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Reductionist Challenges to Explanatory Pluralism: Comment on McCauley

Markus I. Eronen

Institute of Cognitive Science

University of Osnabrück

49069 Osnabrück

Germany

Tel. +49 541 969 3365

maeronen@uos.de

1. Introduction

In the article "Time Is of the Essence: Explanatory Pluralism and Accommodating Theories about Long-Term Processes" (this volume), Robert McCauley argues against New Wave and traditional reductionism and defends explanatory pluralism. The article has two central points. First, McCauley proposes a way of saving the traditional conception of general analytical levels from recent criticism (Bechtel, 2007, 2008; Craver, 2007). The motivation for this is that abandoning accounts of general levels of analysis would threaten a long-standing argument against New Wave reductionism, according to which New Wave reductionists fail to distinguish between interlevel and intralevel cases of reduction.

Secondly, McCauley highlights a distinction that has been hitherto largely neglected in

analyses of intertheoretic relations and discussions of reduction: the distinction between *synchronic* and *diachronic* theories and investigations. Taking this distinction into account further complicates analyses of intertheoretic and cross-scientific relations and undermines single-model accounts of reduction. Particularly important is the way in which diachronic theorizing and research about long-term processes contributes to research about synchronic, structural matters. This is illustrated by an example from evolutionary psychology.

The general aim of McCauley's paper is to show that relations between theories and sciences are considerably more complicated than traditional or New Wave reductionists have assumed, and that it is utterly implausible that a single model could account for all cases of reduction. McCauley has presented and elaborated this line of criticism in several earlier publications (1986, 1996, 2007a, 2007b), and its origins are in Wimsatt (1976).

According to McCauley, a more fruitful and realistic approach to understanding cross-scientific relations is explanatory pluralism, which offers a view that highlights the benefits of simultaneous inquiries at different levels of analysis and across different sciences, and does not leave room for the drastic ontological conclusions that the reductionists argue for. The most comprehensive exposition of explanatory pluralism is McCauley & Bechtel (2001).

In this paper, I will first point out some problems in McCauley's defense of the traditional conception of general analytical levels. Then I will present some reductionist arguments against explanatory pluralism that are not based on the New Wave model of intertheoretic reduction. Reductionists that are not committed to this model might not have problems incorporating research on long-term diachronic processes in their analyses. In the last part of the paper, I will briefly compare McCauley's conception of reduction to some other current accounts, highlighting the differences between them.

2. The Problem of Levels

The development of intertheoretic models of reduction started in the middle of the twentieth century, in the afterglow of logical positivism. The New Wave reductionism of Hooker (1981), P. S. Churchland (1986), P. M. Churchland (1989) and Bickle (1998, 2003) is the latest stage in this development. In the traditional models (most importantly Nagel (1961)), reduction consisted in the deduction of a theory to be reduced from a more fundamental theory. In the New Wave model, reduction is still a relation between theories and involves deduction, but what is deduced from the reducing theory is not the theory to be reduced itself, but an *analogue* of it. If the analogue is close enough to the theory to be reduced, the reduction is "smooth" and warrants ontological identities. If the analogy relation is too weak, the reduction is "bumpy" and leads to considerable revision or even replacement of the reduced theory, and to revisions and eliminations of its ontological posits.

However, as McCauley and others have pointed out, this model of reduction fails to account for certain important aspects of cross-scientific relations. First of all, it is presented as a general, all-purpose model of reduction, but there are crucial differences between reductions, and no single model can apply for all cases. Particularly important is the *interlevel-intralevel* distinction (first emphasized by Wimsatt (1976)), which divides reductions into two fundamentally different categories. Intralevel or successional relations hold between competing theories within a particular science, operating at a *single level of analysi*s, for example between Newtonian physics and Galilean physics. Interlevel relations are relations between theories that

are located at *different analytical levels* in science, for example between cognitive psychology and cellular neuroscience. All of the examples of eliminative (or "bumpy") reduction that New Wave reductionists present are *intralevel* cases, and give no reason to expect eliminative reductions in interlevel contexts. In particular, they provide no support for New Wave reductionists' claims that psychology will be reduced to neuroscience, since psychology and neuroscience are at different levels.

This is a long-standing argument against New Wave reductionism, but it is indirectly threatened by Bechtel's (2007, 2008) recent claims that no general analytic levels in science can be defined – all we can have is local, case-specific accounts of levels (Craver (2007) also defends a similar account of levels). If this is true, locating theories on analytical levels and distinguishing between interlevel and intralevel cases becomes problematic and the argument loses some of its force.

In this volume, McCauley defends the traditional conception of analytical levels in science. However, he rejects the old criteria for distinguishing levels, which include most importantly *mereological* considerations, *i.e*., relations of parts and wholes, and *size*. Wholes are at higher levels than their parts, and bigger things are at higher levels than smaller things. These criteria work to some extent, but not all big things that have a lot of parts (*e.g*., piles of sand) demand a higher level analysis, and thus the traditional criteria lead to anomalies (see for example Craver (2007, Chapter 5) for more on these problems). Instead, McCauley proposes two new general criteria: *scope* and *age*. According to McCauley, as we go down the hierarchy of levels, the sciences' explanatory scope increases: atoms are everywhere, but cells are not. Similarly, the lower a science's analytical level, the longer its principal objects of study have been around. Conscious beings are newer than lower-level organisms, which are again newer

than chemical compounds, and so on. These criteria could form a basis for reviving the standard general framework for analytical levels in science.

However, unfortunately McCauley's criteria do not put all the sciences in their traditional places in the hierarchical order. One significant example of this is *thermodynamics*, which has had a central role in discussions of reduction, starting from Nagel (1961). Thermodynamics has been traditionally conceived as a higher level science, and it is quite evident that it should be on a higher analytical level than, say, particle physics. Thermodynamics deals mainly with macroscopic phenomena, while particle physics deals with the smallest things in nature. However, we cannot place these sciences at different analytical levels with McCauley's criteria. Regarding scope, thermodynamics applies to everything in nature. Regarding age, it applies again to everything, also to things that have been around since the beginning of time. Similarly, particle physics studies objects that are ubiquitous and the oldest ones in the universe. Thus, if we apply the criteria of scope and age, both sciences are located on the lowest analytical level. This result is counterintuitive and against the standard view in philosophy of science.[1]

In this case, mereological criteria would be helpful. The objects that thermodynamics primarily studies are composed of the primary objects of study of particle physics, but not vice versa. Thus, with mereological criteria thermodynamics can be located at a higher analytical level than particle physics. All in all, this supports Bechtel's view that no general criteria for distinguishing analytical levels are on offer – all we can have are local, case-specific accounts of levels.

However, distinguishing between interlevel and intralevel cases could be possible without an all-encompassing hierarchical framework of levels. Perhaps it is enough if we can, in each putative case of reduction, decide whether the two sciences or theories are at the same level

or at different levels, without having to locate them in a more general framework. If it is clear enough that, for example, psychology is at a higher analytical level than neuroscience (and few would deny this), it is not necessary to locate these sciences within an all-encompassing framework of levels. In this way, the old argument against New Wave reductionism could be retained.

3. Beyond New Wave Reductionism

Regardless of the question of levels, reductionism based on the New Wave model is not a very attractive position: several other considerations make it highly implausible. Perhaps the most important problem is that the New Wave model is an inter*theoretic* model that focuses on theories that can be handled with logical and set-theoretic tools, but especially in psychology and neuroscience, such theories are rare or nonexistent (Wimsatt, 1976; McCauley, 2007a). Instead, scientists typically look for mechanisms as explanations for patterns, effects, phenomena, etc. (see, *e.g.*, Machamer et al. (2000) and Cummins (2000)). Therefore, cross-scientific relations of these sciences should not be analyzed solely in terms of their inter*theoretic* relations.[2]

In fact, there are not many supporters of the New Wave model left. Even Bickle, its perhaps most prominent advocate, has taken some distance from it (Bickle, 2003, 2006), and emphasizes looking at the "reduction-in-practice" in neuroscience, without appealing to intertheoretic models of reduction. In spite of this, McCauley explicitly states that the traditional and New Wave models are his primary target (p. 30?): "the targets of my critical arguments have been all-purpose models of intertheoretic relations – specifically, traditional and New Wave models of reduction."

There are arguments for reductionism and against explanatory pluralism that are independent of the New Wave model. One line of argument is based on the differences between explanations at different levels: there are good reasons to consider lower level explanations more fundamental than higher level ones.[3] The familiar and rather uncontroversial reasons are that explanations at the lower levels apply to a wider range of phenomena, and that they tend to have fewer exceptions. Furthermore, there appears to be a certain *corrective asymmetry* (see, *e.g.*, Steel (2004)) between higher and lower levels: resources from the lower level are necessary to correct explanations at the higher level, but not vice versa.

Explanatory pluralists acknowledge some of these differences and argue that they do not undermine the necessity or indispensability of higher level explanations. It is true that these well-known considerations do not as such threaten explanatory pluralism. A more serious threat becomes obvious when we consider the role of higher level explanations when lower level explanations are more or less *complete*. Let us consider the example of LTP and memory consolidation, which is often used in the recent debate on reduction and mechanistic explanation (see, *e.g.*, Bickle (2006) or Craver (2007)). LTP (Long Term Potentiation) is a well-studied cellular phenomenon, which is believed to be the cellular basis of memory consolidation.[4] It is a form of synaptic plasticity that exhibits Hebbian learning: when the presynaptic and postsynaptic neurons are simultaneously active, the connection between them is strengthened. Even though not everything is known about the molecular mechanisms of LTP, increasing evidence is making it more and more likely that these mechanisms are the ones of memory consolidation.

The question is this: once the cellular and molecular explanations are in place, what is the role of psychological explanations for memory consolidation? For example, a psychological explanation might say that a certain pattern of numbers is remembered because it was repeated,

say, five times, and there was no "retrograde interference" (electroshock, blow on the head, or something similar). Let us assume that we also have a full cellular and molecular level explanation that tells exactly what processes lead to the consolidation of this memory, from the stimuli that excite the receptors to the molecular details of LTP in the cells that "store" the memory. Is the psychological explanation still an indispensable scientific explanation?

From a strongly reductionist point of view, the correct explanation is at the cellular and molecular levels, and the psychological explanation is needed only for pragmatic and heuristic purposes. The psychological explanation is much less complicated and thus easier to understand and easier to use in contexts where the details are not so important. It can also be useful in guiding research, at least until the lower level explanations are complete. However, the accurate and correct explanation is found at the cellular and molecular levels.

The future of scientific *discoveries* could also present problems for explanatory pluralists. There seems to be a general trend in the sciences, such that more and more discoveries are made at the lower levels, and less and less at the higher levels. This can be seen in physics, which has been moving down to smaller and smaller elements of nature, and in neuroscience, where research at the cellular and molecular levels has considerably increased in the last decades (see however Craver (2007) for a different analysis). This suggests the possibility that at some point most of the discoveries in the domain of human behavior will be made at the cellular and molecular levels, and that there will not be much more to discover with the methods of traditional psychology.[5] This would not imply the complete elimination of psychology, since it would still have a heuristic role in research, providing guidance and interpretation. However, it would have significant consequences regarding the status of psychology within the sciences.[6]

Due to constraints of space, I cannot fully develop these arguments here, and it is not

even necessary for my main point, namely that reductionist arguments of this kind are completely independent of New Wave model, and might pose a more serious threat to explanatory pluralism than reductionism based on the New Wave model does.[7] It is these kinds of arguments that explanatory pluralists should be tackling, and not the obsolete New Wave reductionism.

Explanatory pluralists constantly emphasize how fruitful the cross-scientific connections between neuroscience and psychology are *now* or have been in the past. However, not even the most ruthless reductionists deny that there are numerous fruitful interdisciplinary projects spanning different levels at this moment, and that cross-scientific cooperation can aid progress in both sciences. The reductionist claims can be taken as *prediction*s about the future of these sciences. Regarding the future of scientific discovery, they predict that scientific discoveries will move away from the higher levels. Regarding explanation, they predict that higher-level explanations will be replaced by completed lower-level ones.

4. Diachronic and Synchronic Analyses

In his article, McCauley draws attention to an important distinction: the distinction between theories and investigations of synchronic, structural phenomena on one hand, and diachronic phenomena on the other. The latter can be further divided into long-term and short-term diachronic analysis. It is indeed remarkable that this distinction has been so neglected in the analyses of reduction and intertheoretic relations. The reasons probably go back to the logical positivists' conception of science and theories, and the "one-model-fits-all" approach to

intertheoretic relations that was inherited from them. In any case, it is clear that this distinction should be taken into account in the analyses of cross-scientific relations and in models of reduction.

Traditional and New Wave reductionists have largely ignored long-term diachronic modes of analysis in their models. As McCauley points out, these models are designed for analyzing structural, synchronic relations between theories, and fail to incorporate theories involving long-term diachronic processes. This is a serious shortcoming. However, a reductionist who does not rely on the intertheoretic model and operates with the kinds of arguments outlined in the previous section might be in a better position. There are sciences, for example molecular genetics, that deal with long-term diachronic processes at lower levels, and nothing prevents reductionists from incorporating these sciences in their analyses.

A reductionist of this kind could also accept that we need higher level long-term diachronic analyses and explanations *now*, and that they also contribute to research about structural matters. However, this is only because the lower level explanations are not yet complete. For example, evolutionary psychology will have a merely heuristic and pragmatic role in the future, as research will have moved down to the cellular and molecular levels. The explanatory pluralists can respond that evolutionary psychology and other higher level sciences will continue to contribute to scientific progress and to our explanatory endeavors, even when the lower level explanations are complete (if they ever will be). The dispute is far from settled, and perhaps only the actual progress in science can eventually put an end to it.

5. Complicated Reduction

One of the central points of McCauley's paper is that reduction and cross-scientific relations are far more complicated than traditional and New Wave reductionists have assumed. This is true and not many philosophers of science working on reduction would now deny it. Many would also agree with Feyerabend's (1962) claim from almost half a century ago that no formal accounts of reduction are possible or even necessary. Generally speaking, the concept of reduction has become extremely diffuse: the current accounts of "reduction" don't share much with the traditional models of reduction, or with each other.

For Nagel (1961), reduction was a deductive relation between formalized theories. For the reductionists that adopted this model or some version of it, including the New Wave model, the main aims of reduction were ontological simplification, correction of the reduced theories, and explanatory unification, ultimately even unity of science.

On the other hand, McCauley writes (p.14?): "Reduction looks downstairs, decomposing a system into its parts. Tracing the spatial relations and the connections among those parts can provide a richer understanding of the behaviors the system exhibits. This is the essence of reductionism."[8] A similar view of reduction is evident in the recent accounts of mechanistic explanation (Bechtel & Richardson, 1993; Machamer et al., 2000; Craver, 2007) and in Wimsatt (1976). According to this view, reduction is an important and effective research strategy, but it does not warrant ontological (or even explanatory) simplification. Furthermore, reduction does not involve deduction of theories in any essential way, and it does not lead to unity of science in the sense envisioned by traditional reductionists.

Jaegwon Kim (2005, p. 101) has recently defended a third conception of reduction:

> To reduce a property, […] we must first "functionalize" it; that is, we must define, or redefine, it in terms of the causal task the property is to perform. […] That is the first step. Next, we must find the "realizers" of the functionally defined property – that is, properties in the reduction base domain that perform the specified causal task. […] Third, we must have an explanatory theory that explains just how the realizers of the property being reduced manage to perform the causal task.

This is the "functional model" of reduction that prevails in current philosophy of mind and has its roots in Armstrong (1968), Lewis (1972) and Levine (1983).

It is obvious that these accounts don't have much to do with each other. For Kim, the essence of reduction is functionalizing properties and finding the realizers of these functional roles. For McCauley and the mechanists, reduction is a downward-looking strategy of research and explanation. For Nagel and New Wave reductionists, reductions are deductions between theories. The situation is confusing, to say the least.[9] When discussing reduction, one should make very clear what notion of reduction is at use, in order to avoid severe misunderstandings.

6. Conclusions

I hope to have shown three things in this paper. (1) Even if we change the criteria for distinguishing analytical levels in science, it might not be possible to save the traditional hierarchical framework of levels. (2) There are strong reductionist arguments against explanatory pluralism that do not rely on the New Wave model, and reductionists of this kind have no problems incorporating research on long-term diachronic processes in their analyses. (3) The

debate on reduction has reached a point where the different accounts of reduction have very little to do with each other.

Explanatory pluralism is offered as an alternative to both reductionism and the kind of antireductionism that has dominated philosophy of mind for some decades now. I believe that the pluralists are right in claiming that both of these camps have had a too restricted and simplistic view of reduction and cross-scientific relations. However, explanatory pluralists still have to answer to reductionist challenges that do not depend on the intertheoretic models of reduction.

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Notes

1. To be fair, McCauley does grant that his new criteria are probably sufficient only for distinguishing between the broad families of science, and that his proposal is just a preliminary sketch for reviving something like the standard hierarchical framework for the sciences.
2. Perhaps the same applies to other sciences also, but in this comment I am focusing on the relations between psychology and neuroscience.
3. For the sake of simplicity, in the rest of this article I will talk about levels in the traditional sense, as if this was unproblematic.
4. Memory consolidation is the process by which recent memories are converted into long-term

memories.

5. This is certainly not the situation *now* – the argument concerns the *future* of scientific discoveries.

6. For more on this line of argumentation, see for example Bickle (2003, 2006).

7. One more argument that might present problems for explanatory pluralists is Jaegwon Kim's (2002, 2003) argument against downward causation, which has been extensively discussed within philosophy of mind. The argument also applies to same-level causation at higher levels, and threatens higher level causation and explanations. The main point of the argument is that higher level properties cannot both be distinct from lower-level properties and have a causal influence on them. Discussing the relevance of this argument for explanatory pluralism would be interesting, but causal issues are beyond the scope of this paper.

8. This is what, according to McCauley, the different accounts of reduction have in common. However, McCauley has given up describing his *own* position in terms of reduction nearly two decades ago and presents it in terms of cross-scientific relations instead.

9. See Polger (2007) for a useful taxonomy of different reductionist and antireductionist approaches.

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