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Free Will: A Naturalistic Reformulation

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Abstract– In the classical approach to free will, this property is typically studied in relation to both moral responsibility and ontological determinism. The debates at the core of this approach concern the compatibility between the existence of free will and the existence of ontological determinism. The approach proposed here examines free will as an autonomous property—that is, independently of moral responsibility—and highlights the inconsistency of the definition of ontological determinism within the scientifically known physical world. Free will is naturalised in the form of a specific decision-making process, called the *PSU model*. This process is implemented by an agent in order to overcome potential conditioning when facing a decision in a previously experienced situation.

Keywords: free will, ontological determinism, scientifically known physical world, conditioning, decision-making process

I. INTRODUCTION

While human freedom has been a central preoccupation of the greatest Greek philosophers of antiquity, it appears to have been Saint Augustine, the fourth-century Christian philosopher and theologian, who first formalised the concept of free will by linking it to the existence of evil, divine omniscience, and human responsibility (Augustine of Hippo, D.L.A.V.). Since then, free will has generated an extraordinarily rich and vigorous body of debate whose intensity and richness have not diminished over the centuries, forming a highly active branch of philosophy of mind—what we shall call the *philosophy of free will* (Kane, 2011).

In the *philosophy of free will*, free will is generally approached in two ways: first, by explicating the content of this property (its characterisation and definition), and second, by examining the relationships between free will and moral responsibility. However, both approaches converge on a central question that lies at the heart of the present work: does free will exist? Moreover, free will and moral responsibility are properties that operate at different levels. Free will is a property of individuals, whereas moral responsibility is a social property (blame or praise requires at least two agents). By decoupling the problems associated with the existence of free will from those pertaining to moral responsibility, one can reasonably expect to reduce the overall complexity underlying the concept of free will. For this reason, the present work will focus exclusively on free will as a property of an agent, aiming to specify its characteristics as precisely as possible and to justify its existence. Hereafter, unless otherwise stated, the terms *human being*, *individual*, *subject*, and *agent* will be used interchangeably.

The *philosophy of free will* presents this property in various ways, but we shall emphasize one point in particular: free will is first and foremost a feeling—some would say an intuition. It is the impression that gives the one who experiences it a sense of personal freedom, allowing them to make their own choices and, consequently, to exercise a certain degree of control over their actions.

It represents an internal point of view—that is, a first-person conception of free will. It is also an ambivalent feeling for those who experience it, as the neuroscientist Chris Frith has aptly described:

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> *"Are you one of those neuroscientists that say free will doesn't exist? I don't really want to answer the Professor's question since my beliefs on free will are very ambivalent. What I do know is that I have a very strong experience of free will." (Frith, 2007)*

The central—perhaps essential—problem raised by free will is whether it is merely an illusion, as Spinoza and the contemporary philosopher Saul Smilansky have argued, or whether this feeling can be connected to some concrete reality of human beings. Put differently, the question might be posed as follows: is it possible to naturalise free will?

The article proceeds as follows. Section one briefly outline how the problem of free will is treated within the *philosophy of free will* and highlights the central role played by the concept of *ontological determinism*—what will be called the *classical approach to free will*. The major problems posed by this classical approach will then be described in the second section, while the third part will present a new formulation of free will in the form of a decision-making model, called *PSU Model*, compatible with the subjective experience of free will. Finally, the last section will elucidate the operation of this model and substantiate the pivotal role of indeterminism within it.

II. THE CLASSICAL APPROACH TO FREE WILL

1. Free Will

In the *classical approach to free will*, two conditions are generally invoked for attributing free will to an agent. The first condition is that the agent must have several possible choices available—what are called *alternative possibilities*— that is, genuinely distinct and realisable options. The second condition is that the agent must be the *ultimate source* (or *primary cause*) of the final choice. This implies, in particular, that the individual has a certain degree of control over that choice.

This characterization of free will raises many questions in the *philosophy of free will*, such as: “Could the agent have chosen otherwise than they actually did?”, or, in a different formulation, “Do *alternative possibilities* really exist?”, and “Can an agent be the *ultimate source* of their actions in a world governed by determinism?” As can be seen, determinism plays a key role in debates concerning free will and its existence.

2. Ontological Determinism

When philosophers interested in free will—hereafter called *philosophers of free will*—refer to determinism, they do not mean the same type of determinism considered by scientists. Scientists deal only with specific phenomena from which they attempt to derive laws. These laws, often deterministic, apply only within a given domain of investigation (for example, the deterministic laws present in the theory of gravitation or in chemistry). These are therefore *local*, concrete forms of determinism, restricted to a given descriptive level. Among these deterministic laws, one may distinguish those that enable predictions (predictive determinisms) from those that do not (non-predictive determinisms).

The determinism considered by *philosophers of free will* is of a completely different nature, drawing inspiration from Laplacian determinism. The mathematician and physicist Pierre-Simon de Laplace characterised this form of determinism as follows:

> “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.” (Laplace, 1814)

This determinism is universal insofar as it applies to all scales of the physical world. By invoking an omniscient demon, it is moreover a universally predictive determinism. *Philosophers of free will*, however, retain from Laplacian determinism only its universal aspect. In summary, *ontological determinism* (often called *causal determinism*) is the thesis according to which the *past* and the *laws of nature* determine a single possible future (van Inwagen, 1983). It is consequently a determinism that applies, like Laplacian determinism, to all phenomena in nature, without exception. Metaphorically speaking, *ontological determinism* structures the physical world like a clock, whose gears are the *laws of nature*.

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3. The Ontological Grid of Free Will

The classical approach to free will revolves around the problem of the compatibility between the existence of free will and the existence of *ontological determinism*—the so-called *compatibility problem*. Indeed, *ontological determinism* directly conflicts with the classical characterization of free will. According to *ontological determinism*, there can be no *alternative possibilities*, since there is only one possible future; furthermore, human beings cannot be the *ultimate source* of their actions, since those actions are caused by factors that are at least partially unknown to them.

To respond to these objections, *philosophers of free will* have synthesised their various positions in the form of a grid that we shall call the *ontological grid* (Fig. 1). More precisely, this grid highlights the interactions between three questions: does free will exist? Does *ontological determinism* exist? And is *ontological determinism* compatible with free will? While this grid does not exhaust the richness of the debates and proposed theories, it has the advantage of emphasizing the central importance accorded to *ontological determinism* in the *classical approach to free will* (Kane, 2011).

		Does Free Will exist?	
		Yes	No
Does Ontological Determinism exist?	Yes	Soft Determinism	Hard Determinism
	No	Libertarianism	-----

Fig. 1: Ontological grid

Compatibilism is the thesis according to which the existence of free will is compatible with the existence of *ontological determinism*. Compatibilist philosophers do not all, however, take a position on whether *ontological determinism* exists. Among compatibilists, some defend the position that both free will and *ontological determinism* exist: this is the thesis of *soft determinism*. In general, the central difficulty for compatibilists is to explain how these two apparently contradictory concepts are to be articulated. Two contemporary compatibilist philosophers are John Martin Fischer (Fischer, 1995) and Harry Frankfurt (Frankfurt, 1988).

Libertarianism—bearing no relation to the political philosophy of the same name—is the thesis according to which *ontological determinism* does not exist and free will does. *Libertarianism* encompasses a set of theories known as incompatibilist. By rejecting *ontological determinism*, these theories forge a strong connection between free will and indeterminism, the major difficulty being to articulate these two notions correctly. For instance, the contemporary libertarian philosophers Robert Kane (Kane, 1996) and Laura Ekstrom (Ekstrom, 1999) each propose a different articulation.

Hard determinism is the thesis according to which *ontological determinism* exists and free will does not. *Hard determinism* likewise constitutes a set of incompatibilist theories, though these stand in direct opposition to libertarian incompatibilist theories. Spinoza (Spinoza, 1674) and the contemporary philosopher Ted Honderich (Honderich, 2002) are two hard determinist philosophers.

Difficult to categorise within the preceding grid, *scepticism* encompasses a set of very diverse theories that deny the existence of free will for various reasons. Derk Pereboom, for example, denies the existence of free will on the grounds that the concept is inconsistent, being compatible neither with *ontological determinism* nor with indeterminism, due to its uncontrollable character (Pereboom, 2001). The impossibilist Galen Strawson rejects both compatibilism and incompatibilism, denying the possibility that free will could exist. How, after all, could we possess free will when our character and actions are the product of genetic and environmental factors, of deterministic or random influences (Strawson, 1994)? Saul Smilansky, for his part, holds that free will is merely an illusion—but a necessary illusion for the proper functioning of our societies (Smilansky, 2000).

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III. PROBLEMS RAISED BY THE CLASSICAL APPROACH TO FREE WILL

The *classical approach to free will* is characterized by the importance it assigns to the relationship between *ontological determinism* and free will. This emphasis gives rise to numerous difficulties. Some of these problems stem from the very nature of *ontological determinism*, while others arise from the way free will itself is characterized within the classical approach.

1. Problems Raised by Ontological Determinism

Ontological determinism is first and foremost a metaphysical concept: in absolute terms, its existence can neither be empirically validated nor empirically falsified. In other words, any theory grounded in *ontological determinism* is an "unfalsifiable" theory in the Popperian sense.

A second source of difficulties lies in the very definition of *ontological determinism*. Indeed, this definition enters into conflict with certain aspects of the most widely accepted physical theories within the scientific community. Let us recall the standard definition of *ontological determinism*: it is the thesis according to which the *past* and the *laws of nature* determine a single possible future.

a) Ontological Determinism and Physical Theories

Several questions arise when one attempts to confront the thesis of *ontological determinism* with currently accepted physical theories. These questions concern the notions of *the past* and *laws of nature*.

The first question is the following: what does the concept of *the past* mean?

While the concept of a *law of nature* can easily be related to that of a (deterministic) physical law as understood in the physical sciences, the same is not true of the concept of *the past*. Indeed, the latter has no direct counterpart among the concepts used in the physical sciences. it is closer to a literary notion than to a scientific one. The concept that comes closest to it in physics would be that of *initial conditions*. However, the concept of *initial conditions* is valid only under certain circumstances.

For example, in Big Bang theory, the instant known as *Planck time* differentiates two 'periods': the era preceding *Planck time*, called the *Planck era*, and the era following it (Fig. 2). In the *Planck era*, the structure of space and time is unknown. This means that it is impossible to identify an instant zero (t = 0), that is, an *absolute origin*. It also means that the concept of *initial conditions* cannot be used in this era. Put differently, when tracing time backward, *the past* dissolves into the *Planck era*.

In conclusion, the concept of *the past* as it figures in *ontological determinism* is an inconsistent concept. For the same reasons, the concept of an *absolute origin* is also inconsistent. Choosing an origin at some instant between *Planck time* and the present merely acknowledges the relative and arbitrary nature of the concept of origin. This has the consequence of invalidating any characterization of free will founded on the notion of an *absolute origin*.

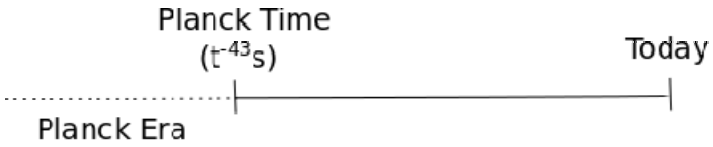

Fig. 2: Temporal division in the Big Bang theory

The second question is: which *laws of nature* are we talking about?

There are different ways of answering this question depending on the theoretical framework adopted. Let us mention two.

The first approach consists in considering only the physical laws that are scientifically known today—and only those. In this case, one speaks of laws or theories describing the *scientifically known physical world*. For instance, Big Bang theory, general relativity, and quantum mechanics are three theories belonging to the *scientifically known physical world*.

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A second approach consists in combining *ontological determinism* with various scientific theories. In this second case, what is at issue is a world different from the *scientifically known physical world*, which we shall call an *extra-world*. Typical models of *extra-worlds* are those constructed by *philosophers of free will* who, in their reasoning, associate *ontological determinism* with theories drawn from various scientific fields such as biology or neuroscience. For example, the *philosopher of free will* Ted Honderich reasons within an *extra-world* when he presents his theory of tripartite determinism (Honderich, 2002). The hard determinist neuroscientist Robert Sapolsky also operates within an *extra-world* when he articulates his vision of determinism:

> *"Imagine a university graduation ceremony (…) you see the person way in the back, the person who is part of the grounds crew, collecting the garbage from the cans on the perimeter of the event. Randomly pick any of the graduates. Do some magic so that this garbage collector started life with the graduate's genes. Likewise for getting the womb in which nine months were spent and the lifelong epigenetic consequences of that. Get the graduate's childhood as well—one filled with, say, piano lessons and family game nights, instead of, say, threats of going to bed hungry, becoming homeless, or being deported for lack of papers. Let's go all the way so that, in addition to the garbage collector having gotten all that of the graduate's past, the graduate would have gotten the garbage collector's past. Trade every factor over which they had no control, and you will switch who would be in the graduation robe and who would be hauling garbage cans. This is what I mean by determinism."* (Sapolsky, 2023)

Other questions also deserve consideration: Is the physical world governed by a countable or uncountable set of *laws of nature*? Are the *laws of nature* immutable, timeless, and independent of human existence? Do the *laws of nature* govern a real world or a perceived world (d'Espagnat, 2003)?

Finally, another problem raised by *ontological determinism* is that it is particularly demanding with respect to the structure of the physical world. Indeed, it requires, first, that all phenomena in the world be governed by laws—which has not been scientifically demonstrated, even if it constitutes a particularly fruitful methodological posture in scientific inquiry—and, second, that all known and unknown laws be deterministic. However, the interpretation of quantum mechanics accepted by the majority of contemporary physicists is indeterministic (Schlosshauer, Kofler & Zeilinger 2013). Consequently, this interpretation may today be regarded as a theory of the *scientifically known physical world* (on an equal footing with the Big Bang theory or general relativity).

It should be noted that deterministic interpretations of quantum mechanics proposed by David Bohm (Bohm, 1952) or Hugh Everett (Everett, 1957), which are frequently invoked in the *philosophy of free will*, are scientifically sterile theories that have yielded no new results and are supported only by a minority of physicists. Consequently, they do not currently belong to the set of theories constituting the *scientifically known physical world*. Indeed, a scientific theory consists not only of laws but also of the interpretations associated with them, the whole forming an integrated framework. It should also be noted that physicists use quantum mechanics primarily as a tool; the interpretation each physicist adopts plays only a minor role in practice. In other words, the interpretation of quantum mechanics has only marginal importance in the daily work of physicists. It is an epistemological issue concerning the physical meaning of certain concepts present in quantum mechanics. Nevertheless, one must not forget that accepting a deterministic interpretation of quantum mechanics amounts, today, to placing oneself in an *extra-world*; one can therefore appreciate the confusion that may arise when a *philosopher of free will* fails to specify, in his reasoning, which world he is speaking from. For example, when Randolph Clarke and his co-authors write:

> *"The scientific evidence for quantum mechanics is sometimes said to show that determinism is false. Quantum theory is indeed very well confirmed. However, there is nothing approaching a consensus on how to interpret it. Indeterministic as well as deterministic interpretations have been developed, but it is far from clear whether any of the existing interpretations is correct."* (Clarke, Capes & Swenson, 2021)

This final claim is inaccurate within the *scientifically known physical world*. Strictly speaking, one cannot place the indeterministic interpretation—supported by strong qualitative arguments (predictions based on probability amplitudes rather than definite values, and experiments conducted by physicist Alain Aspect concerning Bell inequalities, to name just two)—on an equal footing with deterministic interpretations, which are more complex, scientifically sterile, and supported by a minority of

scientists. Even if consensus does not constitute proof, it is accepted in scientific practice that the burden of proof falls upon the proponents of *alternative theories*. Today, the correct interpretation of quantum mechanics is the indeterministic one, and it would appear that there are far more advocates of the deterministic interpretation among *philosophers of free will* than among physicists.

b) Near-Determinism

In response to the indeterministic interpretation of quantum mechanics and the threat it poses to *ontological determinism*, Ted Honderich has defined a weaker version of determinism known as *near-determinism*:

> *"(near-determinism) allows that there is or may be some indeterminism but only at what is called the micro-level of our existence, the level of the small particles of our bodies, particles of the kind studied by physics. At the ordinary level of choices and actions, and even ordinary electrochemical activity in our brains, causal laws govern what happens. It's all cause and effect in what you might call real life."* (Honderich, 2002)

According to Honderich, this means that within the hierarchy of descriptive levels of our world (physical, chemical, biological, mental, social), the influence of quantum indeterminism would not extend beyond the physical level. This view had already been expressed much earlier by the philosopher of science Rudolf Carnap:

> *"The indeterminacy in quantum mechanics has no observable effect on what happens to a stone when each man throws it, because the stone is an enormous complex consisting of billions of particles. In the macro-world with which human beings are concerned, the indeterminacy of quantum mechanics plays no role. For this reason I regard it as a misconception to suppose that indeterminacy on the subatomic level has any bearing on the question of free decision."* (Carnap, 1966)

While I will not take a position on the influence of quantum indeterminism at the chemical and biological levels, it is nevertheless possible to show that this indeterminism can have an indirect but significant influence at the mental level of an individual.

Suppose I wish to send a secret message to a recipient. I will prefer to use a quantum random number generator (QRNG) to encrypt my text (to render it unreadable to anyone other than the intended recipient), rather than a simple shift cipher such as Caesar's. QRNGs are physical systems that exploit the indeterminism inherent in quantum mechanics: their advantage is that they produce very high-quality random numbers. It is my knowledge of how these numbers are generated and of their intrinsic properties that influences my behaviour—namely, my choice of encryption/decryption system.

One might object that even the most irrational beliefs can also influence behaviour (for example, a belief in astrology fostering the reading of horoscopes). This is true. However, the crucial difference with QRNGs is that I can demonstrate their existence and understand their operating principles (which I cannot do with astrological theories). By contrast, the existence or non-existence of quantum indeterminism would have no influence on my choice if, for example, I had to select an algorithm to sort a small sequence of integers (there are several sorting algorithms, each with different properties).

2. Problems Raised by the Classical Characterisation of Free Will

From the standpoint of the *classical approach to free will*, for an agent to possess free will, that agent must be the *ultimate source* of its choices. However, it is generally accepted that a choice is occasioned by certain antecedent events over which we had no control. Examples of such events include neuronal events and unconscious processes. The conclusion generally drawn from this line of reasoning is that the agent cannot be the *ultimate source* of its choices and that free will therefore cannot exist. This is another formulation of what is known in the *philosophy of free will* as the *consequence argument*, analyzed at length by van Inwagen (van Inwagen, 1983).

However, it has been shown that the concepts of *ultimate origin* and *ultimate source* are inconsistent within the *scientifically known physical world*, for two reasons. First, if we place ourselves prior to the birth of an agent and trace time backward, Big Bang theory does not allow us to define an instant zero or an event zero. Second, it is impossible to define which event should count as the first event associated with a human being.

3. Conclusion

In summary, the *classical approach to free will* raises two fundamental problems: the characterisation of the concept of *ontological determinism* and its grounding in the physical world as we scientifically know it; and the characterisation of free will itself.

The *classical approach to free will* relies on a characterization of *ontological determinism* that invokes the concepts of *the past* and *laws of nature* without sufficiently questioning them.

The concept of *the past* as it appears in *ontological determinism* is an inconsistent concept. Moreover, confronted with the *scientifically known physical world*, the existence of *ontological determinism* is invalidated by the standard interpretation of quantum mechanics, and *near-determinism* fails to demonstrate the causal inefficacy of quantum indeterminism. Consequently, within the *scientifically known physical world, ontological determinism* and free will cannot be logically opposed. Likewise, the Big Bang theory renders the concepts of *ultimate origin* and *ultimate source* inconsistent. Free will can therefore no longer be grounded in these concepts, and a different approach must be adopted in order to render the concept of free will more consistent.

IV. AN ALTERNATIVE APPROACH TO FREE WILL

The proposed approach to free will consists in no longer making the existence of free will dependent on a metaphysical concept (*ontological determinism*), but rather in interpreting free will as an operational concept: that of solving a particular problem. The thesis defended here is that free will is as real as the sorting of a sequence of integers. Indeed, both concepts can be associated with the resolution of a specific problem. However, while the problem posed by sorting a sequence of integers is sufficiently explicit, the problem posed by free will requires clarification.

The problem posed by free will might be summarized by the following question: what is it that causes me, in a given familiar situation—that is, a situation I have experienced many times—to act always (or most often) in the same way? Am I truly free to act, or am I being manipulated by some mysterious force (divine, social, or otherwise) that guides my choices? This is an interrogation that has pervaded human thought for centuries and remains highly relevant, particularly in discussions of free will.

A well-known societal-level example of this very general question is provided by the Republic of Venice in the thirteenth century, which sought to free itself from all electoral manipulation by powerful Venetian families during the election of the Doge. To this end, it instituted a particularly complex electoral system, structured in eleven stages and making intensive use of random selection (Maranini, 1927). Although this system did not entirely eliminate electoral corruption, it evidently gave sufficient satisfaction, since it persisted until the end of the Republic in the eighteenth century.

At the level of the individual, this same question refers to the possible *conditioning* of that individual.

Conditioning may be understood, broadly speaking, as the set of manipulations to which a human being may be subjected. For the sake of simplicity, the following discussion will not attempt an exhaustive inventory of the various possible forms of manipulation; rather, certain features relevant to free will will be identified.

1. Conditioning

For present purposes, the conditioning of an individual will be characterised as follows: *conditioning* refers to the set of mechanisms through which an individual's behaviour can be influenced, oriented, or constrained without their explicit awareness or consent.

There are different kinds of conditioning, such as physical conditioning (for example, the individual's need to eat at regular intervals) and psychological conditioning. It is the latter that appears most closely related to free will. Psychological conditioning may be broadly characterised as the ensemble of automatisms that drive one to act without reflection when confronted with a familiar situation. Conditioning may originate from multiple sources: biological, psychological, social, cultural, economic, or technological. From early childhood onward, individuals are subjected to repeated patterns of reinforcement, habituation,

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imitation, and normalization that shape their preferences, beliefs, and actions. When an agent encounters a familiar situation, these habits generally impel the agent towards a predetermined choice.

Some forms of conditioning are benign or even necessary for social life (such as learning a language or internalizing basic social norms). Others, however, may restrict an individual's capacity to decide autonomously, especially when they operate covertly or exploit cognitive biases. Conditioning is therefore not inherently negative, but it becomes philosophically relevant to free will when it leads an agent to act in a predictable and repetitive manner without reflective endorsement.

It should be noted that the neurosciences and the human sciences continually reveal, through their advances, the extent and the nature of the various forms of conditioning and cognitive biases to which human beings are subject. Nevertheless, the question that remains open is: is this conditioning total or merely partial? The view to be developed here is that this conditioning is partial, and that exercising one's free will consists precisely in struggling, in certain situations, against one's own conditioning. Free will will accordingly be defined as the capacity of an individual to extricate herself or himself from conditioning when confronted with a familiar situation.

An example of conditioning that will serve as a guiding thread later is the following. When Paul wants to visit his friend Lise, who lives a few kilometres from his home, he usually behaves as follows: if it is raining, he uses his car; if it is not raining and the sky is gray, he takes his bicycle. Finally, if the weather is nice, he walks to Lise's house.

The important point of this scenario is that the agent (Paul) finds himself in a familiar situation (visiting his friend Lise), in which several choices are available to him, but in which he tends to favour one of them, a choice guided by the circumstances (the weather). This is therefore a context very different from the one usually encountered in studies on free will, whether in neuroscience or philosophy, in which the individual must, for example, move a wrist (Libet, 1999), steal a car (Mele & Robb, 1998), or decide whether or not to end a romantic relationship (Ekstrom, 2001).

2. Free Will : An Alternative Formulation

In situations of choice, human beings may experience two contradictory impressions. On the one hand, they feel that they are the source of their own decisions; on the other hand, they are often overcome by doubt regarding their genuine freedom to choose. Indeed, psychology and neuroscience continually demonstrate the extent to which individuals are susceptible to influence, if only through the workings of the unconscious.

Faced with this ambivalent feeling, exercising one's free will will be considered, from my point of view, as the implementation by an individual of a specific decision-making process aimed at freeing themselves from possible conditioning—that is, preventing a loss of control over their own agency. This decision-making process will involve an ingredient often used when there is suspicion of manipulation or subtle coercion: random selection. Indeed, one major property of chance is that it acts as a impartial judge who cannot be swayed. From this point on, we will use interchangeably the expressions *free will* and *to exercise one's free will*.

More precisely, we shall say that an individual exercises their free will when, after having made a decision $\boldsymbol{C}$ in a known context—that is, a context in which the subject not only has a specific choice associated with each possible situation but also tends habitually to implement that choice—they decide to suspend this choice and instead make a random choice $\boldsymbol{C'}$. In other words, the subject changes their mind by replacing a choice predetermined by the usual situation encountered with a choice that is not predictable. It should be noted that the unpredictability of the final choice constitutes a form of ***artificial indeterminism***, that is, an indeterminism deliberately produced by the individual (as opposed to an indeterminism whose nature would be ontological).

3. The Canonical Model of Free Will

More formally, the implementation of free will by an agent can be described as a three-phase decision-making process: a first phase in which the predetermined choice is selected by the context; a second phase in which the execution of the selected choice is suspended by the agent; and a final phase in which the subject makes a random selection.

This decision-making process can be modelled by the sequential execution of two components: a component whose execution produces a predictable result, and another component that yields an unpredictable result. The first component implements the first

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phase of the decision-making process, whereas the second component implements the last two phases. We will refer to this decision model as the *PSU Model* (*Predictability – Suspension – Unpredictability*) [Fig. 3].

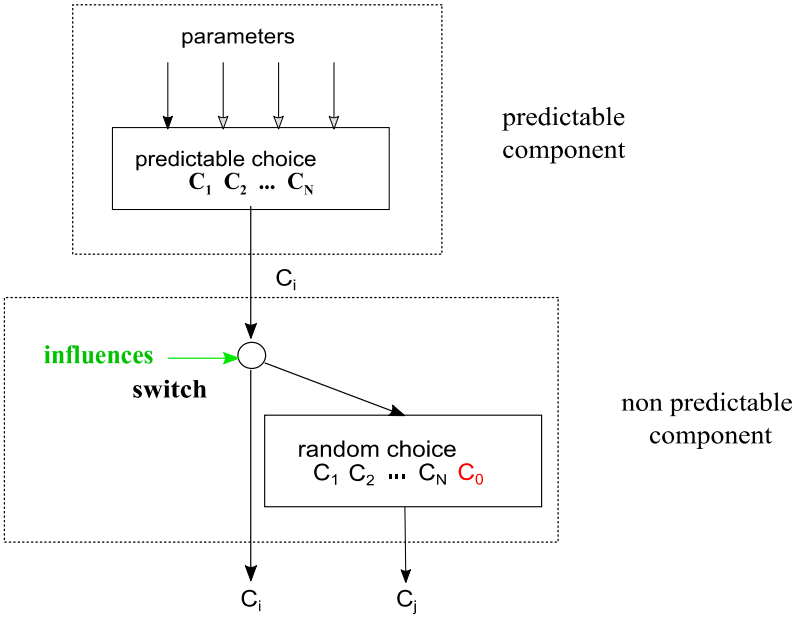

Fig. 3: The PSU Model

In this model, the first component represents the familiar situation faced by the agent. This component is defined by a triple: a *set of choices Cp* ($1 \leq p \leq N$, $N > 1$); a *selection function*; and a *set of parameters*. Depending on the values of the *parameters* and the *selection function*, the component makes the predetermined choice *Ci* from among the N possible choices. A *parameter* denotes a well-identified piece of information that has an effect on the *selection function*. It may represent an internal or external condition, a stimulus, a state, or any other type of known information. Finally, the component is said to be predictable because, if at two different instants *t* and *t'* the same parameters are applied to it, the component will exhibit the same behaviour: the *selection function* will produce the same choice.

Unlike the previous component, the second component operates in a non-predictable manner. It consists of two clearly distinct modules: a *switching module* and a *random choice function*.

The *switching module* can have two possible effects on the choice *Ci* selected by the previous component: a *transparent effect* and a *modifying effect*. In the *transparent mode*, the choice *Ci* produced by the predictable component is ultimately executed. This models the situation in which the agent does not question their habits and carries out the choice predetermined by the situation.

The *modifying mode* represents the situation in which the agent doubts their own freedom of choice, suspecting a form of conditioning whose origin they do not truly know. The previous choice *Ci* is then temporarily suspended, and a *random selection function* is activated.

The operating mode of the *switching module*—*transparent* or *modifying*—depends on internal conditions that are not necessarily known to the agent implementing this decision-making process. These internal conditions are referred to as *influences*.

The second module consists of a single *random selection function*. When this selection function is activated, it performs a random choice *Cj* among N+1 possible options: the N choices provided by the predictable component plus one additional choice, denoted *C0*. This represents the final inhibition of the preceding choice *Ci* by the unpredictable component. The meaning of the choice *C0* depends on the context (veto, cessation of activity, or another outcome).

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After the execution of the non-predictable component, the choice *Cj* ($0 \leq j \leq N$) ultimately selected may differ from the choice *Ci* made by the predictable component. The final choice depends essentially on the operating mode of the *switching module* (*transparent* or *modifying* mode).

4. Illustration

Let us now illustrate how the *PSU model* of free will operates using the scenario presented earlier (Paul visiting his friend Lise). To do this, we need to instantiate the two components with the data of the situation.

Regarding the first component, the *set of choices* includes three possibilities: taking the car, taking the bike, or walking. On the other hand, a single *parameter* governs the *selection function*: the weather condition.

Paul decides to visit Lise while the sun is shining. According to his usual habits, Paul would walk and is physically able to do so. Nevertheless, Paul may adopt two attitudes: he can act as usual without questioning it (*switching module* in *transparent* mode), or he can experience doubt and ask himself the following questions: why do I behave in the same way every time I visit Lise? What are the causes that have shaped this stereotyped behaviour? Of course, Paul will not be able to answer these questions in any reliable way. However, Paul can decide to exercise his free will by suspending the predetermined choice (*switching module* in *modifying* mode)— namely, to visit Lise on foot— and randomly selecting one of the following four possibilities: using one of the three modes of locomotion (walking, biking, driving) or choosing not to visit Lise at all. In this way, Paul frees himself from the coercive mechanisms he presupposes by appropriately employing chance. It should be noted that the quality of the *random selection function* is of relatively little importance in the overall decision-making process.

V. DISCUSSION

1. The Canonical Model of Free Will and Its Implementation

The *PSU model* should be regarded as a canonical model insofar as it represents an idealised process. Indeed, an individual may prefer to use his or her unconscious rather than on a physical device (dice or similar tools) in order to make a random choice more quickly. This can be interpreted **as a** degraded form of the canonical decision-making process, since it reintroduces potential conditioning factors. Nevertheless, the possibility for an individual to execute the decision-making process in its canonical form guarantees the existence of free will, independently of the concepts of *ontological determinism* and *ultimate source*.

Similarly, although the canonical *PSU model* of free will describes an indivisible three-phase decision process, one might object that its execution by an agent can be interrupted for various reasons, such as the consideration of new *influences* leading the agent to modify their behaviour. For example, after becoming aware of his conditioning when it rains, Paul may recall that he has purchased a new umbrella and may wish to try it out by walking to visit Lise. He might also remember a conversation with a physician friend encouraging him to walk more. In both cases, the canonical process is interrupted by a new *influence* whose motivating consideration eclipses the initial one, and whose final outcome might consist less in the agent's sense of having exercised free will than in a judgment about the quality of the umbrella or in the satisfaction of having walked sufficiently during the day. Indeed, in both situations two motives for action overlap: the attempt to extricate oneself from a potential conditioning, and another motive (trying a new umbrella, taking care of one's health). This may render opaque to the agent what the true final motive of the action was. By contrast, the complete execution of the canonical *PSU decision process* follows a single motive—an unambiguous one: to exercise one's free will in order to free oneself from a possible conditioning.

2. The Luck Argument and the Question of Intelligibility

Like all indeterminist models of free will, the *PSU model* must address the following two well-known problems: the *luck argument* and the *question of intelligibility*.

The *luck argument* may be formulated as follows: if an event is undetermined, then that event may either occur or fail to occur. This means that an agent has no control over the production of that event. Yet, for an agent to exercise free will with respect to an event, it is necessary that the agent possess some degree of control over that event. It follows that an agent cannot exercise free will over an undetermined event.

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The *problem of intelligibility*, for its part, raises the following issue: can a meaningful relation be established between the two contradictory elements raised by the *luck argument*— namely, an undetermined event and its control by the agent? Any model of free will that invokes indeterminism must answer this question affirmatively.

In order to respond to *the luck argument* and the *question of intelligibility*, let us summarise the conditions under which an individual exercises free will according to the *PSU model*. First, the agent recognizes a familiar situation in which they become aware of their own inclinations. For instance, Paul wishes to visit Lise, and it is raining: he realizes that in this situation he tends to use his car. Then, in a second stage, doubt arises and Paul questions the origin of this inclination and, more generally, of his conditioning. The emergence of this doubt and questioning in Paul's mind is an undetermined event produced by his cognitive system (an *influence*): it may or may not have occurred. It is an indeterminism 'undergone' by the agent. The conclusion that seems to follow is that Paul has no control over this event.

Yet, the most important aspect of this event is not its unpredictability—that is, the agent's lack of control over the occurrence of the event, or the precise moment at which it actually occurs— but rather the content of the event: the emergence of a specific questioning. Indeed, the thesis defended here is that exercising free will and sorting a sequence of integers have in common the resolution of a specific problem. With respect to free will, this involves an agent breaking free from their conditioning. Similarly, when considering the problem of sorting a sequence of numbers, the crucial aspect is neither when nor under what circumstances the problem arose in the agent's mind, but how the agent solved it. In a similar fashion, in the *PSU model*, the notion of *influence* indicates not only the indeterminist character of the event produced by the agent's cognitive system, but above all the emergence of a questioning—a questioning that triggers the temporary inhibition of the process that would otherwise have led to the execution of a predetermined choice. The concept of *influence* makes it possible to avoid introducing the concept of *cause*, a concept that frequently encourages the construction of *fictions*—a *fiction* being an imaginary construction that may incorporate elements of reality. Indeed, the human cognitive system is a continuously operating system, a ceaseless producer of cognitive events whose cause or primary reason cannot, in any rigorous and scientific sense, be determined. Consequently, the cause typically associated with an action or choice is, in many cases, a mere fiction.

Finally, the agent's use of chance raises the question of the intelligibility of the process. The introduction of chance into a situation is often regarded as a loss of control by the agent over that situation. In the *PSU model*, while the appearance of doubt in an agent's mind is not under their control, the random selection performed by the agent is, by contrast, a fully deliberate, rational, and controlled action—much like when an individual, for reasons of efficiency, opts for a probabilistic algorithm to sort a sequence of numbers instead of a fully deterministic one.

VI. CONCLUSION

Contemporary interest in free will extends well beyond the confines of analytic philosophy, attracting scrutiny from both the physical sciences and neuroscience. By distinguishing between the *scientifically known physical world* and *extra-worlds*, it has been shown how important it is to specify the context in which free will and its associated problems are examined. Certain limitations of the *classical approach to free will* have thus been clarified. In particular, it has been shown that when *ontological determinism*, as presented in the classical approach, is projected onto *the scientifically known physical world*, it becomes an *inconsistent* concept. Furthermore, the standard interpretation of quantum mechanics undermines the very existence of *ontological determinism*. Acknowledging this, some philosophers and scientists have contrasted free will with *near-determinism*, according to which quantum effects are confined to the most fundamental layers of matter. By contrast, it has been demonstrated that the properties of quantum indeterminism can be explicitly exploited by humans in their actions and creations.

Finally, it has been shown that, within the *scientifically known physical world*, the concepts of *ultimate origin* and *primary source* are likewise inconsistent. It follows that free will can no longer be defined in terms of these notions, nor can *ontological determinism* (or *near-determinism*) be coherently set against it: the *ontological grid* is no longer relevant. The naturalization of free will therefore requires an approach that departs from the classical paradigm. The approach proposed here interprets free will as a three-phase decision-making process, enacted by an agent in specific situations to free themselves from potential

conditioning. The process sequentially involves the recognition of a familiar situation, the suspension of habitual action, and a random selection, yielding an indeterminist model of free will: the *PSU model*.

Developed under a naturalistic framework, free will has shifted in status: from a metaphysical notion, it has become a precisely defined concept, fully compatible with the feeling associated with it, and entirely operational.

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