FACTA UNIVERSITATIS
Series: **Physics, Chemistry and Technology** Vol. 21, Nº 1, 2023, pp. 77 - 87
https://doi.org/10.2298/FUPCT2301077D

Original scientific paper

PHYSICAL AND METAPHYSICAL IMPLICATIONS OF A PROBABILISTIC INTERACTIONIST ACCOUNT OF MENTAL CAUSATION

UDC 536.75 : 141.112

Dejan R. Dimitrijević

Department of Physics, Faculty of Sciences and Mathematics, University of Niš, Niš, Serbia

Abstract. *The strongest support to the metaphysical thesis of physicalism – the argument from the causal closure of the physical – is shown to be effective only against the accounts of mental causation manifested in the action of forces. An interactionist account of mental causation based on probabilistic considerations of anomalous correlations of neural events, instead of anomalous accelerations of the particles that make up the nervous system, is proposed. Local violation of the Second Law of thermodynamics by the actions of the mind is implied, and mental causation is explained as the disposition of mental states to alter the state probability distribution within the nervous system, with no violation of the conservation laws. The main features of this account and some of its physical and metaphysical implications and advantages are discussed: an indication of the causal unity of nature, elimination of the problem of causal power drainage, explanatory simplicity, and redefining the domain of the physical. The account refutes the claim of the anomalousness of the mental and anticipates the existence of probabilistic psychophysical laws. Its truthfulness is verifiable by extensive neurophysical and physiological research, involving statistical analysis of neural correlations.*

Key words: *Mental causation, Causal closure of the physical, Second Law of thermodynamics, Maxwell's demon, probability distribution*

1. INTRODUCTION

If we take as the beginning of the rich history of discourse between the ontologies of physicalism and dualism in modern and contemporary philosophy Descartes' separation of the extended substance (*res extensa*) from the thinking substance (*res cogitans*), then the explanatory role of physics in this discourse was established by the demand by Princess

Received: December 15th, 2023; accepted: December 24th, 2023
Corresponding author: Dejan R. Dimitrijević, Department of Physics, Faculty of Sciences and Mathematics, University of Niš, Višegradska 33, 18000 Niš, Serbia, e-mail: dimke68dd@gmail.com

Elisabeth of Bohemia directed to Descartes to explain the mechanism of mental causation – the way in which the thinking substance produces voluntary bodily actions. Descartes' attempt to answer this question by postulating physical processes in the pineal gland came from his awareness that the boundary between physical and mental can only be approached from the observable, physical side, and that one can only cross this boundary by setting the hypotheses whose physical consequences are subject to the empirical verification. However, the failure of his attempt, which Leibnitz controversially ascribed to the incorrect application of the law of conservation of momentum due to the treatment of momentum as a scalar quantity, was the first testimony that such a process is fraught with difficulties and pitfalls.

Any dualistic description of the mind as an immaterial entity is confronted with similar difficulties in explaining the mind-body interaction. They inevitably arise from the principled impossibility of direct observation of mental properties. All we can observe directly are physical effects, such as bodily movements caused by force. Each of these effects can be viewed and studied as the series of instantiations of physical properties on a body at a time – which is a Kimean definition of physical events – and described entirely by means of physics. Our measuring instruments are constructed on the principles derived from the laws of physics and can be used to measure only physical quantities and properties. Mental properties, however, are only available to us subjectively. To explain the causal relationship between mental and physical properties, an interactionist must formulate the theory of mental causation and individuate mental properties based on their causal power.

The pillar of physicalism is the argument from causal closure of the physical (CCP), which rests on the metaphysical claim that all physical events have sufficient physical causes[1]. In this paper, I firstly show, in Section 2, that CCP, as the crucial argument in favor of physicalism, is question-begging because it contains a hidden premise that reduces any observable manifestation of causation to the physical. In Section 3, I indicate the possibility of formulating an intelligible interactionist account of mental causation that would not fall under the impact of this argument. Section 4 is dedicated to the discussion of some metaphysical implications of this account, as well as its advantages over its physicalist counterparts. The paper ends with a brief summary of the discussion.

2. MENTAL CAUSATION AND THE CAUSAL CLOSURE OF THE PHYSICAL

The most convincing argument in favor of physicalism is the argument from causal closure of the physical (CCP). In the form established by its most influential proponents, such as Papineau (2001) and Kim (2005), it claims that it consists of three premises:

(1) Mental events have physical effects.

(2) If a physical effect has a cause at time *t*, it has a sufficient physical cause at time *t*.

(3) If a physical effect has a physical cause at time *t*, then no other event can be a cause of the same effect at time *t*.

The conclusion of the argument is that mental events that have physical effects are identical to physical events. If successful, it eliminates the possibility of irreducible mental causation.

[1] For presentation and defense of the causal closure principle and CCP see Jackson (1996), Spurrett & Papineau (1999), Papineau (2001, 2013), Melnik (2003), and Kim (2005).

The most important objection to CCP, persisting in the literature in different forms, is focused on the incompleteness of that principle[2]. Its ability to support the causal closure principle depends on the acceptance of a hidden metaphysical premise, which ensures that the causal efficacy is limited to physical properties, thus making the argument question-begging in favor of physicalism. Gibb specified (2010, p. 374) that actually two further premises, which she referred to as *Physical affectability* and *Redistribution*, are needed to make the argument complete. The former requires that something non-physical can affect a physical system either by affecting the total amount of energy or momentum, or by redistributing these quantities within a system. The latter specifies that the redistribution of energy and momentum cannot happen without supplying energy or momentum to the system.

The content of the hidden premises explicated by Gibb is essentially a simple generalization of the effects of a physical force operating in a physical system, which follow from the laws of dynamics, to a broader system where additional psychophysical effects occur. A physical force can alter the state of the physical system either by causing accelerations of the particles constituting the system, thus changing its amount of energy and momentum, or by redistributing energy and momentum within the system, which – by the letter of the Second Law of thermodynamics – must also be accompanied by the increase of total energy and momentum of the system. In the former case, the failure to attribute accelerations within a system to the known physical forces would result in a violation of the laws of conservation. In the letter case, the redistribution of energy and momentum within a system without changing their total amount, i.e. without the work of a force being done, would indicate the violation of the Second Law of thermodynamics.

Now, if the mind is a non-material and non-spatial thing, as dualists claim, then it is hard to imagine that physical properties, such as energy, momentum or any other, can be attributed to such an entity. It is even harder to believe that mental causation can be seen as the transfer of these properties from mental to physical states. At any rate, the existing empirical evidence does not support this belief, and an interactionist has no reason to accept it. Equating forces with causes and accelerations with their effects implies that the effects of putative mental forces must be nomologically equal to the effects of physical forces. This means that an observer could verify the manifestation of mental causation only by the presence of anomalous accelerations in the system, not accounted for by any of the known physical forces. In other words, mental forces would manifest themselves by adding energy to the system, thus violating the law of conservation of energy. This is nothing but a generalized mechanism of physical causation; trying to fit mental causation in this picture is plainly begging the question in favor of physicalism. An interactionist can explicitly reject the thesis of *Redistribution*, as suggested by Gibb (2010, p. 379), and claim that mental causation may be manifested by the redistribution of energy and momentum without doing work, therefore without altering the total amount of energy and momentum of the system. This approach implies commitment to the conservation laws, but at the same time it has a price not anticipated by Gibb: violation of the Second Law of thermodynamics. Since this is not the choice which can easily go along with most of the physicists and philosophers, I will next try to elaborate on this idea and show that it is neither new nor physically unacceptable; moreover, I will demonstrate that it offers a handful of philosophically fruitful and attractive possibilities.

[2] Numerous objections to CCP are presented in Lowe (2006), Bishop (2012), Gibb (2010), and Dimitrijević (2020).

3. The Features of an Interactionist Account of Mental Causation

One of the central concepts of thermodynamics is entropy – the measure of disorder of a physical system. The Second Law of thermodynamics specifies that the total entropy S of an isolated physical system never decreases during spontaneous processes, which stems from the tendency of the system towards thermodynamic equilibrium. If entropy is decreased in some part of a physical system that effect must be compensated in other parts of the system, so that net entropy change of the system is zero during reversible, or negative during irreversible processes. The energy and momentum are not being randomly redistributed in the neural systems of living organisms. Our decisions increase order by redistributing conserved quantities in the system, with mediation of physical forces. A physicalist account of this causation, based on CCP, effectively claims that mental agency is one way or the other included in the causal chain, so that this decrease of entropy must be compensated by its increase elsewhere in the system and the overall entropy increases.

However, an interactionist account of mental causation was proposed in Dimitrijević (2019, 2020), based on the idea that redistribution of conserved quantities is accompanied by a local decrease of entropy of selected subsystems within an organism, where the selection is performed by the immaterial mind, with no force acting and no work being done. That way, the total amount of energy and momentum in the system remains unchanged during the causal process, i.e., no conservation laws are violated. Clearly, the Second Law is violated by the actions of the mind. Human creativity is seen as a consequence of predetermined actions aimed at increasing the system regularity and decreasing its entropy. Such disturbances of the state of equilibrium lead to a spontaneous tendency of the system to return to it. A local decrease of entropy results in gradients of various physical parameters, i.e. in physical forces that tend to bring the system back into equilibrium. The account builds on the idea that the mind brings about small-scale correlations of neural processes by using small fluctuations of physical quantities to produce significant behavioral effects. Popper & Eccles (1977) had something similar in mind when they argued that the finely tuned structure of the brain enables small perturbations to have macroscopically significant effects.

The described effect of the mind on the body is analogous to the way Maxwell's demon affects a thermodynamic system. In Maxwell's famous thought experiment (Maxwell, 1871, pp. 308-309), an insulated container full of gas at uniform temperature is divided into two equal chambers, A and B, by a barrier. The demon opens the hole in the barrier only to faster molecules passing from B to A and slower molecules passing from A to B, thus creating a temperature gradient without doing work – contrary to the Second Law. If the demon is seen as an intelligent agent outside the physically isolated system, its actions can be interpreted as manifestations of the causal power of an immaterial mind, which operates through redistribution of momentum and energy in the system, without altering their total amount. Redistribution comes about without the expenditure of work by the mind and without forces operating on particles and causing accelerations. For an outside observer, there are only physical forces in the system, and yet a physically unexplainable, anomalous correlation occurs in the molecular dynamics, resulting in the redistribution of molecules in the container based on their physical parameters. The demon causes the redistribution by controlling boundary conditions in the system – specifically, in the barrier between the chambers. It imposes selection rules, which increase the probability of finding faster molecules in A, and slower ones in B, thus decreasing the entropy in the system. Alternatively, the observer may model the gas dynamics by finding a functional dependence of the *a priori* probability of

physical states A and B, realized in this simple example by the corresponding chambers, on the parameters of the gas molecules. Both approaches establish at least approximate nomological relations between the physical parameters of the gas and parameters of the system set by the demon.

The interactionist worldview rests on the premise that two essentially different classes of properties exist in the world, physical and mental, and that there are causal relations between instantiations of these properties at time *t*, i.e., between physical and mental events. As demonstrated by means of the Maxwell's thought experiment, these relations most probably have the form of probabilistic psychophysical laws. The state of the complex psychophysical system, such as the human neural system, is a function of the set of mutually independent fundamental physical $\{q_i,\ i = 1,2\ldots,\ k\}$ and mental $\{m_j,\ j = 1,2\ldots,\ l\}$ state variables, or degrees of freedom. The choice of the physical parameters that are considered as state variables is dictated by the type of the physical system and context. As in the case of complex, many-particle physical systems, the state of the psychophysical system at time *t* can be represented by a phase point in the generalized, $(k + l)$ – dimensional phase space whose coordinates are (q_i, m_j), and its dynamic evolution by the trajectory of the phase point in this space. The probability of a macrostate realized by many microstates filling a phase volume can be determined, as in conventional statistical mechanics, by calculating the number of elementary cells in this phase volume. Therefore, mental causation is instantiated as the disposition of mental properties to alter the state probability distribution within the living system, thus leading to the redistribution of energy, momentum, and other conserved quantities, without altering the overall energy and momentum content of the system.

The introduction of additional degrees of freedom in the form of mental state variables necessarily changes the probability of the state corresponding to a particular energy. It also increases the number of configurations leading to the corresponding macrostate, thus changing the statistical weight of the level in a way which resembles the splitting of energy levels of a purely physical system into sublevels. On the other hand, how the probability of microstates depends on mental variables is determined by putative psychophysical laws (Chalmers, 1996), which are at present unknown to us. The result of the mind's intervention is the redistribution of energy between the subsystems resulting in a bodily action without the expenditure of work, hence without changing the energy content of the system, but leading to the local decrease in entropy.

It is in principle possible to construct the state probability distribution function $f(q_i, m_j)$ of the system and study its time evolution, in order to establish the probabilistic nomological relations between physical and mental state variables, i.e., psychophysical laws. The function $f(q_i, m_j)$ can be defined as the number of system constituents per unit volume of the generalized phase space of the system. It contains the most complete information about the state of the system, and its time evolution – of its dynamics.

4. Physical and Metaphysical Implications of the Account

In order to demonstrate the rationality of developing probabilistic interactionist account of mental causation, I turn to the discussion of the impact that the acceptance of such an account would have on our conception of reality. Important aspects of the problem of mind-body interaction can be flashed out in a natural and realistic way from this position.

4.1. Some physical implications

It is well-established that at the deepest level of physics, the quantum mechanical causation is manifested in a fundamentally probabilistic way. The description of the state of the system via probability distribution function It is well-established that at the deepest level of physics, the quantum mechanical causation is manifested in a fundamentally probabilistic way. The description of the state of the system via a probability distribution function $f(q_i, m_j)$ would indicate that the modus operandi of both physical and mental causes is fundamentally the same: they influence the state probability distribution, resulting in the occurrence of particular effects – both physical and mental. The physical parallel of this function is the state function ψ, containing complete information about the state of the micro-physical system. In both cases, the description of particular systems based on traditionally used parameters turned out to be incomplete when particular classes of systems were encountered: macro-physical parameters in the case of micro-systems, and physical parameters in the case of psychophysical systems. Also, in both cases, experience has indicated the need to use a probabilistic description of the state of the system. Most importantly, both state functions represent a measure of the system disposition to find itself in a particular state, so a dispositional view of causation is indicated in both these realms. All in all, it appears that a kind of causal unity of nature is suggested by this account.

Another indication of the unifying feature of the proposed mechanism of psychophysical causation is that it effectively eliminates the problem of causal power drainage – which, according to Kim (2005, p. 63), creates particular tension for the proponents of non-reductive physicalism who accept the supervenience argument. While commenting on Kim's supervenience argument for reductive physicalism, Block (2003) demonstrated that if the hierarchy of physical properties continued downward indefinitely, towards the microdomain, as suggested by contemporary physics, then the causal power would completely drain away "into a bottomless pit and there wouldn't be any causation anywhere" (2003, p. 133). Kim believes that "reduction is the stopper that will plug the cosmic hole through which causal powers might drain away" (2005, p. 68). The causal drainage is prevented by invoking $f(q_i, m_j)$ – a property of the system as a whole, and not of its elements – as the measure of the disposition of the system to evolve causally in a particular way. There can be no drainage of causal power in an account where this power belongs to the system as a whole.

Interestingly enough, this approach may well fit the integrated information theorists' account of consciousness as an exemplification of causal powers of "maximally irreducible causal structures", viz. neuronal coalitions situated in the specific areas in the cerebral cortex. These structures possess causal powers that their constituent parts do not have[3], just as the presented analysis suggests that a particular neuronal coalition as a whole may have causal power beyond the causal powers of its constituent parts. The rationality of a probabilistic interactionist account of mental causation is accentuated by the fact that it actually *implies* that causal power of the mind is instantiated in the formation of such complex neuronal coalitions. These coalitions are straightforward physical instantiations of the state probability redistribution inside the nervous system caused by the immaterial mind, as predicted by the interactionist account. This indicates that the analysis of anomalous correlations within neuronal coalitions can make it possible to study the probability distribution function of the structure as the mathematical expression of its causal power.

[3] See e.g. Tononi (2015), Owen (2020), and Albantakis et al. (2023).

Among the advantages of this probabilistic interactionist approach is its explanatory simplicity, compared with popular physicalist accounts. To see this, we can compare it with its closest physicalist analogue: Papineau's (2013) view that causation is essentially a macroscopic phenomenon, with a distinct probabilistic signature, akin to thermodynamic processes. According to Papineau, causation is "constituted by the nature of past facts together with probability distributions over the maximally specific microstates that can realize given macrostates" (2013, p. 129). If the physical conditions are fully known, causation is lost. Papineau's insistence on the analogy of causation and thermodynamic effects and quantities, especially heat, makes his inference analogous to Maxwell's statistical outlook on the nature of the Second Law. This physicalist account bears striking similarities to the interactionist account outlined in this paper, in that causal relations are inferred from the probabilistic facts concerning the way in which a particular microstate is realized.

Now, the main problem of every reductive physicalist explanation of mental causation is multiple realizability. A common feature needs to be discovered at the level of physical realizations of mental events, which would explain the co-variance of a physically supervenient, mental cause and a physical effect. To do this, Papineau posits brain states picked by the phylogenetic and ontogenetic selection processes as generic selectional states corresponding to mental states. These selectional states are variably realized, which means that different physical realizers can be effective causes. Physicalists describe these generic selectional states as physical, while in the interactionist account they are seen as system dispositions and represented by the probability distribution function. The concept of probability equally pertains to the laws governing physical and mental events. It allows an interactionist to claim that the disposition of the system to evolve in a particular way is controlled by the laws that contain both types of state variables. In both accounts the role of immediate causes of physical effects belongs to various physical realizers, such as forces whose laws are the subject of physics; however, in the interactionist account the probability that a particular realizer will lead to the specific physical effect can, at least in principle, be inferred from $f(q_i, m_j)$. Once again, the causal homogeneity of nature is indicated. Therefore, a dualist may be able to claim that an interactionist account developed along the lines presented here is not only explanatory simpler, but also promises significant predictive advantages.

4.2. Refutation of the anomalousness of the mental

While specifying an objective criterion that any causal relation must satisfy, Davidson (1970) famously formulated his *Principle of the nomological character of causality* – the claim that events related as cause and effect must fall under strict laws. It rested on the premise of the anomalousness of the mental, according to which there are no strict psychophysical laws that would allow predicting and explaining mental events – although, according to the *Principle of causal interaction*, mental events undeniably causally interact with physical events. From these premises, Davidson inferred the identity of mental and physical events. He referred to his position as anomalous monism.

The reasons for Davidson's conviction that it is impossible to establish strict psychophysical laws are indisputably relevant. For one thing, he correctly stated that a predicate cannot intelligibly be assigned to an object unless a viable theory of that object exists, and strongly doubted that such a theory can be constructed of our beliefs, desires, intentions, and decisions. For another, he believed that there is no way for the mental to be studied within a closed system due to its constant interaction with the non-mental, so that the laws

concerning the mental would not utilize the notions belonging to the same conceptual domain – instead, they would use heteronomic generalizations, mixing vocabularies from different domains. He even claimed that "mental and physical predicates are not made for one another" (1970, p. 218).

However, an interactionist may accept the *Principle of the nomological character of causality*, while rejecting the anomalism of the mental. The main obstacle to this, which is the heteronomy of physical and mental vocabularies, is overcome by establishing the common ground between these domains in the form of the state probability. To stipulate psychophysical laws, we do not need to have a complete theory of beliefs, desires, intentions, or any other, perhaps more fundamental mental properties – at least not in the first pass. It is sufficient to estimate the measure in which these properties alter the state probability distribution function $f(q_i, m_j)$ of a system, in a way discussed in Section 3 – by investigating anomalous correlations in the nervous systems of living organisms. A comprehensive study of the temporal evolution of this function, as well as the interdependence of physical and mental parameters of the state of the system, should enable the formulation of psychophysical laws in principle. So, the described probabilistic account of mental causation, if correct, will not only overcome the challenge of anomalousness of the mental; it will also be able to provide an explanation of how, if not through strict laws understood in a way which is commonplace in physics and other special sciences, mental causation actually works.

4.3. Redefining the domain of physics

The broadly accepted hierarchy of levels or domains of reality assumes that the fundamental domain is populated by physical properties, objects, and phenomena. Bishop (2012) defines domains as spaces of possibilities, because the limits of a particular domain are determined by the constraints imposed by the laws immanent to that domain. The relations between the elements of the physical domain are determined by physical laws. The hierarchy continues upward, with rising complexity, with the chemical, biological and mental domain. It is loosely based on the "working hypotheses" proposed by Oppenheim & Putnam (1958, p. 9), in which the part-whole relation is proposed between the levels, so that every element of a higher level can be decomposed into elements of a lower level. The differences between authors arise when the question of the relations between levels or domains are raised, such as the ones concerning reduction and emergence. Basically, the reductionists claim that every domain contains sufficient and necessary conditions for all the features of higher domains. Hence, the fundamental, physical domain contains the necessary and sufficient conditions for all properties, objects, and phenomena of the known reality. On the other hand, the emergentists argue that a lower-domain description provides only necessary, but not sufficient conditions for determining behaviors in higher domains.

Recently, Bishop and Atmanspacher suggested that numerous features of the physical domain are dependent on context and that these contextual features include chemical, biological, mental, and even social conditions, so that fundamental physical laws are not sufficient to determine the phenomena occurring in non-physical domains (see Bishop & Atmanspacher, 2006; Bishop, 2012). According to this suggestion, contextual considerations not only specify initial and boundary conditions in the physical domain, but also include constraints not imposed by fundamental physical laws. Even Bishop and Atmanspacher, though, view mental properties as emergent and arguably physically realized.

Historically, all suggestions of the influence of apparently irreducible laws of other domains on the elements of the domain of the physical had roughly the same epilogue: a conflict with some inductively confirmed physical laws, resulting in either abandoning the proposed non-physical explanations, or eventually reducing them to physical laws. The formulation of the principle of causal closure of the physical was the direct consequence of the perceived fact that the laws of physics necessitate events in all domains, while the laws that are valid in other domains have no relevance to the laws of physics, except for providing a context for their application.

However, if the presented interactionist account of irreducible mental causation proves to reflect reality faithfully, the boundaries of the physical domain will inevitably be redefined. The introduction of irreducibly mental properties and psychophysical laws will limit the domain of purely physical laws to events outside the nervous systems of living organisms. Inside of them, physical and mental causation will become inextricably related by the state probability distribution function $f(q_i, m_j)$. Put differently, it will prove the impossibility of giving a complete description of the state of a living system, including the manifestations of consciousness, by applying only the laws of physics. The contextual dependence of physical occurrences on mental states will also get its natural explanation: the influence of initial and boundary conditions will be attributed to the causal competition of purely physical causes in a complex environment, whereas the irreducible influence of the domain of the mental on the domain of the physical will be quantifiable by the constraints derived from psychophysical laws. So, if mental causation proves to be irreducible and probabilistic, the presented account is capable of outlining the significant changes which await future physics.

4.4. Refutation of the argument from methodological naturalism

Ontological dualism has been downplayed in the philosophy of mind mainly because it postulates unobservable properties, such as immaterial minds. On the other hand, the success of physics and related rise of technology have highlighted what Papineau calls "the hegemony" of physics over other subjects (Papineau, 2001). The widespread belief in physicalism in the scientific community is largely a consequence of confidence in the rationality of a metaphysical worldview closely related to the methods of the natural sciences – primarily physics. Since these methods are derived from the general naturalistic framework, this influential argument for physicalism is known as the Argument from methodological naturalism (Stoljar, 2021, Section 6). The first premise of the argument claims that it is rational to form one's ontological commitments relying on the methods of natural science, especially physics. The second premise asserts that the ontological picture of the world implied by the methods of natural science is physicalism. The conclusion of the argument is that physicalism is true.

However, the conceivable interactionist account of mental causation developed in Section 3 is formulated strictly according to the prescriptions of the methodological naturalism. What is even more important, its claims are verifiable and falsifiable by means of neurophysics and physiology. Therefore, the presented account, if successful, is a clear counterexample to the second premise of the Argument from methodological naturalism, because it demonstrates that a rational, naturalistic, interactionist conception of reality is possible. If the investigation of anomalous neural correlations confirms that mental causation is instantiated by altering the state probability distribution within the nervous

system without causing accelerations, not only our comprehension of the limits of physical science will be irreversibly changed – so will be our understanding of methodological naturalism.

5. CONCLUSION

The main reason for the popularity of the ontological doctrine of physicalism among scientists and philosophers is the widespread conviction that the physical world is causally closed. The argument from causal closure of the physical is further corroborated by the inductive fact that no trace of mental forces has been found, despite extensive physiological research. After careful consideration, however, it becomes clear that current physics does not prescribe a form in which mental causation is manifested. Instead of looking for anomalous accelerations, resulting from the operation of some classically-conceived force imposed by the mind, we may find its manifestation in anomalous correlations of neural events. The presented analysis indicates that such manifestations of mental causation probably must conform to the conservation laws of physics, but that the violation of the Second Law of thermodynamics is to be expected. An intelligible interactionist account is conceivable, in which mental causation is instantiated as the disposition of mental properties to alter the state probability distribution within the nervous system, thus leading to the redistribution of conserved quantities without altering the total energy and momentum of the system.

If successful, the construction of an interactionist account along these lines will redefine the limits of the domain of physics, because the dispositions of mental parameters will be manifested in the form of novel, psychophysical laws. Among the advantages of this account are its ability to indicate the causal unity of nature, the elimination of the problem of causal power draining away, and its explanatory simplicity. It repudiates the claim of the anomalousness of the mental and paves the way for the introduction of strict psychophysical laws, at the same time establishing that the nature of these laws is probabilistic. Finally, the account refutes the influential thesis that the ontological commitment to physicalism is implied by the method of natural science – physics in particular.

Acknowledgement: *This work was supported by the Ministry of Science, Technological Development and Innovations of the Republic of Serbia, Contract No. 451-03-47/2023-01/200124.*

REFERENCES

Albantakis, L. et al. (2023). Integrated information theory (IIT) 4.0: Formulating the properties of phenomenal existence in physical terms, *PLoS Computational Biology*, 19 (10), 1-45. DOI: 10.1371/journal.pcbi.1011465

Bishop, R. (2012). Excluding the Causal Exclusion Argument against Non-reductive Physicalism, *Journal of Consciousness Studies*, 19 (5-6), 57-74.

Bishop, R. & Atmanspacher, H. (2006). Contextual emergence in the description of properties, *Foundations of Physics*, 36, 1753-1777.DOI: 10.1007/s10701-006-9082-8

Block, N. (2003). Do causal powers drain away, *Philosophy and Phenomenological Research*, 67 (1), 133-150. DOI: 10.1111/j.1933-1592.2003.tb00029.x

Chalmers, D., 1996. *The Conscious Mind*, Oxford University Press, New York.

ISBN's: 9780195117899 195117891 195105532

Davidson, D. (1970). Mental Events, in Foster, L. and Swanson, J. W. (eds.), *Experience and Theory*, Amherst, MA: University of Massachusetts Press, 79-101. Reprinted in Davidson, D. (1980). *Essays on Actions and Events*, Oxford: Clarendon Press.

Dimitrijević, D. R. (2019). Maxwell's demon and interactionalism, *Facta Universitatis, Series: Physics, Chemistry and Technology*, 17 (2), 161-171. DOI: 10.2298/FUPCT1902161D

Dimitrijević, D. R. (2020). Causal Closure of the Physical, Mental Causation, and Physics, *European Journal for Philosophy of Science*, 10 (1), 1-22. DOI: 10.1007/s13194-019-0267-3

Gibb, S. (2010). Closure Principles and the Laws of Conservation of Energy and Momentum, *Dialectica*, 64, 363-384. DOI: 10.1111/j.1746-8361.2010.01237.x

Jackson, F. (1996). Mental Causation, *Mind*, 105 (419), 377-413. DOI: 10.1093/mind/105.419.377

Kim, J. (2005). *Physicalism or Something near Enough*, Princeton, NJ: Princeton University Press. DOI: 10.1515/9781400840847

Lowe, E. J. (2006). Non-Cartesian substance dualism and the problem of mental causation, *Erkenntnis* 65 (1), 5-23. DOI: 10.1007/s10670-006-9012-3

Maxwell, J. C. (1871). *Theory of Heat*. London: Longmans, Green, and Co.

Melnik, A. (2003). A Physicalist Manifesto: Thoroughly Modern Materialism, Cambridge: Cambridge University Press. ISBN's: 9780511056321 9780521827119 9780511498817 0521827116 0521038944

Oppenheim, P. & Putnam, H. (1958). Unity of Science as a Working Hypothesis, in Feigl, H. et al. (eds.), *Concepts, Theories, and the Mind-Body Problem*. (*Minnesota Studies in the Philosophy of Science, vol.* II). Minneapolis: University of Minnesota Press, 3-36.

Owen, M. (2020). The Causal Efficacy of Consciousness, *Entropy*, 22, 823. DOI: 10.3390/e22080823

Papineau, D. (2001). Rise of Phisicalism, in Gillett, C. & Loewer, B. (eds.), *Physicalism and its Discontents*, Cambridge, MA: Cambridge University Press, 3-36. ISBN's: 9780521801751 0521042127 9780511889271 0521801753

Papineau, D. (2013). Causation is Macroscopic but Not Irreducible, in Gibb, S., Lowe, E. J., and Ingthorsson, R. D. (eds.), *Mental Causation and Ontology*, 126-152, Oxford: Oxford University Press. DOI: 10.1093/acprof:oso/9780199603770.003.0006

Popper, K. & Eccles, J. (1977). *The Self and its Brain*, New York: Springer.

Spurrett, D. & Papineau, D. (1999). A note on the completeness of 'physics', *Analysis* 59, 25-29. DOI: 10.1093/analys/59.1.25

Stoljar, D. (2021). Physicalism, *The Stanford Encyclopedia of Philosophy* (Summer 2023 Edition), Edward N. Zalta (ed.), https://plato.stanford.edu/entries/physicalism/. (Accessed 12 December 2023).

Tononi, G. (2015). Integrated information theory. *Scholarpedia* 10 (1), 4164.

FIZIČKE I METAFIZIČKE IMPLIKACIJE PROBABILISTIČKOG INTERAKCIONISTIČKOG PRIKAZA MENTALNE UZROČNOSTI

Najsnažniji oslonac metafizičkoj tezi fizikalizma – argument o kauzalnoj zatvorenosti fizičkog – pokazao se efikasnim samo protiv prikaza mentalne uzročnosti koja se manifestuje u delovanju sila. Predlaže se interakcionistički prikaz mentalne uzročnosti koji se zasniva na probabilističkim razmatranjima anomalnih korelacija neuralnih događaja, umesto na anomalnim ubrzanjima čestica koje čine nervni sistem. Podrazumeva se lokalno kršenje Drugog zakona termodinamike usled delovanja uma, a mentalna uzročnost se objašnjava kao dispozicija mentalnih stanja da menjaju distribuciju verovatnoće stanja unutar nervnog sistema, bez kršenja zakona održanja. Razmatraju se glavne karakteristike ovog prikaza i neke njegove fizičke i metafizičke implikacije i prednosti: naznaka kauzalnog jedinstva prirode, eliminacija problema odlivanja kauzalne moći, jednostavnost objašnjenja i redefinisanje fizičkog domena. Prikaz pobija tvrdnju o anomalnosti mentalnog i anticipira postojanje probabilističkih psihofizičkih zakona. Njegovu istinitost moguće je proveriti opsežnim neurofizičkim i fiziološkim istraživanjima, koja uključuju statističku analizu neuralnih korelacija.

Ključne reči: *Mentalna uzročnost, uzročna zatvorenost fizičkog, Drugi zakon termodinamike, Maksvelov demon, raspodela verovatnoće*