



# Biological Energy and the Experiencing Subject

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## Abstract

As physical things have mathematical properties we in this paper let mental things have biological properties. The work is based on recent metaphysical findings that shows that there could be interfaces between separate ontological domains. According to this view there could be mathematical objects, physical objects, and also mental objects. The aim of this study is to establish a view of the biological object that allows it to possibly generate the experiencing subject. Based on the notion that energy per se is related to the ability of a system to do some work, biological energy is defined as a biological object's ability to recover from the load it is exposed to. Introducing the concept of the experiencing subject, the experiencing subject would be the *agent* experiencing the biological object's *need* of recovery from the load it is exposed to. Once established, the experiencing subject may develop non-biological needs. On this basis experiencing subjects have biological properties without being biological in exactly the same manner as physical things have mathematical properties without being mathematical (would that be the case).

**Keywords** Philosophy of mind · Metaphysics · Causal closure · Biological energy · Scientific ontology · Dualism

## Abbreviations

APSNOR	Ability to perceive the signals of need of recovery
BO	Biological object
BOES	Biological object with an experiencing subject
$E_{\max}$	The maximal amount of energy that a biological object can convert to kinetic energy
ES	Experiencing subject
NoR	Need of recovery
SnoR	Signals of need of recovery

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## 1 Introduction

The old question of the relation between body and mind recently has been reopened by Gamper (2017) who showed that the body possibly could affect a non-physical mind indirectly via an interface between the two ontological domains. This possibility was discovered as a result of a redefinition of the classical Principle of the causal closure of the physical universe. In the redefinition a universe is causally closed if it is not causally affected by anything from another universe. This definition of causal closure permits something in a universe to cause something that is not in a universe. Since something that is not in a universe is allowed to cause something in another universe that is causally closed, two causally closed universes can be causally linked via an interface between them.

In (under review) Gamper discusses two kinds of interfaces. Even though interfaces are between universes Gamper distinguishes one kind of interface that is caused by one universe and in turn is causing another universe, from another kind of interface that is caused by a universe but that is not causing another universe. Specifically he discusses a universe  $w_i$  causing an interface that causes a universe  $w_{i+1}$ , as compared to universe  $w_{i+1}$  causing an interface between itself and universe  $w_i$ .

Gamper (ibid.) exemplifies this with the eventuality that a (platonic) mathematical universe has caused the original singularity inside the Big Bang whereas the physical universe causes singularities inside black holes. If such singularities really are interfaces, the Big Bang singularity causes the physical universe whereas black hole singularities do not cause the mathematical universe.

These two kinds of interfaces—Gamper calls them ‘vertical’ and ‘horizontal’—may constitute a conceptual basis for a potential interaction between two separate ontological realms. In (2018) Gamper discusses what the possibility of ontologically different kinds of objects has for the very concept of ‘object’. For our discussion here we can draw upon Gamper’s reflection and ask what a potential interaction between a pre-physical universe and the physical universe entails for the potential interaction between the physical universe and a potential post-physical universe, a non-physical universe of the mind. Following Gamper (under review) the latter kind of interaction would require a vertical and a horizontal interface between body and mind.

In Gamper’s terminology these matters belong to the field of ‘scientific ontology’ (2019). Scientific ontology is the science of investigating what basic assumptions and ontologies that permit interfaces between universes.

When a set of basic assumptions is dressed up in an ontology that permits interfaces between universes the next step is to let science test the ontology empirically (the ontology asserts modal properties for any scientific framework and can thereby be refuted).

In this paper a smaller step is taken. The focus is to pinpoint ‘The unreasonable effectiveness of mathematics in the natural sciences’ (Wigner 1960) and to transfer it to the potential interface between the body and the mind. If there is a mathematical universe, many of its characteristics seem to linger in the physical universe.

The question, in this paper, is what in the physical universe could be found in the potential universe of the mind? Specifically, we will suggest a biological principle that could be found in the potential universe of the mind. The topic, thus, is based in Gamper's discovery of a potential interaction between ontologically different fields.

## 2 From one Interface to Another

The fact that mathematics seems to be, or is, integrated with physics, could be due to physics being dependent upon but separate from mathematics. An argument for this view is that one can imagine a possible world with no physical stuff but in which two and two makes four (this is the platonic view of mathematics), whereas it seems impossible to imagine a possible world with physical objects, in which two apples and two apples did not make four apples. According to this view apples (and all other physical entities) have mathematical properties although they are not mathematical.<sup>1</sup> Analogously, objects of the mind would belong to physical dimensions as well as non-physical dimensions of the mind.<sup>2</sup> Physical objects, on the other hand, would not belong to non-physical dimensions of the mind.

What is missing here in this tentative approach, is an idea of what physical 'things' could be found in the universe of the mind (which we are talking about).

When we look at the mathematics/physics pair we acknowledge that there are no mathematical objects in the physical world. Even so, the physical world seems to follow mathematical laws. The idea that I will argue for is that we have to be very specific when we try to find some common ground for the body and the mind. Concretely I will suggest that the common ground for the body and the mind will be found when we look closer at the concept of 'energy'. Narrowed down the idea is to define an energy tied exclusively to biological objects and then let 'psychic' energy be dependent upon biological energy.

Furthermore, I will let biological energy be tied to a biological object. In the next step I implicitly suggest that the biological object may cause an interface that in turn causes an experiencing subject. On this ground we have biological objects with biological energy and experiencing subjects with psychic/mental energy based and dependent upon the biological object with its biological energy. Finally, I will suggest an experimental design to test the hypothesis empirically.

## 3 Biological and Psychic Energy

### 3.1 Recovery as a Universal Biological Feature

Let us make the claim that biological objects are in a flux; they always change. The idea generally is a perspective on biological homeostasis and specifically frame all

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<sup>1</sup> A practical solution to this would be that mathematical objects and physical objects all reside in mathematical dimensions whereas mathematical objects do not belong to physical dimensions while physical objects do belong to physical dimensions.

<sup>2</sup> To follow the thought through, objects of the mind then perhaps also would belong to the dimensions of mathematics?

biological processes that promote homeostasis to be the biological object's efforts to recover. Since biological individuals are hard to define we let the term 'biological object' be undefined.<sup>3</sup> Its meaning, however, is meant to be humans, dogs, rats and other more developed biological organisms as well as less developed ones but not artificial systems as computers, robots et cetera.

### 3.1.1 Biological Energy

A general definition of energy is that energy is tied to the object's ability to do some work.<sup>4</sup> We see here that energy is directly linked to an object (or, more precisely, to a system). So, biological energy would be the ability of a biological organism or a biological object to do some work. At closer inspection this can be further analyzed into two parts: the objects potential ability to do some work and the actual work being done by the object.

In physics we talk about an object's energy of *position*, or, *potential* energy, and its *kinetic* energy. An object gains potential energy if it is positioned higher above the ground and it can use the energy to gain speed (kinetic energy). A steel ball that is moved in this way is intact and "has" and "loses" energy while remaining the same object. The opposite is true if we look at nuclear energy. When we extract nuclear energy (in a power plant for instance) the object losing energy does not remain the same. Obviously, therefore, there are two kinds of energy in regard to a system or an object. The one kind permits the object to gain and lose energy while being intact, or "the same" object, whereas the other kind of energy destroys the object carrying the energy if it is used.

Concerning biological objects this distinction is crucial but previously unnoticed in the literature. Traditional "biological "energy is, as it seems, mixed up with *chemical* energy. A typical example is the following:

Strictly speaking, "biological energy" ought to refer to the chemical potentials produced and consumed by the myriad and interwoven reactions that take place within the compartments of living matter as it... well, lives! But these processes are perhaps better known, collectively, as metabolism.

We use the phrase "biological energy" as a convention to refer to a specific social and technological endeavor: to use the metabolic capacities of organisms to convert some combination of light, biomass, organic compounds, gases and water into useful chemical-bond energy; i.e. storable, transportable, energy yielding molecules as well as industrially useful materials. Examples include hydrogen, methane, alcohols, ammonia and bioplastics. (Massachusetts Institute of Technology, mission statement from the biological energy interest group, 2019)

<sup>3</sup> "The impressive variation amongst biological individuals generates many complexities in addressing the simple-sounding question *what is a biological individual?*" (Wilson et al. 2019).

<sup>4</sup> *Fundamentally, all energy is related to the ability of a system to do work.*" (Anslyn and Dougherty 2006, p. 66).

What we look for, instead, is a concept of biological energy that permits the object to do some work while remaining intact. It should therefore correspond to the concepts of potential and kinetic energy in physics.

**3.1.1.1 Biological Energy as the Organism's Ability to Recover from Load** Since there is no concept of biological energy in the literature, in the sense discussed here, the first step towards such a concept is a leap into the unknown. From an abstract perspective, however, we can construe *all* biological activities as efforts of biological organisms to recover from load upon them. From here the next step is easy. We let biological energy be defined as the biological object's ability to recover from load upon it.

**3.1.1.2 Two Kinds of Biological Energy** The suggested definition of biological energy is that biological energy is the biological object's ability to recover from load upon it. The biological object, therefore, has an absolute maximal amount of biological energy that it can use to recover. Let us call that amount  $E_{\max}$ . For a specific biological object  $i$  ( $BO_i$ ) we could adopt the notation  $E_{\max}(BO_i)$  to denote the maximal amount of ability to recover that the biological object has.

One part of  $E_{\max}$  is energy that could be used but that is not used at the moment. This is analogous to potential energy in physics and we will use that terminology here too. The ability to recover that the BO has that is not in use is its *potential* biological energy. Likewise, we adopt the term *kinetic* energy for the part of  $E_{\max}$  that is in fact being used at a given moment. Kinetic biological energy is the very recovering going on.

### 3.1.2 Load

For practical reasons we will not say much about load as such. The basic assumption is that biological organisms constantly need to recover and they need to recover from the load that is put on them. One thing, however, must be sorted out immediately. We have discussed that ability to recover, or, energy, is related to load. We have also stated that the organism has an amount of energy, at any given moment, that it either uses or has to its disposal, or any mix of the two. The thing that has to be sorted out is the relation between load and energy.

### 3.1.3 The Organism's Need of Recovery

As noted above the basic assumption is that biological organisms constantly need to recover and they need to recover from the load that is put on them. We can therefore postulate that load and need of recovery has a positive relation; the more load, the more need of recovery. We can now use the concept of need of recovery to link load to energy or ability to recover.

As need of recovery can be thought of as increasing with load up until a point where the organism simply collapses (dies), the organism's level of kinetic energy will not increase in the same manner. On the contrary, kinetic energy has its

maximum at  $E_{\max}$ . When the kinetic energy is at  $E_{\max}$ , the organism has no potential energy and if load continues to raise the organism will not be able to recover as much as it needs to. This produces a backlog of need of recovery.

### 3.1.4 Reduced $E_{\max}$ at High Levels of Load

An implicit basic assumption behind the energy-concept is that biological organisms allocate resources for recovery continuously. The organism allocates more resources for recovery purposes, if it can, the more it needs to, that is, the more load there is. At low levels of load, therefore, the kinetic energy is low whereas the potential energy is high. At intermediate levels of load the kinetic energy also is intermediate. At the same time the level of potential energy is intermediate. At a certain point of (high) load the level of kinetic energy meets  $E_{\max}$ . If load increases beyond that level  $E_{\max}$  is reduced.

### 3.1.5 The Relation Between Load and Kinetic Energy

The hypothesis, thus, is that need of recovery has a positive relation with load. We have also seen that the kinetic energy raises with load up to a point,  $E_{\max}$ , after which the level of kinetic energy decreases since all energy is absorbed by the kinetic energy and  $E_{\max}$  is reduced with load. At low and moderate levels of load, thus, the level of kinetic energy matches what is needed for recovery. When load exceeds what is possible to recover from right away the level of kinetic energy decreases. At the point of  $E_{\max}$ , thus, load is optimal for the level of kinetic energy.

On the basis of the concept of the biological energy of the biological object, we now can go on and look at our options to transpose the concept of the biological energy of the biological object to a concept of psychic energy of an experiencing subject.

## 3.2 The Experiencing Subject

The basic idea, thus, is that an experiencing subject is grounded in a biological object and that the link between the two goes through the concept of energy. We are not stating what the potential interface would be. We just try to establish a concept of psychic energy. The very experiencing subject will be undefined just as we let the biological object be undefined. The first step, thus, is to assume that we have an experiencing subject that is grounded in a biological object.

The path to how the relation between the biological object and the experiencing subject can be conceived is established by way of the suggested concept of biological energy as the biological organism's ability to recover from load. With help of the intermediate concept of need of recovery (NoR), we can picture the kinetic energy of the organism raise with load up until a point after which the kinetic energy decreases with load. Increased load after  $E_{\max}$  leaves the organism with a backlog of NoR and the organism's ability to recover is lowered.

On an ontological level the NoR of a biological object (BO) is an abstraction. When it comes to a BO with an experiencing subject (ES), however, we acquire a

possibility to make the NoR less abstract. Initially, however, NoR is abstract also for a BO with an ES (a BOES). The BOES is basically in the same relation to its NoR as the BO is. The concept of the BOES, however, opens up for an adjoining concept of *signals* of need of recovery (SNoR). This is because if there is an experiencing subject it can perceive signals of need of recovery. Without an experiencing subject no one can perceive anything. *With* an experiencing subject, however, we can postulate a one-to-one relation between NoR and SNoR, and replace NoR with SNoR in our model (when it is applied on BOESs), without needing to do any further adjustments. The relation between load and kinetic energy is the same for BOs and BOESs. The difference is what the intermediate dimension is. For BOs it is NoR and for BOESs it is SNoR.

Looking at this closer we can see an analogy between mathematics/physics and biology/psychology. The relation, for example, between the area of a square and its sides is the square root. In mathematics, however, there is nothing that has an area or a length of a side of something. In the physical world, nevertheless, there are things with lengths and squares have sides with the length of the square root of their areas. The analogy is that biological objects have NoR in principle but experiencing subjects have real NoR.

### 3.2.1 Itches and Pains

In our most simple model of the energy of the biological object itches, for just focusing one of the two in the paradigmatic philosophical pair of ‘bodily sensations’, takes an ES to be accounted for. The load should relate to a need for scratching. In a BO without an ES there is no itch since no one can perceive the sensation. In a BO without an ES, therefore, there is only a need to scratch and if the object can scratch it will scratch. The need to scratch without an ES has no sensational basis. A BOES, on the other hand, may have the same need to scratch but the very scratching is mediated by the signals of the need to scratch. Those signals are the itching. In this model, therefore, the old debate as to the significance of experiences (itches in this case) is closed when it comes to BOESs. The importance of experiences is paramount when it comes to BOESs. For BOs the need to scratch leads to the scratching.<sup>5</sup> For BOESs the itching leads to the scratching.

### 3.2.2 The Impact of the Signals of Need of Recovery (SNoR)

The dimension of SNoR replacing NoR does not change anything in relation to the correlation between load and kinetic energy. The interest, however, instead is focused on behavioral aspects of the BO and the BOES, respectively, in regard to load/kinetic energy.

<sup>5</sup> To complicate things further it should not be necessary that the subject *knows* that it has an itch. If we require the subject to have such higher order function in order to experience the itch, we exclude the possibility of there being experiencing subjects without self-awareness. If we allow such subjects, however, we cannot assert them having experiences without basing the assertion on an undefined concept. This since we cannot ask them.

Leaning only on kinetic energy, load, and NoR/SNoR we have no reason to consider behavioral differences between BOs and BOESs since the correspondence between NoR and SNoR is assumed to be one-to-one. The difference between a BO and a BOES, however, is, of course, paradigmatic. We can articulate the difference by introducing a most obvious additional dimension. NoR in the BO case leads to recovery measures. SNoR in the BOES case, however, leads to behavioral conduct insofar as the SNoR are *perceived*. Crucial here, thus, is that NoR in the BO case is an abstract dimension having no behavioral impact. SNoR in the BOES case, on the other hand, is not an abstract dimension. The signals are real. Also, they are only acted upon to the extent they are perceived.

A biological organism without an experiencing subject per definition cannot act upon signals of any kind, nor act upon signals of need of recovery. Such an organism, therefore, who is in need of nutrition, will eat if it can. A biological organism with an experiencing subject, on the other hand, will eat if *three* conditions are met: first, it has to have signals of need of recovery, in this case have hunger. Second, it must be able to eat. Third, and this is where a BO and a BOES really differ, the BOES has to be able to perceive the hunger it has. Biological objects and other objects without ESs, on the other hand,—computers, stop lights, and thermostats alike—neither have signals of need of recovery, nor do they have any ability to perceive such. They, per definition, have no experiencing subjects and do not have anything to experience.

The impact of SNoR, therefore, is dependent on the subject's ability to perceive the SNoR. The subject's ability to perceive the SNoR will be postulated to have a negative relation with load. This is to say, the more load the less ability to perceive the SNoR (APSNOR).

The dimension of APSNoR gives us the possibility to make predictions as to how BOESs will behave depending on the level of load. The postulation of the dimension in itself may be commented with reference to everyday experiences of difficulties to feel hunger under high stress, but it is also important to remember the categorical difference between BOs and BOESs. A computer, for instance, simply cannot suffer. The BOESs can suffer and the APSNoR mitigates the impact of high level of load so the situation for the BOES becomes more manageable under high levels of load.

This “mitigating” dimension, however, has a profound behavioral impact on the BOES. While the BO recovers as much it needs and can, the BOES will tend to recover more willingly at low and moderate levels of load. This is due to the high level of APSNoR. Small increases of load are highly detectable and will be met by recovery measures. At high levels of load, on the other hand, the *low* level of APSNoR will make the BOES more reluctant to recover. This is due to the accumulated backlog of SNoR. The backlog of SNoR is a source of difficult signals of NoR. The more the BOES recovers, the more it can feel the signals. This, of course, is more of a problem at rather high levels of load, when the backlog is considerable and the BOES's kinetic energy is low.

### 3.2.3 Conclusion

The very simple model that we have built appreciates the fundamental difference between biological objects with and without an experiencing subject. The difference is spelled out in two steps. First, the BO recovers as much it needs to and can, while the BOES's incitement to recover comes from signals of need of recovery. This is to say that while the BO eats when it needs to the BOES eats when it is hungry. Second, the BOES ability to perceive the signals of need of recovery decreases with level of load. While this drives it to really take care of itself at low levels of load it also drives it to push itself at high levels of load. The risk, therefore, is that the BOES, besides, naturally, that it can *be pushed* towards high levels of load, can push *itself* towards high levels of load.

## 4 An experimental design

### 4.1 Subjects

Humans, dogs and rats (and/or more suitable subjects for the design).

### 4.2 Method

Subjects are placed on a treadmill.

The speed of the treadmill is increased step by step.

Measuring the heart rate the speed is increased when the heart rate is adjusted to the previous speed. At some speed (coupled with duration)  $E_{\max}$  is reached.

Further increases of the speed will build up a backlog of need of recovery.

Lowering the pace step by step will eventually enable the subject to recover from the backlog.

### 4.3 Prediction

Higher order biological objects will show delayed recovery.

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