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Hempel's Dilemma: Scientific Explanation and The Challenge to Physicalism

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Abstract: Hempel's Dilemma posits that the thesis of physicalism is either false or empty. This presents a significant challenge to the definition of physicalism, which asserts that everything is ultimately physical in nature. Originally articulated by Carl Gustav Hempel, the dilemma critiques how physicalism can be coherently defined in light of the evolving nature of physics. This paper explores the intricate relationship between scientific explanation, physical theories, and Hempel's Dilemma. Thus, the article examines how explanatory frameworks in physical science are constrained and shaped by the structure and content of physical theories, given the challenge to physicalism wrought by the weighty sledgehammer of the dilemma. The tension between current and ideal physics raises important questions about the adequacy of scientific explanation and the metaphysical commitments of physicalist worldviews. The article provides a critical discussion of the role of explanation in both contemporary and theoretical physics, while also assessing the implications for broader metaphysical and epistemological debates. The dilemma is explored in the light of recent scholarship by critically analyzing various responses to Hempel's Dilemma, examining the implications for reductionism, emergentism, and the mind-body problem, and the broader philosophical consequences for scientific explanation and metaphysical commitment. This study concludes that philosophical flexibility is necessary in addressing the dynamic nature of scientific progress and suggests a pluralistic approach to these discussions.

Keywords: Hempel's Dilemma, Physicalism, Scientific Explanation, Mind-Body Problem, Physics

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1. Introduction

The concept of explanation is central to both the philosophy of science and metaphysics, particularly in the context of physical theories [1][2][3]. Scientific explanation, in the context of physical theory, refers to the process of providing a coherent and systematic account of natural phenomena. This involves the development of theoretical frameworks that can accurately predict and explain the behaviour of physical systems [4]. Theoretical frameworks are not only developed to explain and predict the behaviour of physical systems, but they also shape our understanding of reality [5]. Philosophers and scientists seek to explain phenomena by appealing to physical laws, models, or theories, yet the nature of these explanations often reflects deep metaphysical assumptions about the nature of the world [1][3]. One such assumption is physicalism, the view that everything is ultimately physical or explainable in terms of physics [6]. However, physicalism faces a significant challenge known as Hempel's Dilemma [2][7]. This dilemma raises important questions about how we understand physical theories and their role in explaining the world.

Physicalism posits that everything, including mental phenomena, is ultimately physical. According to Montero and Papineau [6], "it may not be immediately obvious why this need to account for physical influence should demand that we view the mental, biological, and other realms as themselves physical." However, Carl Gustav Hempel's dilemma presents a fundamental challenge to this position by questioning what is meant by the term 'physical'. If 'physical' is defined according to current physical theories, this definition risks being incomplete or inaccurate, given that scientific knowledge evolves. On the other hand, defining 'physical' based on some ideal future physics makes the term speculative and meaningless. This dilemma, now known as Hempel's Dilemma, after the name of the philosopher who succinctly articulated it, continues to generate discourse among contemporary philosophers, especially with a hint on its enduring impact on debates about physicalism [8].

This work makes an effort to clarify the relationship between the nature of scientific explanation, physical theories, and Hempel's Dilemma, by outlining the basic structure of explanation in scientific practice with particular reference to the covering law model proposed by Carl G. Hempel, introducing Hempel's Dilemma, and examining its challenge to physicalist explanations. We shall discuss the responses to the dilemma, analyze how these responses affect our understanding of explanation in contemporary physics, and finally, offer concluding remarks on the significance of this debate for both science and metaphysics.

According to Peter Bokulich, Hempel's Dilemma is the claim that physicalism is an ill-formed thesis because it can offer no account of the physics that it refers to: current physics will be discarded in the future, and we do not yet know the nature of future physics. Thus, Hempel's Dilemma poses two central problems for physicalism, encapsulated in its two "horns," current physics horn and future physics horn. The dilemma poses a problem for physicalism, which asserts that everything can be explained in terms of physical processes and laws. The dilemma challenges physicalists to specify what they mean by 'physical' when claiming that everything is physical. These challenges expose an inherent instability in physicalism as a philosophical position: if physicalism relies on scientific theories that are constantly evolving, it may lack the foundational robustness needed to define the "physical" [9]. Hempel's Dilemma thus forces physicalists to choose between an inadequate current understanding of physics or a speculative future understanding that could diverge significantly from contemporary notions of the physical. Let us look at the horns:

The First Horn (Current Physics)

If physicalists mean that everything can be explained in terms of current physics, their view seems implausible. Current physics is widely acknowledged to be incomplete. For example, the Standard Model of particle physics does not account for gravity at the quantum level, and it is unclear how current physical theories could explain consciousness or other complex phenomena. Defining physicalism according to our current understanding of physics risks instability, as our scientific understanding of the physical world is not yet complete [10].

Second Horn (Future Ideal Physics)

On the other hand, if physicalists mean that everything can be explained in terms of a future, ideal physics, they face a different problem. We have no way of knowing what such a future theory will look like, and thus it seems speculative to claim that it will be able to explain everything. Moreover, a theory that is so radically different from current physics might not even resemble what we now consider to be "physical." So, defining physicalism according to some ideal, future physics involves speculative assumptions about what future theories will reveal, rendering the concept vague or meaningless [11].

Physicalism as a Significant Strand of Naturalism

The concept of naturalism is a comprehensive ideology, frequently interwoven with physicalism's principles in such a way that physicalism is recognized as a significant strand of naturalism in the contemporary understanding [12]. Physicalism, which holds that all substances and events are ultimately physical, has acquired significant traction among contemporary philosophers. A recent poll found that the majority of philosophers today support physicalism, in sharp contrast to the more diverse opinions of the nineteenth century. This shift calls for a more in-depth investigation of the underlying causes of such a transition. Modern versions of naturalism, while permissive, imply that all things are made out of physical components. However, this does not mean a reductionist approach that ignores the intricacies of fields like psychology or biology. Rather, proponents of physicalism argue for a sophisticated understanding of how these "special sciences" function within a framework that recognizes their distinct techniques, which cannot be fully encompassed by fundamental physics.

The metaphor of a divine being orchestrating the cosmos exemplifies the physicalist viewpoint: once the fundamental physical truths are established, all other facts, including those pertaining to consciousness, are predetermined. This concept of necessary reliance reinforces the conviction that conscious minds emerge from physical realities, calling into question the antiphysicalist position that mental phenomena exist in their own domain. The case for physicalism is compelling, particularly in its ability to explain how supposedly non-physical things can exercise influence over the physical world. The scientific understanding that all physical consequences are the result of physical causes compels a re-evaluation of mental and biological phenomena, which must likewise be grounded in the physical realm in order to be causal. This viewpoint does not deny the presence of mental and biological realities; rather, it aims to define their nature as fundamentally physical.

2. Materials and Methods

Unlike classic objections of Cartesian dualism, which challenge the causal link between mind and body, this scientific argument contends that non-physical things have no influence on the physical universe. This leads to a more nuanced understanding of physicalism: it does not assert that everything is physical in an absolute sense, but rather that all entities in the space or temporal realm must be seen as physical. Thus, the debate over naturalism and physicalism pushes us to reconsider the complex relationships between mind, body, and the larger cosmos, underlining the significance of rooting our understanding of all occurrences in the physical facts that make up our existence.

3. Results and Discussion

Responses to Hempel's Dilemma and its Implications for Physicalism

Various responses to Hempel's Dilemma have been proposed, each has implications for the relationship between physical theories and explanation. We have the deflationary response, the pragmatic approach and the non-reductive physicalist approach.

Deflationary Response

One response to the dilemma is to adopt a deflationary view of the term "physical." Proponents of this view argue that physicalism should not be tied to specific physical theories, whether current or future, but should instead be understood as a commitment to whatever the best empirical science eventually reveals. This response sidesteps the dilemma by claiming that the content of physicalism is not dependent on the specifics of any one theory but rather on the methodological principles of scientific inquiry. However, critics argue that this response renders physicalism vague and potentially empty. If physicalism is just the claim that the world conforms to whatever future science says, then it seems to lack substantive content, offering little insight into the nature of explanation.

The Pragmatic Approach

Another response is a pragmatic approach that embraces the idea that scientific explanations are always provisional and subject to revision. This view holds that current physics provides the best available explanations, even if those explanations are incomplete. The future development of physics will lead to new and improved explanations, but this does not undermine the explanatory power of current theories. While this approach acknowledges the fallibility of scientific explanation, it still faces the problem of how to reconcile current explanations with phenomena that seem resistant to physicalist accounts, such as consciousness or moral properties.

Non-Reductive Physicalism

A third response is to adopt a non-reductive physicalist stance, which maintains that while everything is ultimately grounded in physical processes, not all explanations need to be framed in physical terms. According to this view, higher-level explanations, such as those in biology or psychology, are autonomous and cannot be fully reduced to physics, even though they are consistent with physical laws. In the article "Hempel's Dilemma: Not Only for Physicalism," Firt et al. [1] argue that Hempel's Dilemma challenges the physicalist thesis that everything is either physical or supervenes on the physical. The dilemma posits that physicalism is either false or lacks clear content because the concept of "physics" is unstable due to changes in physical theories over time. While Hempel himself argues against the inherent obscurity of the physicalist claim that the language of physics can serve as the unifying language of science [2], Firt et al. [1] extend the scope of the dilemma, arguing that it applies not only to physicalism but also to any theory involving changeable deep-structure accounts of our experience, including dualist theories. They propose that "the scope of Hempel's Dilemma turns out to be very wide: it is a special case of a general sceptical argument" [1]. The paper also outlines two conditions for the dilemma's applicability: the theory must be a deep-structure theory, and it must be subject to change [1]. This leads to a "generalised Hempelian Dilemma" that challenges not only physicalism but also non-reductive physicalism and mind-body dualism [1]. This approach allows for a more pluralistic understanding of explanation but raises questions about how different explanatory frameworks relate to one another and whether they can be fully integrated into a coherent worldview.

Defining Physicalism

Physicalism – the claim that everything that exists is physical – is confronted with Hempel's Dilemma arising from attempts to define the physical. Two possible approaches emerge. Is the physical defined based on current physical theories, or is it defined based on future or ideal physical theories? Adopting the definition based on current physical theories would likely render physicalism false or incoherent, while adopting definitions inspired by future physical theories would make physicalism uncertain or potentially trivial, thereby undermining its significance. That is why Bokulich [13] says that Hempel's Dilemma renders the concept of physicalism problematic. Hempel's Dilemma fundamentally questions whether physicalism can maintain a stable and coherent definition of the "physical." The reliance on current physics leaves physicalism vulnerable to scientific revolutions, such as the transition from classical mechanics to quantum mechanics [14]. On the other hand, relying on future physics introduces uncertainties that undermine the concept's clarity [15]. First suggests that without a definitive understanding of the "physical," physicalism risks devolving into a shifting doctrine that is dependent on the unpredictable trajectory of scientific progress.

Stability and Metaphysics

A further challenge posed by Hempel's Dilemma is the suggestion that physicalism might require metaphysical assumptions that extend beyond empirical science. Firt et al. [1] argue that the dilemma implies physicalism's dependence on the speculative belief that future physics will provide a complete account of reality, even though this account cannot

be specified in advance. This makes physicalism as much a metaphysical commitment as it is a scientific stance, complicating its role in philosophical discourse.

Domains of Physics and the Mind-Body Problem

Hempel's Dilemma complicates physicalist approaches to the mind-body problem by challenging whether consciousness can be explained through current or future physical theories. If current physics is insufficient for explaining consciousness, and future physics remains speculative, physicalism's capacity to fully explain mental phenomena remains questionable [16]. Maimon [17] explores whether an alternative metaphysical framework might offer a solution, though he concludes that a sustainable resolution to Hempel's Dilemma is not easily achievable within current scientific paradigms.

Philosophical Implications

Reductionism

Physicalism often aligns with reductionism, the view that all phenomena can be reduced to physical processes. However, Hempel's Dilemma suggests that reductionism is threatened by the evolving understanding of the physical [18]. Firt [1] expands on this, arguing that reductionism becomes unstable if the foundational physical laws to which all higher-order phenomena are reduced are themselves subject to future revision.

Emergentism

Emergentism provides an alternative to reductionism, positing that new properties and behaviours emerge at higher levels of complexity and cannot be fully explained by lower-level physical processes [19]. This position is more compatible with Hempel's Dilemma, as it recognises the limitations of a purely physicalist framework in light of our incomplete understanding of physics. Firt et al. [1] argue that emergentism allows for the possibility that scientific explanations may require concepts beyond those provided by physics, thus offering a more flexible approach to explaining higher-order phenomena.

Metaphysical Commitments and the Nature of Causation

Hempel's Dilemma reveals the need for physicalism to incorporate metaphysical commitments that extend beyond the empirical. This is particularly significant for understanding causation. If the concept of "physical" is unstable, our understanding of physical causation may also be in flux, leading to uncertainty about the nature of scientific laws and predictions [10]. Davatos [11] explores this issue in the context of methodological naturalism, suggesting that metaphysical commitments play an essential role in stabilizing scientific explanation when the empirical boundaries of physicalism are in question.

Scientific Explanation and Physical Theories

Scientific explanation, in the context of physical theory, refers to the process of providing a coherent and systematic account of natural phenomena. This involves the development of theoretical frameworks that can accurately predict and explain the behaviour of physical systems [12]. Carl Hempel's work on the logic of scientific explanation provides an important starting point for understanding the relationship between explanation and physical theories. Hempel and Paul Oppenheim's Deductive-Nomological (D-N) model posits that scientific explanations are arguments in which the phenomenon to be explained (the explanandum) is logically deduced from general laws and specific initial conditions (the explanans). According to this model, an explanation is successful if it shows how the occurrence of the explanandum was to be expected, given the laws of nature and the conditions at play. Physical theories play a central role in this framework, as the laws used to derive explanations are typically those posited by physics or other natural sciences. For example, Newton's laws of motion can be used to explain the trajectory of a projectile, while quantum mechanics provides explanations for phenomena at the atomic and subatomic level.

Limitations of the Covering Law Model

While Hempel's model offers a formal structure for understanding explanation, it has faced several criticisms. One key criticism is that the model is overly focused on deductive relationships and cannot adequately capture the probabilistic nature of many physical theories, such as those in quantum mechanics or statistical mechanics. Probabilistic explanations, where the explanandum is not guaranteed by the laws and conditions but only made more likely, seem to resist the deductive form of the D-N model. Hempel provides another type of the covering law model called the Inductive Statistical (I-S) model to answer critics about probabilistic explanations. However, that attempt met another hiccup in the sense that Hempel's I-S explanation requires a high probability to be included as explanation. This is worrisome as it is very unlikely to account for any explanation involving quantum phenomena because sometimes very low probability outcomes are accepted as explanatory at the quantum level.

Additionally, Hempel's model has been criticized for being too general and abstract, failing to account for the causal mechanisms that are often central to scientific explanations. For example, explaining the behavior of a gas in terms of the kinetic theory of gases involves understanding the causal interactions between gas particles, not merely subsuming the phenomenon under general laws. These criticisms suggest that a more nuanced view of explanation is needed, especially in the context of physical theories. This is where Hempel's Dilemma comes into play, raising the question of what physicalism - and by extension, explanations based on physical theories - really commits us to.

Explanation in Contemporary Physics

The responses to Hempel's Dilemma have significant implications for how we understand explanation in contemporary physics. For instance, many physical theories, such as quantum mechanics and general relativity, operate with radically different conceptual frameworks, yet both are considered successful in explaining the phenomena they address.

Quantum mechanics provides probabilistic explanations, which challenge the determinism presupposed by the traditional covering law model, while general relativity offers geometrical explanations of gravitational phenomena. The tension between these theories, particularly in attempts to develop a theory of quantum gravity, highlights the difficulty of providing a unified physical explanation of the universe. Moreover, contemporary discussions of emergent properties in complex systems suggest that higher-level explanations may be indispensable, even if they are ultimately grounded in physical processes. This complicates the physicalist assumption that all explanations must eventually reduce to physics.

4. Conclusion

The intersection of explanation, physical theories, and Hempel's Dilemma reveals a complex philosophical landscape. While physical theories provide powerful explanatory frameworks, their limitations - both in their current form and in their speculative future development - challenge the assumption that everything can be fully explained in physical terms. Responses to Hempel's Dilemma highlight the need for a more nuanced understanding of explanation, one that can accommodate the diverse and evolving nature of physical theories. The relationship between physical theories and explanation is far from straightforward. Hempel's Dilemma underscores the tension between the ambitions of physicalism and the practical realities of scientific explanation, raising important questions about the future direction of both philosophy and science.

Hempel's Dilemma exposes the philosophical instability at the heart of physicalism. Given the evolving nature of physics and scientific understanding, physicalism must adopt a more pluralistic approach, recognising that a purely physicalist framework may not suffice to explain all phenomena. Instead, physicalism could coexist with emergentist

or dualist interpretations, allowing for a more flexible and comprehensive understanding of the relationship between science and philosophy. Such an approach acknowledges the limits of current and future physics while exploring alternative metaphysical frameworks that may offer solutions to Hempel's Dilemma.

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