

The impact of science on metaphysics and its limits

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Abstract

The paper argues for three theses: (1) Metaphysics depends on science as a source of knowledge. Our current scientific theories commit us to certain metaphysical claims. (2) As far as science is concerned, it is sufficient to spell these claims out in such a way that they amount to a parsimonious ontology. That ontology, however, creates a gap between our experience and the scientific view of the world. (3) In order to avoid that gap and to achieve a complete and coherent view of the world including ourselves, we have to enrich that ontology at its foundations, thus making it less parsimonious. The criterion of the integration into a complete and coherent view of the world including ourselves is the way in which the interpretation of scientific theories depends on metaphysics. These three theses are argued for and illustrated by means of two examples from the philosophy of time (eternalism vs. presentism) and the philosophy of mind (mental causation).

1. *Eternalism vs. presentism in the philosophy of time*

For the last thirty years or so, there has been a renewed interest in metaphysics in the sense of the project that seeks to bring together all our knowledge in a complete and coherent view of the world. This project depends obviously on science as a source of knowledge: science tells us what there is at the fundamental level of the world and what there is not. As Sellars once put it, “in the dimension of describing and explaining the world, science is the measure of all things, of what is that it is, and of what is that it is not” (Sellars 1963: 173). That statement, however, is not the whole truth. Science depends on philosophy as well, for any scientific theory needs an interpretation, and it is philosophy qua epistemology of science that assesses the criteria of the interpretation of scientific theories. Moreover, that dependence stretches to metaphysics in the sense of the mentioned project, for the integration into a coherent and complete view of the world is an important criterion in the interpretation of scientific theories. Thus, there is an impact of science on metaphysics, but also a constraint that metaphysics imposes on the ontology of science, namely to be rich enough to allow for a coherent and complete vision of the world. In this paper, I shall argue for and illustrate that thesis of a mutual dependence between science and philosophy by drawing on two examples – one from the philosophy of time (eternalism vs. presentism), the other one from the philosophy of mind (mental causation).

We experience a distinction between the past, the present and the future. Is that distinction objective or relative to subjects of experience? If one takes that distinction to be objective, one is committed to the following claim as a necessary condition for that distinction being objective: consider some event e_0 . Given e_0 , it is determined in an objective manner for any other event e_n in the world whether e_n is simultaneous with e_0 , earlier than e_0 or later than e_0 .

On that basis, one can then claim that the past, the present and the future are objective modes of time. Furthermore, one may go as far as maintaining that existence is relative to a mode of time in the sense that only what there is at a certain time exists. Presentism is the most popular version of that position. According to presentism, only what is present exists. What is in the past no longer exists, and what is in the future does not exist as yet.

However, according to the physical theories of special and general relativity, there is no objective temporal order of the events in the world. Conceiving special relativity, Einstein (1905) poses as axiom the principle of the constancy of the velocity of light. This principle allows us to define for any event e_0 in the physical sense of a space-time point a future light cone and a past light cone. All the events in the light cone of e_0 are either in the past or in the future of e_0 objectively. But there are events that are elsewhere, being outside the light cone of e_0 . For these events, there is no temporal order with respect to e_0 defined.

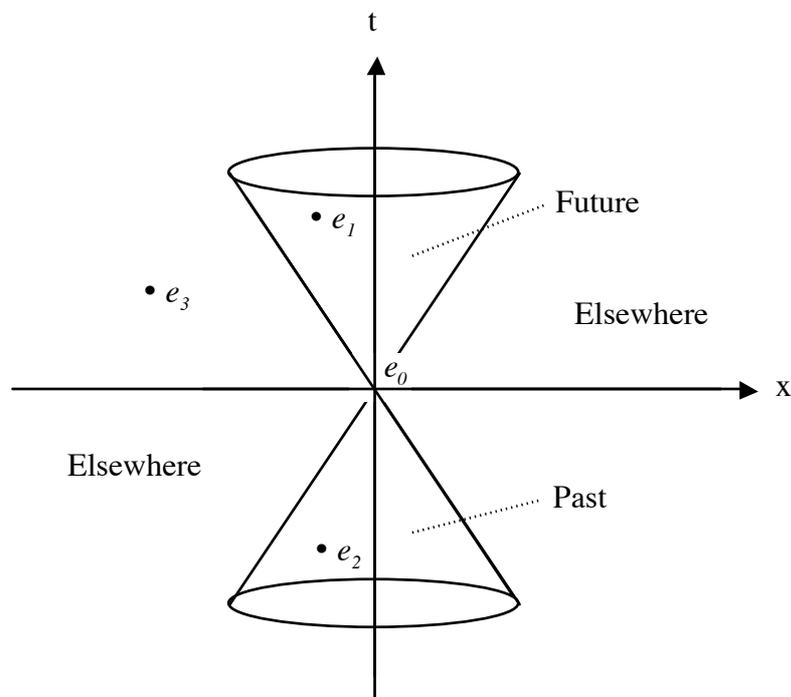


Figure 1: the light cone: above, the future light cone of e_0 with an event e_1 , below the past light cone of e_0 with an event e_2 . “Elsewhere” indicates the events that are outside the light cone of e_0 , such as e_3 .

There is hence no objective simultaneity. One can introduce a reference frame in order to settle which events outside the light cone of e_0 are simultaneous with e_0 . But there is no privileged reference frame. The events that are simultaneous with e_0 according to one reference frame are still in the future of e_0 according to a second reference frame or already in the past of e_0 according to a third reference frame. It is also an axiom of special relativity that all inertial reference frames are equivalent for the description of the physical phenomena.

According to special relativity, there is between any two events a four-dimensional space-time interval. One can represent that interval by an invariable, that is, a number that remains always the same whatever reference frame one considers. That is the reason why people say that space and time are unified in a four-dimensional space-time in relativity physics; for one can regard as objective only those features that do not depend on a particular representation of a physical theory, that is, in this case, those features that do not depend on the choice of a particular reference frame.

In the language of special relativity, the adjective “present” (“now”) has the same status as the adverb “here”: both indicate the position of the speaker in four-dimensional space-time. As there is no objective “here”, there is no objective “present”. Only if one selects one point in space-time, designating it as “present”, there is a future and a past relative to that point, defined by its light cone. It is of course logically possible to designate one reference frame as the objectively privileged reference frame – as it is logically possible to maintain that Greenwich is not an arbitrarily chosen point of reference for the measurement of spatial and temporal distances on Earth, but an objectively privileged location. However, such a position would be completely *ad hoc* and contrary to all admissible criteria in the interpretation of scientific theories. Given that the velocities with which we are familiar are very small in comparison to the velocity of light, special relativity is able to explain why we experience the world as if there were one objective temporal order of all events.

The physical theories of special as well as general relativity thus yield a cogent argument against any position in the philosophy of time that presupposes that there is a global and objective foliation of four-dimensional space-time in a three-dimensional space and a one-dimensional time (globally privileged frame of reference in the vocabulary of special relativity). Consequently, given these physical theories, it is no longer possible to maintain the philosophical position according to which the past, the present and the future are objective modes of time. *A fortiori*, one cannot tie the notion of existence to one particular mode of time (as does presentism). Hence, everything that there is in time – more precisely, everything that there is in four-dimensional space-time – simply exists. That position is known as *eternalism*. If one bases that position on relativity physics, it amounts to what is known as the conception of a *block universe*: the universe is a single block so to speak, space-time with all its content. All there is in space-time simply exists, making up the content of the block universe and being linked by metric relations as defined by relativity physics (four-dimensional, invariable space-time intervals). Eternalism, spelled out as the block universe view, is a clear example of a metaphysical position to which current science commits us as far as space and time are concerned: if one did not accept that position, one would be committed to endorse a stipulation that contradicts the foundation of our scientific theories of space and time, namely the stipulation of there being a privileged foliation of space-time.

As far as the interpretation of our physical theories of space and time is concerned, including their application in cosmology, one can stop there. There is no scientific reason stemming from those theories to enrich the parsimonious ontology of the block universe. However, there is a problem, namely the one of the arrow or the direction of time, more precisely the one of asymmetric processes in time. The physical laws that describe space-time and its material content are in principle time-symmetric laws: they allow in principle the time-reversal of all processes they describe. As such, they do not enable us to give any physical signification to the designation of one part of the light cone of a given point in space-time as

the past of that point and the other part as the future of that point. However, the vast majority of the processes with which we are familiar is asymmetric, thus exhibiting a direction of time. For example, all forms of life are based on an irreversible process that stretches from birth to death. If one bases oneself exclusively on the parsimonious ontology of the block universe, one creates a gap between the description of the world by fundamental physics and our experience of the world (for a proposal to remedy that gap within that ontology see Loewer forthcoming).

However, space-time physics – that is, general relativity – is not our only fundamental physical theory. There is also quantum physics. Quantum theory describes physical systems as being in entangled states – that is, in short, correlated states of several systems that are a superposition of all the possible values of the quantum properties of the systems in question instead of being such that the systems possess definite numerical values of their properties. Schrödinger (1935: 812) has highlighted that feature of quantum physics by imagining a cat that is in a superposition of being alive and being dead relative to an atom being in a superposition of not having decayed and having decayed. In order to conceive definite numerical values as outcomes of measurements – and in general macroscopic objects with definite properties – one has to interpret quantum physics as containing a dynamics that describes processes of state reduction dissolving superpositions and entangled states. There is a concrete physical proposal for such a dynamics (see Ghirardi, Rimini & Weber 1986 and Bell 1987). If there are processes that dissolve quantum entanglement and superpositions, these are time asymmetric processes at the fundamental level of nature (cf. Albert 2000: chapter 7). It is possible to conceive a dynamics for such processes without contradicting relativity physics, that is, without postulating that there is privileged foliation of space-time (see Tumulka 2004 and Maudlin forthcoming). Hence, it is possible to conceive asymmetric processes in time and thus a direction of time without presupposing that there is a unique objective temporal order that includes all events in space-time.

These brief reflections on the philosophy of time allow us to draw the following conclusions:

1) Metaphysics depends on science: science shows on all reasonable criteria of the interpretation of scientific theories that there are certain philosophical positions that one cannot maintain – such as the position that there is a global and objective past, present and future. Science commits us to accept certain philosophical positions – such as the block universe view in the mentioned sense.

2) These philosophical positions amount to a parsimonious ontology that is sufficient as far as the interpretation of the scientific theories in question is concerned. Those theories as such, however, do not tell us anything as to whether or not that ontology is sufficient as a complete ontology of the world. If one takes that ontology to be complete, one creates a gap between the scientific view of the world and our experience of the world. There is, of course, no question of introducing into metaphysics elements that are in conflict with or even contradict the ontological commitments that derive from our scientific theories. Such a move would block from the beginning any philosophical understanding of the knowledge claims stemming from our common sense experience of the world.

3) In order to gain a coherent view of the world as a whole, including ourselves, we have to enrich the parsimonious ontology deriving from science at its foundations, thus making it less parsimonious – for example, by adding the recognition of asymmetric processes in time and

thus a direction of time. All the philosophical work consists in finding a way to do this that does not come into conflict with physics, that is to say, to choose an interpretation of physics that is acceptable from the physical point of view – such as, for instance, an interpretation of quantum physics that admits processes of state reductions. The criterion of the integration into a complete and coherent view of the world including ourselves is the way in which the interpretation of scientific theories depends on metaphysics.

2. *Mental causation*

The philosophy of time can serve to introduce and illustrate this thesis of a mutual dependence between science and philosophy. This thesis, however, has a wider range, being applicable notably to the philosophy of mind as well.

It is common to represent the world as being organized in levels or layers – there are the layer of microphysical systems, the layer of molecules, the layer of organisms, the layer of living beings with consciousness, etc.

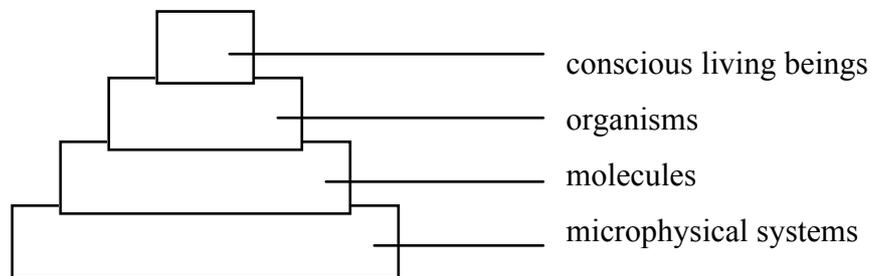


Figure 2: the layered view of the world.

There is a causal relationship between these layers: human beings developed on the basis of organisms, organisms on the basis of molecules, molecules on the basis of microphysical systems, etc. For each layer, there are one or more scientific theories applying to the systems of the layer in question as well as to all the systems at higher layers due to this causal relationship. For instance, not only psychological laws, but also biological laws and physical laws apply to us human beings.

Each layer is complete in a causal, nomological and explanatory manner with respect to all higher layers. For instance, for each token of a microphysical property p_n , insofar as p_n has causes, comes under laws and admits of an explanation, there are microphysical causes, microphysical laws and microphysical explanations. It is never necessary to have recourse to biological causes, laws or explanations (concepts), when it comes to the causes, laws or explanations of any microphysical token p_n . The same goes for biological properties: if one searches for causes, laws, an explanation of a token of a biological property b_n , it is never necessary to invoke causes, laws or explanations (concepts) from psychology. By contrast, some biological tokens have only chemical (or physical) causes and admit only of a chemical (or a physical) explanation. In that sense, each layer is complete in a causal, nomological and explanatory manner with respect to all higher layers, but depends in a causal, nomological and explanatory way on all lower layers. This principle is again a clear example of a philosophical position that is firmly grounded on our scientific theories. If, by contrast, one maintained that, for instance, some physical tokens have biological causes instead of physical ones, one would be committed to the conclusion that our physical theories are either false or

incomplete, because they would then not indicate the correct probabilities for the occurrence of those physical tokens (cf. Papineau 2002: appendix for an elaborate argument for the principle of completeness being based on science).

Nonetheless, there is a relation of cause and effect between tokens of higher layers and tokens of lower layers. For example, mental intentions cause a good deal of our behaviour. In other words, mental causes have physical effects, and these are effects down to the change of the positions of microphysical particles in the body. However, for all these physical effects, there are also physical causes insofar as there are causes at all. Consequently, mental intentions cannot cause anything that is not also caused by physical causes as well.

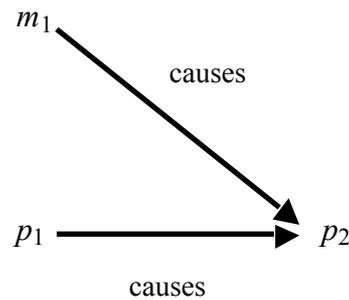


Figure 3: mental causation facing physical causation: a mental token m_1 causes a physical token p_2 . But p_2 possesses also a complete physical cause, namely p_1 .

Taking mental causation and the completeness of physics for granted, there are two possible ways that one can pursue in order to solve the problem of mental causation – or, in general, the problem of how higher layer tokens can be causally effective. The one way is to maintain that m_1 in the drawing above is not identical with p_1 so that there is *systematic overdetermination*. Whenever a mental token is the cause of a physical token, the physical token in question also has a physical cause that is not identical with the mental one. This position seems, however, difficult to defend: given that there always are sufficient physical causes anyway (insofar as there are causes at all), why do mental tokens function as additional causes for some physical effects? It therefore seems that the idea of systematic overdetermination ends up in epiphenomenalism with respect to mental tokens (see, by contrast, Loewer 2001 and Sparber 2005 arguing against Loewer).

The other way is to maintain that m_1 is *identical* with p_1 so that there is only one causal relation between $m_1 = p_1$ and p_2 . If all mental tokens are considered to have a causal influence on behaviour, this position amounts to the view that all mental tokens are identical with physical tokens, more precisely with certain configurations of physical tokens (certain brain states, for instance). If causes are property tokens and if there is token identity, it does not make sense to wonder whether the cause brings about the effect qua being physical (p_1) or qua being mental (m_1). The cause is mental qua being physical, namely qua being a certain, highly complex configuration of physical tokens. “Mental” (“ m_1 ”) and “physical” (“ p_1 ”) are two ways of describing the same property token; their meaning is different, but their extension is the same. Consequently, the common representation of the world as being organized in layers indicates different degrees of organization or complexity in the configurations of physical tokens.

Identity is a symmetric relation: if all mental tokens are identical with configurations of physical tokens, then some configurations of physical tokens are mental tokens. Nonetheless,

this position is an *ontological reductionism*: all there is in the world are physical tokens and their configurations. Only some of these configurations are chemical, biological, mental tokens, etc. Consequently, all the entities that there are in the world make true a physical description, and some of them make also true a chemical, biological, mental description, etc. Since the entities that make true chemical, biological, mental descriptions, etc. are property tokens that are identical with configurations of physical property tokens, there has to be a systematic relationship between the different descriptions that one and the same configuration of property tokens makes true – in other words, a systematic way from the physical description to these other descriptions.

The common way of spelling out this position is the following one: in the world, there are tokens of physical properties and their configurations. These make true a privileged description of the world, that is, a physical description. From this description it is then in principle possible to deduce all the other descriptions – the chemical, biological, mental descriptions, etc.

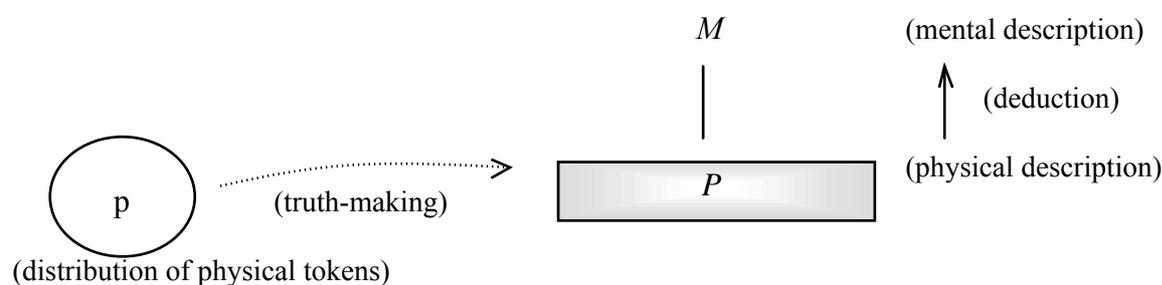


Figure 4: *standard reductionism*

The most prominent version of that reductionism is David Lewis' thesis of Humean supervenience (see Lewis 1986: ix-x). The world is the distribution of physical properties instantiated at space-time points over the whole of space-time. There is nothing but tokens of these properties and their configurations. The distribution of these properties over the whole of space-time makes true a physical description of the world, and from that description can then in principle be deduced all the other descriptions; they refer to and are made true by certain configurations of physical tokens.

The physical properties instantiated at space-time points are perfectly natural, intrinsic and categorical properties. Each element in the distribution of those properties over the whole of space-time is contingent. There are no necessary connections in nature. Thus, there are no dispositions or powers whose manifestations establish necessary connections. The laws of nature are certain salient regularities in that distribution of properties. Causation either is simply one such regularity (Humean regularity theory of causation) or it is a relation being derived mainly from such regularities (theory of causation in terms of relations of counterfactual dependence; the truth value of the counterfactual conditionals in question depends in the first place on the regularities in the distribution of the physical properties over the whole of space-time; see Lewis 1973). This reductionism thus has to accept the whole distribution of the fundamental physical properties in space-time as primitive. Nonetheless, it is a parsimonious ontology, because it has to endorse only that distribution as primitive. Everything else, including laws and causation, can in principle be derived from the description of that distribution.

On the one hand, given that science commits us to the mentioned principle of causal, nomological and explanatory completeness, that austere reductionism is a parsimonious ontology based on science. On the other hand, that position provokes the objection of not being able to take into account what characterizes mental causation. It is at odds with the way in which we experience mental causation, namely our experience as acting beings (agents) in the world. That experience is veridical if and only if there is a causal relation between mental intentions and behaviour such that the intention brings about the behaviour in the sense that the intention makes it that the behaviour in question exists (given certain favourable background conditions in the body of the person and in the environment). I don't know of any non-circular argument for that claim, that is, an argument which does not presuppose this experience described in these or similar terms. What I shall try to do is to illustrate that claim by contrasting it in two respects with what is the case according to the parsimonious, austere reductionist ontology under consideration.

Suppose that I have the intention to raise my right arm and that this intention causes my right arm to go up. What does this mean on this parsimonious, reductionist view? The description "intention to raise one's right arm" refers to and is made true by a certain configuration of physical tokens, and the description "right arm goes up" refers to and is made true by another configuration of physical tokens. The statement "My intention to raise my right arm causes my right arm to go up" is true on a Humean regularity view of causation if and only if configurations of physical tokens of the first type are spatio-temporally contiguous with configurations of physical tokens of the second type in a regular manner. That is to say, whether or not there is a causal relation between my intention to raise my right arm and my right arm going up depends on what there is elsewhere in space-time. The reason for this dependence is that causation depends on laws, and the laws supervene on the distribution of the fundamental intrinsic physical properties over the whole of space-time. If one switches to a counterfactual theory of causation, the account of causation is more sophisticated than a regularity view, but the mentioned dependence remains the same, for the truth value of the counterfactual conditionals mainly depends on the laws.

If the relation between my intention to raise my right arm and my right arm going up is a causal one in virtue of what is going on elsewhere in space-time, that relation being a causal one does not depend on me. Whether or not configurations of physical tokens making true a statement of the type "intention to raise one's right arm" are regularly followed throughout space-time by configurations of physical tokens making true a statement of the type "right arm going up" is nothing which is under my control. The point is not that being an agent may be an extrinsic property instead of an intrinsic one, depending on, for instance, social relations to other agents. The point is that according to the position under consideration, whether or not there is a causal relation between my intentions and my behaviour depends on there being specific intrinsic properties instantiated elsewhere in space-time to which my intentions and my behaviour bear no particular relation apart from similarity. (The argument of Hawthorne 2004 from mental properties against the Humean view of causation amounts to considering these properties as intrinsic; cf. the reply by Weatherson 2004).

What is more, if the causal relation between mental intentions and behaviour is such that the intention brings about the behaviour, then the relation between the intention – or the brain state with which it is identical – and the behaviour cannot be simply the one of a contiguous spatio-temporal sequence. If that sequence is contingent, the existence of each property token

in that sequence is primitive, that is, not grounded on the existence of other property tokens in that sequence. If we acknowledge that the existence of some property tokens in that sequence (those ones that are identical with the behaviour or with parts of it) is grounded on the existence of certain other property tokens in that sequence (those ones that are identical with the intention), then we have to endorse necessary connections. In short, if and only if there is a glue that ties the behaviour to the intention such that the intention necessitates the behaviour (given the mentioned background conditions), then we are agents – instead of simply undergoing contingent sequences of mental and behavioural property tokens that happen to satisfy certain regularities in virtue of what is going on elsewhere in space-time.

Consequently, the parsimonious ontology under consideration cannot admit our experience as acting beings (agents) in the world as being veridical. There is no room for agents in that ontology. The distribution of the fundamental physical properties over the whole space-time, accepted as primitive, can make true statements of the type “Mental intention *m* causes behaviour *p*”, interpreted along the lines of a regularity or a counterfactual theory of causation. But our experience of mental causation in the sense of an experience of agency cannot be accepted as veridical within that position. This objection is important. Mental causation is the argument for mental tokens being identical with physical tokens. However, that argument would be considerably weakened if it turned out that the position which elaborates on that identity is unable to do justice to the way we experience mental causation.

On the one hand, we hence need a metaphysics of causation that is richer than the one of the austere reductionism of Lewis–Hume. On the other hand, there is of course no question of conceiving a sort of causation that contradicts the principle of the causal completeness of the physical. By contradicting a principle to which our scientific theories commit us on all reasonable standards of interpretation, one would block from the beginning any possibility of understanding ourselves as thinking and acting beings in the world. The argument for the identity of mental tokens with configurations of physical tokens stands. However, that argument as such does not imply the sketched austere reductionism and its minimalist conception of causality.

In order to pay heed to the experience and the vision of ourselves as acting beings (agents) in the world, it is necessary and sufficient to conceive causation as a relation of the cause bringing about the effect in the sense of producing it (being its ground of existence). Consequently, the relation between cause and effect cannot be a contingent one, but is necessary: the cause is a power that brings about the effect. This position thus commits us to accepting irreducible powers or dispositions – that is, powers or dispositions that do not supervene on categorical properties. If mental causes are identical with physical causes, it follows that the properties on the fundamental physical level are or include powers. (It does, however, not follow that powers as such possess intentionality: only certain highly complex configurations of physical tokens are identical with mental tokens). (Kim forthcoming also maintains that a theory of causation in terms of regularities or counterfactuals is not sufficient to take mental causation into account; he however limits his consideration of an alternative to the conserved quantity theory of causation (e.g. Dowe 2000); but the mere transfer, transmission or exchange of a conserved physical quantity does not establish a necessary connection in contrast to a simple contingent sequence of spatio-temporally contiguous property tokens).

There are two versions of a metaphysics of powers proposed in the current literature. The one version considers each property to be categorical and dispositional (powerful) in one. More precisely, to the extent that there is a distinction between the categorical and the dispositional, it is a distinction among predicates instead of properties, each property admitting of a categorical as well as a dispositional description (see notably Martin 1997: in particular sections 3 and 12; Mumford 1998: chapter 9; Heil 2003: chapter 11). The other version identifies properties with powers (dispositions). In short, properties are defined by what they do, and what they do is what they are (see Shoemaker 1980 and Bird forthcoming, as well as Ellis 2001: in particular chapters 1 and 3; Ellis, however, admits powers as well as categorical properties as two distinct kinds of properties existing in the world).

The difference between these two versions is not great: the first version does not conceive the distinction between the categorical and the dispositional as an ontological one (so that one cannot even talk in terms of categorical and dispositional aspects of properties), and the second version does not conceive powers as pure potentialities, but as real, actual properties – and thus as categorical in a certain sense. Furthermore, each power can be considered as qualitative in a certain sense, since it is the power to produce certain specific effects.

An ontology of powers is less parsimonious, admitting not only categorical properties, but conceiving these properties as being or including powers. Again, the argument for this position is one of coherence – the philosophical goal of a coherent and complete view of the world including ourselves. If one limits oneself to physics, one can content oneself with a parsimonious ontology that admits only categorical properties (or relations). There is nothing in physical theories that commits us to recognizing irreducible powers. Physics is silent on whether there are necessary connections in nature or whether there are only contingent sequences of property tokens in space-time. It is in the first place the experience of ourselves as acting beings (agents) in the world that is the reason for conceiving causation in terms of powers, having in view the aim of reaching a coherent view of the world including ourselves. Incidentally, there is a link between the two positions set out in this paper on the basis of that argument: if causes are powers producing their effects, one can make a case for the claim that causal processes are asymmetric processes, being directed to the future and thus introducing a direction of time.

If one subscribes to a metaphysics of powers, one can elaborate on the causation argument for token identity in another way than the austere reductionist ontology of Lewis' Humean supervenience. As already mentioned above, identity is symmetric: if all biological, mental, etc. tokens are identical with configurations of physical tokens, then some configurations of physical tokens are biological tokens, mental tokens, etc. How can this be so if some mental tokens are agency tokens? As argued in this paper, this is possible only if there are powers such that the physical tokens and their configurations are or include powers. Once we accept that metaphysical view, we are not only in a position to put forward a reductionism (identity theory) that does not provoke the charge of eliminating anything, but we can also maintain that the entities in the world (the property tokens) make true biological descriptions, mental descriptions, etc. in the same way as physical descriptions. There is only one relation of truth-making that applies in the same way to all true descriptions of what there is in the world. We thus get to a conservative reductionism – reductionism, because all the entities (property tokens) in the world can be described in a physical way, conservative, because some of these

entities make true descriptions other than physical ones in the same way as physical ones, and all these descriptions belong to a coherent view of the world including ourselves.

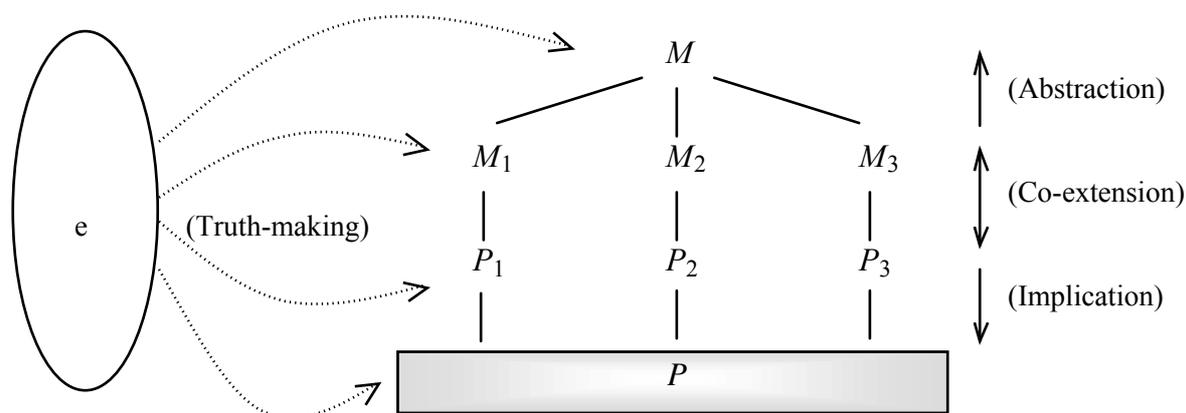


Figure 5: conservative reductionism: “*e*” stands for the entities (property tokens) in the world, “*P*” for a fundamental and universal physical theory, “*P*₁, *P*₂, *P*₃” stand for descriptions in the vocabulary of *P* that are made true by configurations of physical tokens that are identical with mental tokens, “*M*₁, *M*₂, *M*₃” are precise mental descriptions that are co-extensional with *P*₁, *P*₂, *P*₃, “*M*” is a general, abstract mental description (as regards the issue of such co-extensional descriptions, see Sachse 2005 and Esfeld & Sachse 2006).

These brief reflections on the philosophy of mind confirm the conclusion that we have reached in the first section of the paper by considering the philosophy of time:

1) Metaphysics depends on science: science commits us on all reasonable criteria of the interpretation of scientific theories to accept certain philosophical positions – such as the principle of the causal, nomological and explanatory completeness of the physical – and their consequences, such as, for example, the position that mental intentions cannot cause behavioural effects that do not have a complete physical cause as well.

2) One can elaborate on these philosophical positions in such a way that they amount to a parsimonious ontology. That ontology is sufficient as far as the interpretation of physics is concerned. However, when it comes to the philosophy of mind, that ontology amounts to an austere reductionism that provokes the objection of eliminating what is central to our experience of mental causation (experience of agency). Consequently, if one takes that ontology to be complete, one creates a gap between the scientific view of the world and the experience that we have of ourselves as thinking and acting beings in the world.

3) In order to gain a coherent view of the world as a whole, including ourselves, we have to enrich that ontology at its foundations, thus making it less parsimonious – for example, by considering properties as being not only categorical, but as being or including irreducible powers. The criterion of the integration into a complete and coherent view of the world including ourselves is the way in which the interpretation of scientific theories depends on metaphysics.

The methodology summed up in these three theses avoids the oscillation between one the one hand too parsimonious an ontology that takes science as the only guide for metaphysics, thus provoking the objection of eliminating central elements of our experience of the world

and ourselves, and on the other hand a vague pluralism that simply puts side by side the different positions without engaging in an exchange of arguments.

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