Center for Open Access in Science ▪ https://www.centerprode.com/ojsp.html
Open Journal for Studies in Philosophy, 2025, 9(1), 33-44.
ISSN (Online) 2560-5380 ▪ https://doi.org/10.32591/coas.ojsp.0901.03033m

A Hylomorphic Analysis of the Problem of Persistence and Identity of Objects

Henrique Ribeiro

The University of São Paulo, Department of Philosophy, São Paulo, BRASIL

Received: 10 May 2024 ▪ Revised: 30 June 2025 ▪ Accepted: 7 July 2025

Abstract

This article aims to analyze the problem of the identity and persistence of objects based on the hylomorphic doctrine, that is, the doctrine according to which objects are mereological compositions of the elements of form and matter. After introducing the contemporary discussion on the problem of identity and persistence and identity of objects, we propose a brief formalism of the logic of the relationship between part and whole or mereology to define the solution to the problem under study that defines a possible solution for it.

Keywords: identity, persistence, mereology.

1. Introduction

How do physical objects persist over time through the natural changes of their constituent parts? This question is one of the central questions of contemporary metaphysics. It was indicated by the famous example of the ship of Theseus. Theseus' ship walks on the sea and has its parts replaced as the journey progresses. Then it arrives at its destination with all or a set of its parts replaced. How can we say that the ship that arrived is the same ship that left? Another example is the river of Heraclitus; The waters of the river flow over time, so can we bathe in the same river twice?

There are arguments to explain the persistence and identity of objects with their changes over time. Such arguments are for or against two well-defined theses: endurantism and perdurantism. They seek to answer the question: how does a material object persist over time? We have four answers to consider here; There are others of course, but these four are the ones that touch us the most. Perdurantists of the perdurantist thesis consider that material objects are extended in four dimensions (three spatial and one temporal) and are composed of temporal parts. In this case, persistence over a time interval is a matter of being partially present at different times in such an interval. Endurantists of the endurantist thesis consider the material object to be an extensive entity in three dimensions (all spatial). Persistence over a time interval is a matter of being localized at different times in that interval (that is, being multi-localized in a series of non-simultaneous three-dimensional regions). Stage -*theorists* consider the persistent material object to be an extended entity in three dimensions (all spatial). In this case, persistence over a time interval is a matter of having certain counterpart relations concerning other objects located at different times in that time interval. Regionalists of the regionalist thesis consider a persistent material object to be an entity extended in four dimensions (three spatial and one temporal) but

Correspondence: Henrique Ribeiro, The University of São Paulo, Department of Philosophy, São Paulo, BRASIL.

remain neutral about whether or not it has commitments to parts of its own (whether spatial or temporal). In this case, persistence over a time interval is a matter of bearing a location relation concerning a region that intersects more than one time, that is, the region containing points in more than one hyperplane of the block that remains the object in question.

Lewis (2001: 202) puts the main theses of endurantism and perdurantism as follows:

> The question of the intertwining of parallel worlds the mundane problem of identity across time; and our problem of accidental intrinsics is parallel to the problem of temporal intrinsics, which is the traditional problem of change. Let's say that something *persists* if and only if, in one way or another, it exists at various times; this is the neutral word. Something *hardens* if and only if it persists by having different temporal parts, or stages, at different times, although no part of it is fully present at more than one time, whereas it *hardens* if and only if it persists by being fully present at more than one time. what a while. Perdurance corresponds to the way a road persists through space; part of it is here and part of it is there, and no part is fully present in two different places. Endurance corresponds to how a universal if such things exist, would be fully present wherever and whenever it is instantiated. Enduration involves intertwining: the content of two different tensions has the endurant thing as a common part. Duration does not.

Thus, according to the endurantist thesis, physical objects persist and are identical through time, being three-dimensional and being fully present in space. According to the perdurantist thesis, also called four-dimensionalist, objects have a temporal dimension and, therefore, are only present temporally according to their parts. A widely debated aspect is the relationship between endurantist and perdurantist change with Leibniz's principle of identity. In mereological terms of proper parts of a physical object, Leibniz's principle can be described according to Varzi's presentation [2009, formula 27]:

$$(\exists zPPzx \vee \exists zPPzy) \rightarrow (x=y \leftrightarrow \forall z(PPzx \leftrightarrow PPzy)).$$

in which, for example, PPxy is interpreted in natural language as `x is a proper part of y' and says that two physical objects x and y are identical if and only if they have the same proper parts PP. Now, change can contradict Leibniz's principle because an object can change in time with its temporal parts and remain identical to itself.

Having presented the definitions of the varieties of endurantism and perdurantism, let us now consider the negative arguments of these varieties in the context of the debate about the identity and persistence of objects in metaphysics.

2. Arguments against enderantism and perdurantism

Endurantism can have varieties to avoid contradiction with Leibniz's principle, but the solutions have been problematic with the problem of temporary intrinsics. Perdurantism or four-dimensionalism, according to some objections in the literature, seems to be counter-intuitive because the objects of common experience in common sense have three dimensions. So, it appears that, based on current discussions, another solution appears to be required to deal with the problem of object persistence and identity. Let us consider further the objections to endurantism and perdurantism. As Costa (2022: 10) explains:

> The first serious objection against endurantism that goes back to ancient philosophy... comes from change. In its simplest form, the objection sounds as follows. Change seems to require difference: if something has changed, it is different from how it was. But if it is different, it cannot be identical, under penalty of contradiction. Well, endurantism requires that something that changes be identical throughout the change, so, the objection goes, endurantism is false. In this simple form, the objection has a simple answer, which is based on the distinction between

> qualitative and numerical identity outlined. The kind of difference required by change is qualitative difference (not being perfectly identical), not numerical difference (being two instead of one). Therefore, in a change, you can be the same as before (numerical identity) as well as different from before (qualitative difference), without this being contradictory.

Thus, endurantism can face the objection and explain the change of qualitative properties over time. Perdurantism also has an interesting objection relevant to our purposes, as Costa continues (2022: 20):

> First, we should wonder: why is endurantism supposed to be more intuitive than perdurantism? What aspects of perdurantism are supposed to be counterintuitive? Perdurantism implies that when we see a tree or talk to a friend, what we have in front of us would not be the whole tree or the whole friend, but only parts of it. This also implies that objects are extended in time just as they are extended in space and just as an event is supposed to be. These mereological and locative consequences of perdurantism are supposed to be counterintuitive; Intuitively we would say that what we have in front of us in the cases described are a whole tree and a whole person and that we are extended in time as in space or as the events are supposed to be.

Thus, perdurantism can be objected to as being counterintuitive to the common sense that objects have three dimensions.

We can highlight here two responses to the problem of persistence and identity of objects. A hylomorphism or substantial doctrine and a doctrine of processes. Let us briefly consider each.

Regarding process theory, Seibt (1997: 20) states that:

> Ontological process theory differs fundamentally from any familiar process-based scheme. In this theory, called DMT (Dynamic *Mass Theory)*, all entities exist as four-dimensional or less four-dimensional activities and are more or less geometric, as in the limiting case. The main examples of mass dynamics are `subjectless' activities, that is, activities not performed by a subject, whether animate or inanimate, as is the case of an electromagnetic wave traveling in space... These complexes of subjectless activity and parts of such complexes are the ontological categorizations for the denotations of our familiar discourse about different types of changes and entities that change; generations, destructions, locomotions, activities linked to subjects, actions, forms, phenomenal qualities, masses, collections, things and people, etc.

Thus, Johanna Seibt's theory opposes Aristotle's theory of substance to a classical ontology and adopts a dynamic ontology of perdurantist or four-dimensional processes. But we saw that four-dimensional or perdurantist theories are subject to the objection of being counter-intuitive and such a theory would only explain the change in accidental properties of substances.

There are in Aristotle, in the famous Metaphysics, books G, D, and Z, as well as the intentional mereology of occurrences and continuants, which are objects whose parts change over time, some important elements for understanding the persistence of objects with time. Initially, we can highlight that the concepts of form and matter of physical objects would support a view that these are constitutive parts of objects and can be a reference to raise and confirm the hypothesis that the mereological hylomorphism, according to which objects are preeminently made up of formal and material parts, is capable of solving the problem of the persistence and identity of objects.

The substance theory of neo-Aristotelian mereological hylomorphism, in our view, still has the advantage over Seibt's dynamic mass theory for actually explaining the persistence and identity of objects in a way that does not contradict the common sense that objects are fully present in space and present an essential form that captures the persistence and identity of objects. In our

view and as we intend to detail throughout the development of this project, the dynamic mass theory would only explain the change in accidental properties of objects.

Thus, the present article consists fundamentally of raising and confirming the hypothesis of mereological hylomorphism together with the essentialist supplementary hypothesis as a solution to the problem under study that overcomes the aforementioned limitations of enduranceism and perdurantism previously highlighted, since our hypothesis is based on the notion of property of the essential form of the substance and not merely in the change of common properties of objects as presupposed by endurantism and perdurantism. Our research contribution to the debate on persistence and identity constitutes the presentation of a theory of persistence and identity in the direction pointed out by the works of Koslicki (2006) and thus offering a more detailed mereological treatment of neo-Aristotelian mereological hylomorphism and applied to the problem in question. study. We intend to point out that there are gaps in Koslicki's work (2018) that can be remedied with a more complete mereological analysis and with the formulation of mereological essentialism with a new solution to the problem under examination in this article.

3. Hylomorfism, mereology, endurantism, and perdurantism

The problem of persistence and identity of objects presupposes the notion of time. We can then consider the relations between mereology and time, that is, temporal mereology. According to Imaguire's explanation (2006: 77):

> A mereological theory can integrate the dimension of time into its analysis in two distinct ways. Firstly, consideration can be given to the analysis of entities that have an intrinsically temporal nature, such as events in general. As such entities persist through time, they are technically called “enduring” (*perdurants*) or “occurring” (*occurents*). Occurrences are events, processes, and states or phases. Some examples have already been mentioned: a football match, a person's life, and a war. The parts of an occurrence are equally temporal occurrences (the first term of the match, the first year of life, the last battle).

After introducing the first temporal aspect, Imaguire (2006) introduces the second aspect saying that it is possible to analyze entities that do not have an essentially temporal nature, but that have an existence over time. As such entities have a continued existence over time, they are technically called “continuants”. Imagine then cites examples of continuants that would be: a human being, a tree, and a ship (Theseus' famous ship is one of the preferred examples of a continuant, whose problem can be solved very elegantly in mereological theory. In general, continuants last for some time interval, although extreme cases of entities that exist only for some instant are possible (a ray, for example)., such as Poland or the *Pink Floyd group*.

Constants and occurrences require an intentional mereological treatment in which the dimension of time is taken into account. Still, as Imaguire[2006) explains, continuants change parts throughout their existence. For continuants, therefore, what Aristotle realized about substances is valid: they can have distinct and contradictory properties throughout their existence. To account for this fact, the most obvious formal solution is the addition of a temporal indexical: $x<y$ at t_n or $x <_{tn} y$ which means in natural language x is part of y at time tn. As in the case of occurrences the question about temporality makes no sense, the introduction of a temporal indexical is unnecessary – its formalization can be completely framed within the axiomatic system of classical extensional mereology. For continuants, classical extensional mereology must be expanded with some new definitions and axioms.

Thus, the classical extensional mereology relevant for our purposes of defining mereological hylomorphism must be expanded with intentional notions to include time as follows:

$a \ _{tn} b =_{def} (a <_{tn} b) \wedge (b <_{tn} a)$

$a \circ_{tn} b =_{def} x((x <_{tn} a) \wedge (x <_{tn} b)$

The existential quantifier also needs to be modally modified to express the temporality required by the problem of the persistence and identity of objects:

$E!a \leftrightarrow tn(Extnb)$

$Ex_t a \rightarrow a <_t a$

$a <_t b \rightarrow Ex_t a \wedge Ex_t b$

$a <_t b \wedge a <_t c \rightarrow a <_t c$

$a \ _{tn} b \rightarrow (x \ _t b \wedge x \ _{tn} a)$

It is important to highlight that some theorems can be deduced from the axiomatic system presented above representing variations in composition to explain the identity and persistence of objects.

Once the fundamental axioms of temporal mereology have been introduced, it is worth noting with Lewis (2001: 202) that:

> The question of the intertwining of parallel worlds the mundane problem of identity across time; and our problem of accidental intrinsics is parallel to the problem of temporal intrinsics, which is the traditional problem of change. Let's say that something persists if and only if, in one way or another, it exists at various times; this is the neutral word. Something hardens if and only if it persists by having different temporal parts, or stages, at different times, although no part of it is fully present at more than one time, whereas it hardens if and only if it persists by being fully present at more than one time. what a while. Perdurance corresponds to the way a road persists through space; part of it is here and part of it is there, and no part is fully present in two different places. Endurance corresponds to how a universal if such a thing exists, would be fully present wherever and whenever instantiated. Enduration involves intertwining: the content of two different tensions has the enduring thing as a common part. Duration does not.

And so Lewis's explanation continues with the further claim that enduring through time is analogous to the transmundane identity of intertwined common parts of the world and that enduring through time is analogous to transmundane identity if one can call it that. a trans-mundane individual composed of distinct parts of non-intertwined mutes.

Lewis also adds to the debate about the persistence and identity of objects in which endurantism and perdurantism are opposed.

Once the considerations about endurantism and perdurantism that define the debate have been made, let us next consider the classic question of temporary intrinsics and their relationship with the aforementioned debate.

4. Related question of temporary intrinsics

He explains that the main and decisive objection against endurance, as an approach to the persistence of ordinary things like people and puddles, is the problem of temporary intrinsics. Persistent things change their intrinsic properties. There would then be three possible solutions to this problem. One solution is that, contrary to what one might think, shapes are not intrinsic properties. They are disguised relationships, which an enduring thing can exhibit over time. The same endurant can exhibit the double form relation at times, and the straight form relation at other times. In itself and considered independently of its relations to other things, it

has no form at all. Lewis further states that the same can be said about all other temporary intrinsics; they must all be reinterpreted as relations that something with an invariable nature exhibits at different times. The solution to the problem of temporary intrinsics is that there are no temporary intrinsics at all. This is, in Lewis' opinion (2001: 204), absolutely incredible, if we are talking about the persistence of ordinary things. If we know what a form is, we know that it is a property and not a relation.

Thus, as Lewis explains, endurantism is defended by perdurantism by stating that there are no temporary intrinsic properties. As Lewis further explains, two other solutions seem to reject endurantism. A second possible solution that can be defined is to state that the only intrinsic properties of a thing are those that it has at the present moment. Other times are like false stories: they are abstract representations, composed from the materials of the present, that represent, well evil, the way things are. When it only has different intrinsic properties according to one of these tenses that Lewis calls arts, that is, it does not mean that this, or any part of it, or anything else, just has them; no more so than when a man is dishonest according to the *Times* or honest according to the *News*. This is a solution that rejects enduration because it rejects persistence entirely. And this, as mereologists still explain, is even less credible than the first solution. Saying that there are no other times, as opposed to false representations of these, goes against what is commonly believed. No man, unless he is at the moment of his execution, believes that he has no future; even less does anyone believe that it has not passed.

The second solution is called presentism for the current philosophy of the persistence and identity of objects. Yet a third solution would be possible. Different forms and different temporary intrinsics generally belong to different things. Enduration must be rejected in favor of perduration. We harden, we are made of temporal parts and our intrinsics are properties of these parts, in which they differ from each other. There is no problem at all about how different things can differ in their intrinsic properties. In the conclusion of this article, we will return to the parallel issue of temporary intrinsics and argue that mereological hylomorphism seems to offer a solution to this problem.

In the final considerations of this work, we will briefly return to the issue of temporary intrinsics and offer a position on this issue based on an axiomatic formulation of mereological hylomorphism.

Having considered the question of intrinsics, we will now focus on the related question of the relevance of the debate on endurantism and perdurantism.

5. Related question: About the relevance of the debate between endurantism and perdurantism

Some authors offer a more precise characterization of the debate over perdurantism and endurantism. According to Sider (2001) and Magidor[2016], it can be said that x is an instantaneous temporal part (PTI) of y if and only (i) exists in, but only in t; (ii) x is part of y at t; (iii) x intertwining in everything that is part of y in t. Second, let endurantism be the view that for every object x and for every time t at which x exists, there is a PTI of x at t. Finally, let endurantism be the negation of endurantism. The literature on the topic of endurantism and perdurantism consists of a wide variety of arguments and counterarguments in favor of each view. The typical form of a pro-perdurantism answer argument is to present some apparent challenge to which perdurantism, it is argued, has a direct, while endurantism has more problems in responding. Endurantists then typically respond to such arguments either by reducing the problem (by showing that there is no problem in the first place), or by arguing that they also provide a satisfactory answer to the problem. Mutatis mutandis for pro-perdurantist arguments.

Some authors comment that much of the debate between endurantism and perdurantism is misinterpreted. It is widely recognized that those who accept perdurantism typically also accept a niche of other claims that strictly speaking do not follow perdurantist doctrine. One example is the doctrine of universal fusion. The other claim is that in every collection S of space-time points that are occupied by matter, there is an object that occupies all points of S and no other points (call it an urgency for liberalism). Similarly, endurantism typically endorses claims that do not strictly follow endurantism. For example, the denial of universal fusion and the denial of liberalism. Unfortunately, when it comes to the debate between enduranism and perdurantism, little care has been taken to distinguish between the role of the doctrines in question in the arguments, and the role played by these additional claims that usually accompany the two doctrines.

One possible position for the debate is to assert that most (perhaps even all) of the central arguments of the endurantist/perdurantist debate crucially rest on these orthogonal claims and so the arguments do not directly target the doctrines they are used to support. And some authors try to prove they are right. Consider a typical pro-perduratist argument. As some authors note, this argument consists of a challenge or problem that endurantists have difficulty formulating, and to which perdurantism has a direct answer. There is a version of endurantism that mimics the perdurantist response. That is to say, endurantism can offer the same or at least a highly analogous answer to what perdurantism offers. Mutatis mutandis for the pro-endurantist arguments. To be clear, the position is not merely that endurantism or perdurantism has some satisfactory way of responding to the arguments. Putting the position better is that endurantists/perdurantists can provide essentially the same answer as the opposing view. This shows that the original argument cannot be plausibly interpreted concerning the doctrine of endurantism/perdurantism *per se*.

According to other authors, it can be said that the debate has been in vain. But it certainly isn't. For a start, to the extent that the arguments in the debate are successful, they serve to support some of these orthogonal claims. Nor are the arguments in the debate irrelevant to defending either endurantism or perdurantism per se. They may still play a role in that debate, albeit a much more indirect role than they are considered to play.

The debate on endurantism/perdurantism has received more criticism. It is usual to say that something persists and only if it is located more than one time. This neutral term gives us a way to frame the question. How does something persist? One answer is to say that the persistence of the thing involves its endurance. What makes something last? It has generally been held that endurance evolves by persisting by having temporal as well as spatial parts. And what is it for something last? It is often put in terms of a thing being fully present every time it exists. Again, sometimes the endurance/perduration distinction is put in terms of differences between strict identity and a looser unity sometimes called genidentity. On this understanding, a thing persists or hardens if and only if for whatever time the thing is located, there exists something identical to that thing. A thing persists or hardens if and only if for which time pairs in which it is located it has different temporal parts in those times in which it maintains the relationship of genidentity between them. The distinction between perdurantism and endurantism also seems to be problematic. Hopefully, the above description gives the reader some sort of sense of what the endurantism/perdurantism distinction might look like. Unfortunately, none of the above suggestions seems adequate to capture the distinction between endurantism and perdurantism. For example, the idea of the endurance of a thing being captured in terms of being fully present at all times in which it is located has been shown by some authors in the literature to be problematic. It is commonly said that an endurantist partition is an irreducibly temporally relative matter. Contrast the situation of induration with that of perduration. We can establish without temporal indexation what parts a lasting thing has. What parts a lasting thing has, this one has them *simpliciter*. These parts have the subsequent property of being located at various times. On the

other hand, we cannot establish what parts an enduring thing has without mentioning the relative times to which this thing has those parts.

Thus, the distinction between endurantism and perdurantism appears to be problematic in some cases, according to some objections in the literature. MacKinnon (2002: 291) for example questions the core of the distinction between induration and perduration through consideration of the notion of temporal part. He then introduces the notion of the temporal part:

> What is a temporal part? Those who believe in temporal parts take them to be among the parts of persistent things. As such, they are located at instants and over intervals of time. Let's start by focusing on the instantaneous temporal parts. Plausibly, x is an instantaneous temporal part located at t of y if and only if (i) x is part of y; (ii) x is located only at t and, (iii) x entangles every spatial part of y that is located at t.

Alluding only to temporal parts without reference to parts, the definition given above reduces to: (PT) x is an instantaneous temporal part at t of y if and only if (i) x is a part of y, (ii) x is located only in the (iii) x entanglement every part of y that is located in t. Based on the definitions presented, it is possible to offer a distinction between induration and perduration by stating that (E) x indurates if and only if, (b) x has no temporal parts, and (c) for any time in which x is located, there exists a set whose members make up x at that time. Two other complementary definitions would be: (P) it has temporal parts that last; (EP) x endura/perduras if and only if it has at least one enduring temporal part.

Thus, at the heart of the distinction between induration and perduration, the notion of the temporal part seems to be presupposed. The perdurantist endurantist debate appears to involve three main issues: (1) Debates over moderatism and perdurantism (or three- and four-dimensional) typically deal simultaneously with several issues concerning persistent objects. Three interconnected issues at the center of current debates are: (DIM) Whether objects are three-dimensional or four-dimensional; (TP) Whether or not the object has its temporal parts. (PART) Whether objects last only in partition relations relative to time. Perdurantists tend to claim that persistent objects are four-dimensional, that every persistent object has a temporal part for each moment through which it persists, and that objects harden in timeless partition relations. Endurantists tend to claim that all objects are three (or less) dimensional and lose temporal parts of their own.

There is a division in the debate regarding endurantism. The standard endurantist position on PART depends, to some extent, on whether the endurantist is an eternalist (believing that all times, and objects present at those times, are equally real) or a presentist, believing that only current time and current present objects are real. In addition to this division, it is still possible to characterize the relevance of the debate on endurantism and perdurantism with an example. Let's say that an object persists through time if and only if it exists at multiple times. Today, many philosophers agree that objects persist through time. Still, they disagree about how they do it that way. The core of their disagreement is whether or not such objects have temporal parts. So-called perdurantists think they have, so-called endurantists think they don't. The conflict between endurantists and perduratists is made up of several well-known arguments against enduratism. Perdurantists think that temporal parts are necessary to explain phenomena such as change, mereological coincidence, and vagueness. For their part, endurantists insist that they can explain such phenomena just as well without temporal parts. And so they think that any idea that objects have temporal parts is unmotivated, if not *per se* implausible.

Another characteristic of the debate between endurantism and perdurantism can be highlighted. Yet another challenge for the endurantist concerns the main definition of his vision. Perdurantism may be based on a *prima facie implausible principle*, yet it has a clear and positive feature: according to it, persistent objects have temporal parts. On the other hand, endurantism is often characterized in purely negative terms, such as the thesis that objects have no temporal

parts. Endurantism is sometimes defined in positive terms, with the thesis that objects are fully present at various times. Still, this definition remains on the notion of being fully present, which many consider unclear. What does it mean that x is fully present at time t? This does not mean that every part x has at any time is part of x at t, otherwise, it would be impossible for x to change its parts over time. Nor does it mean that every part that x has at t is a part of x at t because that is a trivial legacy that the perdurantist would like to maintain as well. Perhaps this just means that x has no temporal parts in t. But in this case, being fully present several times would only mean persisting without having temporal parts, in such a way that enduratism would become defined in purely negative terms.

We thus see that there are several aspects of the relevance of the debate between endurantists and perdurantists. In the final considerations of this work, we will define the axioms of mereological hylomorphism and take a position on the related question of the relevance of the aforementioned debate.

6. Final considerations

With the elements of the discussion presented in this article, we can now make some final considerations that define mereological hylomorphism. Mereological hylomorphism is the doctrine according to which the persistence and identity of physical objects can be considered relative to the formal and material parts that make up the objects. We have to consider that the persistence of objects throughout their changes of part in time can be explained based on the notion of the formal essence of the substance, while the change of temporal parts occurs based on the accidental properties of the substance. Now, mereological hylomorphism was proposed by Aristotle who in Metaphysics, book Z, 1035b, defined that: "A part, then, can be part of the form – by form I understand the essence – or of the concrete whole composed of form and matter, or of matter itself…"

To define mereological hylomorphism in the sense of Aristotle mentioned above, we can start nowadays with axioms of temporal mereology that define the temporal accidents of substance in the sense of Aristotle. We can then reconsider the following axioms of temporal mereology, namely:

$a <_{tn} b =_{def} (a<tnb) \wedge (b <_{tn} a)$

$a \circ_{tn} b =_{def} x ((x <_{tn} a) \wedge (x <_{tn} b)$

These are the definitions of proper part and superposition that change over time, that is, they are mereologically variable, which explains the accidents of the substance in the traditional Aristotelian sense. It is also necessary to reconsider the temporal existence of material or accidental properties of the substance. There is a time-independent existence E! a which means "there is exactly one a" and an existence quantifier modally considered in time, that is, Exa_{tn} a existed at moments a. Theseus' ship, for example, has its temporal parts of the matter from which it is built and these parts change over time, which requires the following axioms of temporal mereology, namely:

$E!a \leftrightarrow tn(Extnb)$

$Ex_t a \rightarrow a <_t a$

$a <_t b \rightarrow Ex_t a \wedge Ex_t b$

$a <_t b \wedge a <_t c \rightarrow a <_t c$

Such would be the axioms describing the parts of matter from which physical objects are constructed and would be mereologically variable in time, thus completing temporal

mereology. Simons, for example, defines some theorems that can be used in a mereology of temporal parts.

We can cite two theorems as examples according to the presentation by Simons (1986: 180) namely:

E!a a < a

E!a a ○ a

This means that there is only one is equivalent to affirming that a is part of itself and also that there is only one a is equivalent to affirming that it intertwines it with itself.

Along with the tensioned or modalized notion of time in the mereology of the temporal matter of the substance, we must also consider the question of its essence and here we must consider mereological essentialism. There would then be a principle of mereological essentialism according to which, being formalized, it states that for all x, if x has y as one of its parts, then y is part of x in every possible world in which x exists. y is then an essential part of x. This principle, in its strong version that characterizes the Aristotelian position, can be formalized according to Simons [1986: 272) as follows:

(□)(x«y →□E!y→ ∀t(Exty →x «t y))

The necessity operator described above describes the necessity of the relevance of the essential part of any physical object.

Once the axioms for mereological hylomorphism and the corresponding notions of mereologically variable material accidental part and mereological essentialism with the notion of essential part or mereologically constant form have been defined, we can now return to the related question of temporary intrinsics posed by several authors, including Lewis[2001] detachments that we considered in section 3. The position pertinent to the doctrine of mereological hylomorphism is that there are no temporary intrinsic properties since the formal part is related to all possible worlds of relevance and therefore the intrinsic properties are of the order of the essence of physical objects and thus cannot be temporary. Only the material properties of objects are mereologically temporary, but in this case, they are extrinsic properties of the objects. It is important to add that only all substantials are capable of being considered for mereological essentialism. The essential parts are mereologically continuants or simply continuants *of* intentional mereology, while the material parts of objects are mereologically the occurrences *of* intentional mereology.

As for section 4 on the relevance of the debate as a related issue, we can state that the doctrine of hylomorphism presented is an intermediate position between endurantism and perdurantism since the essential parts of objects are endurants and the material parts of objects are in turn, lasting and variable as temporal parts of objects. Therefore, the doctrine of mereological hylomorphism is a contemporary relevant position for the debate on the persistence and identity of objects.

Acknowledgements

This research was granted by the Carlos Chagas Filho Foundation for Research Support in the Rio de Janeiro, Brazil, (FAPERJ) grant number E-26/200.507/2025.

The author declares no competing interests.

References

Aristotle. In The Perseus Digital Library. http://www.perseus.tufts.edu/hopper/text?doc=Perseus%3Atext%3A1999.01.0052%3Abook%3D7%3Asection%3D1035b.

Costa, D. (2022). Persistence in time. In *The Internet Encyclopedia of Philosophy*. https://iep.utm.edu/per-time/ . Accessed in October 2022.

Imaguire, G. (2006). Mereology: The whole and its parts. In *Contemporary Metaphysics*. Ed. Vozes.

Koslick, K. (2006). Aristotle's mereology and the status of form. *The Journal of Philosophy,* 103(12).

Lewis, D. (2001). *On the plurality of worlds*. Blackwell Publishing.

Magidor, O. (2016). Endurantism vs. Perduratism? The debate reconsidered. *Nous* (3), 509-532.

Mackinnon, D. (2002). The endurance/endurance distinction. *Australasian Journal of Philosophy*, *80*(3), 288-306.

Varzi, A. (2022). Mereology. Entry from the Stanford Encyclopedia of Philosophy. https://plato.stanford.edu/entries/mereology/. Accessed in October 2022.

Seibt, J. (1997). Existence in time: From substance to process. *Special Issue of Boston Studies in Philosophy of Science*, 189, ed. by Jan Faye et al., pp. 143-182.

Simons, P. (1986). *Pars: A Study in Ontology*. Oxford University Press, Oxford.

Wasserman, R. (2016). Theories of persistence. *Philosophical Studies*, *173*, 243-50.


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