PhB Advanced Studies Course

The role of scientific explanation in addressing the easy and hard problems of consciousness

Josephine Davies
PhB Science student, Australian National University
Under the supervision of Dr Jason Grossman, ANU College of Physical and Mathematical Sciences

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1. Introduction

For centuries, philosophers and scientists have struggled to explain the nature of consciousness; whilst considerable progress has been made, there remains no widespread consensus as to what constitutes a valid explanation. The contribution of science to this debate has been particularly interesting; questions that were once considered purely philosophical in nature are now often approached from a scientific perspective. In light of this development, it is worth drawing attention to the following question: to what extent is science able to explain the nature of consciousness?

The purpose of this essay is to examine some of the issues relating scientific explanation to consciousness. I begin with a brief discussion of scientific explanation, outlining the deductive-nomological and causal-mechanical accounts, and acknowledging the absence of an ideal explanatory model. I then introduce the hard and easy problems of consciousness, and examine the role of scientific explanation in addressing these problems.

2. Models of scientific explanation

The philosophical nature of scientific explanation is an issue of great complexity; considerable debate has been raised as to what constitutes a valid scientific explanation, and the great expanse of philosophical literature on this subject would no doubt provide ample material for a separate research study. In light of this fact, and in consideration of time constraints, an exhaustive survey of the philosophical literature on theories of explanation was deemed unfeasible.

Nevertheless it requires only a brief survey of the literature to reveal that in spite of the considerable attention devoted to this subject by philosophers and scientists alike, the philosophical problems associated with scientific explanation remain unresolved. Hempel and Oppenheim (1948), Salmon (1971), Friedman (1974), Kitcher (1989), Achinstein (1983), Scriven (1962) and Woodward (2003) are just several of the philosophers who have contributed to the debate, and whilst between them numerous models of scientific explanation have been proposed, none of these models have been conclusively agreed on.

In the discussion that follows in sections 2.1 and 2.2, I will outline the deductive-nomological and causal-mechanical accounts of scientific explanation and note that neither of these accounts resolve the philosophical problems associated with scientific explanation. I will further suggest that the inadequacy of these two accounts is typical of such accounts in general, and as it stands, there exists no alternative account that has achieved substantially more success than either of them.

But in the first place, having neglected to discuss a great number of alternative theories of scientific explanation, it is worth justifying the discussion of these two particular accounts. In doing so I first acknowledge the somewhat arbitrary nature of the choice. Given that an infallible account of scientific explanation has not yet been established, at least within the scope of the literature review conducted for this project, any of a large number of accounts could have been presented as examples of the inadequacy of existing models. Nevertheless, I here present several brief reasons for my discussion of the deductive-nomological and causal-mechanical accounts.

The deductive-nomological account, initially proposed by Hempel and Oppenheim (1948), despite being poorly regarded amongst current philosophers, remains one of the most influential historical accounts of scientific explanation, with early advocates of the model including Popper (1959), Braithwaite (1953), Gardiner (1959) and Nagel (1961). Its selection for discussion was based partially on this historical context, as well as on the fact that its limitations provide an interesting foundation for analysis; note that a comprehensive review of these limitations is provided by Salmon (1989).

In contrast with the deductive-nomological model, which today receives little support, the causal-mechanical account of scientific explanation retains a degree of current popularity; Woodward (2003), for example, remains a strong advocate. Initially proposed by Salmon, the account is in some senses a rebuttal of Hempel and Oppenheim's deductive-nomological model, against which Salmon raised numerous criticisms (Salmon, 1989). For this reason the causal-mechanical model lends a degree of breadth to the overall discussion of these two divergent accounts.

It is important to note in selecting these two accounts, that a number of alternative influential accounts of scientific explanation have been neglected, including, for example, pragmatist accounts. Pragmatist accounts suggest that successful explanatory theories draw upon the context in which an explanation is given, such that physical theories can no longer be regarded independently of

conceptions of the physical world (Woodward, 2003). In highlighting an example of an influential pragmatist theory, I draw attention to Peter Achinstein's relatively recent 'illocutionary' account (Achinstein, 1983), noting that its exclusion from discussion was decided on the basis of its sheer complexity rather than its irrelevance. Many explanatory models were excluded from discussion on similar grounds.

Returning to the main discussion, I remark that in presenting the limitations of the deductive-nomological and causal-mechanical accounts of scientific explanation, I give two *examples* of the failure of current philosophical accounts of explanation. Whilst these examples do not, in themselves, allow any definitive conclusions to be drawn as to the universal failure of explanatory models, they are certainly illustrative of widely-observed failure amongst the explanatory models examined within the scope of this project's literature review.

Having exemplified the inadequacy of current accounts of scientific explanation in section 2, I will discuss in section 3 why the scientific explanation of consciousness is particularly problematic. The difficulties of obtaining evidence for subjective experience and providing a definition of consciousness will be highlighted as uniquely demanding philosophical challenges in this context.

2.1. The Deductive-Nomological account

The deductive-nomological account of scientific explanation suggests that an event or generalisation is explained by derivation from laws of nature and background conditions. That is, if we are given laws L1, L2, L3, etc. and background conditions C1, C2, C3, etc. we can deduce that E must be the case, where E is a statement of the explanandum (Hempel and Oppenheim, 1948). An example of a simple deductive-nomological explanation might therefore be the following:

(L) $E = mc^2$.
(C) 1 gram of mass was converted into energy.
(E) Therefore, 9×10^{13} J of energy were produced.

The deductive-nomological account is not entirely without merit; for example, it gives a reasonably accurate depiction of the kind of scientific explanation we might expect to find in a high-school physics textbook. The notion of a sound deductive argument is reasonably clear in this context

(Woodward, 2003). Nevertheless, the account raises the following problematic issues (Salmon, 1989, p. 46-50):

- *Heavy reliance on laws of nature*: The deductive-nomological account relies heavily on the existence of laws of nature. If such laws do not exist, or if they are unable to be determined, then valid scientific explanations according to the deductive-nomological model cannot be obtained.

- *Problem of unique causes*: This problem arises if an explanandum has only one possible cause. In such cases, the deductive nomological account allows us to make suspicious inferences from the occurrence of the explanandum to the cause. We would like to avoid these kinds of suspicious inference!

- *Problem of side effects*: This problem arises if a particular event E always causes two separate events A and B. If this is the case, we can infer from the occurrence of A that B occurred. But this is again suspicious; A did not actually cause B!

- *Problem of pre-emption*: This problem arises if a cause C guarantees an event E, but something happens *before* cause C that results in the occurrence of E. The deductive-nomological model would suggest that cause C can explain event E, but this doesn't seem like a satisfactory explanation.

- *Problem of irrelevant conditions*: This problem arises when irrelevant conditions are introduced into the explanatory model. Consider, for instance, the following example: if Bob takes birth control pills and does not get pregnant, we can, according to the deductive-nomological model, cite the 'law' saying that nobody who takes birth control pills gets pregnant. This doesn't seem like a valid explanation, and we'd like to avoid it!

Given that the deductive-nomological account leads to the problems listed above, it is apparent that it cannot resolve all of the philosophical problems associated with scientific explanation. We reject this account as an ideal model of scientific explanation.

2.2. The Causal-Mechanical account

The causal-mechanical account of scientific explanation, developed by Wesley Salmon (1989), suggests that an explanation of an event E traces:

(I) the processes and interactions that make up the event itself
(II) the causal processes and interactions *leading up to* the event E

Salmon suggests that causal processes can be distinguished from non-causal processes by looking for 'mark transmissions'; that is, a causal process is one that is able to transmit a mark in a continuous way (Salmon, 1989). For example, if a dent is made on the bumper of a car, this dent will be transmitted throughout space and time, even in the absence of further interactions with whatever caused the dent. A moving car is therefore a 'mark transmitter' and a causal process.

The causal-mechanical account solves some of the problems that arise from the deductive-nomological account, but leaves others unresolved. Problems associated with the causal-mechanical account include the following (Hitchcock, 1995; Woodward, 2003):

- *Heavy reliance on counterfactuals*: It is important to note that the causal-mechanical account of scientific explanation relies heavily on counterfactuals. For example, the movement of an *undented* car would also be a mark transmitter, and a causal process, because if one *were to* mark the car, this mark would be transmitted through space and time. Thus if counterfactuals were found to be an invalid philosophical basis for explanatory inference this would threaten the validity of the causal-mechanical account.

- *Action at a distance*: Whether or not ‘action at a distance’ is a physically-accurate concept, it sometimes features in scientific explanation, for example, Newton’s explanations of gravity. If we wished to classify these cases as scientific explanations according to the causal-mechanical model, we would find it difficult to apply the concept of mark transmission.

- *The problem of irrelevant conditions*: As for the deductive-nomological account, the causal-mechanical account leaves this problem unresolved. It is difficult to see how one could use the concept of mark transmission to explain Bob’s lack of pregnancy.

- *Seemingly indirect relevance of mark transmission to scientific explanation*: It seems strange to introduce a concept like mark transmission in the first place; the concept of mark transmission seems to have only indirect relevance to the problem of scientific explanation.

- *High-level explanations in science*: Our explanations of the behaviour of gaseous systems are often 'high-level' in that they do not refer to each of the individual gas particles, but instead generalise over the entirety of the system. It is difficult to see how to reconcile these kinds of explanations with the idea of mark transmission in Salmon's causal-mechanical account.

Given that the causal-mechanical account leads to the problems listed above, it is apparent that it is unable to resolve the philosophical problems associated with scientific explanation. On these grounds we reject the causal-mechanical model as an ideal account of scientific explanation.

We conclude, based on the material presented in sections 2.1 and 2.2, that neither the deductive-nomological account nor the causal-mechanical account are ideal models for scientific explanation. It is widely agreed, furthermore, that no such model has thus far been developed (Woodward, 2003); the inadequacies of the deductive-nomological and causal-mechanical accounts of scientific explanation appear to be typical of accounts in a broader sense.

In claiming that an ideal model of scientific explanation has not yet been developed, I wish to acknowledge the limitations of my own research. As noted in the introductory remarks of section 2, I was unable, for practical reasons, to conduct an exhaustive survey of all models of scientific explanation. For this reason I cannot declare conclusively that no current account of scientific explanation is infallible; instead I support the claim via reference to the shortcomings of the deductive-nomological and causal-mechanical models.

3. Scientific explanation in relation to consciousness

It is clear from examination of the deductive-nomological and causal-mechanical accounts of scientific explanation, that scientific explanation presents some difficult philosophical challenges; although some progress has been made on these challenges, I have argued in section 2 that an ideal philosophical model for scientific explanation remains undetermined.

It is worth considering, furthermore, that it may not even be possible to construct a single model of explanation that fits all disciplines of science. The application of explanatory practice differs significantly across different areas of science, and it may be the case that numerous models of scientific explanation are required to account for this sensitivity to disciplinary difference (Woodward, 2003).

Nevertheless, acknowledging the fact that these issues remain unresolved, we turn our attention to the scientific explanation of consciousness. Given that scientific explanation is such a difficult philosophical issue to resolve in general, it is unsurprising that the scientific explanation of consciousness is particularly problematic. There are three major reasons for this:

(i) Firstly, as demonstrated in section 2, scientific explanation is a complex philosophical issue in its own right; this is the case even in well-established areas of scientific enquiry. Although numerous accounts of scientific explanation have been proposed, including, for example, the deductive-nomological and causal-mechanical accounts, there is convincing evidence to suggest that no current models have been able to completely resolve the issues surrounding scientific explanation.

(ii) Secondly, the study of consciousness introduces its own problems, perhaps most notably the difficulty of observing and obtaining evidence for consciousness. Issues such as these present themselves as more or less problematic depending on how consciousness is defined.

(iii) The definition of consciousness is itself problematic. Consciousness is a notoriously ambiguous term, the definition of which has raised considerable debate amongst philosophers.

We have already examined, in section 2, some of the issues surrounding the first point, namely, the difficulties involved in developing a successful philosophical account of scientific explanation. Discussion of the second point will lead us into the central theme of the research essay; the role of scientific explanation in addressing the philosophical problems of consciousness. But given that discussion of this second point relies upon some preliminary reflection on the third, it is to the third point of discussion, the definition of consciousness, that we will now turn our attention.

4. The hard and easy problems of consciousness

4.1. Defining consciousness

It is worth acknowledging that 'consciousness' is a notoriously ambiguous term; studies of consciousness are frequently criticised for not defining what consciousness actually is. Many definitions of consciousness have been proposed, and none have been widely agreed on (Gennaro, 2014).

For the purposes of the following discussion, I will define consciousness in terms of Thomas Nagel's famous 'what it is like' criterion. According to Nagel, a being is conscious if there is 'something that it is like' to be that creature, or to reframe the concept, if that creature experiences the world from some subjective point of view (Nagel, 1974). Nagel gives the example of the consciousness of a bat; bats are conscious because there is 'something that it is like' for a bat to experience the world through echo-locatory sensation, even if humans are unable to fully understand this mode of consciousness. A rock, on the other hand, is not conscious; it is nonsensical to ask 'what it is like' to be a rock.

Again I acknowledge that this is by no means an ideal definition of consciousness; nevertheless it has been chosen on grounds that it encapsulates the subjective nature of conscious experience, and therefore provides a suitable basis for discussion of the 'easy' and 'hard' problems of consciousness as described by Chalmers (1995).

4.2. The easy and hard problems of consciousness

Chalmers suggests that there are two problems to consider in relation to the explanation of consciousness: the 'easy' problem and the 'hard' problem. Though the distinction between these two problems is itself not something Chalmers claims to have invented, the terminology is certainly most commonly attributed to him (Van Gulick, 2014).

Chalmers (1995) proposes that the data we use in studying consciousness is divided into roughly two categories: (i) third-person data about behaviour and brain processes (i.e. behavioral and neural phenomena) and (ii) first-person data about subjective experience (i.e. subjective phenomena).

In the third-person data category, Chalmers includes the following:

- perceptual discrimination of external stimuli
- the integration of information across sensory modalities
- automatic and voluntary actions
- levels of access to internally-represented information
- verbal reportability of internal states
- the difference between sleep and wakefulness

In the first-person data category, Chalmers includes:

- visual experience (e.g. the experience of color and depth)
- other perceptual experiences (e.g. auditory and tactile experience)
- bodily experiences (e.g. pain and hunger)
- mental imagery (e.g. recalled visual images)
- emotional experience (e.g. happiness and anger)
- occurrent thought (e.g. the experience of reflecting and deciding)

For a theory of consciousness to be complete, Chalmers suggests that an adequate explanation must be provided both for third-person and first-person data (Chalmers, 1995). Here follows the famous distinction between the hard and easy problems of consciousness: the problem of explaining third-person data is described as the 'easy' problem of consciousness, whilst the problem of explaining

first-person data is described as the ‘hard’ problem of consciousness. The hard problem is given to present particularly significant philosophical challenges (Van Gulick, 2014),

4.3. Perhaps there isn’t a hard problem

An important consideration to note is that some branches of philosophy, including eliminativism, suggest that perhaps there is no hard problem of consciousness in the first place. Daniel Dennett (1990), for example, argues that the phenomenal nature of consciousness is an illusion, and that the notion of consciousness as it is proposed philosophically can be rejected outright.

Whilst acknowledging that these perspectives exist, I have chosen not to pursue them. Firstly, I find such arguments unconvincing; I support, for example, Chalmers (1995) and Nagel (1974) in their criticisms of Dennett. Furthermore, the time constraints of this project disallowed me from examining this subtopic in sufficiently substantial depth. It is assumed in the remaining discussion that both the easy and hard problems of consciousness exist as they are described in section 4.2.

5. The role of scientific explanation in explaining the easy and hard problems of consciousness

The easy problem of consciousness, as described in section 4.2, focuses on third-person data, including, for example, explanations of behavioral and neural phenomena. Since science focuses on finding patterns in such data, it can and does play a key role in explaining these kinds of phenomena. In this sense scientific explanation is highly applicable to the easy problem of consciousness.

This is not to say, however, that the easy problem of consciousness is easily solved by science. To begin with, as discussed in section 2, it appears that the problem of finding an ideal philosophical account of scientific explanation remains unresolved, and it is clear that this raises considerable difficulties for providing a valid scientific explanation of the easy problem of consciousness. Furthermore, even if an ideal explanatory model was known to exist, the scientific application of this theoretical model would be greatly complicated by the practical difficulties associated with experimental science.

In order to illustrate some of the experimental difficulties that may arise, consider, for example, a human brain. Even if a scientific explanation of the brain's physical behaviour was possible theoretically, it would nevertheless be very difficult, in practice, to capture the brain's immense neural complexity. I emphasise that such challenges are non-trivial; the experimental study of the brain, for example, is a challenge that has occupied and continues to occupy neurological research teams across the globe.

These difficulties aside, in looking for a good scientific explanation of the easy problem of consciousness, we can be guided by the criteria we apply to our assessment of scientific theories in general. That is, good scientific explanations should agree broadly, albeit accounting for anomalies not necessarily identically, with scientific evidence, they should be simple and elegant, and they should be consistent with other established theories. Einstein's relativity theories, for instance, are often cited as examples of good scientific explanations.

It is important to stress, at this point, that exploring the easy problem alone does not give us conclusive or definitive answers to the hard problem of consciousness. Since the hard problem of consciousness rests on data about subjective experience, rather than data about objective functioning (Chalmers, 2013), even if a complete account is given of a conscious being's objective functioning, if this account provides no relation to subjective experience a number of questions will still remain. In the first place, how does objective functioning give rise to subjective experience? And secondly, how do particular kinds of objective functioning give rise to particular kinds of subjective experience? The easy problem of consciousness, in itself, does not allow us to resolve these issues.

There is no doubt that the hard problem raises some substantial challenges. It is important to note, however, that these difficulties do not lie solely in the accessibility of the data required. It may well be true that the only form of subjective experience an individual has *direct* access to is their own, and that there is no feasible method by which one can gain *direct* access to the subjective experience of another (Nagel, 1986). Indeed at first this restriction may seem to begin to explain why the hard problem is so intractable. Upon closer inspection, however, we find that data which has been gained indirectly (e.g. from other scientists) is often relied upon to make scientific claims; to invalidate such data as a source of knowledge would discount a large proportion of what we

consider to be scientific knowledge. Thus the difficulty of the hard problem cannot be reduced solely to the indirect accessibility of relevant data.

Neither does it arise solely from the fact that subjective data is involved. Subjective data, after all, is ubiquitous in experimental science; some would argue that, because all experimental measurements occur in unique spatio-temporal frames of reference, all scientific data is subjective. Thus we cannot reduce the difficulty of the hard problem in this way either. The difficulty seems to be much more fundamental; it appears that there exists, at least at this point in time, no scientific or conceptual framework which can provide an explanatory connection between physical and subjective phenomena.

How then, can we hope to make progress on the hard problem, if indeed such progress is possible? It is first worth noting that on the latter point, philosophers are divided. Some argue that it is an impenetrable problem; Colin McGinn (1989), for example, argues that our minds are cognitively incapable of finding solutions to the hard problem, just as rats are unable to solve complex mathematical problems. The reason for this, McGinn argues, lies not in the *complexity* of the hard problem of consciousness but in its theoretical construction. Other philosophers, such as Nagel (1998), are less pessimistic, allowing for the possibility that scientific advances may one day allow us to solve the hard problem of consciousness.

Nagel suggests that progress will only be achieved once a necessary connection is made between the subjective and the physical (Nagel, 1998). How such a connection will be achieved remains undetermined, and it is broadly agreed that current scientific paradigms are insufficient to solve the problem. It is hoped that the development of new conceptual and theoretical paradigms will allow the hard problem to be addressed.

In the meantime, how can we get closer to these new conceptual frameworks? As it stands, considerable scientific progress is being made in relation to the easy problem, and I would argue that if this is combined with our current understanding of subjective experience, we may be able to make some progress on the hard problem by better understanding the subjective experiences of other conscious organisms.

For example, whilst we can never ourselves experience directly what it is like to be a bat, we can be convinced by scientific evidence, that bat brains share sufficient similarity with human brains, such that we can make the probabilistic inference that there is ‘something it is like’ to be a bat just as there is ‘something it is like’ to be a human. We can also perhaps get a sense of whether it is likely, based on physical evidence (e.g. analysis of neural networks), that being a bat is very different, or similar, to being a human.

Take, for example, the scientific study of the sensory organs of animals. Based on scientific theories and evidence, we make the knowledge claim that bees see lightwaves in the UV region of the spectrum. Whilst this doesn't allow us to 'experience' the bees' UV vision, we may be able to get a hint of how 'what it is like to be a bee' might resemble and differ from 'what it is like to be a human'. We can even try to guess how it might be to experience this UV vision; whilst some might argue that this is as hopeless as trying to experience the consciousness of a round of cheese, it might be that in some cases, hybridising different features of our own consciousness can bring us closer to understanding the foreign experiences that we cannot access directly.

In this way, scientific explanation of the easy problem of consciousness may be able to bring us closer to understanding certain aspects of the hard problem. Although it is possible that the hard problem may not be conclusively addressed by scientific explanation, perhaps by addressing the easy problem in this way we can arrive at some solid guidelines to steer our understanding of subjective experience.

6. Conclusions

The scientific explanation of consciousness is a complex issue; the substantial philosophical difficulties associated with models of scientific explanation become especially pronounced in extension to the study of consciousness. The hard problem of consciousness is found to lie beyond current scientific frameworks; it is hoped that new conceptual and theoretical approaches will allow the problem to be solved. On the other hand, scientific explanation is found to play a key role in addressing the easy problem of consciousness, and whilst insights into such questions cannot conclusively solve the hard problem, they may be able to shed some light on 'what it is like' to be conscious.

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