

and that some kind of holism is a better view, certainly of the quantum realm and, if quantum mechanics is the correct theory of reality, then perhaps of everything. What looks like machretic determination from the point of view of the small-to-large building up picture of compositionality is perhaps an artefact which results from imposing it on a holistic reality. The imposition is, at macroscopic scales, correct to a very close approximation and thus we might expect it to be very hard to find machretic determination in easily accessible natural domains. It was, thus, somewhat disappointing to find that Gillett never discusses quantum decoherence or the way effective field theory and the use of renormalization techniques has helped us begin to understand the general success of the small-to-large building up picture of compositionality (here, we find yet another notion of emergence worth exploring).

But that would have been another major project. Gillett has done a magnificent job in clarifying a horrifically jumbled up set of concepts of emergence and reduction, significantly improved the links between science and philosophy in this domain and introduced a strikingly novel and empirically significant conception of emergence.

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## Emergence

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Paul Humphreys’ main aim in this wide-ranging and ambitious book is to defend a novel account of ontological emergence he refers to as *transformational emergence*.<sup>1</sup> His secondary aims are many: to show how ontological emergence so understood can

1 *Emergence: A Philosophical Account*, by Paul Humphreys. Oxford University Press, 2016. xx + 288 pp.

be usefully seen against the backdrop of a reductionist position he calls *generative atomism*; to compare and contrast his preferred position with historical and contemporary alternatives; and to consider a range of scientific cases both as potential examples of ontological emergence and of weaker forms of emergence stemming from our computational or conceptual limitations. Humphreys is clear from the outset that the range of scientific cases that satisfy certain positive criteria for emergence is too diverse for a single, unified account, and he is more concerned to highlight the differences that preclude such an account than to abstract away from them. The result is a mosaic of case studies, to which are applied a range of alternative conceptions of emergence, drawing out various similarities and differences between the cases, and assessing their credentials as emergent according to the various alternative conceptions considered.

Generative atomism is a methodological approach, according to which the synchronic and diachronic properties of a target system are determined solely by the essential and inessential properties of the fundamental atoms of a given theory and the fundamental laws that govern their dynamics in isolation (11–15). Atoms are immutable, in that they do not change their essential properties over time, and indivisible but only relative to certain properties of the embedding theory. A human agent, thus, counts as an atom of common-sense psychology relative to belief, because no proper part of a human agent has beliefs (21–24). Humphreys often writes as though he takes the failure of generative atomism to be a necessary condition for any kind of ontological emergence, although it is not entirely clear that he endorses this condition in full generality. He offers in addition four positive criteria. Emergence is relational, and emergent entities exhibit at least some of the following: (i) novelty, (ii) autonomy and (iii) holism (26–37). One might be inclined to suppose that the failure of generative atomism is necessary for ontological emergence because its failure makes room for an entity to satisfy one or more of the stated positive criteria, but things are rather less straightforward than that.

One way for generative atomism to fail, and the one to which Humphreys appeals to describe a possible mechanism for ontological emergence, is for the atoms of a given theory to undergo *transformations* in their essential properties as a result of interactions or simply as a result of being part of a complex whole. A limiting case of transformation is fusion, in which two or more atoms lose the property of numerical identity and fuse into a further non-composite entity. I focus here on transformation without fusion. Changes in the essential natures of the atoms of a theory can (but do not necessarily) result in the instantiation of novel, autonomous or holistic properties, which properties can be synchronically explained in terms of the properties of the transformed atoms but not in terms of the properties of the atoms prior to their transformation. Diachronic ontological emergence, for Humphreys, can be explained by essential changes in the atoms, rather than being a brute synchronic connection between properties, as in traditional supervenience emergentism. Transformation of the constituent atoms of a system removes the need for brute determination of its emergent properties by the properties of its parts.

As a putative example, Humphreys considers mobs, in which ordinarily rational individuals are psychologically transformed, resulting in a collection of individuals whose behaviour cannot be explained by appealing to the same psychological theories that apply to them when they are not part of a mob (57–59). *Prima facie*, mobs satisfy all of Humphreys' criteria for ontological emergence. Generative atomism fails in the

sense that the behaviour of individuals within a mob is not fully determined by their essential properties qua rational human beings but by the abnormal psychological properties they have (and laws they obey) when transformed. The behaviour of mob members certainly seems novel in relation to their normal behaviour, and mobs plausibly have a certain autonomy, for instance the insensitivity of their characteristic properties to substitution of their members. Furthermore, mobs seem to possess properties as mobs (such as unruliness) that their individual members could not have in isolation, which is sufficient for holism according to the definition given on page 36. However, Humphreys says, this is not likely to count as genuine ontological emergence, because while generative atomism fails when the generative theory is ordinary psychology, it is likely that a generative atomist theory of mobs can be given in terms of a more fundamental theory such as cognitive neuroscience. That is, the transformations that humans undergo when part of a mob can be fully explained in a theory that does not consider them to be atoms, and which can appeal to changes in the non-essential properties of *its* atoms (e.g. neurons) to account for behavioural change in the agents. It is not just any failure of generative atomism that is necessary for transformational emergence, then, but failure tout court.

It is not immediately obvious why Humphreys does not offer a weaker notion of ontological emergence. After all, he is clear that entities that are ontologically atomic relative to one theory may be complex relative to another (22–24), so why not embrace a relativized notion of ontological emergence, according to which mob psychology is emergent relative to normal psychology, but reducible relative to neuroscience? Furthermore, Humphreys' insistence that there be no reductive theory available to account for the transformation of atoms in cases of transformational emergence is in tension with his claim that no 'natural piety' is needed to accept this kind of ontological emergence in the sciences (42). Suppose mobs are ontologically emergent due to transformation of individuals. It follows that normal agents undergo psychological transformation within mobs that cannot be fully explained solely in terms of changes in the non-essential properties of their proper parts (e.g. differences in neural firing patterns), and it is these unexplained changes that explain the novel properties of the mob. While we do not need natural piety to accept the novel properties of mobs themselves, we do seem to need it to accept the transformation of the agents, which by hypothesis gives rise to a case of ontological emergence only when it has no further explanation.

A case Humphreys thinks likely to be one of ontological emergence is muon decay in the standard model, in which the putatively non-composite muon transforms into other such entities, for instance, an electron, an electron neutrino and a muon neutrino (66–69). If there is no more fundamental theory than the standard model, Humphreys argues, then this is a failure *simpliciter* of generative atomism, and a case in which an electron and its novel nomic and dispositional properties diachronically emerge from a muon. It is a clear advantage of the transformational account that it can make sense of emergence without appealing to levels or supervenience. However, given that true ontological emergence occurs only when an unexplainable transformation occurs, it seems to me to fare no better than traditional supervenience emergentism in terms of requiring natural piety. Many physicists would regard the standard model as an effective field theory rather than a fundamental theory, in no small part, I suspect, *because* of such brute transformations in its fundamental particles.

One aspect in which I think Humphreys could have been clearer is the issue of how ontological emergence differs from weaker forms of emergence such as pattern emergence in *positive* terms. Ontological emergence should buy us something unique - some special kind of novelty or autonomy, perhaps - that explains why we should care whether anything is ontologically emergent, as opposed to (say) merely inferentially so. However, when Humphreys discusses inferential emergence, while the failure of generative atomism is replaced by a form of non-deducibility as the negative necessary condition (145), the four positive criteria applied are apparently the same. Humphreys argues that in addition to non-deducibility, properties like the patterns that develop diachronically from a distinct initial pattern in the Greenberg–Hastings model also exhibit all of novelty, autonomy and holism, despite being cases to which generative atomism applies, and in which no ontological emergence is present (150–65). In short, it is not entirely obvious what kind of novelty or autonomy a failure of generative atomism makes room for that is not also possible in cases where generative atomism succeeds. It is also not entirely obvious why non-deducibility is necessary for the novelty, autonomy and holism of patterns, but I shall not press that point here for reasons of space.

Part of the problem is that Humphreys is operating with a broad conception of novelty that permits a range of cases, some of which are consistent with generative atomism and some of which are apparently not: ‘An entity E is novel with respect to a domain D just in case E is not included in the closure of D under the closure criteria C that are appropriate for D’ (29). Assuming D to be the broadly physical domain, we can appeal to different closure criteria to define different conceptions of novelty. If the closure criterion is deducibility, then entities that are non-deducible from entities in D will be novel; if we embrace a causal closure condition, then entities that are causally related to members of D without themselves being members of D will be novel. I think Humphreys is right to point out that in the literature on emergence, ‘novel’ is used in a wide range of often incompatible ways (32) and right to offer an abstract general account that promises to cover them all. However, it does muddy the waters somewhat that when he describes various entities as novel during the course of the discussion, it is not always entirely clear what kind of novelty is being predicated of them.

Plausibly, any entity that is fully grounded in physics according to a generative atomist methodology is itself broadly physical. Hence, it is not possible for entities that satisfy generative atomism in relation to physics to violate the causal closure of the broadly physical, for they are ipso facto members of the closed domain. Does Humphreys then think, as others have maintained (Wilson 2015), that the possession of genuinely novel causal powers by dependent entities precludes a generative atomist reduction thereof? It is unclear. A generative atomist reduction of a set of entities to physics guarantees that the reduced entities are part of the broadly physical domain, but this in itself does not rule out that they are causally novel in relation to the atoms. More would need to be said about the nature of generative atomist *determination* to rule that out. For instance, I have argued that there are physically realized pattern-like properties whose causal powers are novel in relation to their realizers: their instances are grounded in fundamental physics, but they bestow certain powers solely in virtue of being the patterns they are (Yates 2016). It would be nice to hear more about what kind of novelty Humphreys takes inferentially emergent patterns to possess, if any, over and above that supplied by their non-deducibility. What he says about patterns

seems consistent with their novelty being causal, and if so, then failure of generative atomism is not a necessary condition for causal novelty.

In a final chapter discussing ferromagnetism, Humphreys makes remarks that might be taken to suggest that indeed he does not think that generative atomism rules out causal novelty or even ontological emergence. Ferromagnetism occurs in materials such as iron and nickel, and results from the spontaneous alignment of magnetic dipoles below a critical temperature, resulting in a material that remains magnetized even in the absence of an external field. As Humphreys notes, the process by which ferromagnetism occurs seems to obey the norms of the generative atomist methodology, with large-scale synchronization of magnetic dipoles resulting solely from local interactions between dipoles of exactly the sort we would expect based solely on their permanent properties and the laws of quantum physics. Ferromagnetism seems to be a property that satisfies all four positive criteria for emergence, and whose novelty seems to be specifically causal, but without any obvious failure of generative atomism. Early on in the book, Humphreys tells us that diachronic ontological emergence ‘can be present within systems that possess the central features of generative atomism’ (13). If that is a reference to ferromagnetism, then maybe Humphreys thinks ferromagnets are novel enough to count as ontologically emergent despite not being failures of generative atomism. However, it should also be noted that Humphreys does briefly suggest that something inconsistent with generative atomism might occur during phase transitions, in which small perturbations in temperature result in large-scale global changes to the orientation of the dipoles (254–55), but never explicitly says why generative atomism fails to account for this process.

It would be nice to know more about how Humphreys conceives the relationship between generative atomism and ontological emergence, and in particular, in the light of his discussion of ferromagnetism, whether he thinks that failure of the former is strictly necessary for the latter. If ferromagnetism turns out to satisfy generative atomism, but also to be causally novel, autonomous and holistic, should it be treated as ontologically emergent? If not, then what is at stake in the debate over whether there is any ontological emergence, other than the independently interesting question of whether generative atomism is universally applicable? Despite my reservations about these points of detail, there is much to recommend this book. Humphreys’ focus on scientific case studies to develop alternative models of emergence is commendable and illuminating; transformational emergence is a distinctive and original account of one possible mechanism by which novel properties, powers and laws might emerge from interactions between atoms; and the shift away from thinking of emergence in terms of brute nomological supervenience relations between properties at different levels is most welcome. Furthermore, the methodology Humphreys most often employs, of assessing scientific cases on their merits against positive criteria for emergence, is to my mind much more promising than deciding in advance that emergence is to be construed in terms of some kind of irreducibility and then looking to see whether anything is irreducible in the appropriate sense. This is a thought-provoking and rewarding read, and a valuable addition to the literature.

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## Discourse Contextualism

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In *Discourse Contextualism*, Alex Silk defends a new contextualist account of expressions at the centre of recent debates over contextualism versus relativism, namely, gradable adjectives, taste predicates and epistemic and deontic modals (a.k.a. ‘CR-expressions’ (2)).<sup>1</sup> The first part of the book, which lays out the view and shows how it explains the phenomena at issue in those debates, focuses on the case of epistemic modals. The second part of the book extends that account with Discourse Contextualist treatments of the remaining expressions. *Discourse Contextualism* is truly impressive in its scope, fully engaging with the relevant literature in linguistics, philosophy of language and meta-ethics. It is clearly written, carefully argued and makes a very significant contribution to the literature on the debates over contextualism, relativism and expressivism. No short review could possibly do justice to Silk’s book in its entirety. Here, I focus on its most fleshed out case study, that of epistemic modals. But the whole book will be required reading for anyone engaged in any of these debates.

Silk’s central aim is to show how Discourse Contextualism meets what he argues is the central challenge to its contextualist rivals, namely to explain the apparently distinct ways CR-expressions behave in contrast to paradigmatically context-sensitive expressions (‘PCS-expressions’ (22)) without ‘positing linguistically unconstrained interpretive mechanisms or ad hoc pragmatic principles’ (23).

Characteristic of any contextualist treatment of an expression is the idea that their successful use places a constraint on contexts to supply the needed parameter value. Silk’s central insight is that the use of CR-expressions, in contrast to PCS-expressions, ‘systematically’ involves negotiation between interlocutors over which context to be in, that is, which parameter value should be presupposed for the purposes of their

1 *Discourse Contextualism: A Framework for Contextualist Semantics and Pragmatics*, by Alex Silk. Oxford University Press, 2016. xii + 256 pp. Parenthetical numerals indicate page numbers in *Discourse Contextualism*.