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WHAT IMPLICATIONS DOES THE UNDERSTANDING OF THE GOVERNING MECHANICS OF THE UNIVERSE HAVE ON THE CONCEPT OF FREE WILL?

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Contents

Abstract

The purpose of this paper is to present the thesis that free will, in its strongest sense, is not compatible with the prevailing theories of the governing mechanics of the universe. Consequentially, the concept of free will must be revised in order to be reconcilable with these scientifically demonstrable theories. Free will is often understood in terms of agency, which is a product of an actor's volitions. These volitions, in turn, are thought to be the product of the mind and conscious experience of the actor. Depending on the theory, the mind and conscious experience are believed to be rooted in the physical human body, often leading to discussions surrounding the relationship between the mind and body. As a result, it is easy for the topic of free will to become subsumed into these areas. By allowing the discussion on free will to be led by the governing mechanics of the universe, the free will discussion should remain unobscured. The governing mechanics of the universe are logical and coherent theories that have been established and supported by the scientific method. By adhering to these scientific theories, any model of free will that is discussed must also be in keeping with the spirit of the scientific method and, as a result, the governing mechanics of the universe. Discussions on the mind and consciousness will inevitably form due to the topics being inextricably linked. When introduced, the purpose of these theories will be to add value and build upon the free will debate. Similarly, the above methodology means that incompatible theories can quickly be discounted if they are not in keeping with the scientific method. Consequentially, the paper should lead towards a holistic conclusion on the implications of the governing mechanics of the universe for the concept of free will.

Introduction

On first reading, it is clear that the question can be divided into two topics. Firstly, ‘the governing mechanics of the universe’ requires an examination into the scientific laws of physics that the universe follows. Secondly, ‘concept of free will’ refers to the various definitions and interpretations on the extent to which the actor can exercise choice. ‘Implications’, the noun that links these two topics together, requires exploration and evaluation of the impact that the former has on the latter. It should be noted that the following introduction is intended to familiarise the reader with the structure of the paper and concepts that will be discussed throughout. As the paper will cover topics in both science and philosophy, it is necessary to provide some rudimentary definitions and descriptions that will help inform the reader why the paper follows a particular structure. It is not possible or suitable to provide comprehensive explanations within the introduction; these will be discussed in greater depth at the appropriate chapters of the paper. Instead, these definitions will aid the introduction by laying out an understandable framework that overlays the two topics, allowing for the theories, concepts, and implications between the science and philosophy to be drawn out. Additionally, the paper will justify why the scientific method has been selected to provide an apparatus that philosophical theories will be judged against.

To offer some additional familiarity to the framework that will be adopted, it is first necessary to provide a short synopsis on free will in the context of the actor exercising will or intent freely. The following synopsis should provide an accessible starter on the governing mechanics of the universe, making the discussion surrounding the theories of free will clearer. At its most basic, agency and volitions are often presented as the fundamental characteristic of free will. Agency refers to the actor’s facility to act within their conditions, while volition is the ability of the actor to act or choose in accordance with their will.

Therefore, for free will to exist, conditions should allow for the actor to choose to act. In limiting agency or volitions, free will has been simultaneously removed. If choices are predetermined, then the ability to choose does not exist; free will is removed due to the inevitable exercise of volitions in a particular way. The framework adopted for understanding the governing mechanics of the universe will be entirely grounded in the dominant hypotheses advocated by the scientific community, which are classical and quantum mechanics. Fundamentally, the former theory suggests that the outcome of events are determined by, or reduced to, the events that preceded them, making future events predictable. A consequence of this theory is that it is not possible for future events to deviate from a given path based upon previous events. The latter theory suggests that events are probabilistic, which makes determining future events unpredictable. If future events are unpredictable, then these are events that are not wholly determined by previous events. The difference between these two theories is where the bulk of the discussion on choice and free will shall occur. If the universe is deterministic, all events or choices are a consequence of previous events or choices, making all future events predictable and any meaningful understanding of the free will to choose impossible. However, if the universe is probabilistic, then future events are not completely determined by previous events. The probabilistic deviation from the influence of previous events raises the question of whether choice can exist within this indeterminism. By positioning this paper with theories that can be demonstrated beyond reasonable doubt, it will be possible to prevent the discussion from degenerating into an exploration of mysticism that cannot be proven or disproven.

While the paper will broadly cover two topics, these topics will be linked and evaluated throughout four overarching chapters. Chapter one will establish the underlying issues for the ‘concept of free will’ and ‘governing mechanics of the universe’ by breaking the problem down into five subsections, designed to explain the interrelatedness of key subject areas.

These subsections will introduce, explain, and provide working definitions for subjects that have implications for and fall within the two overarching topics of the 'concept of free will' and 'governing mechanics of the universe'. The subsections of chapter one will allow the reader to follow the linear progression of the discussion and measure the effect of scientific and mechanical principles on subsequent subjects. The first subsection of chapter one will provide characterisations of free will. The second subsection will begin to relate the definitions of free will in terms of incompatibilism, seen in the previous paragraph, and compatibilism. Subsection three will present the principles of the scientific method and explain why scientific theories have been given primacy in the discussion. The fourth subsection of chapter one will look to identify the origin of free will through agency by providing definitions of the mind and consciousness. Finally, the last subsection of chapter one will build upon the principles explained by the scientific method, showing the implications when discussing the relationship between the mind and physical body in the mind-body problem; attempts at resolving the mind-body problem will involve presenting theories of the mind and consciousness. Having established initial working definitions, the reader will eventually be able to identify the importance of coherence for these definitions in relation to each other in subsequent chapters. Moreover, the extent to which the philosophical definitions in the first, second, fourth and fifth subsections of chapter one can remain extant, without alteration, is indicative of the scale of influence the governing mechanics of the universe has on these philosophical concepts.

Chapter two will discuss classical mechanics and the intimately related theory of determinism, which is 'the view that everything that happens is such that given whatever happened, nothing else could happen'[1]. LaPlace's Demon thought experiment will be used

[1] Time Crane and Katalin Farkas, 'Freedom And Determinism', in *Metaphysics: A Guide And Anthology,* ed. by Time Crane and Katalin Farkas (Oxford University Press, 2006), pp. 661-672 (p. 665).

to demonstrate how a regression through events and actions, all of which were themselves influenced by previous events and actions, means that is not possible for the actor's will or intent to have ever been different. The accumulation of all previous events and actions leads the actor to their present volitions. As a result, choices that are made are inevitable. Moreover, the will of the actor at that time, subsequent events, and actions, will in turn direct the future will or intent of the actor. Unless the solution presented here by a theory of mind allows otherwise, free will is not possible as will or intent cannot be different due to the influence exerted by previous events or actions.

Chapter three will present an indeterministic interpretation of the universe, according to quantum mechanics, with a libertarian understanding of free will. The libertarian view is juxtaposed to determinism, arguing that humankind possesses 'the freedom to do otherwise and the power of self-determination'[2]. The libertarian accepts free will and determinism are incompatible, but 'claim that the world is indeterministic'[3] rather than deterministic as per the classical mechanical description of the universe. Looking to the quantum mechanical interpretation of the universe, chapter three will explore whether the libertarian can appeal to this model to overcome these issues. Quantum physics is a vast topic, meaning that only a small part of this paper can be dedicated to its explanation in any real depth. A portion of this chapter will be spent introducing the key tenets of the quantum mechanical position and how it diverges from classical mechanics. The key outcome of this discussion will be the introduction of an indeterministic model of the universe. As quantum mechanics introduces probabilism and unpredictability into the universe, the following evaluation will focus on

[2] Timothy O'Connor and Christopher Franklin, *Free Will*, *The Stanford Encyclopedia Of Philosophy* (2022) <https://plato.stanford.edu/archives/win2022/entries/freewill/> [accessed 29 April 2024].
[3] Crane and Farkas, p. 669.

whether variation and unpredictability can be understood in such a way as to account for free will.

Chapter four will attempt to reconcile the concept of free will defined in chapter one with the implications of the governing mechanics found in the preceding two chapters. It is possible to anticipate three possible outcomes from this evaluation. Firstly, the governing mechanics of the universe has no implications on the understanding of free will. It is possible for free will to exist within the principles of the universe without modification to either scientific or philosophical theories. Secondly, free will and the governing mechanics of the universe are incompatible as currently explained, resulting in the requirement to modify one or both theories. Any reconciliation discussed here will resemble a compatibilist approach, whereby it is advocated that 'free will is compatible with determinism'[4]. If it is necessary to drastically alter the character of these theories to make them reconcilable, arguably the theory of free will require reconsidering more so than theories proven through the scientific method. The extent to which these theories require modification to allow for the coherent existence of each other is indicative of the implication that the governing mechanics of the universe has on the concept of free will. The final possible outcome is that free will cannot be reconciled with the governing mechanics of the universe. As a result of this, the implications that the governing mechanics of the universe have on the concept of free will are total. Based upon the success that free will has in resisting or co-existing with these scientific theories, it will be possible to draw a conclusion and answer the question. Having established the parameters that form the chapters that will follow, it is now possible to move forward with the discussion.

[4] O'Connor and Franklin, 2020.

Chapter One - Defining the Problem

The purpose of this chapter is twofold. Firstly, the problem must be defined clearly as the issue draws upon several disciplines. Secondly, defining the issue requires establishing working philosophical, scientific definitions and parameters that allow proper discussion to take place. By identifying these definitions early, it is possible to compare, contrast and evaluate philosophical theories of free will and physics against these definitions. The extent to which the theories that follow throughout this paper are in keeping with these initial definitions is indicative of their success. If definitions or theories are shown to be inconsistent with one another, it shows that either the definition, theory, or all need to be altered or rejected. The degree to which the definition or theory is required to diverge from its original description is demonstrative of how forceful the implication physics has on the theory of free will.

1.1 Free Will

There are generally agreed to be two overarching definitions of free will. The following subsection will look purely at the definitions of free will in isolation, without considering the moral or metaphysical aspects. Free will can be separated in to the otherwise or sourcehood definitions of free will. Firstly, the otherwise definition of free will, which is also sometimes known as the open alternative or alternative possibilities definition of free will, defines free will at its most basic as:

> The 'freedom of action. I have freedom of action at a time if more than one alternative is then open to me'[5].

According to this definition, free will is possessed by the actor if there is the possibility to act or have acted differently at a point in time. The implication from this being that by acting differently, the actor has the ability to realise alternate futures. However, by offering a broad and generous definition of free will, whereby the only requirement for free will is 'having access to alternative options for action'[6], any theory which adopts this definition must account for subsequent issues surrounding the realisability of alternative options. An important issue regards clarifying what is considered an alternative option for the actor. While the definition of free will seems uninterested in the origin of the actor's actions, how the conditions surrounding the actor impact on the viability of alternatives seem entirely down to interpretation. For example, a person suffering addiction could be judged as possessing free will on the basis that they had the choice on whether to act or not act on their habit; an alternate option exists as there are two possible choices. However, it appears as though the strength of the compulsion for the actor is not being accounted for. A heavily addicted actor would have little free will other than to act on their compulsion; therefore, a legitimate alternate option does not exist. In this case, this one definition of free will allows for two interpretations of whether alternative options are possible. If this is to be resolved, the definition could be refined in order to be able to identify whether free will exists in certain circumstances. A solution would likely involve introducing further conditions that recognise influences on the actor. However, by recognising factors which influence the alternative options open to the actor, how options are selected by the actor are being tacitly acknowledged. Consequentially, it appears as though the alternative options definition of

[5] Michael McKenna and Derk Pereboom, *Free Will: A Contemporary Introduction* (Routledge, 2016), p. 7.
[6] McKenna and Pereboom, *Free Will: A Contemporary Introduction,* p. 7.

free will is incomplete if additional considerations are required beyond the simple freedom of action.

The sourcehood definition builds upon the alternative option definition of free will, concerning itself primarily with the authorship of choice and decision making of the actor, with Kane defining free will as:

> The 'power to be the ultimate creator and sustainer of one's own ends and purposes'[7].

The above definition rejects the premise that it is simply enough for alternative actions to be possible for free will to exist. Instead, free will is being expressed in relation to the source of the actor's actions, whereby the 'sources or origins of our actions must be in us and not in something else'[8]. The theory aims to be able to identify the actor as being ultimately responsible for their actions. While the ability to do otherwise is implicit within this definition, the sourcehood definition is far more 'substantive and not merely a definitional matter'[9] of the possibility of choice existing. Rather than being preoccupied with counterfactuals, the emphasis is placed upon the origins and control that the actor generates and then acts upon. In its truest sense, the definition appears to identify the actor as being a primer mover, capable of 'uncaused causes'[10], meaning that the actor can generate the origins and control of their actions in isolation to and away from the influence of external factors. However, the feasibility of whether an actor can ever possess the ability to be the ultimate creator or

[7] Ibid. p. 8.
[8] Robert Kane, *A Contemporary Introduction To Free Will* (Oxford University Press, 2005), p. 121.
[9] McKenna and Pereboom, *Free Will: A Contemporary Introduction,* p. 8.
[10] Kane, *A Contemporary Introduction To Free Will*, p. 47.

originator of their choices is questionable. If every actor is a 'causal patient'[11], being passive or affected by activity that is external to them, then the conditions or experiences of that actor would seem to influence their actions, ends or purposes. The actor could be 'causally active'[12] in so far that they generate and control their activity, but this must be considered in light of the preceding chain of influences and factors that are external to them. For example, when considering addiction, the compulsion to act on that addiction is internally driven. Addiction would have been formed through prior exposure, but those previous events continue to influence the actor. The ability of the actor to control their behaviour and overcome the compulsion influences the choices available. While the source of control over their actions is internal to the actor regardless of whether the addiction is acted on or not, the ability to break from the compulsive behaviour indicates the prior influence that addiction has on the actor's immediate control over their actions. As a result, an issue for the sourcehood definition of free will appears to be accounting for how much power or control the actor has over their actions.

1.2 Incompatibilism and Compatibilism

Having provided philosophical definitions of free will, it is necessary to understand how these can be understood in the wider context of the universe. Theories of free will are grouped according to their coherence with the theory of determinism, which is 'the thesis that at any time only one future is physically possible'[13] and that all current and future events are a consequence of proceeding causal events. On the basis that the actions of an actor can have an effect in the world, and the actor can in turn be affected by events external to them,

[11] Stephen Mumford and Rani Lill Anjum, *Causation: A Very Short Introduction* (Oxford University Press, 2013), p. 92.
[12] Mumford and Lill Anjum, *Causation: A Very Short Introduction*, p. 92.
[13] McKenna and Pereboom, *Free Will: A Contemporary Introduction*, p. 16.

it indicates that ‘we are not apart from the causal world. We are very much a part of it’[14]. The compatibility of free will against the backdrop of causal determinism exists across a spectrum. Incompatibilist accounts of free will fall to either end of that spectrum, simply holding that ‘free will and determinism cannot go together’[15]. Hard determinists and libertarians are both incompatibilist accounts, but reject either the existence of free will or the deterministic description of the universe respectively.

While the hard determinism and libertarianism are incompatibilist accounts of free will, the measure of success required to vindicate either theory varies significantly. The libertarian account of free will is arguing from a weaker position, holding that ‘(1) free will and determinism are incompatible (incompatibilism), (2) free will exists, and so (3) determinism is false’[16]. At its most fundamental, the deterministic picture of the universe has been replaced with an indeterministic universe to account for free will. As the universe is no longer deterministic, preceding events do not necessarily entail future events. If future events are open, then alternative options exist for the actor as per the alternative option definition of free will. However, while the libertarian must initially demonstrate that the universe is indeterministic, they must account for the following two issues. Firstly, what does libertarian free will look like? Secondly, how is the libertarian account of free will compatible with an indeterministic universe? In contrast, the hard determinist has far less to prove than the libertarian. The hard determinist holds that the laws of physics that dictate the universe are deterministic. As a result, the theory of free will or denial of free will must be compatible with that deterministic picture. Neither the otherwise of sourcehood definitions of free will are compatible with determinism as, according to Kane, ‘we cannot now do otherwise than we

[14] Mumford and Lill Anjum, *Causation: A Very Short Introduction*, p. 92.
[15] Meghan Griffith, *Free Will: The Basics* (Routledge, 2022), p. 27.
[16] Kane, *A Contemporary Introduction To Free Will*, p. 33.

actually do. Since this argument can be applied to any agents and actions at any times, we can infer from it that if determinism is true, no one can ever do otherwise; and if free will requires the power to do otherwise, then no one has free will'[17]. The otherwise definition requires that the actor has alternative options open to them; however, all preceding events inevitably lead to one option. Therefore, the otherwise definition of free will fails. Similarly, the sourcehood definition requires that the actor is the ultimate source for their actions. If the actor is the sum of all previous events, all future actions are driven by previous events that the actor is not the ultimate source of. The only way that current or future events could be different is if it were the case that preceding events were different; however, the new series of future events would now be inevitable based upon preceding events. Consequentially, free will must be rejected in light of a deterministic universe. To be vindicated in their position, the determinist must simply demonstrate that the universe is deterministic.

The middle ground between libertarianism and determinism is compatibilism or soft determinism. The compatibilist advocates that 'that there is really no conflict between determinism and free will - that free will and determinism are compatible'[18]. As a deterministic model of the universe necessitates one outcome, meaning that there is 'no metaphysically possible way'[19] for either the alternate possibilities or sourcehood definitions of free will to be meaningfully reconciled with determinism, the compatibilist will instead adjust the definitions of free will or context in which free will is understood to cohere with a deterministic universe. The compatibilist position argues that as long as the volitions of the actor are conceivable within the deterministic model of the universe, the actor has free will.

[17] Ibid. p. 24.
[18] Ibid. p. 13.
[19] McKenna and Pereboom, *Free Will: A Contemporary Introduction*, p. 8.

For example, if universal events are in keeping with the volitions of an actor, the actor has free will; moreover, if the universal events are at odds with the volitions of an actor, but the universe could conceivably have been in keeping with the volitions of an actor if preceding causal events were different, then the actor also has free will. Whether the actor was the source of the events or truly causally efficacious in the universe is irrelevant, it is the actual and possible manifestation or coherence of the volitions of the actor with events in the universe that is central to compatibilism. Ultimately, the compatibility of the volitions of an actor with the universe is what important, not how those volitions influence the universe or how those volitions are realised. As a result, the alternate possibilities definition of free will becomes an issue of conceivability or a counterfactual exercise. Similarly, the need for the actor to be the prime mover or have any meaningful power over volitions, as per the sourcehood definition of free will, is no longer required.

At this point, incompatibilist and compatibilist accounts have been discussed in view of philosophical definitions of free will and a cursory understanding of determinism and indeterminism. The underlying principles of classical and quantum mechanics, which offer insight into the permissibility of determinist or indeterminist accounts of the universe, have not yet been unpacked. Therefore, the strongest philosophical definitions of free will can be adopted until such time that they become unsustainable in the face of these theories. The results of this examination should demonstrate the ‘implications’ that ‘the governing mechanics of the universe’ has ‘on the concept of free will’.

1.3 The Scientific Method

The sciences, with a particular focus on physics, are held in primacy for the purposes of this paper. Both classical and quantum mechanics followed the principles of the scientific

method when being hypothesised. The methodology adopted by philosophy and science overlap to a great extent, with the scientific method offering a formalised means of conducting research. It is due to the high standards demanded by the scientific method that these theories are given such importance. The scientific method offers a means to be able to move beyond a priori knowledge, which is knowledge that is definitionally true and can be known without outside experience. Examples of a prior knowledge and deductive reasoning are:

P1) All bachelors are unmarried.

A priori reasoning, when used within deductive reasoning, is extremely important in its ability to guarantee the validity of conclusions when all premises are true. For example:

P1) All bachelors are unmarried.
P2) Harry is unmarried.
C1) Harry is a bachelor.

If a priori and deductive reasoning were the sole methods of gaining knowledge, the breadth of human knowledge would be greatly restricted as inferring from specific to general becomes impossible when attempting to create a theory. As a result, it is necessary to use a posteriori knowledge, which is gained through empirical or experiential means and inductive reasoning. The effects of gravity were observed and documented by Newton in *Philosophiæ Naturalis Principia Mathematica* and are an example of a posteriori knowledge. A statement that all matter is affected by gravity was possible through inductive reasoning, such as the below:

P1) Every apple dropped has fallen to the earth.

C1) Therefore, the next apple dropped will fall to earth.

Unfortunately, a posteriori knowledge can lead to false conclusions if not rigorously tested. As a result, the scientific method is a system designed to reduce the risk of invalid inductive reasoning by introducing principles to test a posteriori, empirical knowledge. These principles include:

1) Observation.
2) Theory.
3) Application.
4) Analysis.
5) Conclusion.

On observing activity in the universe, a theory is built that seeks to explain and predict that behaviour. The explanatory power of a theory means that underlying principles can be identified and extrapolated to account for certain behaviours. These inferences should be testable under controlled and reproducible conditions to build a large set of results. If experimentation produces inconsistent results, then the initial theory may be flawed and require further refinement; the experiment should not be adjusted to create desirable results. Similarly, if coherent principles cannot be identified in the data set produced by experimentation, then the hypothesis does not offer a robust explanation and should be adjusted accordingly.

The wide adoption of the scientific method as the accepted approach to demonstrating a theory has resulted in the rigorous and uniform building of collective knowledge. Moreover,

the unbiased nature of the methodology has resulted in either the refutation or acknowledgement that certain hypotheses are indemonstrable, forcing them to be temporarily or permanently disregarded until more supporting evidence exists or a more robust theory is available. The pursuit of underlying principles within a theory, that cannot be further reduced or explained, ultimately set a requirement for a 'fundamental principle'[20] or principles from which all other principles or hypothesis can be derived. As 'physics is usually regarded as the most fundamental science'[21] due to its study of matter and light, it has been suggested that the other sciences can be explained by and collapse into a discussion of physics as 'the other sciences are ultimately composed of physical particles'[22]. The extent to which this is a valid hypothesis will be crucial when discussing whether biological systems can be reduced entirely to physical principles, particularly when considering whether the mind and conscious experience is reducible to the physical brain. The outcome of this will be essential in understanding whether the actor is also governed by deterministic or indeterministic interpretations of the laws of mechanics.

1.4 The Mind and Consciousness

Theories of mind and consciousness are not the primary concern of this paper; however, it is necessary to appreciate these topics to understand where volitions and the resulting exercise of free will may originate or be directed from within the actor. Although the mind and consciousness are private to the individual, unless the observer is a sceptic of other minds, it is usually assumed that other humans also have minds and an inner mental life. Similarly, just as the mind and consciousness are fundamental to the understanding of

[20] Samir Okasha, *Philosophy Of Science: A Very Short Introduction* (Oxford University Press, 2016), p. 49.
[21] Okasha, *Philosophy Of Science: A Very Short Introduction*, p. 51.
[22] Ibid. p. 51.

personhood in others, free will is 'pertinent to our life not only as we perceive it in our choices, but also through the fact that we attribute it to others'[23]. In Griffith's *Free Will: The Basics,* the mind and free will are described as the 'intellect' and the 'will' retrospectively, offering the following definitions:

> 'The "intellect" is the part that reasons. The "will" is the part that chooses'[24].

Each area has a different function, with the will making decisions informed by the information and reasons fed by the mind. Should the mind and consciousness form the root of volitions and decision making in the human actor, then knowledge of the operation of the intellectual aspects of the mind is extremely useful in understanding how volitions result in decisions. As a result, two questions need to be understood regarding the mind and consciousness. The topic of this subsection answers the first question, which is 'what is the mind and consciousness'? The topic of subsection 1.5 addresses the second question, which is 'how does the mind or consciousness interact with the human body'? The first question will define the mind and consciousness prior to discussing the mind-body problem in 1.5, as the ambition is to be able to identify what is being referred to when the mind and consciousness are being discussed. While related, the mind and consciousness do not refer to the same topic. They are distinct from one another and are vast disciplines when considered in isolation; the Philosophy of Mind and the Philosophy of Consciousness are dedicated to the study of each area, respectively. Although the scale of these topics prevents anything other than rudimentary definitions from being offered, it is essential to provide these definitions if there is to be any meaningful conversation.

[23] Crane and Farkas, p. 663.
[24] Griffith, *Free Will: The Basics*, p. 3.

Chalmers offers one of the clearest distinctions of the mind and consciousness in the influential paper *Facing Up to the Problem of Consciousness.* These definitions will be adopted by this paper with some further refinement and clarification. Acknowledging the intimate relationship between the consciousness and the mind, Chalmers refers and differentiates between them as the '"hard" and "easy problems"'[25]. The easy problem of consciousness is routinely described throughout the paper as an issue of 'mechanisms'[26], being 'straightforwardly vulnerable to explanation in terms of computational or neural mechanisms'[27]. Without wishing to advocate Chalmers' theories now beyond the explanation of how the mind differs from consciousness, it should be noted that alternative theories of the mechanisms responsible for the mind exists beyond the computational or neural approach that Chalmers mentions explicitly. Therefore, the key takeaway should be that the easy problem of consciousness could be understood to be an inclusive discussion on all theories of the mechanisms, systems or means that allows for the interaction between the human body and cognition. The totality of the discussion surrounding the mechanisms, systems or means that could give rise to cognition are collectively known as the Philosophy of Mind. To avoid confusion, Chalmers' easy problem of consciousness will be used as a synonym for the mind in this paper, with a refined definition being understood as:

> The cognitive function or awareness resulting from a mechanism, system or means of interaction in the human body.

[25] David J. Chalmers, 'Facing Up To The Problems of Consciousness' in *The Character Of Consciousness* (Oxford University Press, 2010), pp. 3-24 (p. 4) <DOI: 10.1093/acprof:oso/9780195311105.001.0001>.
[26] Chalmers, *The Character Of Consciousness*, p. 4.
[27] Ibid. p. 4.

The cognitive abilities that Chalmers'[28] preferred explanatory mechanism allows can include some or all of the following:

1) the ability to discriminate, categorize, and react to environmental stimuli;
2) the integration of information by a cognitive system;
3) the reportability of mental states;
4) the ability of a system to access its own internal states;
5) the focus of attention;
6) the deliberate control of behaviour;
7) the difference between wakefulness and sleep.

If the mind is cognition or awareness resulting from the mechanisms, system or means in the human body, it is now necessary to understand what consciousness is referring to. Chalmers characterises consciousness as the 'really hard problem'[29].

> The really hard problem of consciousness is the problem of experience. When we think and perceive, there is a whir of information-processing, but there is also a subjective aspect. As Nagel (1974) has put it, there is something it is like to be a conscious organism. This subjective aspect is experience.[30]

According to Chalmers, cognitive abilities and awareness of the mind should be explainable through science and investigation. The hard problem of consciousness, which will now just be referred to as consciousness, alludes to the subjective or privileged access that individuals have when experiencing the features produced by the mind. These experiences

[28] Ibid. p. 4.
[29] Ibid. p. 5.
[30] Ibid. p. 5.

are often referred to as qualia or 'phenomenal character'[31]. As seen in the above quote, Chalmers borrows Nagel's understanding of conscious experience, who held that consciousness exists 'at many levels of animal life'[32], suggesting that if it is possible to imagine or infer the conscious experience of an external actor then that object or actor has consciousness. A working definition of consciousness can be refined as:

Consciousness is the subjective experience derived from the mind.

According to this definition, if the mind is stimulated by the colour blue, then consciousness is an associated phenomenal experience to that stimulus. If the phenomenal experience associated with the colour blue can be imagined in another, then that actor would also experience consciousness. Through studying the mechanisms responsible for the various cognitive functions, it would appear as though mind is mappable and could be perceived by an external actor if the appropriate systems of access to the mind were in place. In contrast to this, Putnam used the term 'the autonomy of our mental life'[33] to refer to how the private nature of consciousness means that access to subjective experience is limited to the individual. While it would be possible to identify a stimulus and associated activity, the conscious experience of that event is privileged to the individual and is not mappable.

When referring to Griffith's presentation of the intellect, Chalmers' explanation suggests that cognitive function and resulting reasoning occur in the mind. Moreover, the deliberate control

[31] Michael Tye, *Qualia, The Stanford Encyclopedia Of Philosophy* (2021), <https://plato.stanford.edu/archives/fall2021/entries/qualia/> [accessed 2 June 2024].
[32] Thomas Nagel, 'What Is It Like To Be A Bat?' *The Philosophical Review*, 83.4 (1974), 435-450 (p 436) <http://www.jstor.org/stable/2183914> [accessed 23 June 2016].
[33] Hilary Putnam, 'Philosophy And Our Mental Life' in *Mind, Language and Reality: Philosophical Papers, 2* (Cambridge University Press, 1975), pp. 291–303 (p. 291) <DOI: 10.1017/CBO9780511625251.016>.

of behaviour, in reaction to and based upon that cognitive function and reasoning, also occurs in the mind. Furthermore, Chalmer's explanation also suggests that reasoning and decision making should have an associated subjective conscious experience. However, what remains unclear is whether volitions, or the part that chooses and wills the deliberate control of behaviours, also occurs in the mind or in the subjective conscious experience of the actor. If volitions occur in the mind, then they appear vulnerable to understanding through the scientific method, meaning that they could be predicted. On the other hand, if volitions are formed in the consciousness, then they are privileged to the individual and not immediately knowable to an observer.

1.5 The Mind-Body Problem

With definitions of mind and consciousness established, it should be noted that there are numerous theories which seek to explain the operation of the mind, consciousness and how they are related to the body. The attempted reconciliation on what appears to be two seemingly different components of human experience is known as the mind-body problem. The mind-body problem refers to the explanatory gap in the relationship between the physical human body and the cognitive and conscious aspects of human experience; particularly, how it is possible for each of these two seemingly different things to affect each other. For example, when physical damage occurs to the body it can be manifested as a conscious experience, such as a pain sensation. Moreover, a volition on the part of the actor can direct the physical body to act in a certain way, such as the deliberate thought to raise both arms above the head results in this action taking place. Ideally, a theory of mind will be able to offer a convincing description of the relationship between cognitive function or awareness and the physical human body by way of mechanism, system, or other means.

Of particular interest to this paper is understanding the association between the mind and body when considering the environmental conditions, agency and volitions of an actor.

As seen in subsection 1.3, a requirement of the scientific method is that the principles of a theory are universally valid and applied without bias. While there are multiple laws of physics, any identical matter that exists in the same conditions should be subject to the same physical laws and should be expected to behave in the same way. For example, where X^n is matter which exists in identical conditions, such as the weight and mass of the object, and a is a law of physics, such as gravitational pull, X^n should be expected to behave identically.

P1) $X^1 = a$

P2) $X^1 = X^2$

C1) $X^2 = a$

Variation in behaviour would begin to become visible when the conditions between examples of X vary. However, physical laws would still apply dependent upon the condition of X. On this basis, the universality of physics is also applied to living things. Therefore, the role that science and physics plays must also be accounted for when discussing how the human body and brain operates. As the 'boundary between physics and other sciences is not always clear'[34], debate arises when considering how the mind and consciousness are understood in relation to the body. If the mind and consciousness are housed in a body governed or affected by physical laws, then the extent to which the mind and consciousness are also bound by these laws is a key question.

[34] Benjamin Crowell, *Newtonian Physics* (Light and Matter, 2001), p. 19.

According to the principle of transitivity, a relation is transitive if it holds true between causes and effects; for example, '*c* is a cause of *d* and *d* is a cause of *e*, then *c* is a cause of *e*'[35]. If all environmental conditions have a completely causally transitive relationship with the mind, consciousness and volitions, then the actor is entirely a causal patient based upon the events that preceded them. The actor cannot be causally active independent of previous events; in no sense is the actor a causal prime mover. However, theories of mind offer differing views on the extent to which the principle of transitivity applies between the body, mind and consciousness. On the one hand, dualism holds that the mind and physical body are different things. Dualist accounts can encompass either property dualism or substance dualism, sometimes known as Cartesian dualism. The substance or Cartesian dualist believes that the mind and body are distinct substances, with the mind being 'a thinking thing and not an extended thing'[36]; while the body is 'an extended thing and not a thinking thing'[37]. Alternatively, the property dualist rejects the ideas of 'mental substances, but allow mental events as causally inert by-products of events involving material substances'[38]. The property dualist is 'committed to the irreducibility of mental phenomena to physical phenomena'[39], with physical substances exhibiting both physical and non-physical properties. As a result, a physical body can output a physical property and non-physical or mental property simultaneously. On the other hand, the materialist holds that there is only one substance that exists. Examples of these theories are behaviourism, the type-identity theory, and functionalism. Firstly, the behaviourist holds that due to the privileged access of the mind, outward publicly observable behaviour is the only meaningful way to understand others. The

[35] Neil McDonnell, 'Transitivity And Proportionality In Causation' *Synthese*, 195 (2018), 1211–1229 (p. 1212) <DOI: 10.1007/s11229-016-1263-1>.
[36] Rene Descartes, 'Meditations On First Philosophy' in *Discourse On Method And Meditations On First Philosophy*, ed. by Donald Cress (Hacket Publishing Company, 1998), pp. 46-103 (p. 96).
[37] Descartes, *Meditations On First Philosophy*, p. 96.
[38] John Heil, *Philosophy of Mind: A Contemporary Introduction* (Routledge 2000), p. 40.
[39] Scott Calef, *Dualism And Mind, Internet Encyclopedia Of Philosophy* (2016) <https://iep.utm.edu/dualism-and-mind/#H6> [accessed 15 June 24].

behaviourist asserts that statements on the mind do not offer any value to the conversation, as access to and knowledge of the minds of others is limited. Therefore, conversations on the internal workings of the mind should be set aside and better understood as mental activity or the mind being exhibited as a 'behaviour or dispositions to behave'[40] in a particular way. For these purposes, at its most basic, 'the mind just is the behaviour of the body'[41]. Secondly, the type-identity theory does not deny mental activity, but instead advocates that 'processes of the mind are identical to states and processes of the brain'[42]; with the mind or consciousness being the 'material of physical properties'[43]. Finally, functionalism 'allows for the multiple realization of mental states'[44], meaning that no system that produces cognition or consciousness has preference over any other system. Bias against possible non-human minds or consciousness is entirely dismissed. Instead, the conscious or cognitive outputs are viewed against the purpose, role or function they have in a particular system. As a result, if non-identical systems *A* and *B* can produce conscious state *C*, the output *C* is examined against 'causal relations to sensory stimulations, other mental states, and behaviour'[45] rather than the internal workings of the systems *A* and *B* that produce *C*. While the theories of mind may offer an insight on the extent to which the principle of transitivity applies between the mind and body, these theories must also provide compelling reasons why they should be more widely accepted beyond free will. Otherwise, an appeal is being made to

[40] John R. Searle, *Mind: A Brief Introduction* (Oxford University Press, 2004), p. 60.
[41] Searle, *Mind: A Brief Introduction*, p. 50.
[42] J. J. C. Smart, *The Mind/Brain Identity Theory, The Stanford Encyclopedia of Philosophy* (2022) <https://plato.stanford.edu/archives/win2022/entries/mind-identity/> [accessed 15 June 24].
[43] Heil, *Philosophy of Mind*, p. 79.
[44] Barbara Gail Montero, *Philosophy of Mind: A Very Short Introduction* (Oxford University Press, 2022), p. 41.
[45] Janet Levin, *Functionalism, The Stanford Encyclopedia of Philosophy* (2023), <https://plato.stanford.edu/archives/sum2023/entries/functionalism/> [accessed 15 June 24].

the exceptionalism of the mind and consciousness, favouring that theory counter to the principles of the scientific method.

The model of the universe proposed by classical physics is commonly acknowledged to be deterministic, whereby 'events can only unfold in exactly one way'[46] if certain starting conditions are met. The principles of scientific method seen earlier established that theories must be based on repeatable and demonstrable experimentation in order to be formalised as viable theories. The end state of the formalisation of these theories means that when 'sufficient knowledge of the laws of nature and appropriate boundary conditions'[47] are all known, the outcome or results of starting conditions can be predicated into the future. Within the model of classical physics, Newtonian mechanics are the most widely accepted laws of nature used to describe 'cause and effect'[48] behaviours and relationships between objects. These laws can be used to suggest that future events are predictable based upon preceding events. As a result, it is necessary to provide a preface on Newton's laws of motion. Once these have been appropriately explained, the implications of these laws will be discussed. The implications being, firstly, whether the laws are being correctly interpreted as deterministic and, secondly, the impact on the concept of free will based upon the correctness of the interpretation.

[46] Griffith, *Free Will: The Basics*, p. 5.
[47] Brigitte Falkenburg and Friedel Weinert, 'Indeterminism And Determinism In Quantum Mechanics' in *Compendium of Quantum Physics,* ed. by D. Greenberger, K. Hentschel, F. Weinert (Springer, 2009), pp. 307-311 (p. 307) <DOI: 10.1007/978-3-540-70626-7_96>.
[48] J.P McEvoy and Oscar Zarate, *Introducing Quantum Theory* (Icon Books Ltd, 2013). p. 19.

2.1 Philosophiæ Naturalis Principia Mathematica

Three laws of motion were discovered by Sir Isaac Newton and codified in *Philosophiæ Naturalis Principia Mathematica*[49], which seek to explain the relationship between forces and the momentum of an object. At its most basic, force (*F*) should be understood as the effects of push or pull exerted on an object. Objects consist of mass (*m*), which is the measurement of the matter forming an object. Speed (*s*) is a measurement of distance travelled (*d*) within an established time (*t*). Speed (*s*) can be combined with direction of travel to produce the velocity (*v*) of an object; objects do not have any velocity (*v*) if they are stationary. The resulting sum of an object's mass (*m*) multiplied by its velocity (*v*) is known as momentum (*p*), which is expressed as $p=mv$. The use of time (*t*) to measure a change in the velocity (*v*) of an object is known as acceleration (*a*). These definitions are required to understand the following laws of motion.

The first law of motion, also known as the principle of inertia, states:

> 'Every object in a state of uniform motion tends to remain in that state of motion unless an external force is applied to it'[50].

All objects will remain stationary or at constant velocity (*v*) unless it is affected to do so by a resultant force (*F*). Only through an unbalanced force (*F*) acting on an object will the object

[49] George Smith, Newton's Philosophiae Naturalis Principia Mathematica, The Stanford Encyclopedia of Philosophy (2024) <https://plato.stanford.edu/archives/fall2024/entries/newton-principia/> [accessed 27 Jul 24].
[50] George Hrabovsky and Leonard Susskind, *Classical Mechanics: The Theoretical Minimum* (Penguin Books, 2016), p. 70.

move from being stationary or experience a change in velocity *(v)*. The resultant force (*F*) is used to describe any force (*F*) remaining after all other forces (*F*) have been subtracted.

The second law of motion, also known as the principle of force, provides a means of calculating the behaviour of objects in various conditions and the subsequent changes to momentum (*m*), force (*F*) or acceleration (*a*) that can be observed.

> 'The relationship between an object's mass m, its acceleration a, and the applied force F is F=ma'[51].

The force (*F*) experienced by an object, which could result in a change in momentum (*p*), is a proportionate result of the mass (*m*) and acceleration (*a*) experienced by that object.

The third law of motion, also known as the principle of action, reaction, and the conversation of momentum, is expressed as:

> 'For every action there is an equal and opposite reaction'[52].

Should one object exert a force on a second object, the second object will exert an equal and opposite force on the first object. On this basis, no force can exist in isolation and the outcome of all objects involved in an interaction are calculable if the conditions of the interaction are known.

[51] Hrabovsky and Susskind, *Classical Mechanics: The Theoretical Minimum*, p. 70.
[52] Ibid. p. 93.

The formalisation of the above laws is an example of a posteriori knowledge that underpin the causal chain seen when discussing the principle of transitivity. Empirical evidence, gathered from observation of the interactions between specific objects in the universe, has been used to produce inductive reasoning that generalised about all objects in the universe. Moreover, the results were repeatable, verifiable, and universally applicable, meeting all the requirements of the scientific method. The robustness of the theory and ability to generalise allowed for the future patterns to be anticipated and past events identified. By pushing Newton's laws of motion to a logical extreme, it appears as though there is no limit to this.

2.2 Laplace's Demon and Determinism

In *A Philosophical Essay on Probabilities*, Pierre Laplace explained what he believed was the logical outcome of the various scientific discoveries that were being found using the scientific method. The famous Laplace's Demon thought experiment can be seen in the extract below.

> We ought then to regard the present state of the universe as the effect of its anterior state and as the cause of the one which is to follow. Given for one instant an intelligence which could comprehend all the forces by which nature is animated and the respective situation of the beings who compose it - an intelligence sufficiently vast to submit these data to analysis - it would embrace in the same formula the movements of the greatest bodies of the universe and those of the lightest atom; for it, nothing would be uncertain and the future, as the past, would be present to its eyes[53].

[53] Pierre Simon Laplace, *A Philosophical Essay on Probabilities*, 6th edn, ed. by F.W. Truscott and F.L. Emory (Dover Publications, 1951), p. 4.

By knowing key pieces of information such as the position and momentum (*p*) of an objective at an established time (*t*), it is possible to plot the previous and future movements of that object in isolation. The results of interaction with other objects and the resultant forces (*F*) are also captured within these laws. While the environment can grow increasingly complex with the introduction of multiple forces, calculations of the interactions between objects, and the resulting outcome, is theoretically possible if the position and momentum (*p*) of all objects are known at any one point in time (*t*). Moreover, those interactions and the changes to momentum are also calculable, which is also true of any subsequent interactions. The resulting picture of the universe offered by classical mechanics is entirely predictable, which is a result of the 'causal closure'[54] and 'causal completeness of physics'[55]. As all cause and effect within physics, and therefore the universe, is calculable and explainable, the universe should be considered a closed system with no unknown causes or effects; any possibility of variation from a set course is impossible, as all objects are subject to the same laws of nature. Moreover, as human actors exist within the universe, they too are subject to these same laws; any deviation appears as impossible for the human actor as it does for an inanimate object, with all movement in the universe being mapped out ad infinitum. As a result, a deterministic view of the universe appears to be the outcome of classical mechanics.

When comparing this information to the definitions of free will seen in subsection 1.1, it is clear that the alternate possibilities definition is incompatible with classical mechanics. Alternate options are not open to the actor as only one outcome is possible based on

[54] Harald Atmanspacher and Robert C. Bishop, 'The Causal Closure of Physics and Free Will' in *The Oxford Handbook of Free Will,* 2nd edn, ed. by Robert Kane (Oxford Univeristy Press 2011), pp 101-111 (p. 1) <DOI: 10.1093/oxfordhb/9780195399691.003.0005>.
[55] Atmanspacher and Bishop, p. 1.

preceding events. The only way alternate options would be available if preceding events were different. While an appeal could be made that alternate possibilities may exist in differently realised worlds, the ability of the actor to access these is unavailable based on the causal chain that exists in their reality. The ability of the actor to have any real sense of power or control over their volitions also seems doubtful when considering the sourcehood definition of free will. Regardless of whether volitions are formed in the mind or consciousness, they are also determined by prior events if the universe is causally closed. As a result, any action based on a volition is result of events that formed that volition. According to Chalmers' theories seen in section 1.4, the real difference between volitions formed in the mind and consciousness would be the eventual explainability or access to volitions formed in the mind in contrast to the private nature of volitions that are in the consciousness. However, if materialist theories of consciousness are considered, volitions that are formed in the consciousness could be accessible through understanding prior cause and effect, but the subjective aspect associated with those volitions would remain inaccessible to an external observer.

As noted in the remainder of the paragraph from Laplace's thought experiment, humanity can understand the methods involved in the computations for building a predictive system.

> The human mind offers, in the perfection which it has been able to give to astronomy, a feeble idea of this intelligence. Its discoveries in mechanics and geometry, added to that of universal gravity, have enabled it to comprehend in the same analytical expressions the past and future states of the system of the world. Applying the same method to some other objects of its knowledge, it has succeeded in referring to general laws observed phenomena and in foreseeing those which given circumstances ought to produce. All these efforts in the search

> for truth tend to lead it back continually to the vast intelligence which we have just mentioned, but from which it will always remain infinitely removed[56].

While Laplace is not suggesting that such a being exists, there is nothing inconsistent about the proposal. The intelligence could be a demon, deity or a computer with the power to process and compute all of the information that it is being fed. The primary limitation being access to the starting information and power to compute that information, which is not available to humanity. As a result, the predictive ability appears conceivable but not achievable.

2.3 Determinism and Dualism

The classical mechanical and deterministic account of the universe supports the concepts that universe is causally closed and the model of the universe is complete. On this basis, the alternate possibilities and sourcehood definitions of free will are incoherent with classical mechanics. It is possible to argue that the ability of the agent to be meaningfully causally active in the universe by way of exercising their volitions only becomes problematic when discussing materialist theories of the mind. Therefore, it should be considered whether substance dualism offers any opportunity for free will to exist in a deterministic universe, as if 'minds are spirits or souls, then they might not be bound by the regular causation of the purely physical world'[57]. For ease of understanding, Cartesian dualism, found in *Meditations of the First Philosophy*, with supporting information and detail found in *The Passions of the Soul,* will be the substance dualist theory of mind presented in this subsection. Additionally,

[56] Laplace, p. 4.
[57] Mumford and Lill Anjum, *Causation: A Very Short Introduction*, p. 45.

Descartes' arguments from scepticism, the foundation for his dualist account of the mind, will be omitted to focus purely on the actual theory of mind.

Throughout Descartes' various works, automata are used to refer to animals, humans and machines, going so far as to refer to an organic body as a 'machine made of earth'[58]. The use of the same materials in the construction of all matter in the universe does not privilege any particular thing, committing Descartes to the principle of the universality of physics. Moreover, as the bodily substance of animals, humans and machines are all physically extended in space and exist in time, they will also follow the deterministic mechanical laws of the universe. Descartes was committed to this determinism, using imagery that draws attention to the clockwork nature of the universe and everything that exists in it.

> The difference between the body of a living man and that of a dead one is the same as that between a watch, or some other automaton (I mean some other machine that moves itself), when it is wound up and when it has in itself the physical principle of movements for which it was designed, along with everything else that is required for it to act, and the same watch or other machine when it is broken and the principle of its movement ceases to act[59].

The internal organs and workings of animals operate 'in the same way as the movement of a watch is produced purely by the power of its mainspring and arrangement of its wheels'[60]. When fuelled and working as intended, 'clocks, artificial fountains, mills, and other similar machines which, even though only are only made by men, have the power to move of their

[58] Rene Descartes, 'The Treatise On Man' in *The World And Other Writings*, ed. by Stephen Gaukroger (Cambridge University Press, 2004), p. 99.
[59] Rene Descartes, 'The Passions Of The Soul' in *The Passion Of The Soul And Other Late Philosophical Writings,* ed. by Michael Moriarty (Oxford University Press, 2015), pp. 195-280 (p. 197).
[60] Rene Descartes, *The Passions Of The Soul,* p. 203.

own accord'[61]. Similarly, the 'mechanism of the body which is so constructed by nature that it can move in various ways by its own power[62] operates in the same way as a machine. Although livings things may not have a designer like a machine, it is the 'disposition of their organs'[63] that inform the actions of that living thing. However, the point at which conditions negatively affect the internal workings of both machines and animals, they begin to fail.

In contrast to the physically and temporally extended physical substance of the body, the mind is the thinking, non-material 'essence'[64] of the human. The mind is housed 'between the cavities'[65] of the pineal gland. These cavities are filled with 'animal spirits'[66] that the mind can manipulate, allowing interaction with the body and causing movement. The mind 'radiates outwards'[67] from the pineal gland, allowing the mind to receive inputs from animal spirits when they are affected by the physical body. Descartes states that there 'remains nothing in us that we should ascribe to the soul except thoughts'[68], with mind and soul being used interchangeably. These thoughts are formed of actions and passions. Actions are volitions, which either remain as thoughts or 'produce the desired effect'[69] in the body. Passions are 'perceptions, or sensations, or emotions'[70] which can be produced by the external world or through reflection in the mind. Importantly, as volitions are not a product of the body, they 'can never be compelled'[71], but they can be influenced indirectly by the

[61] Descartes, *The Treatise On Man*, p. 99.
[62] Rene Descartes, 'Principles Of Philosophy', in *The Passion Of The Soul And Other Late Philosophical Writings,* ed. by Michael Moriarty (Oxford University Press, 2015), pp. 119-166 (p. 163).
[63] Descartes, 'Discourse On Method', in *Discourse On Method And Meditations On First Philosophy*, ed. by Donald Cress (Hacket Publishing Company, 1998), pp. 1-44 (p. 33).
[64] Descartes, *Meditations On First Philosophy*, p. 96.
[65] Descartes, *The Passions Of The Soul*, p. 209.
[66] Descartes, *Discourse On Method*, p. 30.
[67] Descartes, *The Passions Of The Soul*, p. 209.
[68] Ibid. p. 203.
[69] Ibid. p. 213.
[70] Ibid. p. 206.
[71] Ibid. p. 212.

passions. The mind can act on 'the mere fact that it wants something, it causes the little gland, to which it is closely joined, to move in what manner is necessary to produce the effect connected with this volition'[72]. Although the world is casually closed, the mechanical laws which govern the world do not apply to the non-material mind. Being unaffected by these laws, the mind, following its volitions, can act on the body and cause an effect in the material world. When comparing these to the sourcehood definition of free will, the non-material mind has the ability to be a prime cause of events in the world based on its volitions. Moreover, by introducing new events into the material world, the non-material mind can cause new events and alternate possibilities for itself according to its volitions.

Unfortunately, although the theory of mind accounts for free will in a deterministic universe, the issue of the mind-body problem persists. The explanatory gap in the causal relationship between the material world and non-material mind is noted in *Correspondence with Princess Elisabeth of Bohemia.*

> For it seems to me that movement can be produced only by an impulsion applied to the thing moved, by the manner in which it is impelled by the thing that move it, or by the quality and shape of the latter's surface. The first two situations require contact, the third extension. You altogether exclude the latter from your notion of the soul, and the former seems to me incompatible with an immaterial thing[73].

[72] Ibid. p. 212.
[73] Rene Descartes, 'Correspondence With Princess Elisabeth Of Bohemia' in *The Passion Of The Soul And Other Late Philosophical Writings,* ed. by Michael Moriarty (Oxford University Press, 2015), pp. 1-165 (p. 3).

Descartes is unable to offer a satisfactory explanation to this question, only suggesting that there has been confusion with the 'the notion of the force by which the soul acts on the body with that by which one body acts on another'[74] and the means for this interaction is currently unknown. Instead, in *Objections and Replies,* Descartes appeals to how it is accepted that heat and weight can 'act on the body'[75] despite not being the same substance while his dualist theory is rejected. However, it should be noted that the effects of heat and weight are explainable through the scientific method; Descartes' theory cannot be verified and, as a result, does not add value to the questions at hand.

[74] Descartes, *Correspondence With Princess Elisabeth Of Bohemia*, p. 6.
[75] Rene Descartes, 'Objections And Replies' in *The Philosophical Writings of Descartes Volume II*, ed. by John Cottingham, Dugald Murdoch and Robert Stoothoff (Cambridge University Press, 2005) pp. 63-397 (p. 275).

Quantum mechanics is 'one of the most empirically successful'[76] scientific theories. Combined with the discovery of the atom, quantum mechanics appeared to call into question Newton's laws of motion to the extent that it is now understood that 'quantum physics differs fundamentally from classical physics'[77]. Quantum physics describes the combined disciplines that 'deals with physical phenomena at microscopic scales'[78]. These areas include the behaviour of light, matter, and energy at the quantum level. Pratt offers a suitably robust description of quantum physics.

> Quantum is a Latin word correlated with "quantity," and quanta are the smallest amount of any physical entity. The term suggests that quantum physics studies the material at the most minimal scale to understand how particles work and interact with each other. It underlies how atoms function and why chemistry and biology work as they do. Everything, including our bodies, is involved at some level with particles and forces with which they interact. For this reason, quantum physics is often described as the science that explains everything[79].

In the same way classical mechanics focuses on the laws governing the behaviour and relationships between different objects, quantum mechanics is concerned with the behaviour and relationship of atoms or subatomic particles. The previously casually closed

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[76] Robert C. Bishop, 'Chaos, Indeterminism, and Free Will' in *The Oxford Handbook of Free Will*, 2nd edn, ed. by Robert Kane (Oxford Univeristy Press 2005), pp. 111-124 (p. 119) <DOI: 10.1093/oxfordhb/9780195178548.003.005>.
[77] Carl J. Pratt, *Quantum Physics For Beginners: From Wave Theory To Quantum Computing. Understanding How Everything Works By A Simplified Explanation Of Quantum Physics And Mechanics Principles* (Ippoceronte Publishing, 2021), p. 10.
[78] Pratt, *Quantum Physics for Beginners*, p. 9.
[79] Ibid. pp. 7-8.

universe of classical mechanics does not appear complete as these laws break down and fail at the quantum level. As the laws of classical mechanics are replaced with principles of quantum mechanics, it has been suggested that a less rigid prescription of causal closure than seen in the previous system may allow for free will to exist. Consequentially, future events may no longer be predicated on preceding events. To understand the implications for free will, it is essential to offer an introduction to the principles of quantum mechanics. Once these principles have been appropriately explained, it is necessary to explore whether the principles of quantum mechanics are being correctly interpreted as indeterministic. Depending on the correctness this interpretation, it will then be possible to understand what the impact on the concept of free will is.

3.1 Quantum Mechanics and Indeterminism

Unlike Newton's laws of motion, the principles of quantum mechanics are a product of multiple theorists, often drawing from other disciplines within quantum physics before being consolidated. The four most fundamental principles to quantum mechanics are wave-particle duality, superposition, entanglement, and the uncertainty principle. Often the discovery of one principle affects others, which can be seen throughout the descriptions in the following paragraphs.

The concept of wave-particle duality grew from its origins in stating that 'light can exhibit the properties of a wave or a particle'[80] to being more universally applied to all matter. The double-slit experiment[81] demonstrated that when a lone source of light shines through two slits in an otherwise unbroken opaque screen, the two resulting light sources on the opposite

[80] Ibid. p. 34.
[81] Ibid. p. 19.

side of the opaque screen behave like waves, interfering with each other and creating a diffracted pattern on a completely opaque final screen. In an almost identical experiment, it was tested whether matter also demonstrates 'wave-like properties'[82], which involved replacing the source of light and firing electrons instead. Similar to the original double split experiment, 'scientists noticed that electrons, like light, created a diffraction pattern'[83], proving that electrons also behave like waves. From this experiment, electrons, which are a fundamental component of all matter in the universe have the ability to 'exhibit both wave-like and particle-like behaviour'[84]. Wave-like behaviour would disperse the electron over an area, while particle-like behaviour would see the electron localised to a specific point. What was once thought to be mutually exclusive properties were now being exhibited in matter, making it difficult 'to accurately describe[85]' electrons. Furthermore, when scaling upwards, it appears as though all matter in the universe shares these properties.

Quantum superposition is the principle that 'a particle can assume more than one state simultaneously'[86], demonstrating that matter is able to exist across multiple and temporal locations simultaneously; the inverse is also established, with matter having the ability to share the same spatial and temporal locations simultaneously. Using quantum superposition, it is possible to explain the behaviour of the electrons in the double slit experiment 'acting like waves'[87]. Single electrons can adopt a superposition, passing through each slit in the screen simultaneously. Likewise, multiple electrons pass through each slit simultaneously, interfering with each other and behaving like a wave. However, when under observation or measurement, the observer effect takes place, and the electrons

[82] Ibid. p. 40.
[83] Ibid. p. 40.
[84] Ibid. p. 41.
[85] Ibid. p. 39.
[86] Ibid. p. 51.
[87] Ibid. p. 40.

adopt a single position and pass through only one slit. The diffracted pattern seen when the electrons were unobserved also change to reflect a particulate pattern on the completely opaque final screen. The effect of observing this 'is known as wave function collapse, where the act of measurement causes the electron to become localised to a specific location'[88]. Prior to identifying the electron as a particle in one location, there is a possibility of measuring the electron in multiple locations as it forms part of a wave function, which is the expression of probability that describes 'the likelihood of finding an electron at a certain point'[89]. Having the ability to adopt multiple states simultaneously means the electron has the ability to affect multiple possible outcomes. Only until the electron is observed does wave-function collapse and the electron adopts a single state with a single possible outcome.

The principle of entanglement is intimately related to wave-particle duality and superposition, describing 'a physical phenomenon that occurs when a pair or group of particles is generated, interacts, or shares spatial proximity in a way such that the quantum state of each particle of the pair, or group cannot be described independently of the state of the others, including when a large distance separates the particles'[90]. The interdependence of the relationship between entangled particles means that when information is gained on any one particle, additional information is learnt about every particle. If being understood in relation to wave-particle duality and superposition, it is possible that electrons can be entangled within a wave function and while in superposition. Through observing or measuring one electron that is in superposition, it is necessary that all other electrons in the system are in superposition. When the wave function for that one electron collapses due to the observer effect, which means the electron is no longer in superposition, the wave function for all entangled electrons will also collapse. As cause and effect within entangled

[88] Ibid. p. 51.
[89] Ibid. p. 51.
[90] Ibid. p. 76.

particles are immediate and can occur at limitless distances, it is impossible to distinguish or identify causal relationships as previously understood within the model of classical mechanics.

The uncertainty principle states that even theoretically, ‘a particle's position and velocity cannot be measured precisely simultaneously’[91]. Moreover, there is an absolute upper limit to the accuracy that can be applied to measuring the position and velocity of a particle. The lack of precision in these measurements is another consequence of wave-particle duality. According to the light momentum equation[92], the momentum of a wave (*p*) is equal to Planck’s constant (h) divide by wavelength (λ). Using this equation, the momentum of an electron can be measured if that electron is being understood as behaving like a wave. However, by acknowledging the electron as a wave, it must also be accepted that waves do not exist with a specific position; by ‘describing the electron in a way that allows us to measure its momentum, we lose the ability to measure its position’[93]. As a result, it is possible to calculate momentum at the expense of position. Similarly, if the electron is understood as a particle instead of a wave it is possible to measure position, but the measurement of momentum is sacrificed. To overcome this problem, electrons can be described as ‘waves packets’[94], which is a ‘collection of waves bundled together’[95], allowing for position to be estimated to the detriment of accurately measuring momentum. In turn, the precise measurement of ‘the combination of momentum and position of an electron’[96] is limited. In contrast to a classical mechanical understanding of the universe, ‘the very concepts of exact position and exact velocity together, in fact, have no meaning in nature’[97],

[91] Ibid. p. 59.
[92] Ibid. p. 57.
[93] Ibid. p. 58.
[94] Ibid. p. 57.
[95] Ibid. p. 57.
[96] Ibid. p. 59.
[97] Ibid. pp. 99-100.

making accurate identification of position and momentum conditions problematic for further calculations that could help determine cause and effect, which introduces uncertainty into the results.

Through experimentation at the atomic and sub-atomic levels, the classical mechanical model of the universe, known a posteriori through empirical evidence, was shown to have limitations. The combined principles of wave-particle duality, superposition, entanglement, and the uncertainty principle, although often counterintuitive, explained these observed behaviours. With these foundational principles of quantum mechanics laid out, it is necessary to understand their implications for the governing mechanics of the universe and whether the resulting mechanical model of the universe allows enough space for free will to exist.

3.2 Indeterminism and Free Will

In contrast to the classical mechanical account of free will, where appealing to the dualistic nature of mind was the counter argument to the hard determinists, quantum mechanics offers the libertarian the opportunity to reject the deterministic characterisation of the universe instead of relying purely upon a characterisation of the mind. As quantum mechanics has set a new set of criteria by which to judge free will against, it is necessary to refer back to the earlier definitions of free will to understand whether they are coherent and possible.

According to the otherwise definition of free will, the actor has free will if there is ‘more than one possible path into the future available’[98]. The theoretical application of Laplace’s Demon

[98] Kane, *A Contemporary Introduction To Free Will*, p. 7.

excluded this possibility on the basis that the future was calculable based upon understanding cause and effect, preventing the possible existence of alternate futures unless there was a corresponding change in the start state. Therefore, it is necessary to understand how the quantum mechanical model of the universe allows for alternate possible futures to exist. At its most basic, the Laplace's Demon thought experiment is incompatible with quantum mechanics.

> No superintelligence (not even God perhaps) could know the exact positions and momenta of all the particles of the universe at a given moment because the particles do not have exact positions and momenta at the same time (the Heisenberg uncertainty principles); hence their future behaviour is not precisely predictable or determined[99].

Where previously classical mechanics had allowed for the movement of objects to be predicted and mapped if the initial conditions of momentum and position were known, quantum mechanics is not as forgiving and replaces a deterministic account with an indeterministic or probabilistic picture of the universe. The behaviour of electrons as part of a wave function in the double slit experiment demonstrated that electrons could exist in both wave and particulate form, providing evidence for wave-particle duality. The uncertainty principle establishes that wave-particle duality must be acknowledged when attempting to identify the momentum and location of a particle; waves have momentum, but no specific location and particles have location but no momentum unless understood as part of a wave function. The resulting calculations required to measure either momentum or location become estimations, reducing the accuracy to map future interactions. Overall, the

[99] Ibid. p. 8.

combination of these principles and behaviours at an atomic and sub-atomic level reduce the certainty seen in classical mechanics to an exercise in mapping probable outcomes.

While the uncertainty principle limits the predictive ability for future events, the implications that the principles of superposition and quantum entanglement are fundamental for the realisation of possible futures. The principle of superposition allows for a particle to exist in multiple states simultaneously in all 'possible positions within the associated wave. By occupying all possible positions, it no longer has an actual place of existence or direction'[100]. Through existing in every possible state within a wave, every possible outcome or future is available to the particle existing within that wave. Until the collapse of a wave function into a single state, multiple alternate possibilities exist for every particle. Moreover, there is an inherent possibility of being able to observe the particle in every position within the wave function. Should that particle in superposition also be entangled with all other particles in that wave function, these particles will also be in superposition. As observation of a particle will collapse its wave function, the observation of one entangled particle in superposition will collapse the entire wave function instantaneously. A further implication of entanglement is that with no limit to the distance that this can occur, determining any meaningful cause and effect relationship becomes impossible. When applied to the alternate possibilities definition of free will, multiple alternate possibilities exist until the wave function collapses into one state. The actions of an actor, such as an observing or measuring a quantum system, will collapse the wave function from multi-realisable states or futures in to a single state or future.

Although quantum mechanics appears compatible with the alternate possibilities definition of free will, the role of the actor must be understood when choosing between two possible futures. Consequentially, it is necessary to ascertain whether quantum mechanics can be

[100] Pratt, *Quantum Physics For Beginners*, pp. 99-100.

coherently applied to the sourcehood definition of free will. It is often claimed that quantum mechanics offers little value 'to discussions of free will, since quantum indeterminacy only involves microevents, while human choices and action are a macroscopic phenomena'[101]. By claiming that the functions of the actor occur at the macroscopic level and not at the microscopic level, it is being argued that the laws of quantum mechanics are not applicable. By targeting the quantum mechanical applicability to the material actor, any subsequent mechanism that the material actor has for free will is also affected. To overcome this argument, any coherent explanation from the libertarian must answer the two following questions. Firstly, can quantum mechanics be convincingly scaled upwards to apply to the macroscopic level, or can macroscopic behaviours be explained or reduced to underlying microscopic behaviours. Secondly, how does the application of quantum mechanics to a material mind and consciousness allow the actor to exercise agency. As seen in the subsection 1.5, when discussing the mind-body problem, and subsection 1.4, when characterising the mind and consciousness, significant debate surrounds how two seemingly qualitatively different things, the material body and phenomenal consciousness, are related. Subsection 1.3, on the scientific method, explained how science pursues fundamental principles that can explain behaviour in the universe; debate exists on the extent to which other sciences can be collapsed or reduced to explanations offered by physics. By appealing to a materialist account of the mind and consciousness, the libertarian can seek to explain the mind and consciousness through brain function. Furthermore, by appealing to the reducibility of biological brain function to physics, the libertarian could argue that the brain, and by extension the mind and consciousness, are further reducible to the principles of quantum mechanics. As a result, the libertarian could propose that the brain, the mind and consciousness all follow the principles of quantum mechanics, meaning that

[101] Barry Loewer, 'Freedom From Physics', in *Metaphysics: A Guide And Anthology, ed. by* Time Crane and Katalin Farkas (Oxford University Press, 2006), pp. 707-719 (p. 711).

the resulting behaviours are indeterministic. Outwardly, the chemical and biological processes of the brain are understood.

> We know that information processing in the brain takes place through the firing of individual neurons or nerve cell in complex patterns. Individual firings or neurons in turn involve the transmission of chemical ions across neuronal cell walls, stimulated by carious chemicals, called neurotransmitters, and by electrical stimuli coming from other neurons[102].

The challenge here for the libertarian is that although indeterminism is true at the quantum level, observation suggests that 'the brain remains deterministic in its operations'[103], meaning that the principles of quantum mechanics do not appear to apply.

> After all, a single neuron is known to be excited by on the order of a thousand molecules, each molecule consisting of ten to twenty atoms. Quantum effects, though substantial when focusing on single atoms are presumed negligible when focusing on system involving large numbers of atoms. So it seems that quantum effects would be too insignificant in comparison to the effects of thousands of molecules to play any possible role in deliberation[104].

The principle of transitivity seems to fail when offering correlations between biological systems and fundamental principles of physics. An issue of scalability arises when moving from the quantum mechanics seen at the microscopic to the macroscopic level. Due to the large number of particles involved in the biological systems 'any quantum

[102] Kane, *A Contemporary Introduction To Free Will*, p. 133.
[103] Bishop, p. 119.
[104] Ibid. p. 119.

indeterminacies would most likely be “damped” out and would have negligible effects on the larger activity of the brain and body’[105]. As a result, any mind or consciousness that is based upon the physical brain would also not have any indeterministic characteristics. However, the libertarian could respond to this challenge by appealing to a chaotic model of the brain. As chaos is ‘the mechanism which allows such rapid growth of uncertainty’[106], it is possible for small changes in initial conditions ‘to lead to large and unpredictable changes in the system’s subsequent behaviour’[107]; small changes in underlying atoms could grow by an order of magnitude when scaling upwards. Therefore, if a materialist account of the mind is considered, changes in the ‘brain states would carry forward such quantum effects that affect the outcomes of human choices’[108], meaning that it is possible for the laws of quantum mechanics to also apply at the macroscopic level.

Unfortunately, even if the brain can accommodate a combination of chaos and quantum mechanical indeterminism when constructing a theory of mind and consciousness, questions remain regarding how such a theory allows the actor to have any meaningful agency. The principle of superposition allows for a particle to exist in multiple states simultaneously. It is only through interfering with the superposition of the particle that it is localised to one state, collapsing the wave-function. However, the interference does not direct that the particle should localise in an exact position, with the collapse to a single state occurring across a possible range of locations. As seen when firing a single electron during the double slit experiment, the results indicate that the electron is in superposition and passes through both slits. It is only when being observed that the electron localises and

[105] Kane, *A Contemporary Introduction To Free Will*, p. 134.
[106] Leonard Smith and Lenny Smith, *Chaos: A Very Short Introduction* (Oxford University Press, 2007), p. 2.
[107] Kane, *A Contemporary Introduction To Free Will*, p. 134.
[108] Bishop, p. 119.

passes through one slit. The observer has no influence over which of the double-slits that the electron passes through, with the particle having a ½ probability of localising in either slit. When used as a system of decision making on the part of an actor, it appears as though volitions and actions in a particular direction would not necessitate corresponding events in the universe.

> If indeterminism is important in determining the outcome of an agent's decision to do A, then there would be no sufficient reason for the agent having chosen to do A rather than otherwise. Everything was a matter of chance and as such, fails to explain the agent's decision nor explain the agent's power to decide[109].

Two issues are raised here; firstly, how are the actor's volitions formed, and secondly, how are these volitions actioned. On the first issue, if processes in the brain and mind exist in superposition until collapsing into a single state, the associated phenomenal consciousness to that single state is random or a product of chance. Should consciousness be the sourcehood of volitions within the actor, then these volitions are also random and the product of chance if they are the result of indeterministic interactions within the brain and mind. On the second issue, even if the strongest definition of the sourcehood of free will is considered, whereby the actor is the prime mover in their volitions, the results of any decision made is entirely a matter of luck. Although the actor may act on a conscious desire, the collapse of particles in superposition in the mind and brain will not necessarily correlate to that desired outcome. As a result, the actor seems to have very little meaningful control over the interactions that they have with the universe.

[109] Ibid. p. 116.

At this point, neither the hard determinist or libertarian have offered particularly compelling reasons to support either definition of free will. The classical mechanical model of the universe offered by the hard determinist has been undermined by quantum mechanics. However, even if the quantum mechanical activity can be scaled to the macroscopic level, explaining how free will can be accounted for within probabilistic outcomes remains unanswered. The unexpected outcome of acknowledging whether a deterministic of indeterministic model is preferable when discussing free will arises. While hard determinism is incompatible with both definitions of free will, the libertarian fails to explain how the actor has any meaningful control over either their volitions or the outcome of their volitions.

4.1 Superdeterminism

Despite the apparent indeterminism offered by quantum mechanics, certain interpretations of the theory assert that the universe is, in fact, superdeterministic. The Einstein-Podolsky-Rosen Paradox[110] is a thought experiment that proposes that the model of the universe offered by quantum mechanics is incomplete. The outcome of the thought experiment suggests that hidden variables exist which are able to explain the apparent random behaviour seen in quantum mechanics, particularly the relationship between entangled particles that occur regardless of the distance between them. Hidden variables would allow the conditions and surrounding environment, or locality, of a particle to be known. As a result, the causal relationship between particles can be restored, meaning that determinism could

[110] Arthur Fine, *The Einstein-Podolsky-Rosen Argument in Quantum Theory, The Stanford Encyclopedia of Philosophy* (2020) <https://plato.stanford.edu/archives/sum2020/entries/qt-epr/> [accessed 14 September 2024].

be applied to quantum mechanics. In response to the thought experiment, Bell's theorem introduced 'inequalities that must be satisfied by correlation derived from any theory'[111] that features hidden variables as a requirement. Through violating these inequalities, the non-locality of quantum mechanics seen in entanglement is demonstrated. While numerous experiments have verified Bell's theorem, superdeterminism challenges the measurement independence assumption[112] of Bell's theorem, which requires that the observer or measurement exists independently of what is being observed or measured. When establishing the experiment, it is necessary that observer or measurement tool is not influenced by the hidden variables that Bell's theorem is trying to disprove; otherwise, the experiment and analysis of the results required by the scientific method are unreliable and are unable to prove the theory. If the actions of the observer, when establishing the experimental parameters for measurement, were determined by previous events in the environment being measured, then it is possible for hidden variables in that environment to also explain many of the features being measured, such as the causal interaction between entangled particles at a distance. While the application and experimental evidence seemingly support Bell's theorem, arguably the measurement independence assumption is not truly in keeping with the scientific method. By presupposing the independence of the measurement tool and the environment being measure, the theorem has begged the question by establishing premises that force a particular set of results and conclusions. In light of this, reliance on Bell's theorem to disprove the existence of hidden variables should be re-examined.

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[111] Wayne Myrvold, Marco Genovese and Abner Shimony, *Bell's Theorem, The Stanford Encyclopedia of Philosophy* (2024) <https://plato.stanford.edu/archives/spr2024/entries/bell-theorem/> [accessed 14 September 2024].

[112] Myrvold, Genovese and Shimony, 2024.

4.2 Free will and Determinism

A consequence of accepting superdeterminism would return the universe back to a deterministic model like that discussed in chapter two, meaning that the same issues regarding the compatibility of the alternate possibilities and sourcehood definitions of free will would also become relevant to a superdeterministic interpretation of quantum mechanics. Discovery of the hidden variables would reaffirm the logically consistency of Laplace's Demon thought experiment; through knowing these hidden variables, cause and effect becomes traceable into past events and mappable into the future events. As a result, alternate possibilities collapse into a single future and the mind and consciousness become contingent upon the material brain unless substance dualism is appealed to; however, the issues with the mind-body problem remain. While those two definitions of free will may no longer be viable, the compatibilist could define free will as the following:

> Free will is '(1) to have the power or ability to do what we want or desire to do, which in turn entails (2) an absence of constraints or impediments'[113].

The requirements that the actor is the ultimate source of their volitions or has access to alternate options have been removed. While the new definition requires that the actor has the power to act on their volitions, the definition is not dependent on that power being realised. The compatibilist definition of free will is the freedom of self-realisation.

[113] Kane, *A Contemporary Introduction To Free Will*, p. 13.

> The Freedom of Self-realization: the power or ability to do what we want or will to do, which entails an absence of external constraints or impediments preventing us from realizing our wants purposes in action[114].

The compatibilist definition simply requires that there are no obstacles that would prevent the actor from acting in accordance with their desires. While the universe follows a deterministic path, it simply necessary that the actor has the power and ability to conceptually act according to their volitions in that deterministic universe if the universe was different. A causally deterministic universe should not be confused with an external constraint on the agent. While constraints or impediments prevent acting in accordance with volitions, it is not the necessarily the case that causal determinism or prior causes are contrary to the volitions of the actor. For example, free will exists when the power to act as desired is in harmony with universal events. If universal events are in discord with the desired volitions despite the power to act, the universe could hypothetically have been in keeping with the desired volitions if prior events were different, meaning the actor's free will remains.

As compatibilism does not require the mind or consciousness to function as the source or prime mover of volitions, the issue of trying to explain a mechanism that allows for non-determined mental causes disappears. As a result, the mind-body problem can revert to explaining consciousness without the secondary issue of mental causation.

> The Freedom of (Reflective or Rational) Self-control: the power to understand and reflectively evaluate the reasons and motives one wants to act upon, or

[114] Ibid. p. 164.

should act upon, and to control one's behaviour in accordance with such reflectively considered reasons[115].

The control of behaviour was a component of Chalmers' theory of mind, while the cognitive function of awareness and reflection is part of the consciousness. While reflection, reasoning and motivation are discussed, their origins are irrelevant. By accepting a deterministic universe, volitions and motives can become part of the deterministic narrative, meaning there is no need for the compatibilist to appeal to problematic theories of mind and conscious in order to account for uncaused volitions. To an extent, John Libet's experiments on readiness potential could be interpreted as supporting a compatibilist theory of mind. The experiments demonstrated that activity in the brain 'regularly begins at least several hundreds of milliseconds before the appearance of a reportable time for awareness of any subjective intention or wish to act'[116]. While conscious awareness appears to be the result of prior brain activity, the conscious actor has the power or ability to control or 'veto'[117] the preparatory behaviour in the brain. As a result, the compatibilist could claim that a deterministic form of free will has been empirically demonstrated.

[115] Ibid. p. 165.
[116] Benjam Libet and others, 'Time Of Conscious Intention To Act In Relation To Onset Of Cerebral Activity (Readiness-Potential): The Unconscious Initiation Of A Freely Voluntary Act', *Brain,* 106 (1983), 623-642 (p.641) <DOI: 10.1093/brain/106.3.623>.
[117] Benjam Libet and others, 'Time Of Conscious Intention To Act In Relation To Onset Of Cerebral Activity (Readiness-Potential)', p. 641.

Conclusion

It was identified at the start of the paper that the concept of free will is inextricably linked to physics, the mind and consciousness; an unintentional consequence of this being that free will becomes subsumed into these wider areas, resulting in the topic becoming obscured or neglected. In explicitly focusing on ‘what implications does the understanding of the governing mechanics of the universe have on the concept of free will’, the paper adopted a strict and methodical approach to prevent unintended deviation. The methodology used to achieve this required the establishment of philosophical and scientific definitions and theories that could be compared and contrasted, allowing the implications between ‘the governing mechanics of the universe’ and ‘concept of free will’ to be identified through recognising areas of coherence and tension.

To achieve a sense of clarity, chapter one was devoted entirely to explaining the overarching problem, drawing together several interrelated issues. The ‘concept of free will’ was introduced in subsection 1.1, offering the alternate possibilities and sourcehood definitions of free will. The intended purpose of these definitions was to provide a reference point that could continually be referred to throughout the paper. If these definitions were coherent with ‘the governing mechanics of the universe’, then the implications for the ‘concept of free will’ was minimal. The potential implications were explained in subsection 1.2, with the areas of possible tension being identified; namely the compatibility of a deterministic or indeterministic universe with the definitions of free will provided in subsection 1.1. The scientific method was introduced in subsection 1.3, detailing the reasons why scientific theories were given primacy and the similar amount of rigour that would also be expected of philosophical concepts. The mind and consciousness were defined and differentiated in

subsection 1.4 in order to provide the sourcehood definition of free will an origin for volitions within the human actor. By explaining the mind-body problem in subsection 1.5, the implications of the previous subsections were drawn together and allowed chapter one to close. The application of the scientific method seen in subsection 1.3 required that physical matter, including the body of the actor, should be governed by the same deterministic or indeterministic laws that were referenced in subsection 1.2. The definitions of free will, discussed in subsection 1.1, required that the actor has the option to act on their volitions. If volitions are the product of a material mind or consciousness, explained in subsection 1.4, then volitions also appear to be governed by physical laws. With the problem explained, the onus is now upon the hard determinist, libertarian or compatibilist to demonstrate the viability of their accounts of free will.

Chapters two, three and four were dedicated towards exploring and applying the definitions of free will from subsection 1.1 to the scientific principles that underpin the deterministic and indeterministic descriptions of the universe introduced in subsection 1.2. Chapter two explored the classical mechanical account of the universe. Laplace's Demon thought experiment was used to illustrate the logical conclusions of classical mechanics. The result being that if the laws of physics are uniformly applied to all matter, including the mind and consciousness, then both definitions of free will are incompatible with classical mechanics. A solution to this was offered by Cartesian dualism, whereby the mind and consciousness are not material substances; unfortunately, the theory is ultimately unconvincing due to the explanatory gap for mind-body interaction. Respite for the libertarian appeared to come in the form of quantum mechanics in chapter three, replacing the previously understood deterministic model with an indeterministic model of the universe. Through not fixing a future, quantum mechanics allowed for the alternative possibilities definition of free will; however, the libertarian still needed to account for the sourcehood of volitions to realise one

of those possible futures. While the libertarian could appeal to a combination of chaos theory and indeterminism to apply quantum mechanics to the macroscopic level of the brain, the theory remained unable to meaningfully explain the relationship between the volitions of an actor and the probabilistic outcome of particle localisation. Quantum mechanics appeared to reduce the realisation of a desired effect between the actor and universe to a matter of chance. Chapter four reflected on whether a deterministic or indeterministic universe was preferential for free will. Superdeterminism was presented in an attempt to return determinism back to the universe via quantum mechanics. Although suffering from the same incompatibilities with the alternate possibilities and sourcehood definitions of free will as the hard determinist, a review of these definitions and adoption of compatibilism allowed for a weakened interpretation of free will to be salvaged.

Finally, the implications that the understanding of the governing mechanics of the universe has on the concept of free will is total when scientific theories and methodology are held in primacy and applied uniformly to all correlated theories. As a result, the initial definitions of free will that were presented are not combatable with either a deterministic or indeterministic models of the universe. Only through adopting a weaker, compatibilist, definition is any concept of free will coherent with the governing mechanics of the universe. For either of the initial definitions of free will to be viable, the universe must be indeterministic or the mind and consciousness must not be causally determined. Therefore, if a suitably robust theory of mind and consciousness can explain how volitions are effective in a material and indeterministic universe, or how the mind and consciousness can be indeterministic in an otherwise deterministic material universe, while overcoming the mind-body problem, then a return to the initial definitions of free will could be possible.

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