Self-Identities and Durability of Biosystems via Their Abstracting Capacity

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Abstract
Any surviving organism is unique in abstracting and holding its self-identity as experiencing and processing different individual events of a concrete nature. The organism that can survive maintains its self-identity as abstracting its own durability as a class property out of those different individual events to be met and processed. Rather, the organism has the internal propensity of making its own actualization durable while processing the material resources available that are individually distinguishable. Biology is distinctive as compared to physics in availing itself of the synthesis of organization with use of the material act of measurement as a form of abstraction.

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1. Introduction
Robustness of material organization to be grasped to the extent beyond the scope of being comprehensible physically is a major challenge confronting the transition from physics to biology at least on the phenomenological level. One pressing agenda in this regard is how one could descriptively make an access to a plain fact of the survival of an organism as an individual and also as a species. This problem would become most acute when the origin of life is focused upon. At issue is a critical scrutiny of the nature of the available trustworthy means that may be competent enough to describe something durable.

One well-known prototype for addressing durability appearing in nature is Galileo’s inertia. If one accepts the abstraction of a friction-less sliding movement of a material body on a horizontal plane as Galileo Galilei did, the durability of the sliding movement can be associated with the class property called inertia latent in that material body. There has been no argument against the prevalence and ubiquity of inertia in mechanics. Despite that, it would be a bit too hasty to associate inertia directly with the durability observable
in the biological realm.

A major objective of this short article is to propose another descriptive scheme which may be able to refer to durability other than inertia. Its crux will be found in the reappraisal of the notion called conditional probability. Referring to conditional probability enables us to see that the act of measurement necessarily participates in fixing the probability of an event given the observation of another event having occurred by assumption or evidence of whatever sort. Above all, the occurrence of a conditional probability of unity can be associated and synonymous with the availability of a durable agency that can set and identify the condition as such. No conditional probability is conceivable unless the agency setting the condition, whether the mathematician or whatever else for this matter, is likely. At issue will be whether there could be a likelihood for making the conditional probability to asymptotically approach unity on the material ground alone.

2. Conditional probabilities

When we write the probability of the occurrence of event \( A \) under the condition of the occurrence of event \( B \) as \( P(A|B) \), Kolmogorov's definition of conditional probability will tell us the equality \( P(A|B) = \frac{P(A \cap B)}{P(B)} \) in which \( P(A \cap B) \) is the joint probability of the product event \( A \cap B \) and \( P(B) \) is the probability of the occurrence of \( B \) (Kolmogorov, 1956). One concrete implication of this definition will be \( P(A|A) = 1 \) if \( B \) happens to be \( A \), since the product event \( A \cap A \) is identical to the event \( A \).

Needless to say, the content of \( P(A|A) = 1 \) would remain simply vacuous as a tautology if the two events of \( A \) appearing in the expression belong to the same type. The class property as a type remains invulnerable in and of itself unless acted upon otherwise from the outside. Once a type \( A \) as a class property is accepted as such, it will remain as it is. Formal logic underlying Kolmogorov's axiomatic theory of probability that has already been established in the mathematical discipline is exclusively about types and is tenseless, thus making any class property appearing there also tenseless.

Nonetheless, there may also be another possibility such that conditional probabilities could be conceivable even if each event is referred to as an individual concrete token, instead of being limited to a type representing a general universal class, under the conditions which may be temporal in their qualification (Ulanowicz, 1999, 2009). In fact, what can be specified there temporally is concrete particulars, rather than types of a general universal character that remains tenseless, because of the participation of the empirical act of measurement. Measurement, whatever it may be, is about the material activity of an abstraction as encountering and processing concrete particulars. Durability imputed to concrete individual events may thus be made envisaged if a class property can
be abstracted from them. What is more, the class property conceivable from the participating individual events has the internal propensity for being durable of itself with a probability of unity unless it is forcibly disturbed externally. In particular, a concrete particular event may be seen durable if it happens to equip itself with a class property that is already durable on its own.

Galileo’s observation is unique in abstracting the class property called inertia from the temporal succession of a concrete individual material body in movement while keeping it immune to any influences of external origin. The mere tautology \( P(A|A)=1 \) will then gain a new empirical implication if an individual event of a concrete nature happens to be associated with a class property occurring with a conditional probability of unity. Once an individual event is associated with a class property, it can be seen as being durable thanks to the very nature intrinsic to the durability of the class property. Despite that, Galileo’s inertia is not the only case of durability to be abstracted from concrete particulars.

There could also be one more possibility of abstracting the durability as a class property under the condition of the prior occurrence of an individual event \( A_1 \) followed by another individual event \( A_2 \) differing from the prior \( A_1 \). The underlying premise is such that there should be an intervention of a material agency of internal origin being capable of abstracting the invariable class property while mediating between these two different individual events. Whether such a material agency functioning as a durable token processor could exist at all must totally be an empirical issue. In essence, that is about the empirical likelihood for the occurrence of an agency processing both resource intake and excretion. Put it differently, the equality \( P(A_2|A_1)=1 \) implying a conditional probability of unity may apply to such a mediating agency occurring with a probability of unity since the agency can process both \( A_1 \) and \( A_2 \) on its own behalf in a durable manner. Rather, both the events occur in succession so that they may participate in holding the invariable identity of the concerned material agency.

A simple example of the equality \( P(A_2|A_1)=1 \) of empirical relevance is that the material body processing the two different individual events \( A_1 \) and \( A_2 \) in a successive manner is going to keep the same identity. A possible scheme for keeping the identity is such that its component elements may be exchanged with the different component elements belonging to the same kind in the process. As a matter of fact, any material body to be maintained through the constant exchange of the component elements belonging to the same kind can hold its own class identity. The component elements to be exchanged remain individually different and distinguishable among themselves.

Accordingly, the tautological expression of \( P(A|A)=1 \) in terms of the class identity
alone can now gain a de novo empirical signification when it is expressed as $P(A_2|A_1) = 1$ in terms of concrete particulars. This expression of the conditional probability in terms of concrete particulars points to the agential activity of abstracting the durability as a class property for its own sake. The two different individual events $A_1$ and $A_2$ are concatenated in a successive manner with a probability of unity. This is because the class property, once reached and extracted as such as processing the individual events, remains durable. The equality $P(A_3|A_2) = 1$ will then also hold if the follower $A_3$ differing from both $A_2$ and $A_1$ is taken to belong to the same class by the concerned agency, and ad infinitum in a similar manner.

In particular, what is prerequisite to the holding of a class identity in the face of meeting different individual concrete events in an alternating manner is the participation of an agency that can keep its own identity as processing those different individual events. The sustainable agency being competent in abstracting the durability as a class property from experiencing the different individual events can thus equip itself with the propensity for recruiting those different events on its own behalf. For the agency abstracting the same class property out of the participating different individual events in a durable manner is selected for. It is guaranteed to occur with a probability of unity thanks to the class property that is durable in and of itself unless disturbed forcibly externally.

Inertia is unique in requiring no agency of abstracting a class property of duration from each individual material body other than the physicist overseeing from the outside. In contrast, one more class property of duration grounded upon the occurrence of conditional probabilities explicitly requires the material agency of abstracting the class property from the participating different individual events. Rather, the emergence and evolution of the durable material agency occurring with a conditional probability of unity could eventually be selected for empirically. This could be likely unless the prohibitive stipulations are applied externally in an overwhelming manner as with the case of imposing the condition of thermal equilibrium forcibly.

If an abstraction of the same class property is likely from a temporal sequence of different individual events, the material agency in charge of such an abstraction could be selected for in the end with a probability of unity. That is because of the synthesis of the durability from an abstraction (Matsuno, 2013). As a matter of fact, the basis of such an abstraction is upon the process of measurement since the latter is already an instance of abstraction. A typical example demonstrating the measurement as the form of an abstraction is seen in Everett’s relative state formulation of quantum mechanics (Everett, 1957).

A sequence of individual events occurring with a conditional probability of unity one
after another comes to uphold the material agency possessing the durability unique to itself. Conversely, the material agency comes to take advantage of the temporal sequence of different individual events for the sake of holding its own identity.

In a nutshell, the robust durability of a material agency processing both resource intake and excretion rests upon the closure of efficient causation in a successive manner indefinitely (Rosen, 1991). Resource intake is a cause of excretion, while at the same time excretion is also a cause of resource intake. That is to say, the input is a cause of the output, while the output is a cause of the input though not in a concurrent manner. This closure is equivalent to saying that excretion anticipates resource intake and resource intake also anticipates excretion. More specifically, the closure as a cycle is a material embodiment of abstraction in the sense that the identity of the cycle remains invulnerable to the exchanges of the component atomic elements of the same kind. Durability as a class property rests upon the instantiation of the closure of a cycle, rather than the other way around. A reflexive loop of the measurement thus makes abstraction of an invariable class property feasible through disregarding the individual differences among the component elements belonging to the same kind.

What underlies the empirical possibility of a conditional probability of unity between resource intake and excretion is to relate the most probable causation to the most likely anticipation. This coupling between the causation and the anticipation is already implicit in Bayes’ theorem relating the posterior probability of causation to the likelihood function of anticipation. The mutual enhancement of both causation and anticipation through the positive feedback between the two would make the reflexive loop of the measurement durable and robust enough. That is to proceed, of course, without offending various facts already established in quantum mechanics and non-equilibrium thermodynamics.

The likelihood for the occurrence of the material agency abstracting the durability as a class property as experiencing the different individual events would thus make the functional operation of biology unique as compared to physics.

3. Experimental confirmation
One example pointing to the direct reference to a class property of molecules rather than to the concrete particular attributes of each participating molecule is the bacterial chemotaxis. The unicellular organism such as *Escherichia coli* demonstrates the affinity toward glucose molecules. What is specific to glucose molecules as the chemoattractant is that it is the unicellular organism which abstracts the chemoattractant as an invariable class property from glucose molecules while experiencing each glucose molecule individually and differently in a distinguishable manner.
In particular, the likelihood of the unicellular organism as a durable material agency abstracting the same class property out of the participating individual molecules, that are different and distinguishable among themselves, can critically be examined if the organism is placed under nutritionally deprived and adverse conditions (Cairns et al., 1988). Insofar as the organism, for instance, one strain of *E. coli* called *FC40*, can survive under such stress and adverse conditions (Foster, 2000), it would have to adapt its self-identity to the harsh conditions while revising the class property of the nutrients to be figured out of the then available substrates of a deficient quality. In fact, the strain *FC40* that could not have initially metabolized lactose molecules could happen to come to digest them in the course of time development when no other chemoattractants such as glucose were present. A promising material vehicle available for this objective is adaptive mutation.

The likelihood of the durable material agency grounded upon the class property of duration is, however, not limited only to the evolutionary stage after the emergence of unicellular micro-organisms. One possibility in this direction might be the prebiotic likelihood of the emergence of a reaction cycle under the geothermal conditions conceivable on the ocean floor of the primitive Earth, of course, in the absence of enzymes of biological origin.

When a reacting molecule $A$ placed in a certain reaction environment is transformed into another molecule as being subject to various chemical affinities originating from the immediate neighborhood, the likely outcome, reactant $B$ must be the one that is most rapid in the transformation among the possible contenders. There remains no chance left for the slower contenders. The quickest-transformed $B$ will similarly be subject to various chemical affinities from the immediate neighborhood and subsequently yield another quickest-transformed $C$. As repeating the process of the quickest transformation, the possibility may arise of forming a cycle as letting the quickest-transformed $Z$ be further transformed back into the original $A$.

Once the transformation sequence constitutes a cycle, the resulting reaction cycle can function as an agency abstracting the sameness of the cycle itself as the class property out of the participating substrate molecules that could be individually different with each other. The reaction cycle that is about a class property is already an abstraction by itself since the component atomic elements constantly come and go. An abstraction underlies the occurrence of a class property.

The class property is unique in keeping the propensity of holding itself with a probability of unity unless perturbed forcibly externally. Once a material agency being competent in abstracting a class property out of the participating individual events
happens to appear, it may survive thanks to the durable sameness of the derivative class property. The reaction cycle would then repeat itself with a probability of unity with use of the chemical affinities latent in the reaction environment.

Moreover, each reaction step round the cycle is also to occur with a probability of unity since the likely reactant to appear there is the quickest-transformed one among the possible alternatives. Both implementation of the quickest transformation in each reaction step and holding the reaction cycle as a whole with a probability of unity with use of the durability as a class property thus derived are reciprocal in supporting each other. This perspective can be confirmed even in an actual experiment attempted for an abiotic operation of the oxidative citric acid cycle in the laboratory (Matsuno, 2012). As a matter fact, the durability as a class property to be abstracted is rooted in the continuous survival of the cycle as constantly mediating between the two different individual events; one is to feed upon the acetyl group released from each pyruvate molecule as a resource and the other is to let the carbon dioxide molecules as an excretion to go out of there.

The experimental demonstration of a reaction cycle is just a material manifestation of the agency abstracting the durability as a class property out of the participating individual substrate molecules with a probability of unity. Utilizing the durable sameness of the class property may also be advantageous for the evolutionary onset of replicating polynucleotides and polypeptides and for the evolutionary fixation of membranous structures compared to the cases otherwise, since all of these are about the class properties abstracted from the participating individual molecular events.

A biological significance of the durability as a class property can further be enhanced by processing those individual events which can already incorporate into themselves a certain class property on the lower level, as revealed in the appearance of a new class by means of, say, horizontal gene transfer.

4. Concluding remarks
Both physics and biology concern themselves with something durable. Such a durability is sought in the class property common to the relevant individual events participating there, since the latter alone can be variable or even ephemeral in some cases. An advantage of focusing upon the class property is on its durable sameness unless it is acted upon otherwise. In this regard, the transition from physics to biology is unique in paying attention to the role of a material agency being capable of abstracting the durability as a class property from the approachable and available individual events strictly on the material ground. Biology takes advantage of the synthesis with use of the agency of abstraction of a material origin, in contrast to physics in which only the physicists
monopolize the agency of abstraction.

It is thus historically interesting to observe that Aristotelian physics is concerned with concrete individual events as addressing the transition between potentiality and actuality at the expense of their common class property. Galilean physics, on the other hand, legitimately pays attention to the class property of each individual event as focusing upon the efficient and material causes at the expense of the formal and final causes. Alternatively, contemporary biology suggests to us the likelihood of arriving at the durable class property through the material act of measurement as the form of an abstraction as processing distinguishable concrete individual events.

References