the bill here. Composition occurs when an entity is 'made up' of several others and it is typically a many-one relation. In contrast, many other common determination relations, such as constitution and realization, are typically a one-one affair, and therefore it is not plausible that these other relations apply in the cases we have discussed. Some philosophers reserve the term 'composition' for the category of objects, but it is also fairly common for philosophers to apply the concept of composition to entities in other ontological categories, such as events (Fine 2010), states of affairs and properties (Armstrong 1997 and McDaniel 2009), and, importantly for us, power instances (Marmodoro 2017). We propose to take a similarly liberal view of composition and follow pluralists in thinking there are different forms of composition (e.g. Fine 2010) which apply to different kinds of relata (e.g. McDaniel 2009).

What emerges, then, is the following picture of so-called higher-level powers. Such powers are irreducibly plural properties, which means they are collectively instantiated by a plurality of individuals (simple substances). Our second, supplementary claim is that collective powers are grounded in the low-level properties (non-relational and relational) of the individuals that plurally instantiate those powers. To be more specific, higher-level (collective) powers are composed of low-level property instances. However, to be clear again, none of this means that collective powers are reducible. As we understand it, grounding relations do not entail reduction, and for reasons discussed, it is highly unlikely that collective properties can be *reduced* to properties of individuals or logical constructions thereof.

Three further features of this grounding theory are well worth noting. First, we avoid exacerbating the problems of tractability that afflict views on which powers are treated as merely functional 'black boxes' (Marmodoro 2022). Such views individuate powers by their manifestations – such as a power *to roll downhill* – but say little about what it is about the *natures* of powers in virtue of which they have these manifestations. Such ontologies of powers merely parcel up and label, rather than illuminate, the phenomena that powers are invoked to explain. We do not claim that our proposal completely clears up this mystery about the nature of powers. However, we *do* claim that the ingredients of our proposal – collective plural instantiation, grounding, and so on – are as tractable and transparent as

any in metaphysics and hence do not *compound* or add to any 'black box' mysteries in explaining composition for powers. In particular, we avoid positing *sui generis* or otherwise mysterious composition relations to explain the part-whole structure of powers: powers composed by powers are simply *collective* powers.

Second, our account, if correct, introduces a corresponding *grounding constraint* on what higher-level powers are ontologically admissible. Admissible higher-level powers are those that can be accounted for as collective powers. Third, our proposal is *testable* by counterexample: it fails if there are compelling reasons to accept a higher-level power which violates the grounding constraint.

With our picture of collective powers now in place, we shall consider some immediate lines of resistance that the theory is likely to face. By offering replies to these objections, we shall hopefully shed further light on the theory.

Some objections and replies

In this section, we anticipate, and reply to, six objections to the theory sketched thus far. In what follows we convey the objections and replies through a discussion with an imaginary interlocutor.

Objection 1

It is absurd to suggest that, for example, a bunch of particles can plurally instantiate the power to be driven at 70mph. Particles are just not the kinds of things that can be driven – collectively or otherwise. Only cars and other medium-sized vehicles can instantiate the power to be driven at 70mph. So, the theory is clearly wrong.

We suspect that this kind of objection rests on an implicit commitment to the Aristotelian tradition in which a power has to be instantiated by a single individual.²³ Of course, if one accepts this Aristotelian assumption, then a car – qua composite substance – will be the obvious candidate as the possessor of the power to be driven. However, once we leave such Aristotelian assumptions behind, a new possibility opens up: the power to be driven is collectively instantiated by substances at a more fundamental level.²⁴ If we accept Heil's arguments against composite substances, then the individuals in question might be simple

substances such as the fundamental particles of physics. We do not deny that the so-called manifest image presents the world as one in which cars are composite objects that instantiate various higher-level powers. We also do not deny that it's true to say that a car has such powers. The crucial point is just that the deeper truthmaking story behind such truths is that these higher-level powers are collectively instantiated by pluralities of fundamental entities. Like Heil's (2021) theory, the view we have proposed about higher-level powers can be seen as an attempt to shed light on the relationship between the scientific and manifest images of the world.

Objection 2

I'm still not convinced that you need irreducible collective powers in order to tell a plausible truthmaking story here. In the Aristotelian tradition, a property is said to be instantiated singularly by an individual. However, no sensible Aristotelian would deny that relations are instantiated by more than one thing. Can't your so-called collective properties simply be analysed in terms of relations? Once the individuals in a plurality are relationally arranged in a certain way, do you not get the collective properties for free? If that's the case, then ontologically speaking there is no need to accept collective powers in addition to relations.

We think this suggestion paints a misleading picture of collective properties. Many collective properties are grounded not only in the relational features of a plurality but also specific non-relational properties of the relevant individuals involved. As we saw earlier, the power of some H₂O molecules to form solvation shells around Na⁺ ions is collectively grounded in the power of each (electronegative) oxygen component to attract an (electropositive) Na⁺ ion. We take it that this power of each oxygen component is non-relational. So, to ascribe a collective property to a plurality is to do more than ascribe relations among the substances in that plurality.

Objection 3

If your truthmaking story were the only plausible truthmaking candidate, then perhaps I would be convinced by your account of higher-level powers. However, I worry that you are failing to distinguish propertyhood and composition. I also detect this kind of worry in Heil's (2021: 46) discussion of shape. A complex, such as a ship, is composed of its parts

organized in a certain way, and the ship's shape is just a matter of how the complex is composed. Similarly, couldn't we also say that a tomato's being red is just a matter of how it is composed?

This compositional analysis may not be a live option – at least not for us. Indeed, we have tried to move away from the idea that complexes like ships are composite substances or particulars. So, it would be implausible to think that we are conflating propertyhood and composition. On our account, collective powers are plurally instantiated and do not require mereological wholes to bear them. That is, we are not treating an arrangement of individuals as some further thing to which higher-level properties are being ascribed. It is true that we employ compositional language when theorising about the properties themselves: we are happy to say that collective powers are composed or 'made up' of various properties of the individuals which collectively instantiate those powers. However, this idea must not be confused with the further idea, which we do not endorse, that such powers involve a composite particular.

Objection 4

Your response to objection three shows that your theory of higher-level properties pushes you towards a nihilistic picture on which there are no composite objects (e.g. van Inwagen 1990). But such a view is implausibly radical and counterintuitive.

Here we believe we may make the same sorts of moves as Heil when he is accused of being an anti-realist or eliminativist about higher-level entities such as tomatoes. We maintain, for example, that it is true that tomatoes exist and are red. The point is just that the *truthmakers* for such claims involve a plurality of simple substances collectively instantiating various powers. Like Heil's (2021: 45; 52) view, we do not regard this as leaving us with an anti-realist or eliminativist position about ordinary things. Tomatoes exist, it's just that, according to the view we are proposing, the deep metaphysical story about tomatoes is that they are pluralities of simple substances arranged in a certain way and collectively instantiating various powers. Note also that, like Heil (2012: 25), we do not endorse the idea that talk of tomatoes can be *conceptually* reduced to talk of simple substances having various properties.

Objection 5

Your response to the previous objection suggests that there is not a great deal of divergence between your view and Heil's. Indeed, although Heil does not explicitly discuss collective powers, we see no obvious reason why his picture cannot accommodate them. Sure, Heil is sceptical of 'higher-level' properties. However, if there are collective properties which are instantiated by pluralities of simple substances, then such properties seem not to be higher-level after all. We do not need a 'levels' conception of reality here, given that it is always the fundamental, simple substances which are instantiating the properties.

We concede that we are not entirely comfortable with the terminology of 'higher-level' powers. However, the important point is that our theory lets in more powers than Heil's does, since Heil denies that powers such as sphericity or redness are genuine (ontologically speaking). According to the theory we have proposed, such powers are genuine but collectively instantiated by various pluralities of simple substances. Maybe the upshot of all this is that when endorsing such powers we should simply replace talk of higher-level powers with talk of collective powers. In that case, the 'higher-level' terminology can be regarded as a ladder that we have used in a helpful way before kicking it away.

Objection 6

Okay, but there remains a possible way of accommodating 'higher-level' powers like sphericity or redness that you have overlooked. Like your theory and Heil's, this alternative does not need to posit high-level composite substances. It also beats your theory on parsimony because it respects the collectivity of at least some powers, while doing away with collective instantiation. On this view, while all powers are instantiated by substances individually, it is open to some powers to have joint, or collective, manifestations. Although a plurality of substances may be needed for such collective manifestations to occur, the manifestations in question are nevertheless collective manifestations of singularly instantiated powers - not singular manifestations of collectively instantiated powers. This suggests that your theory might rest on a confusion between power instantiation and the conditions of a power's manifestation.

In a recent discussion about collective powers, Williams (2019: 72f.) develops precisely this kind of argument. According to Williams, all powers are intrinsic powers. Hence, putatively collectively instantiated powers must be accounted for in terms of non-collectively instantiated, intrinsic powers. A concrete case will help us to grasp Williams' idea. To use Williams' own example, consider the power that a rugby team has to lift a 1,200 lb grand piano. *Prima facie*, this looks like an example of a power that is non-distributive and plurally instantiated by members of the team. However, as we interpret Williams, his view is that while the rugby team plainly *can* lift the piano, they do not instantiate any power to do so, either individually or collectively. Each individual may have an intrinsic power to lift, say, 200 lbs, but it is a mistake to account for the team's ability to lift the piano by ascribing to its members, collectively, a power whose manifestation is in some sense the *sum* of the manifestations of their intrinsic powers (2019: 75). Instead, according to Williams, each individual has a power to lift 200 lbs, and these intrinsic powers *themselves* have a further joint, or collective, manifestation - namely lifting a 1,200 lb grand piano. Hence, for Williams, while pluralities of intrinsic powers can have collective manifestations, there are no collectively instantiated powers.

Why think that all powers must be intrinsic? For Williams, the central answer is parsimony (2019: 69). Since at least some powers are intrinsic, any powers ontology should admit intrinsic powers. Then collectively instantiated powers are rejected in the following way. If there were any collectively instantiated powers, then the only manifestations that they could have would be such manifestations as could equally arise, in the same circumstances, as collective manifestations of intrinsic powers. Hence, collectively instantiated powers fail Williams' *novelty* condition (2019: 70) and should not be admitted.

Williams offers an interesting alternative here, and it is one that deserves more attention than we are able to offer.²⁵ Nonetheless, our position is that of the two theories (collective instantiation versus individual instantiation with collective manifestation), the collective instantiation theory has greater theoretical virtue overall, all else being equal.²⁶

In particular, Williams writes that 'It is a brute fact about any [type plurality of powers] that it produces the manifestation type that it does, and that is the end of the story' (2019: 75). That this is a theoretical cost appears not to be in doubt: 'If we take things down to the fundamental level, the brutality might be easier to swallow' (2019: 75).

In the next section, we briefly discuss some grounding-based alternatives to the brute fact approach to collectivity. We leave it open whether Williams' collective manifestation account is compatible with these alternatives.

Moreover, considerations of parsimony work in favour of collective manifestation here only if we assume that there are no *other* grounds to accept collective instantiation. Yet our arguments above attempt to provide precisely such grounds. If collective instantiation is accepted on other grounds, then accepting collectively instantiated powers will do no harm to the parsimony of our ontology overall.

Some remaining issues: causal exclusion and the metaphysical source of grounding

In this final section, we briefly address some outstanding issues. First, we discuss a so-called exclusion problem which Heil and others have raised against higher-level properties. We argue that advocates of our collective powers theory need not be worried by this alleged problem. Finally, we end with some speculations about the ultimate source of the compositional grounding principles governing collective powers.

The first important problem to address – the exclusion problem – is one that first came to prominence in critiques of non-reductive theories in the philosophy of mind (e.g. Kim 2005). The same sort of worry has been applied more generally by Heil (2003) and others to theories which accept higher-level properties. The problem can be expressed in terms of the issue of causal overdetermination: If higher-level collective powers are part of ontological furniture, then surely they should make their own causal contributions to the world. However, the worry is that such causal work is already carried out by the properties of the individuals that allegedly collectively instantiate those higher-level powers. Hence, it starts to look as if higher-level powers are theoretically redundant. If, however, we are to insist that collective powers and their low-level grounds *both* carry out the relevant causal work, then we seem to be committing to widespread causal overdetermination in the world. This leaves us with an inelegant, cluttered theory on which the same causal work is being carried out by both the properties of individuals *and* their collective properties. In the interests of economy, then, it would be better to say that only the low-level properties of individual substances are genuine.²⁷

Fortunately for us, work has already been undertaken by non-reductionists in the philosophy of mind on how to blunt the force of this kind of overdetermination worry (see e.g. Kroedel and Schulz 2016; for earlier discussions see Yablo 1992, Bennett 2003 and Stoljar 2008).²⁸ A common theme in these responses is to emphasise that higher-level properties (such as mental properties) are not metaphysically independent of the low-level properties (such as physical properties of the brain) with which they are supposedly in causal competition. So it is urged that this kind of overdetermination is crucially different to that which we find in the common examples of causal overdetermination, such as when a person is simultaneously shot with lethal bullets from different guns. In that example, the different bullets come from independent sources. If this example is used as a model for overdetermination, and overdetermination is thus defined in such a way that overdetermining causes are independent, then higher-level and low-level properties do not overdetermine their effects after all. Note that this argumentative move is also available within our collective powers theory given that we develop it as a grounding theory. Given that collective powers are grounded in low-level property instances, the former are metaphysically dependent on the latter.

At this point, the opponent might try to weaken the notion of overdetermination so that it applies in cases where the overdetermining causes are not metaphysically independent. However, it is not at all clear why this kind of overdetermination is problematic. If the relevant causes are not metaphysically independent, then it is far from clear that they are in causal competition. Indeed, the fact that a higher-level collective power is causing the relevant effect is simply a reflection of the fact that the relevant low-level properties are operative. The higher-level power inherits its causal profile from its grounds, ensuring that they work in harmony. Notice also that as soon as we take the special sciences metaphysically seriously, it looks inevitable that this weak form of overdetermination is widespread. For example, biological and chemical properties appear to play important explanatory roles. Indeed, our earlier chemical example of dissolution illustrates this. However, we take it that few chemists would deny that chemical powers are dependent for their existence on various properties in physics, which themselves make sufficient causal contributions to chemical processes such as dissolution. Our theory accepts this and, importantly, provides an account of how such dependence arises: it arises because higher-level powers are collectively grounded in the relevant properties at the lower level.

Setting the exclusion worry aside, let us finally address an important lingering question about the source of the dependence between higher-level and low-level powers. In

particular, one might wonder why collective powers are grounded in just the way(s) that they are, rather than some other way(s). Is it a brute fact that a collective power is grounded in one way rather than another, or is there a deeper metaphysical story to be told about the grounding profiles of collective powers? These questions take us into interesting territory in the so-called meta-grounding literature. The same sort of question also arises if we replace talk of grounding with the more specific notion of composition. There are arguably numerous metaphysical principles at work in determining what composes what. For example, according to Fine's (2010) operational account of composition, different forms of composition are defined by the various formal and material principles that they obey. In the case of power composition, so-called 'characterization conditions' (Fine 2010: 571) will be particularly important since the character of a higher-level power is presumably a function of the characters of the low-level property instances out of which it is built. To return to our toy example, the power of H₂O molecules to form solvation shells is plausibly a function of the character of the (electronegative) oxygen components, particularly their power to attract an (electropositive) Na⁺ ion. What, then, is the metaphysical source of such compositional characterization conditions?

In response, we could adopt a primitivist stance and just accept it is a brute fact that collective properties are grounded in the way that they are. However, there are two other main options, which elsewhere Tugby has called the 'bottom-up' and 'top-down' strategies for explaining grounding (2022a: 146).²⁹ According to the bottom-up approach, it is the low-level grounding entities themselves which explain why the grounding or composition occurs. On an essentialist reading of this approach, it is part of the essences of the grounding entities that they help to ground or compose the things that they do. Focusing on the compositional characterization conditions introduced earlier, the idea would be that it is part of the essential character of the composing properties that they collectively compose a higher-level power with a certain character. In contrast, in a top-down essentialist approach, the direction of explanation would run in the opposite direction, from the composed entity to its compositional grounds. The top-down idea would be that it is part of the essence of the collective power itself that it is collectively grounded or composed by low-level property instances with a certain character (or, perhaps, a certain disjunction of such properties). So which of these options is to be preferred?

We do not have any conclusive arguments to offer here but it seems to us that of the non-primitivist options, the top-down explanation is more plausible. The main problem with the bottom-up approach is that it seems rather extreme to require that in order to grasp the

essence of, say, a fundamental physical property, we must grasp all the grounding or compositional contributions that it could make towards a vast array of higher-level powers. Such a view would make the essences of fundamental low-level properties incredibly complex.

What we tentatively suggest, then, is that if there is a deep explanation for the way in which certain low-level property instances collectively ground or compose certain higher-level powers, this explanation is more likely to come from a top-down direction. And indeed, in recent grounding literature, the top-down approach has attracted a good deal of attention, having been endorsed in varying degrees by, for example, Rosen (2010), Fine (2012, 2015) and Dasgupta (2014). Again, if this view is carried over to the composition of collective powers, we are left with a picture in which it is part of the essential character of a collective power that it is composed in just the way it is by certain kinds of low-level property (or a disjunction of such properties, if the same higher-level power can be composed in more than one way). The upshot of all this would be that the characterization conditions mentioned earlier are determined by the essences of the higher-level powers themselves. This suggests that collective powers have a complex essence, which is perhaps unsurprising given that such powers require a plurality of instantiators. By accepting this view rather than the bottom-up theory, we can accommodate the compelling idea that low-level, non-collective properties have a simpler essence.

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¹ The authors have made an equal contribution to this chapter.

² Florio and Linnebo (2021) are a notable exception. Previously, metaphysical literature on collective properties has tended to focus more on topics such as emergence and monism rather than powers (e.g. Bohn 2012, Caves 2018). However, in recent powers literature, a more abundant conception of powers has started to become popular, as in work by Vetter (2015: Ch. 3) and McKittrick (2018: Ch. 8), who both argue that some powers are extrinsic. So, perhaps the tide is beginning to turn.

³ A certain pragmatic neutrality may also be in play: constructing a theory of predication might not require a commitment to any metaphysics of properties (although see Lowe 2013: 55). Fair play, say we. But we *are* after such a theory here.

⁴ For what it's worth, at least one of the authors leans towards the grounding theory; see Tugby (2021, 2022a). Prominent advocates of dispositional essentialism include Ellis (2001) and Bird (2007), and well-known proponents of the identity theory include Heil (2003) and Martin (2008). It is a matter of dispute as to whether there is a substantial difference between dispositional essentialism and identity theory; see Taylor (2018).

⁵ We are not entirely comfortable with this terminology and later shall recommend simply replacing talk of higher-level powers with talk of collective powers. Bird's terminology of macro-powers is also not ideal, as we want to discuss an example involving powers in chemistry which are arguably not macroscopic.

⁶ We use these terms interchangeably.

⁷ The idea has its roots in Aristotle. In the *Categories* (Ackrill 1963), Aristotle appears to allow that both composite substances and their substantial parts are primary substances.

⁸ Heil also provides further reasons for doubting the coherence of the notion of a composite substance. For instance, according to the traditional definition of substance, substances are non-dependent entities. Yet, *prima facie*, composite objects are always dependent in some way on their substantial parts. For details see Heil (2021: 45).

⁹ Note that a predicate may appear to be both collective and distributive at the same time, for example *the families gathered in the courtyard*. In such cases—which resemble cases of syllepsis—it suffices for our purposes that the distributive element does not undermine the collective one. A similar thing occurs in the subject place with ‘Tim and Alex met in the pub and had a pint’ (Oliver and Smiley 2001: 294).

¹⁰ We will, however, return to CTP in the case of properties.

¹¹ We use ‘set’ for illustration, but the point applies *mutatis mutandis* to ‘fusion’, ‘whole’, ‘sum’, ‘bunch’, or any other aggregate kind.

¹² Again, *mutatis mutandis* whatever aggregate kind one prefers.

¹³ Note that the target plural statements involve no antecedent or purely set-theoretic commitment to a set of all sets, or anything like a separation axiom. It is CTS which supplies these ingredients of the paradox.

¹⁴ The move will be automatic, of course, if every predicate corresponds with some property. But we assume that the task should not be so easy.

¹⁵ We trust it to cause no confusion that we are, of course, now changing the *property* and the *substance(s)* rather than the predicate and the subject.

¹⁶ It should not matter whether we treat locations as monadic properties or relations. The point is that a location is something that *each* light has.

¹⁷ Not that it would help if we helped ourselves to conjunctions: *the conjuncts form a conjunction* is still irreducibly collective and brings us back to the main point of our reply.

¹⁸ Parallel reasoning applies with *the jury members are unanimous*. The availability of a prefabricated kind-term *jury* may tempt one to blend CTP with CTS, offering a two-step reduction in which *the jury members are unanimous* reduces to *the jury is unanimous*, which reduces *in turn* to facts about each jury member and their respective belief. But the second step fails for the reasons already given: *the jury is unanimous* is true only in virtue of the members being *collectively* of the same view.

¹⁹ For similar reasons, we reject the thesis of composition as identity. This will be of relevance in the next section.

²⁰ Of course, if there are no such cases, then our account simply needs no such caveat.

²¹ We maintain this grammatically singular way of talking about a 'plurality' as a convenience. Strictly (or rather, metaphysically) speaking, of course, there are no such singular things - on pain of the Russellian paradox presented earlier. Where we use 'a plurality', what we mean can always be paraphrased more plurally, correctly, and circuitously in terms of 'some things'.

²² The precise definition of metaphysical emergence is a matter of dispute but a common idea is that emergents bring with them novel powers which are not fully accounted for in terms of the powers on which they depend. For discussion, see Wilson (2021).

²³ Ironically, for this reason, the objection risks overgenerating gerrymandered substances. For suppose that some things have a collective power. Then on the Aristotelian view, those things must compose a substance which is the bearer of that power. But there is no clear in-principle constraint on what things may have a collective power – not, at least, without dogmatically taking the Aristotelian view as an assumption.

²⁴ This is not at all to say that it should not matter to *which* more fundamental substances the relevant collective powers are attributed. Compare Oliver and Smiley (2001: 293) on this point.

²⁵ Williams' view relies in part on his mutual manifestation model of powers. A thorough critical discussion of that model would require a separate paper.

²⁶ Our theory must be able to respond to the exclusion-type worry that Williams himself raises (2019: 69–70). See the next section.

²⁷ Another alternative, which is not attractive, is to say that collective powers exist but are causally redundant. But this seems to clash with the very idea that they are *powers*.

²⁸ Here we provide only a brief sketch of how to blunt the force of the exclusion worry. For more details of this strategy, see Kroedel and Schulz's (2016) defence of grounding physicalism. See also McKittrick's (2018: Ch. 9) and Tugby's (2022a: 151–154) recent defences of the causal efficacy of dispositions.

²⁹ We do not claim that our discussion of the possibilities is exhaustive. For example, another option is to say that the grounding profiles of low-level properties are determined or governed by so-called laws of metaphysics. However, we think that this option raises further difficult questions about the nature and source of such laws. For discussion, see Wilsch (2015), Schaffer (2017), Rosen (2017), and Tugby (2022b).

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