Emergentism and the contingent solubility of salt

Lok-Chi Chan

National Taiwan University

**Abstract:** Alexander Bird (2001; 2002; 2007) offers a powerful argument showing that, regardless of whether necessitarianism or contingentism about laws is true, salt necessarily dissolves in water. The argument is that the same laws of nature that are necessary for the constitution of salt necessitate the solubility of salt. This paper shows that Bird’s argument faces a serious objection if the possibility of emergentism – in particular, C. D. Broad’s account – is taken into account. The idea is (roughly) that some emergent laws in some possible worlds may disrupt the solubility of salt without disrupting its constitution.

**Keywords:** Alexander Bird; laws of nature; emergentism; necessitarianism; contingentism

**I Bird’s argument**

Alexander Bird (2001; 2002) offers a powerful argument showing that, regardless of whether necessitarianism or contingentism about laws is true, salt necessarily dissolves in water. This paper shows that Bird’s argument faces a serious objection if the possibility of emergentism – in particular, C. D. Broad’s account – is taken into account.

I first introduce the debate between necessitarianism and contingentism about laws, beginning with Bird’s own view of necessitarianism:

**Necessitarianism about laws** Any fundamental property necessarily behaves in accordance with the law(s) of nature about it.

The idea here is that in any possible world where a fundamental property *p* exists, *p* must behave in accordance with the same law(s) of nature: e.g., if it is a law in some possible world that *p* is attracted to *q*, then the law must be true in every possible world where *p* exists.[[1]](#footnote-1) (In the literature, ‘laws’ has two possible meanings: (1) some scientific statements concerning regularities and (2) the regularities themselves or some governing entities or powers behind them. For the sake of clarity, I will mean only the former, and will use ‘lawmaker’ to mean the latter. [[2]](#footnote-2)) Many, including Bird (2007; 2010) and other influential theorists like Sydney Shoemaker (1980) and Chris Swoyer (1982), argue for necessitarianism about laws because it seems to be entailed by the following view (which they accept for independent reasons):

**Dispositionalism about properties** Any fundamental property must be identical with a particular disposition(s) or power(s).

It follows from this view that in any world with *p*, there must be the same set of dispositions or powers to which *p* is identical. There must be, then, the laws whose truth supervenes on the pattern of causal behaviours of *p*, which in turn supervene on the set of dispositions or powers. Put simply, it follows from this view that the very nature of *p* is the lawmaker of the law(s) about *p*.

The major rival of necessitarianism is contingentism:

**Contingentism about laws** The relation between any fundamental property and its nomic role(s) is contingent.

The idea here is that a fundamental property *p* can play different nomic roles in different possible worlds: e.g., *p* may be attracted to *q* in one world and be repelled by *q* in another world. Contingentism is often considered as closely associated with categoricalism about properties, which is the rival view of dispositionalism (see, for example, Langton 1998; 2006; Lewis 1986; 2009):

**Categoricalism about properties** Any fundamental property is a categorical property and thus not identical to its disposition(s) or power(s).

Many categoricalists consider *p*’s dispositions, causal behaviours, and corresponding laws in a world as not supervening on the intrinsic nature of *p*, but on some lawmaker(s) extrinsic to *p*: e.g., some systematic regularity(ies) of the overall arrangement of properties in that world (e.g., Lewis 1986) or some ontologically independent and fundamental lawmaker(s) in that world (e.g., Langton 1998). Accordingly, if the lawmaker(s) were different, *p* may exhibit different dispositions and causal behaviours that are in accordance with different laws.

Some contingentists favour the following argument from modal intuition: it is our intuition that actual things could have behaved otherwise in some other possible worlds, and if this intuition is correct then laws must be contingent (see, for example, Langton 1998; 2006; Lewis 1986; see also Hume 1748/2003). For instance, Rae Langton (1998, p. 118) gives the example of an intuition according to which soluble things in the actual world might be insoluble in another world. In response to this argument, Bird’s strategy is to show that our modal intuitions about such counterfactual behaviours are largely mistaken and thus that we cannot use them to guide our metaphysical inquiries (2001, p. 274; 2002, p. 263; 2007, p. 170). Our metaphysical inquiries, in his view, must instead be guided by empirical science (2001, p. 274; 2002, p. 260).

Bird describes a fairly incontestable counterexample to our modal intuitions and argues that the same is true in many other cases of the same kind. Thus, if our modal intuition is mistaken in so many cases, it must be utterly unreliable. His particular counterexample is the fact that salt dissolves in water, which he argues to be necessary under most respectable metaphysical views – e.g., under necessitarianism about laws, contingentism about laws, dispositionalism about properties, and categoricalism about properties (2001, p. 267). Other than being a contribution to the debate between necessitarianism and contingentism, the argument itself is also of independent philosophical interest.[[3]](#footnote-3)

How could the solubility of salt be necessary? Bird’s answer is simple but powerful. Salt is an ionic crystal lattice with the chemical formula NaCl, which has a 1:1 ratio of positively charged sodium ions and negatively charged chloride ions. These ions form the crystal lattice structure as the electrostatic attraction between them forms ionic bonds. (The measure of the strength of ionic bonds is called lattice energy, which is -787.3 kJ/mol in the case of salt.) Both the necessitarian and the contingentist have to accept this fact drawn from empirical science. Bird then argues that if Saul Kripke and Hilary Putnam are correct, if salt must be *identical to* its microscopic structure, then this is a *necessary* fact (p. 270). Hence, the mere existence of salt necessitates the existence of sodium ions, chlorine ions, and electrostatic forces, and so on, and also necessitates the truth of the laws of electrostatics and other relevant laws (e.g., the laws of thermodynamics). For if contingentism about laws is true, and so if the fundamental physical laws were different, then salt could not be constituted out of its constituents. Something similar can be said about water. Water is a collection of H2O, each molecule of which is constituted by two positively charged hydrogen atoms and one negatively charged oxygen atom – as the electrostatic attractions between the atoms cause them to share electrons and thereby form covalent bonds. And the mere existence of water necessitates the existence of its constituents and the truth of the laws of electrostatics.[[4]](#footnote-4)

The second step of Bird's argument states that the truth of the laws of electrostatics and other relevant laws makes it necessary that salt can dissolve in water. Under these laws, water molecules have a dipole structure: they have a partial negative charge near the oxygen atom – which is called the negative dipole – and a partial positive charge near the hydrogen atoms – which is called the positive dipole. As such, there is electrostatic attraction between the positive dipole and the negatively charged chloride ion and between the negative dipole and the positively charged sodium ion. Even though the strength of such ion-dipole attraction is much weaker than the lattice energy of salt, the attraction would nonetheless disrupt and break the ionic bonds of salt when each ion is surrounded by multiple water molecules. Recall that this whole process occurs in accordance with laws like the laws of electrostatics, the truth of which is required in the constitution of salt and water. Hence there cannot be any world where salt and water both exist but the former does not dissolve in the latter (p. 271).

Bird calls this the ‘down and up structure’ (2002, p. 258): the existence of some higher-level entity necessitates the existence of its constituents and the truth of the laws about these constituents; and the truth of these laws, in turn, necessitates the truth of some higher-level laws about the higher-level entity concerned. In Bird’s view, the argument can proceed on the assumption that contingentism is true, and it can be generalised to many higher-level laws other than the law that salt dissolves in water (p. 258).[[5]](#footnote-5)

**II Broad's emergentism**

I believe that the above argument is correct insofar as **reductionism** – according to which all higher-level properties (or entities) are reducible to lower-level ones and the relations between them – is true.[[6]](#footnote-6) However, in line with Bird’s intention – which is to show that the assumptions and conclusion of the argument should be acceptable to his rivals – I will argue that a particular rival of reductionism is unfairly ignored. The view is **emergentism**, according to which a property may emerge out of a structure of lower-level properties and yet be irreducible to them and thus ‘novel’.[[7]](#footnote-7) In many (though not all) accounts of emergence (see, for example, Broad 1925; Van Cleve 1990; O’Connor 1994; Braddon-Mitchell 2007; Wong 2010), since the emergent property is not any sum of lower-level properties and their causal behaviours, it is not (solely) produced and governed by lower-level lawmakers. (Recall the distinction between ‘laws’ and ‘lawmakers’; see Section I.) Instead, it must be governed by some emergent lawmakers that, despite being on some higher level, are ontologically fundamental, in the sense that they are ontologically irreducible to and independent of lower-level lawmakers and the properties they govern. These lawmakers interact with some lower-level properties under certain conditions – such as the case where those properties constitute certain structures – conferring some novel causal powers to those properties and/or disabling some of their original causal powers.[[8]](#footnote-8) This is how we get emergent properties and their causal behaviours according to the account. (There will be a further discussion and precise examples of how this may happen in Section III.) For instance, in his famous 1925 book, C. D. Broad argues that water molecules and their causal behaviours cannot be explained by hydrogen atoms, oxygen atoms, and the laws governing those atoms. Instead, those molecules and their causal behaviours have to be explained by some chemical-level lawmakers which are ontologically fundamental (pp. 63-64). Let us call this account of emergence which posits fundamental emergent lawmakers **Broad’s account**.

Now most of us agree that Broad, constrained by the science of his era, was simply wrong. Water molecules and their causal behaviours can be reductively explained by quantum mechanics – in ways which were not known by Broad and his contemporaries. Nevertheless, the debunking of the emergence of water alone cannot show that emergentism or Broad’s account is false and that there is no emergence in the actual world. In contemporary philosophy and philosophy of science, it has been suggested that emergence exists in domains such as quantum mechanics (see, for example, Teller 1986; Humphreys 1997; Silberstein and McGeever 1999; Rosenberg 2015) and consciousness (see, for example, Van Cleve 1990; Goff 2015; Rosenberg 2015). I shall discuss this further at the end of the paper. For now, let us set aside whether Broad’s account is adequate, and assume that these suggestions are correct.

**III The** **argument from contingent emergence**

To develop my argument, I shall begin with an assumption: Broad’s account is true – or at least possibly true – about quantum mechanics and consciousness. While Broad is wrong – there are, in the actual world, no emergent lawmakers that specifically govern salt and water – there could be such emergent lawmakers in some other possible worlds. The problem with Bird’s argument is this. There could be, in a possible world *w*, an emergent chemical-level lawmaker *E* which realises an emergent chemical law *e*, ‘the ionic bonds between sodium ions and chloride ions cannot be broken by the electrostatic forces produced by the dipole structure of water molecules’. Salt in world *w* would behave (and be constituted) in a way like actual salt in most circumstances, because both would display a pattern of behaviours that is describable by relevant lower-level laws like the laws of electrostatics.[[9]](#footnote-9) However, when placed in water it would not dissolve because its solubility – despite appearing to be implied by *lower-level* laws – is intervened upon by the *emergent chemical-level* lawmaker *E*: lawmaker *E* confers some novel causal powers to NaCl or H2O, or disables some causal powers of NaCl or H2O and thereby prevents dissolving from happening. Meanwhile, lawmaker *E* may do this in some tricky ways that do not disrupt the microphysical constitution of the salt (which I will discuss in the next paragraph). Hence, if Broad’s account is possibly true, salt dissolves in water but not necessarily, because it is contingent that there are no emergent lawmakers that forbid the dissolving of salt in water in the actual world. Let us call this argument **the argument from contingent emergence** (henceforth, **ACE**).[[10]](#footnote-10)

Up to this point, the idea of conferring or disabling causal powers to prevent dissolving from happening (without disrupting the microphysical constitution of salt) is still imprecise. As mentioned earlier, the mechanism of the dissolving of salt in water is the following: the dipole structure of water molecules produces an electrostatic attraction that disrupts the ionic bonds of salt. By what precise mechanism can lawmaker *E* prevent this from happening? I believe that there are plenty of possibilities, some of which could be: (1) that there is a mysterious field that isolates the ionic bonds from external electrostatic forces, (2) that the lattice energy of salt (i.e. the strength of its ionic bonds) increases when an external electrostatic force disrupts them, (3) that it is a brute and inexplicable fact that the ionic bonds of salt neglect the influence of external electrostatic forces, and so forth. It is important to note that, in Broad’s account, fundamental emergent lawmakers are something similar to a demon that can confer novel causal natures to entities; and since these causal natures are novel and are conferred by the demon, they do not need to operate in ways explicable in terms of the theoretical framework of our actual physics. For example, they do not necessarily supervene on fundamental physical forces that we know of, such as the electromagnetic force, the gravitational force, the strong force, and the weak force. Being unconstrained by such theoretical frameworks, there are countless possibilities of how lawmaker *E* could turn salt into an insoluble substance without disrupting its constitution.

It is important to note, though, that the demon is an imperfect analogy. Many take such a demon to be metaphysically impossible and the idea of its existence to be problematic; but we are now assuming that emergentism and Broad’s account are possibly and actually true. Furthermore, the action of a demon is arbitrary: the salt still dissolves in water when the demon changes its mind and refrains from acting, so it might be said that the salt is still disposed to dissolve in water. Bird actually does consider the possibility of a demon, and his response to the worry is in line with my point above: his argument demonstrates the necessity of the law that salt dissolves in water (henceforth, I will call this law *d*), not the necessity of the law that salt *always* dissolves in water. While the latter law is a universal law, the former law is a *ceteris paribus* law or a dispositional law (namely, a law that describes a disposition) – both of which allow for exceptions (2001, pp. 273-274; see also 2002, pp. 267-269). I shall now discuss these two possible accounts in turn.

First of all, lawmaker *E*, contra the demon, could be a universal lawmaker which makes law *e* (i.e. ‘the ionic bonds between sodium ions and chloride ions cannot be broken by the electrostatic forces produced by the dipole structure of water molecules’) a universal lawin some worlds: in those worlds, it never stops working; it holds true *in all circumstances*. This means that law *d* does not even have the status of a *ceteris paribus* law in those worlds. It is simply false there. Of course, there might be some worlds where lawmaker *E* exists but law *e* is only a *ceteris paribus* law, which allows for exceptional cases to which law *d* might apply. Following the argument presented in this paper, another emergent lawmaker might disrupt lawmaker *E*. For example, lawmaker *E* might be ineffective inside the body of some emergent biological creature, which is governed by an emergent biological-level lawmaker *B*. But those worlds with lawmaker *B* are irrelevant: as long as there is any world where law *e* is a universal law, law *d* is not true in all worlds and is thus not necessary.

The idea that law *d* is a dispositional law deserves more attention, since it relates to Bird’s influential discussion of antidotes (or masks). In this case, law *d* is considered as the claim that salt is *disposed to* dissolve in water. The worry is as follows: it is widely agreed that *x* can be said to be disposed to do *y* even when there are some antidotes that may intervene in the causal process and thereby stop *x* from doing *y*. Can lawmaker *E* be said to be a mere antidote which does not really negate law *d*? The notion of antidotes is an independent and important philosophical topic to which many have contributed; to narrow down the scope, I shall focus my discussion on Bird’s own account. Bird in fact believes that the antidote of a disposition could be some physical effects, a sorcerer’s spell, or a demon (1998, p. 231) – the last of which is our imperfect analogy above – and he accepts that there could be a universal antidote which *always* intervenes on the manifestation of a disposition (p. 234).

To discuss whether or not lawmaker *E* is just a universal antidote which does not really neglect law *d*, it would be wrong to begin by asking whether lawmaker *E* is an antidote – since this question is not that crucial. Instead, we should ask why there could still be a disposition when there is a (normal) universal antidote, and whether or not the case applies equally to salt in world *w* (namely, a world with lawmaker *E*). Bird’s response to my former question is as follows:

We might consider what would happen if the fink or antidote were removed – for instance a knowledge of physics might tell us what would happen to a nuclear pile if the moderating rods were removed, even if we had not seen a nuclear explosion in this or any other pile. […] We are thinking of cases *like* this one (apart from the boron rods), *under the same circumstances*. (Bird 1998, p. 234; original italics)

This brief response is not very clear. But it seems to me that it may be interpreted as follows: under the same physical laws (which are posited by our knowledge of physics), with a slightly different structural arrangement of the entity concerned or its surrounding environment, the entity concerned would provide the expected response. For instance, even if the demon always stops salt from dissolving in water in a world, it could refrain from doing so in a nearby possible world with the same laws.

However, if my interpretation is correct, salt in world *w* is not disposed to dissolve in water, because all nearby possible worlds – which share the *same laws*, including law *e* – would be ones where salt never dissolves. No doubt, one could very well reject Bird’s account of universal antidotes (or my interpretation of it) and accept another. Nonetheless, if one wants to assert that salt in world *w* is disposed to dissolve in water, one still has to answer the following difficult question: how could the assertion be made when it is simply *nomologically impossible* for salt in world *w* to dissolve in water? Of course, some might consider metaphysical possibilities apart from nomological possibilities. Even from the perspective of world *w*, there are *metaphysically possible* worlds where salt could dissolve in water: worlds like our actual world. And it is agreed upon by many theorists that dispositions are essentially modal in character: a thing’s dispositions track its *possible* responses to stimuli, including some possible responses that might never be actualised (see, for example, Mumford & Anjum 2011; Armstrong 1997, p. 79). Nonetheless, it seems to be a very unattractive view that a thing’s dispositions track *all* of its possible responses, including nomologically impossible and merely metaphysically possible ones. For this view is a dispositional non-naturalism of some kind. To be more precise, under this view dispositions can track mere metaphysical possibilities, which are abstract metaphysical posits; accordingly, we must understand dispositions as some merely abstract relations which are not grounded in the ways the natural world really operates. Any theorist who takes a (more) naturalistic attitude toward the metaphysics of disposition should avoid holding such a view. This is particularly the case for theorists like Bird (2007) who takes the metaphysics of disposition as part of ‘nature’s metaphysics’. Hence, it appears that a simple, good answer to our question above is: its assumption that salt in world *x* is disposed to dissolve in water is just wrong; salt in world *x* is not disposed to dissolve in water.

My main aim in this paper is to offer my argument, ACE, as a counterargument to Bird’s contention that salt necessarily dissolves in water, but it is also of value to see the implications of ACE to the more general discussion of the metaphysics of dispositions and laws. To begin with, it appears that ACE is plausibly compatible with both dispositionalism and categoricalism about properties. For fundamental emergent lawmakers, like other fundamental properties, could plausibly be dispositional or categorical properties. To be more precise: on the one hand, I see no reason why fundamental emergent lawmakers cannot be understood as primitive dispositions of some kind. For instance, we may understand lawmaker *E* as salt’s disposition not to dissolve in water. On the other hand, while the categoricalist believes that dispositions require categorical bases, fundamental emergent lawmakers can plausibly have categorical bases as well. Furthermore, while some categoricalists posit lawmakers as abstract objects that are ontologically irreducible to and independent of the categorical properties they govern (e.g., Langton 1998), or as mere systematic regularities of the overall arrangement of categorical properties (e.g., Lewis 1986), lawmaker *E* can, again, plausibly be understood as something of these kinds.

The implications of ACE to the debate between necessitarianism and contingentism about laws are more notable, for ACE seems to support contingentism against necessitarianism. The necessitarian can of course argue that, even if ACE is correct, the fundamental properties of salt[[11]](#footnote-11) nevertheless necessarily behave in accordance with all the fundamental laws of nature about them (e.g. some laws of electromagnetism, if they are as fundamental as contemporary physics tells us). For while some fundamental laws are, in some circumstances, neglected by lawmaker *E* in world *w*, they just fail to be *universal* laws there, but are nevertheless *ceteris paribus* laws. However, the necessitarian cannot explain everything away. ACE shows that the fundamental properties of salt do not necessarily behave in accordance with some higher-level laws like law *d*: it is not true that when they form salt, the salt necessarily dissolves in water. Furthermore, they are, in some worlds like world *w*, associated with one additional law, law *e*: when they form salt, they behave in accordance with law *e*, unlike their counterparts in the actual world which do not ever behave in accordance with law *e.* Hence, necessitarianism is false. One particularly interesting implication here is that ACE provides a possibility that necessitarianism is false while dispositionalism is true. This goes against the standard view that the latter entails the former (see Section I).

**IV Possible objections**

There are at least four possible objections to my argument. Firstly, it can be said that what we have in world *w* is an *emergent entity*, which is a product of lawmaker *E*. Call this saltE. Since salt in the actual world is not an emergent entity, it is not the same thing as saltE. With this in mind, there is no salt but only saltE in world *w*. But this would be a mistake, for saltE is the joint product of the NaCl molecular structure (henceforth, molecular structure *M*) and lawmaker *E*. If there is saltE in world *w*, then there must be molecular structure *M* in world *w* as well. For if the molecular structure *M* is what we call ‘salt’ in the actual world, it seems that we can call molecular structure *M* in world *w* ‘salt’ as well – this is because they are exactly the same. The idea here is what we have all learned from Kripke: if we discover the actual watery stuff to be H2O, then the term ‘water’ picks out H2O in all possible worlds.

Secondly, it might be argued that the molecular structure *M* in world *w* (henceforth, the molecular structure *Mw*) cannot be called ‘salt’, because it behaves differently under the influence of lawmaker *E*. The assumption here is that only when two things behave in the same way can they be the same thing; and if they behave differently, then they cannot be the same thing. I agree that there might be such a conceptual necessity, but this would make Bird’s argument trivial: salt necessarily dissolves in water simply because it could not be called ‘salt’ if it does not. To make sense of Bird’s argument, we need to assume a conceptual possibility: something intrinsically, structurally, and/or behaviourally similar to actual salt and yet not soluble in water might nevertheless be salt. Only by assuming this conceptual possibility, can the conclusion that such a thing is in fact not possible be non-trivial. If we accept this as an assumption, then there would be no good reason for saying that molecular structure *Mw* is not salt. Note that lawmaker *E* would not affect molecular structure *Mw* unless it is placed into water. In terms of their intrinsic nature and structures, molecular structure *Mw* and actual salt are qualitatively identical; in terms of their behaviours, there is only one single difference: the difference between their behaviours in water.

Thirdly, it can be questioned whether or not the laws of electrostatics like Coulomb’s law are true in world *w*. The worry is that, because such laws are false in the situation where molecular structure *Mw* is placed in water, the laws cannot be applied universally as they are supposed to be. An analogous case is Newton's laws of motion. They cannot be applied when the speeds involved are close to the speed of light; and some people (though not everyone) therefore take them to be false. As such, if there was no Coulomb’s law in *w* but a law, say Coulomb’s law1, which allows for or adequately describes the exception, then it might be impossible for there to be salt in *w*.[[12]](#footnote-12) This is because molecular structure *Mw* is produced by a different law, and should thus be considered as a different entity. This possible objection involves a confusion between two possible meanings of the term ‘laws’ in metaphysics: what I call ‘laws’ and ‘lawmakers’ (see Section I). Suppose that in a world *x* particles have intrinsic powers to causally behave in a way describable by Coulomb’s law, and in a world *y* God is constantly and endlessly moving and arranging particles in a way describable by Coulomb’s law. We can say that Coulomb’s law, as a scientific statement, holds true in both worlds. But if we are concerned with lawmakers, then certainly we have different lawmakers doing the job in *x* and *y* – for the powers involved have tremendously different nature. Let us return to our salt case. If we simply take Coulomb’s law as a scientific statement, it might be false in world *w.* However, we do not have a different lawmaker playing the role of Coulomb’s law (or Coulomb’s law1). Instead, we have exactly the same lawmaker, and it has exactly the same way of producing and governing molecules such as molecular structure *M*; it is simply intervened upon and disrupted by lawmaker *E* sometimes. It is difficult to see why, assuming that my responses to the previous two objections are correct, molecular structure *Mw* and its supervenience bases have to be considered as different kinds of things than their actual counterparts.

Fourthly, my argument, ACE, assumes the metaphysical possibility of *non-actual, counterfactual* emergent lawmakers. It may be questioned whether these lawmakers are really metaphysically possible, even under the assumption that Broad’s account is actually true: for instance, even if there actually are emergent lawmakers at the quantum level, this does not obviously imply that lawmaker *E* is metaphysically possible. After all, conceivability does not entail possibility. I cannot discuss in detail the issue of conceivability and possibility here, but my basic stance can nevertheless be stated. For one thing, one may appeal to David Chalmers’s approach to the issue (2002, p. 148; see also a discussion in Chan forthcoming): conceivability does not entail possibility, but ideal conceivability – which is derived from an all-informed, perfectly rational reasoning process – does entail possibility; and we may attain – or, in my view, attain something closer to – ideal conceivability. This happens when we have justification for the view that the conceivability claim concerned cannot be defeated by further evidence and reasoning. Now suppose, as we did above, that Broad’s account is true; that is, suppose that there really are fundamental emergent lawmakers, such as emergent quantum-level lawmakers, in the actual world. If emergent quantum-level lawmakers are really possible, then it must be ideally conceivable – nothing in principle would successfully defeat its conceivability. Now note that emergent quantum-level lawmakers and emergent chemical-level lawmakers like lawmaker *E* differ only in their *nomological* nature, not in their *metaphysical* nature. (Furthermore, note that they are both fundamental; there cannot be defeaters of their conceivabilities that appeal to their constituents: e.g., they cannot really be constituted out of their constituents.) This means that their ideal conceivabilities are most probably the same: if emergent quantum-level lawmakers are really ideally conceivable, then lawmaker *E* is most probably ideally conceivable as well. This implies that lawmaker *E* is presumably metaphysically possible. Of course, nothing I say in this paper relies on Chalmers’s particular account of conceivability and possibility (nor on my argument above) for there are other good accounts. More importantly, as Daniel Stoljar remarks, ‘everyone’s problem was nobody’s problem’ (2006, p. 51): the presumption that conceivability is good evidence for possibility is ubiquitous in most philosophical discussions, and hence any scepticism about this presumption is a problem for philosophy generally and has nothing much to do with particular philosophical discussions like ours (pp. 51-54). Hence, it is not obvious why the issue of conceivability and possibility is a significant worry here.

There might be a further possible objection to my argument above. It might be objected that the idea of lawmaker *E* in fact violates an important metaphysical principle that many, including Bird, accept: necessitarianism about laws. Necessitarianism implies that actual fundamental properties necessarily behave in accordance with actual laws, and cannot possibly behave in accordance with non-actual, counterfactual laws. The fact that lawmaker *E* is a non-actual, counterfactual lawmaker that interacts with actual lower properties to produce non-actual, counterfactual behaviours necessitates its impossibility. Here it is not useful to appeal to the similarity between lawmaker *E* and emergent quantum-level lawmakers, the latter of which we are assuming to be actual, because the actuality of the latter is what makes the crucial difference. I have three misgivings about this objection. Firstly, one of the aims of this paper is to assess whether or not necessitarianism is true; but this objection is simply proclaiming that since necessitarianism is true, my objection to it must be incorrect. This is question-begging. Secondly, we are now discussing Bird’s argument that salt’s solubility must be necessary *even* *without the assumption that necessitarianism is true*. It is unreasonable to suddenly betray this starting point and assume necessitarianism here. Thirdly, why should anyone assume necessitarianism at all? As seen in Section I, many seminal necessitarians like Bird, Shoemaker, and Swoyer take the view as a conceptual entailment of their dispositionalism about properties – which they have some independent reasons for accepting. Hence, for them, the basic, crucial metaphysical principle is in fact dispositionalism; necessitarianism is merely a derivative principle. However, in the previous section I showed that ACE is plausibly compatible with dispositionalism. If this is correct, dispositionalism does not really entail necessitarianism, and hence those who assume necessitarianism because of dispositionalism should reconsider their assumption here.

**V Final remarks**

Bird’s aim is to show that we can, regardless of which major metaphysical view is true, take it to be the case that salt necessarily dissolves in water. If ACE is correct then this paper has shown otherwise: if Broad’s account is possibly true then we have good reason to believe that salt merely contingently dissolves in water. My argument also provides an interesting challenge to necessitarianism about laws: a challenge that is plausibly compatible with dispositionalism about properties.

In these final remarks I shall briefly and quickly describe my take on whether or not we should take emergentism seriously. To do this, I shall begin with a widely held worry: that emergentism is, unlike reductionism, a philosophically implausible and unrespectable view.[[13]](#footnote-13) This paper is certainly not a good place to discuss philosophical challenges to emergentism, nor am I the best person to do so – I am not yet convinced by the view. However, even granted that emergentism is facing serious philosophical challenges, I do think that it is more respectable than it appears. For there really seems to be considerable empirical support to the view. It has been suggested by many that some quantum phenomena such as quantum entanglement can be best interpreted as emergent and not reducible phenomena (see, for example, Teller 1986; Humphreys 1997; Silberstein and McGeever 1999; Rosenberg 2015). Quantum entanglement is the phenomenon where multiple particles bring about a system which possesses entangled states that cannot be understood in terms of the properties of individual particles. The phenomenon is found in, for example, the quantum eraser experiment and the EPR experiment. Reductionism still faces significant difficulties in explaining the results of these experiments, and many physicists believe that there are no hidden variables needed for reductive explanations. My argument here is simple. When our considerations of empirical evidence and philosophical plausibility are in conflict, it is not easy to tell which of them should be revised; there is thus no reason to assume that our consideration of philosophical plausibility is correct and that the conflict is all due to the incompleteness of empirical inquiries. Hence, empirical evidence could grant respectability to emergentism despite the fact that the view faces serious philosophical challenges.

This is actually in line with Bird’s attitude towards metaphysics: we have seen, in Section I, that he attaches importance to empirical science, not philosophical intuitions. In fact, he very well acknowledges that there are some inconsistencies between his metaphysical views and contemporary physical theories, and that he does not yet have good solutions to every one of the inconsistencies. His view is that we should expect that future physics would eventually favour his metaphysical views, such as his necessitarianism and dispositionalism (2007, pp. 211-215). But in our case, do we *really* have sufficient grounds to expect that, say, future quantum theories would eventually favour emergentism over reductionism? Even though I do not think that the answer to this question must in principle be a ‘no’, I also think that more work needs to be done to support a ‘yes’. For now, it seems warranted to conclude that ACE poses a formidable challenge to Bird’s argument that salt necessarily dissolves in water and also to his necessitarianism.

**Acknowledgments**

The author would like to acknowledge Eran Asoulin, David Braddon-Mitchell, Michael Duncan, Wei Fang, Toby Handfield, Andrew James Latham, James Norton, Graham Oppy, Alex Sandgren, Simon Varey, and two anonymous referees for their useful comments. Special thanks are due to Belinda Rickard.

**References**

Armstrong, D 1997, *A world of states of affairs*, Cambridge University Press, Cambridge.

Beebee, H 2002, ‘Contingent laws rule: reply to Bird’, *Analysis*, vol. 62, no. 3, pp. 252-255.

Bird, A 1998, ‘Dispositions and antidotes’, *Philosophical Quarterly*, vol. 48, no. 191, pp. 227-234.

Bird, A 2001, ‘Necessarily, salt dissolves in water’, *Analysis*, vol. 61, no. 4, pp. 267-274.

Bird, A 2002, ‘On whether some laws are necessary’, *Analysis*, vol. 62, no. 3, pp. 257-270.

Bird, A 2007, *Nature’s metaphysics: laws and properties*, Oxford University Press, Oxford.

Bird, A 2010, ‘The dispositionalist conception of laws’, *Foundations of Science*, vol. 10, no. 4, pp. 353-370.

Braddon-Mitchell, D 2007, ‘Against ontologically emergent consciousness’, in B McLaughlin & J Cohen (eds.), *Contemporary debates in philosophy of mind*, Blackwell Publishing, Malden, pp. 287-300.

Broad, CD 1925, *The mind and its place in nature*, Kegan Paul, London.

Carrol, J 1994, *Laws of nature*, Cambridge University Press, Cambridge.

Chalmers, D 2002, ‘Does conceivability entail possibility?’, in TS Gendler & J Hawthorne (eds.), *Conceivability and possibility*, Oxford University Press, Oxford, pp. 145-200.

Chan, LC (Forthcoming), ‘Can the Russellian monist escape the epiphenomenalist’s paradox?’, *Topoi*, special issue on mental powers.

Chan, LC, Braddon-Mitchell, D & Latham AJ (Manuscript), ‘Categorical nature and dispositions in different kinds of worlds’.

Goff, P 2015, ‘Against constitutive Russellian monism’, in T Alter & Y Nagasawa (eds.), *Consciousness in the physical world: perspectives on Russellian monism*, Oxford University Press, New York, pp. 370-400.

Hempel, CG & Oppenheim, P 1948, ‘Studies in the logic of explanation’, *Philosophy of Science*, vol. 15, no. 2, pp. 135-175.

Hume, D 1748/2003, *A treatise of human nature*, J.M. Dent & Sons, London.

Humphreys, P 1997, ‘How properties emerge’, *Philosophy of Science*, vol. 64, no. 1, pp. 1-17.

Kim, J 1999, ‘Making sense of emergence’, *Philosophical Studies*, vol. 95, pp. 3-36.

Langton, R 1998, *Kantian humility: Our ignorance of things in themselves*, Oxford University Press, Oxford.

Langton, R 2006, ‘Kant's phenomena: extrinsic or relational properties? A reply to Allais’, *Philosophy and Phenomenological Research*, vol. 73, no. 1, pp. 170-185.

Lewis, D 1986, *On the plurality of worlds*, Basil Blackwell, Oxford.

Lewis, D. 2009, ‘Ramseyan humility’, in D Braddon-Mitchell and R Nola (eds.), *Conceptual analysis and philosophical naturalism*, MIT Press, Cambridge, pp. 203-222.

Mumford, S & Anjum, RL 2011, ‘Dispositional modality’, in C Gethmann (ed.), *Lebenswelt und Wissenschaft*, Meiner Verlag, Hamburg, pp. 380-394.

Needham, P 2000, ‘What is water?’, *Analysis*, vol. 60, no. 1, pp. 13-21.

Needham, P 2011, ‘Microessentialism: what is the argument?’, *Noûs*, vol. 45, no. 1, pp. 1-21.

O’Connor, T 1994, ‘Emergent Properties’, *American Philosophical Quarterly*, vol. 31, no. 2, pp. 91-104.

Psillos, S 2002, ‘Salt does dissolve in water, but not necessarily’, *Analysis*, vol. 62, no. 3, pp. 255-257.

Rosenberg, G 2015, ‘Causality and the combination problem’, in T Alter & Y Nagasawa (eds.), *Consciousness in the physical world: perspectives on Russellian monism*, Oxford University Press, New York, pp. 224-245.

Shoemaker, S 1980, ‘Causality and properties’, in Peter van Inwagen (ed.), *Time and cause*, Reidel, Dordrecht, pp. 109-135.

Silberstein, M & McGeever, J 1999, ‘The search for ontological emergence’, *Philosophical Quarterly*, vol. 50, no. 195, pp. 182-200.

Stoljar, D 2006, *Ignorance and imagination*, Oxford University Press, New York.

Swoyer, C 1982. ‘The nature of laws of nature’, *Australasian Journal of Philosophy*, vol. 60, no. 3, pp. 203-223.

Teller, P 1986, ‘Relational holism and quantum mechanics’, *British Journal for the Philosophy of Science*, vol. 37, no. 1, pp. 71-81.

Van Cleve, J 1990, ‘Mind – dust or magic? Panpsychism versus emergence’, *Philosophical Perspectives*, vol. 4, pp. 215-226.

Wilson, M 1985. ‘What is this thing called ‘pain’? The philosophy of science behind the contemporary debate’, *Pacific Philosophical Quarterly*, vol. 66, no. 3-4, pp. 227-267.

Wong, HY 2010, ‘The secret lives of emergents’, in A Corradini & T O’Connor (eds.), *Emergence in Science and Philosophy*, Routledge, New York, pp. 7-24.

1. Of course, this is a very rough idea of necessitarianism. For a world’s laws about *p* depend also on the environment of the world. For instance, assuming that *p* is necessarily attracted to *q*, it is nonetheless contestable whether or not the law, ‘*p* is attracted to *q*’, is true in a world with *p* and no *q*. But the idea outlined above is sufficient for our purpose. [↑](#footnote-ref-1)
2. It is noteworthy, however, that a theorist may mean either thing (or even both) when she describes herself as a necessitarian about ‘laws’ [↑](#footnote-ref-2)
3. For discussion, see Psillos 2002; Beebee 2002. [↑](#footnote-ref-3)
4. Of course, both the philosopher’s simplistic understanding of science (like ‘water is just H2O’) and Kripke’s and Putnam’s identity theory are contestable. In particular, the science involved is in fact much more complex (see Needham 2000; 2011; see also Wilson 1985). Nevertheless, for the sake of the argument, I will assume here that the philosopher’s ideas are roughly correct. [↑](#footnote-ref-4)
5. Stathis Psillos (2002) and Helen Beebee (2002) offer two criticisms of Bird’s arguments, to which Bird (2002) responds. Their arguments rely largely on the idea that salt can be constituted differently: it can have a different structure or be produced by a different law. While the argument in this paper is fully compatible with their criticisms, it proceeds on a different and independent basis. [↑](#footnote-ref-5)
6. It is worth noting that Bird, in several places, mentions that some laws ‘supervene on’ or ‘depend on’ basic laws (2007, pp. 267, 272). These choices of wording might reflect Bird’s reductionist attitude. (Of course, these wordings are not incompatible with emergentism [see footnote 7].) [↑](#footnote-ref-6)
7. It is important to note that, under this view, reductionisms about *some* higher-level properties might still be true: *some* higher-level properties (or entities) might still be reducible to lower-level ones and the relations between them. The view is merely incompatible with *universal* reductionism, according to which *all* higher-level properties (or entities) are reducible to lower-level ones and the relations between them (for a further discussion, see Broad 1925). Henceforth, when I use the term ‘reductionism’, I refer only to universal reductionism. [↑](#footnote-ref-7)
8. This view, of course, relies on the idea that there could be lawmakers that are ontologically irreducible to and independent of the objects they govern, and the idea that they could confer causal powers to those objects. Outside the area of emergentism, a number of authors defend the view that there are (lower-level) lawmakers that fit these descriptions (see, for example, Carroll 1994; Langton 1998). [↑](#footnote-ref-8)
9. I will discuss the status and role of these laws in *w* further at the end of Section IV (my response to the third possible objection). [↑](#footnote-ref-9)
10. A question might be raised as to why we *need* emergentism and Broad’s account for ACE. Note that the crucial point here is that ontologically fundamental *higher-level* lawmakers – which specifically govern *higher-level structures* like salt – could possibly exist and be counterexamples to Bird’s view. The idea that there are such lawmakers *is* Broad’s account, and Broad’s account *is* a version of emergentism. This is why ACE is inseparable from emergentism and Broad’s account. Of course, it can again be questioned whether such lawmakers are the only counterexamples to Bird’s view. Since the discussion and arguments in this paper focus on Broad’s account and ACE, I provide a further discussion in Chan, Braddon-Mitchell & Latham manuscript and shall leave this as an open question here. [↑](#footnote-ref-10)
11. Recall that the above metaphysical views concern fundamental properties (see Section I), and so I shall focus on them. [↑](#footnote-ref-11)
12. Both Newton's laws of motion in the actual world and Coulomb’s law in *w* might be considered as *ceteris paribus* laws. Nonetheless, as long as one may consider their universal versions and *ceteris paribus* versions as different laws, the objection remains in force. [↑](#footnote-ref-12)
13. See, for some seminal criticisms of the view, Kim 1999; Hempel and Oppenheim 1948. [↑](#footnote-ref-13)