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BETWEEN SUBSTANCES AND PROCESSES: BRIDGING METAPHYSICAL DIVIDES ON FUNDAMENTALITY, PERSISTENCE, AND INDIVIDUATION*

Entre sustancias y procesos: Superando las divisiones metafísicas en torno a la fundamentalidad, la persistencia y la individuación

Benazir Flores Valdivia [a]
https://orcid.org/0000-0002-6824-0460
befvaldivia@gmail.com

Laura Nuño de la Rosa García [b]
https://orcid.org/0000-0003-0513-0077
laura.nuno@csic.es

Vanessa Triviño Alonso [c]
https://orcid.org/0000-0002-2529-184X
vanesa.trivino@urjc.es

[a] Department of Logic and Theoretical Philosophy, Complutense University of Madrid, Madrid, Spain.
[b] Institute of Philosophy, Spanish National Research Council, Spain.
[c] Department of Education, Rey Juan Carlos University, Madrid, Spain.

Abstract

Since the early 21st century, processualist approaches have gained prominence in analytic metaphysics and the philosophy of science, prompting diverse responses from advocates of substantialism. However, the polarization of the debate between process and substance metaphysics has often led to oversimplifications that obscure the potential for constructive dialogue. This paper argues that these frameworks should not be treated as monolithic systems, but rather analyzed through the lens of specific metaphysical

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problems—namely, fundamentality, persistence, and individuation. Focusing primarily on process metaphysics, we examine how different interpretations within both traditions conceptualize these issues. Our analysis reveals areas of compatibility as well as points of divergence, indicating that the divide between processualism and substantialism is more nuanced than commonly assumed. We conclude by advocating for a metaphysical approach that allows for the integration of criteria from both frameworks.

Key words: Process Metaphysics; Substance Metaphysics; Fundamentality; Persistence; Individuation.

Resumen

Desde principios del siglo XXI, los enfoques procesualistas han ganado protagonismo en la metafísica analítica y la filosofía de la ciencia, lo que ha provocado diversas respuestas por parte de los defensores del sustancialismo. Sin embargo, la polarización del debate entre la metafísica procesualista y la metafísica sustancialista a menudo ha llevado a simplificaciones que oscurecen el potencial para un diálogo constructivo. Este artículo sostiene que estos marcos filosóficos no deben tratarse como sistemas monolíticos, sino analizarse a través del prisma de problemas metafísicos concretos como son la fundamentalidad, la persistencia y la individuación. Centrándonos en la metafísica procesualista, examinamos cómo diferentes interpretaciones dentro de ambas tradiciones conceptualizan estos problemas. Nuestro análisis revela tanto áreas de compatibilidad como de divergencia, sugiriendo que la división entre procesualismo y sustancialismo es más matizada de lo que comúnmente se supone. Concluimos abogando por un enfoque metafísico más flexible que permita la integración de criterios de ambos marcos.

Palabras clave: Metafísica procesualista; Metafísica sustancialista; Fundamentalidad; Persistencia; Individuación.

0. Introduction

Since the early 21st century, there has been a proliferation of process-oriented proposals in both analytic metaphysics and philosophy of science (Ferrari, 2024; Rescher, 1996, 2000; Seibt, 2025). This perspective has been particularly well-received in the philosophy of biology, sparking a highly polarized debate against substantialism (Bickhard, 2011; Campbell, 2015; Dupré, 2021a; Meincke, 2019, 2021; Nicholson & Dupré 2018). According to processualists, traditional substance metaphysics fails to capture the recent scientific developments that reveal the dynamic nature of reality, thereby calling for a radical metaphysical turn. Conversely, defenders of substantialism argue that processualism lacks adequate justification for such a shift. They contend that certain forms of substantialism already account for the dynamic nature of entities and that a purely process-based metaphysics cannot adequately explain order, stability, and continuity over time (Austin, 2020; Morgan, 2022; Steward, 2020).

The long-standing divide between process and substance metaphysics has often been framed in overly simplistic terms, limiting the possibility of constructive engagement between the two traditions. Recent scholarship has begun to caution against this oversimplification, noting that the dichotomy is frequently misrepresented on one or both sides (Ingthorsson, 2021; Morgan, 2022). In this paper, we argue that a more fruitful assessment of their potential compatibility requires moving beyond the treatment of these frameworks as monolithic systems and examining how each addresses specific metaphysical concerns, such as fundamentality, persistence, and individuation. We claim that a comparative metaphysical analysis can significantly clarify the debate between processualism and substantialism, particularly in the philosophy of biology. This approach can help refine the metaphysical tools used in these discussions and contribute to a more nuanced understanding of the issues at stake (Triviño, 2022).

To achieve this goal, we analyze process-based accounts of fundamentality, persistence, and individuality while systematically contrasting them with various substance-metaphysical frameworks.[1] Section 1 examines *fundamentality* by distinguishing between independence and primacy. Section 2 explores *persistence*, analyzing how processualist views align with either perdurantist or endurantist theories. Finally, Section 3 systematizes *individuation criteria* across process metaphysics and compares them with substantialist approaches. We conclude that framing the debate between substantialism and processualism in dichotomous terms is inadequate. Instead, our analysis reveals that the substance-process distinction hinges on specific metaphysical commitments on the fundamentality, persistence, and individuation of entities, thereby bridging traditional divides and offering a nuanced framework for theorizing dynamic entities in science.

1. The Problem of Fundamentality

A central issue in the debate between substantialism and processualism concerns the type of entity that better represents the fundamental constituents of reality: substances or processes. However, the metaphysicians characterize the *fundamental* in two senses: *independence* and *primacy*. This section analyzes how both senses figure in the processualist–substantialist debate and concludes that, in either

[1] One of these is the neo-Aristotelian approach. In this regard, we focus on the metaphysical accounts of those authors who have responded to processualists' proposals—namely, Austin (2020), Morgan (2022), Steward (2020), and Wiggins (2016).

sense, there is no inherent antagonism between process and substance metaphysics regarding the fundamentality of entities (cf. Table 1).

	Substance Metaphysics	Process Metaphysics
Fundamentality		
Independence	Independence of properties (Substratum theory) (Allaire, 1963; Bergmann, 1967) *Rigid ontological independence* (Morgan, 2022)	*Unowned process* (Dupré, 2021a, 2021b; Rescher, 1996; Seibt, 2018) *Rigid ontological independence*
Primacy	Monism (Ayers, 1991; Heil, 2012; Strawson, 1959) *Pluralism* (Machamer et al. 2000; Steward, 2020; Wiggins, 2016)	Monism (Bickhard, 2011, 2024; Campbell, 2015; Dupré, 2021a, 2021b; Guay & Pradeu, 2015; Meincke, 2018; Nicholson & Dupré, 2018; Seibt, 2018, 2025; Simons, 2018) *Pluralism* (Jaworski, 2016; Skrzypek, 2019, 2023; Walsh & Wiebe, 2020)

Table 1. Summary of positions of different versions of substance and process metaphysics regarding the problem of fundamentality; compatible perspectives are highlighted in *italics*.

*1.1. Fundamentality as **Independence***

Processualists critique substantialism for portraying fundamental entities as independent, arguing that substances cannot exist in isolation, devoid of properties, relations, or causal interactions (Bickhard, 2011; Nicholson & Dupré, 2018; Rescher, 1996). Although the critique applies to the Cartesian view that substances require nothing beyond themselves to exist, it fails to capture the broader range of positions concerning the characterization of substances. In particular, the processualists' critique overlooks the notion of independence employed within neo-Aristotelian metaphysics.

According to the proponents of a neo-Aristotelian metaphysics, substances are *ontologically independent* in a *rigid* rather than a *generic*, absolute sense (Morgan, 2022; Steward, 2020). This does not imply that substances are completely isolated. Instead, they are *generically dependent*: they rely on certain classes of entities for their existence, but not on any specific members of those classes. For example, an animal, considered as a substance, depends generically on the presence of cells to maintain its

structure and function, but not on any particular set of cells, allowing for cellular turnover throughout its life history.

This distinction between *rigid* and *generic* ontological independence shows that substantialists do not understand substances as being entirely independent in a causal sense. Neo-Aristotelian metaphysicians acknowledge that substances can be interconnected within networks of causation while still maintaining their fundamental status as entities that do not depend on other particular entities for their existence (Steward, 2020, §2.3). This view, therefore, challenges the processualist critique that substantialism fails to account for the dynamic, interconnected nature of reality.

Interestingly, some processualists invoke a notion of independence when describing processes as fundamental entities. The consideration of so-called *unowned processes* (Dupré, 2021b; Rescher, 1996; Seibt, 2018) — processes that are not tied to specific agents and thus exist independently of any particular subject (e.g., atmospheric cooling, hurricanes, or fermentation)— illustrates this tendency. Like the rigid independence invoked by neo-Aristotelian metaphysicians, this type of independence does not imply isolation; rather, these processes remain *causally interdependent*. For example, the formation of a hurricane depends on complex causal interactions involving wind patterns and atmospheric conditions, even though it is not owned by a specific entity.

As can be seen, metaphysical independence in both substance and process metaphysics is not reducible to absolute independence, whether in a causal or a substratum view. Instead, both frameworks often rely on ontological independence, which can manifest in different forms, such as rigid independence, to describe the fundamentality of entities (cf. Table 1). On more nuanced accounts, substances and processes can be fundamental yet generically and causally dependent on other entities, narrowing the independence gap between substance and process metaphysics and opening space for integrative approaches.

*1.2. Fundamentality as **Primacy***

The second notion of fundamentality relates to *primacy*, signifying that a fundamental entity functions as the foundational element of reality. An entity is fundamental in this sense if other entities rely on it for their existence (Bennett, 2017; Bliss, 2024; Schaffer, 2018). This concept is central to debates between processualists and substantialists, with each side accusing the other of misrepresenting what should be viewed as fundamental. Substantialists argue that substances are the primary

constituents of reality (Austin, 2020; Morgan, 2022), while processualists claim that processes hold this foundational status (Seibt, 1990, 2025).

This antagonism is most pronounced when the debate is approached from strong, monist interpretations of each metaphysical framework. *Strong substantialism* holds that only substances are the ultimate, irreducible constituents of reality. In this view, substances are the most basic entities in the ontological hierarchy—self-sufficient and fundamentally distinct from other types of entities, such as events or properties—upon which all other entities and properties depend (Ayers, 1991; Heil, 2012; Schaffer, 2009; Strawson, 1959). Conversely, *strong processualism* takes a monist stance by arguing that all entities are ultimately processes. Traditional substances (e.g., objects or organisms) are reinterpreted as temporary stabilizations of dynamic activities rather than static, self-sufficient entities (Bickhard, 2011; Campbell, 2015; Dupré, 2021a; Guay & Pradeu, 2015; Meincke, 2018; Nicholson & Dupré, 2018; Seibt, 2018, 2025; Simons, 2018). Under this view, what appear as stable entities are merely moments or phases within ongoing processes, challenging the notion that substances are the primary entities (cf. Table 1).

However, the debate over fundamentality as primacy does not necessitate a commitment to either substantialist or processualist monism. On the contrary, some ontological pluralist interpretations suggest that multiple kinds of fundamental entities can coexist within the same metaphysical framework. Such pluralist approaches—what Rescher (1996) calls *weak metaphysics*—allow for a more flexible ontology where both substances and processes can be considered as fundamental (e.g., Anjum & Mumford, 2018; Jaworski, 2016; Skrzypek, 2023; Steward, 2020; Walsh & Wiebe, 2020).

Monist and pluralist metaphysics demand the deployment of fine-grained analytical tools capable of articulating the distinct implications of competing doctrines. For instance, Schaffer (2018) demonstrates that various forms of monism and pluralism may prove compatible when relativized to two parameters: the *target*—i.e., the domain or aspect of reality under consideration—and the *units of analysis*—i.e., the criteria used to partition or structure that domain. Accordingly, debates between monism and pluralism cannot be settled in binary terms; rather, they require careful attention to which target is under scrutiny and which classificatory units are operative.

According to Schaffer, the incompatibility between two doctrines occurs when both address the same target and use the same units, but yield opposing conclusions. Schaffer illustrates this incompatibility through the contrast between priority monism and priority pluralism: both accounts

focus on the fundamental dependence relations among concrete entities. However, priority monism holds that the whole is ontologically prior to its parts –meaning that parts derive their existence or significance from the whole– whereas priority pluralism asserts that parts are ontologically prior, such that the whole obtains its significance and existence from them. These positions cannot be reconciled without contradiction, which implies that, necessarily, one must be rejected if the other is accepted.

This type of analysis is useful for detecting internal tensions within a single theory. For example, John Dupré's ontology appears inconsistent, as he seems to endorse both priority monism and priority pluralism simultaneously. Thus, Dupré adopts *priority pluralism* when advocating for the ontological significance of diverse, interacting entities. Yet, he also assumes a kind of *priority monistic* commitment by positing a singular, fundamental "flow of life" as the ontological basis of living systems (Dupré, 2021b). This dual commitment places Dupré's metaphysics in a contradictory position: he upholds two incompatible views of ontological priority.

Schaffer's conceptual framework remains a powerful philosophical instrument in this debate, not only because it enables the recognition of tensions such as those found in Dupré's account, but also because of its capacity to reveal genuine compatibility between seemingly rival metaphysical positions. Applied to Dupré's own processualist metaphysics (2021b), Schaffer's framework helps reveal four distinct and complementary theses that would otherwise seem in tension: First, *processual monism* asserts that all concrete entities are fundamentally processes. Second, *classificatory pluralism* maintains that there exist multiple, equally legitimate ways of categorizing the world. Third, *priority pluralism* holds that more than one kind of concrete entity—such as biological processes at various levels—can be ontologically fundamental. Fourth, *essentialist nihilism* denies that intrinsic, immutable properties determine identity. Because each of these theses concerns a distinct combination of targets and units—namely, types of entities, classificatory schemes, fundamental tokens, and intrinsic properties, respectively—they do not conflict in the way that priority monism and pluralism do when applied to the same domain.

By disentangling these dimensions of metaphysical analysis, Schaffer's framework can be applied for discerning when monistic and pluralistic commitments can coexist and when they are in direct conflict. This approach also holds promise for reframing the opposition between substantialism and processualism, suggesting a more integrative methodology that retains the virtues of both while avoiding a rigid dichotomy between monism and pluralism.

2. The Problem of Persistence

A central issue in contemporary analytic metaphysics is the problem of persistence, which examines how entities can change while retaining their identity over time. This problem applies to both substances and processes, as it involves determining (i) whether something persists, (ii) what the persistent entity consists of, and (iii) which aspects of it undergo change (Haslanger, 2003; Wasserman, 2006). Two primary theories attempt to address this issue: endurantism and perdurantism. We propose that by analyzing processual perspectives in terms of their alignment with either perdurantism or endurantism, it becomes possible to evaluate their compatibility with substantialist views and open alternatives that go beyond the traditional dichotomy in the treatment of entity persistence.

Endurantism posits that an entity persists if it is *wholly present* at every time at which it exists (Haslanger, 1989; Lowe, 1987; Mellor, 1981; Oderberg, 2004; Thomson, 1983; van Inwagen, 1990). In this account, entities are considered to be three-dimensional (3D) insofar as they are extended in the three dimensions of space, but not in time. Change, therefore, consists of the *wholly present* 3D entity having different properties at different times. In this view, the gradual color change of a cup over the years, caused by use, can be explained as the cup gaining different properties at different times. *Perdurantism*, on the other hand, posits that entities persist by having different *temporal parts* with different properties manifested at the different times at which they exist (Heller, 1984; Lewis, 1986; Sider, 1997, 2001). In this account, entities are four-dimensional (4D), as they are extended in both space and time. In this context, a color-changing cup is explained by claiming that there are different temporal parts of the cup with different properties manifested at different times.

In the debate between processualists and substantialists, the problem of persistence is often framed as a strict divide: processualists are typically associated with perdurantism, while substantialists are linked to endurantism. This stems from the idea that perdurantism, with its focus on entities extending over time, fits naturally with process metaphysics, whereas endurantism, which emphasizes objects existing *wholly present* at each moment, appears more aligned with a metaphysics of stable, time-independent substances. However, in this section we argue that both process and substance frameworks are compatible with endurantism or perdurantism, undermining the dichotomy and enabling convergence between them (cf. Table 2).

	Substance Metaphysics	Process Metaphysics
Persistence		
Perdurantism	*Perdurantism* (Armstrong, 1980; Heller, 1984, 1992; Lewis, 1986)	*Perdurantism* (DiFrisco, 2018; Guay & Pradeu 2015; DiFrisco & Mossio, 2020)
Endurantism	*Continuants* (Haslanger, 1989; Lowe, 1987; Mellor, 1981; Oderberg, 2004; Simons 2000; Thomson, 1983; van Inwagen 1990; Wiggins, 1980)	*Continuants* (Dupré, 2021a; Galton & Mizouguchi, 2009; Meincke, 2018, 2021; Steward, 2013, Stout, 1997, 2016) Temporal patterns (Galton, 2018) Variable embodiments (Fine, 2022) Temporal masses (Crowther, 2018; Seibt, 2007, 2010, 2018) Dispositions (Anjum & Mumford, 2018)

Table 2. Summary of positions of different versions of substance and process metaphysics regarding the problem of persistence; compatible perspectives are highlighted in *italics*.

2.1. The Perdurantist Characterization of Processes

Perdurantism is often regarded as the default theory of persistence among processualists. Many processualists describe processes as sequences of temporal parts connected by causal relationships (DiFrisco & Mossio, 2020; Dupré, 2021a; Guay & Pradeu, 2015) and argue that perdurantism is the most suitable framework for explaining their persistence. However, this view has been criticized by other processualists (Meincke, 2019; Seibt, 2007), who highlight several metaphysical problems with perdurantism that undermine its ability to adequately account for the persistence of processes (Effingham, 2012; Haslanger, 2003).

One major critique is that perdurantism does not explain change but effectively eliminates it (Heller, 1992; Mellor, 1981; Simons, 1987). This would render perdurantism anti-processualist by definition, since processualism in general affirms the primacy of change (Meincke, 2019; Seibt, 2007). This objection has two versions that are based on an eternalist interpretation of time. The first version argues that perdurantism implies a static view of time, where events are like dots in a pointillist painting. Temporal parts are arranged in a specific way to form a persistent object, but nothing truly moves, comes into being, or ceases to exist. Perduring objects are treated as mereological sums, with their temporal parts fixed and unchanging. For example, imagine a candle burning over time. At t_1, it is tall and unlit; at t_2, it is lit and halfway melted; at t_3, it is extinguished

and nearly gone. According to perdurantism, the candle is not a single object that undergoes real change, but a four-dimensional entity composed of different temporal parts that instantiate different properties and occupies a specific spatio-temporal location: a tall-unlit part at t_1, a lit-melting part at t_2, and a short-extinguished part at t_3. From this perspective, what we ordinarily describe as the candle "changing" or "melting" is just a way of referring to the arrangement of these distinct temporal parts. The object as a whole doesn't change. Thus, persistence and change are explained not by motion or transformation, but by the structured coexistence of these fixed temporal segments.

The second version of the problem, known as the "no alteration objection", focuses on the fact that the temporal parts that constitute an entity do not undergo any intrinsic change. Instead, they are continuously replaced as time progresses, creating the illusion of change through the rapid substitution of one temporal part by another. In this view, change is not a genuine feature of the entity itself nor of its constitutive temporal parts, but a mere *epiphenomenon* created by the succession of its parts. As a result, perdurantism is unable to make sense of the intrinsic change entities undergo.

A different kind of critique focuses on perdurantism's difficulty in accounting for the kind of connections that are given among the different temporal parts that constitute an entity from a presentist viewpoint. According to Meincke (2019) and Seibt (2007), this limitation makes it unable to explain the continuity of processes. They argue that if an entity is understood as a mereological sum of its temporal parts, any addition or replacement of a temporal part would alter the identity of the sum itself. Since sums are defined by their constituent elements (Varzi & Cotnoir, 2021, p. 30), any change in those elements would result in a different sum. Under a presentist frame, this raises the question of whether the entity is replaced each time a new temporal part is added. Consequently, perdurantist processualism risks leading to a theory where "nothing truly remains" (Guay & Pradeu, 2015, p. 342), as it only accounts for the persistence of individual temporal parts or instantaneous sums, along with their succession and disappearance over time.

A final objection points out that perdurantist accounts often describe temporal parts as events—particulars understood as atomic and discrete units in time and space (Meincke, 2019; Seibt 2007, 2010). This creates a tension for processualists who adopt perdurantism, as they appear to rely on the same metaphysical commitments as substantialists. By treating temporal parts as discrete, unchanging units, perdurantist processualists risk replicating the very substantialist framework they seek to set aside.

This raises questions about whether perdurantism can truly provide a processual account of persistence or if it inadvertently reintroduces the static, substance-based metaphysics it aims to reject.

To address these objections, perdurantist processualists turn to the metaphysical notion of *genidentity,* a relation used to connect two different temporal parts that belong to the same entity (Miller, 2006). In this sense, for processualists, persistence is nothing more than the product of the causal and/or functional continuity between the temporal parts of a process (DiFrisco, 2018; Guay & Pradeu, 2015; Pradeu, 2018). Perdurantists argue that the continuity of a process can only be determined retrospectively by identifying specific causal interactions deemed relevant by various scientific practices. For instance, immune systems are said to individuate organisms throughout their life cycles, while processes like gene exchange among these same organisms individuate species across generations. In both cases, the individuating role of the processes of immune activity and gene transfer can only be recognized after they have caused their effects, as organisms and species are identified as such only after repeated instances of these causal, demarcating processes (Guay & Pradeu 2015, p. 363).

2.2. The Endurantist Characterization of Processes

Due to the difficulties posed by perdurantism, and contrary to common assumptions, process metaphysicians have increasingly adopted an endurantist approach to explain the persistence of processes. In this view, processes are understood as entities that are *wholly present* at each moment at which they exist, persisting through time despite undergoing changes, which are intrinsic to their nature. Unlike traditional endurantism, which focuses on three-dimensional objects, processual endurantism argues that an entity remains wholly present throughout its duration, even as it undergoes distinct transformations. This perspective allows processes to retain their identity as integrated wholes, despite changes in their properties over time.

The endurantist characterization of processes is embraced by various metaphysical theories that describe processes as non-located entities, and is supported by both pluralist and monist perspectives. The exact nature of these enduring processes is interpreted differently among authors, reflecting a broad spectrum of views concerning the persistence of processes and the maintenance of their identity over time. These interpretations range from continuants (Dupré, 2021b; Meincke, 2021; Stout, 2016) and temporal patterns (Galton, 2018) to variable embodiments (Fine, 2022),

temporal masses (Crowther, 2018; Seibt, 2018), and dispositions (Anjum & Mumford, 2018).

By comparing perdurantist and endurantist accounts of persistence, we can map areas of overlap between particular substance- and process-based metaphysics (cf. Table 2), showing that, despite their apparent opposition, both rest on several shared assumptions. For example, particularist substantialism (e.g., Ayers, 1991; Strawson, 1959) and perdurantist processualism can both be viewed as "atomistic" or "fragmented" theories of temporal reality, where change is seen as merely apparent or as an epiphenomenon of the succession of static parts (temporal parts in perdurantism and simple substances in particularism).

In other respects, endurantist processualism and neo-Aristotelian substantialism show significant similarities with respect to persistence over time: i) both favor an endurantist theory to explain unity over time (Corkum, 2025; Seibt, 2007); ii) both conceive of fundamental entities as continuants (Meincke, 2021; Steward, 2020; Stout, 1997); iii) both consider change to be compatible with the persistence of the entity and view entities as being *wholly present* while they exist (Seibt, 2007; Stout, 2016; Wiggins, 2016); iv) both recognize the existence of an abstract dimension of the entity (process-types/patterns/masses vs. secondary substances) (Crowther, 2018; Galton, 2018; Morgan, 2022; Seibt, 2007); and v) both are compatible with a dispositionalist causal theory (Anjum & Mumford, 2018; Groff & Greco, 2013).

Finally, when considering the compatibility between processualist perdurantism and processualist endurantism, there are similarities suggesting that the opposition between these views is not absolute. First, both accounts recognize that processes can instantiate properties at various stages of their development (Dupré, 2021a; Meincke, 2025). Second, both permit processes to be part of larger systems extended in space-time, such as organisms or ecosystems (DiFrisco, 2018; Dupré, 2021b; Seibt, 2018; Stout, 2016). Third, both frameworks accept that processes can be represented in terms of temporal parts without undermining their unity: for perdurantists, temporal segments compose the whole; for endurantists, stage-based analyses are methodologically acceptable so long as they do not compromise identity (Anjum & Mumford, 2018; DiFrisco, 2018; Fine, 2022).

3. The Problem of Individuation

Regardless of how the problem of process persistence is addressed, key questions remain about whether processes are individual entities and what determines their identity. In order to tackle the metaphysical issue of the individuation of processes, we will examine the two primary

senses of individuation prevalent in the debate between processualism and substantialism: *individuality* —that which enables us to count entities— and *identity* —that which allows us to classify them into groups.

Both processualists and substantialists have criticized the individuation criteria used by each allegedly opposing framework. The core critique from processualists is that substantialism treats identity and individuality as prerequisites for change and persistence, thereby making identity the fundamental property and resulting in a static view of reality (Meincke, 2019; Rescher, 1996; Seibt, 2018). In turn, substance metaphysicians argue that processualism fails to clearly define entities or offer strong identity criteria, and when such criteria are proposed, they largely resemble those of substantialist metaphysics (Austin, 2020).

In this section, we examine the different accounts of the individuality and identity of processes in order to assess whether these criticisms are justified or they are merely oversimplifications that overlook compatibilities between the two frameworks (cf. Table 3).

3.1. The Problem of Individuality

In classical metaphysics, individuality is typically attributed to substances or *particulars* –entities that possess well-defined boundaries, persist through time, and can be located in certain regions of space (Loux, 2006; see also Allaire, 1963; Bergmann, 1967; Lewis, 1986; Strawson, 1959). This framework has long informed our understanding of what counts as a fundamental entity. Typically, material bodies hold a fundamental status among particulars due to their fulfillment of specific criteria for asserting individuality (Strawson, 1959, p. 15): (i) three-dimensionality, indicating their existence across spatial dimensions; (ii) permanence over time; and (iii) observability by multiple observers through recognizable features.

Processualist philosophers challenge this view, arguing that such a model fails to capture the dynamic and temporally extended nature of processes. Authors such as Rescher (1996) or Seibt (2010) criticize the substantialist conception of fundamental entities understood as particulars that can be identified, counted, and situated within specific, unique spatiotemporal coordinates. Nonetheless, the individuality criterion is not necessarily linked with particularism. From a different standpoint, individuals are considered countable instances of a certain sortal (Lowe, 1989). Based on this definition, some processualists do regard processes as individuals, describing them as countable entities localized in space and time, capable of possessing properties, persisting through time, and undergoing change. In turn, some authors consider processes to be *concrete*

individuals (Dupré, 2021a, 2021b; Meincke, 2025; Steward, 2013; Stout, 1997, 2016) while others argue that they are *abstract* individuals instead (Galton, 2018; Stout, 2016[2]).

	Substance Metaphysics	Process Metaphysics
Individuality		
	Noun-countability (Lowe, 1989)	*Noun-countability* *Concrete individuals (*Dupré, 2021a, 2021b; Meincke, 2025; Steward, 2013; Stout, 1997, 2016) Abstract individuals (Galton, 2018; Stout, 2016)
	Particularity (Allaire, 1963; Bergmann, 1967; Lewis, 1986; Strawson, 1959)	Mass countability (dividuals) (Crowther, 2018; Seibt, 2018)
Identity		
Numerical identity	*as a product* (Corkum, 2025; Feser, 2019; Oderberg, 2007) Simplicity (Lowe, 1994)	*as a product* (Seibt, 2018)
Causal	*Classical* (Rips et al. 2006)	*Classical* (DiFrisco, 2018; Dowe, 1992; Salmon, 1984)
	Dispositional (Austin & Marmodoro, 2017)	*Dispositional* (Anjum & Mumford, 2018; Dupré, 2021a; Meincke, 2020)
	Functional (Wiggins, 2012)	*Functional* (Guay & Pradeu, 2015; Seibt, 2018)
Formal	Structural (Koslicki, 2013)	Structural (Seibt, 2018)
	Activity (Sentesy, 2020; Wiggins, 2016)	*Activity* (Skrzypek, 2019)
		Trajectories (Meincke, 2021; Seibt, 2018)
Mereological	*Classical Mereology* (perdurantism) (Buonomo, 2017)	*Classical Mereology* (DiFrisco, 2018; Guay & Pradeu, 2015)
	Non-classical Mereology (Cotnoir, 2013; Koslicki, 2007)	Non-classical Mereology (Seibt, 2015, 2018)

Table 3. Summary of positions of different versions of substance and process metaphysics regarding the problems of individuation; compatible perspectives are highlighted in *italics*.

[2] Stout defends both theses at once: that processes are both concrete and abstract entities.

Yet, the view that processes are individuals is not universally held among processualists. In this sense, some have considered that processes are not individuals but temporal masses that can be measured or described in general terms (Crowther, 2018; Seibt, 2018). Seibt, for instance, conceives processes as non-located entities that challenge all the assumptions of the so-called myth of substance[3] since (i) processes, like material masses such as water or gold, are mass-countable; (ii) there are unowned processes such as rain that cannot be attributed to any subject; and (iii) specific locality is neither a necessary nor sufficient condition for recognizing processes, as illustrated by the global carbon cycle, which cannot be confined to a single spatial locus and exhibit features of both concrete and abstract entities (Crowther, 2018; Seibt, 2018; see also Stout, 2016).

The distinction between individuals and temporal masses is closely tied to differing conceptions of process persistence. Those who conceive processes as continuants or as abstract types generally treat them as countable entities. By contrast, those who understand processes as analogous to masses of matter deny their countability and, as a result, their individuality. However, this approach is not exclusive to the processualist's framework. Neo-Aristotelian metaphysics also considers that the individuation of substances does not depend on spatio-temporal coordinates or properties exhibited at a given time, despite substances being spatio-temporally situated. Instead, their individuation stems from their substantial form, which determines their membership to a specific class (e.g., Feser, 2019 p. 23; Loux, 1978, p. 164; Oderberg, 2007, p. 110).

When viewed through the lens of individuality, certain forms of substantialism and processualism converge at key points (cf. Table 3). Theories that treat *countable continuants*—whether substances or processes—as the fundamental kind of entity typically individuate these continuants by appealing to an immanent principle of unity. Because each entity is *wholly present* at every moment of its existence, both substantialist and processualist frameworks can support an endurantist view of persistence.

[3] The so-called "myth of substance" is used by certain processualist philosophers to criticize what they regard as the fundamental assumptions of substance metaphysics (e.g. Seibt, 2010, 2025; Meincke, 2019; DiFrisco, 2018). This myth can be summarized as follows: (i) the world is composed of concrete individuals or abstract entities, (ii) substances are the primary subjects of change, and (iii) change is just property variation in stable, immutable, isolated and countable particulars situated in space and time (Seibt, 1990, 1997).

However, important differences between neo-Aristotelian substantialism and processualism remain, particularly regarding boundaries and internal structure. First, primary substances tend to have well-defined mereological and spatial boundaries, while processes often have fuzzy or expandable limits. Second, many biological and mereological processes are *homeomerous*—their proper parts are of the same kind as the whole—whereas substances are usually *non-homeomerous*. Third, a substance's form determines its essence (Oderberg, 2007). A concrete individual —or *substance*— is defined by an intrinsic form that organizes its matter. This form is not a superficial set of traits, but a deep internal principle that determines the substance's essential structure and capacities. As long as this form remains intact, the substance can undergo a wide range of changes—gaining weight, moving, aging, or losing non-essential parts—without losing its identity. However, once the form is destroyed, whether by death, disintegration, fusion, or division, the substance itself ceases to exist. In this view, the loss of form is the loss of the individual.

Similarly, according to some processualists, the identity of processes is not tied to any fixed property but rather to the continuity of a dynamic structure—a causal or temporal pattern unfolding through time. This pattern can persist even as the material components change or rearrange (Dupré, 2021b; Seibt, 2007; Stout, 2016). A hurricane, for instance, can grow, fragment, or merge with another storm while remaining the same named system, as long as its core thermodynamic structure persists. Similarly, a symphony performance continues to be one performance even if the musicians or instruments change, so long as the overall coordination and temporal flow are maintained (Meincke, 2021). In this sense, both substances and processes can be said to possess a principle of formal organization —though one is tied to the essence of a substance, and the other to the continuity of a dynamic pattern. However, incompatibility arises when processual accounts adopt perdurantist or mereologically summative models that treat a process—or any continuant—simply as the aggregate of its temporal parts (DiFrisco, 2018; Guay & Pradeu, 2015). On such views, the identity of a process reduces to the sum of discrete temporal segments, with no unifying principle beyond their totality. This stands in fundamental contrast to perspectives that treat continuity itself as central to individual identity. For these latter views, a process—or indeed any continuant—cannot be adequately captured by mere aggregation; its identity depends on the persistence of an organizing structure that integrates temporal phases into a coherent whole.

3.2. The Problem of Identity

Despite these differing perspectives among processualists on the countability of processes, all agree on the consideration that processes have an identity, and thus they all presuppose the existence of processual *sortals*. These *sortals* are defined by semantic principles that establish how to count their individual instances and specify conditions necessary for ensuring the entity's identity and persistence over time (Lowe, 1989). The individuation of processes and substances within these *sortals* thus requires identity criteria operating as principles of individuation (cf. Table 3).

Processualists tend to reject the individuation criterion given by Leibniz's Law based on the indiscernibility of identicals and according to which "If x and y are identical, then x and y share *all the same properties*". They contend that while this principle applies to substances and their defining properties, it is doubtful for processes, which do not retain all their properties over time (DiFrisco, 2018; Seibt, 2018). Consequently, processualists advocate for principles of individuation that can accommodate change. The dominant criteria can be classified into the following four families: (i) numerical identity, (ii) causal-functional criteria, (iii) formal, and (iv) mereological criteria. As will be argued throughout this section, mapping how each of these criteria is used by processualists and substantialists reveals areas of overlap.

Numerical Identity

For some processualists, substantialists' understanding of identity assumes a static view of reality constituted by fundamental immutable entities (Meincke, 2019; Rescher, 1996; Seibt, 2007). Indeed, some substantialists maintain that all physical objects can be broken down into simple immutable substances —the most fundamental entities (e.g., Lowe, 1994, pp. 547-548). These simple immutable entities possess inherent, stable identities grounded in their nature. In this framework, identity, unity, and simplicity are intertwined and form the core principles for understanding substance.

However, not all substantialists endorse this interpretation. Neo-Aristotelian perspectives, for example, conceptualize substances as *composites* of matter and form that undergo significant transformations over time (Corkum, 2025, pp. 37 ff; Feser, 2019, p. 23; Oderberg, 2007, pp. 108 ff). From this standpoint, identity is not a numerical primitive but emerges from a unifying principle—whether structural, functional (Fine, 2015; Koslicki, 2013), or based on ongoing activity (Sentesy, 2020; Skrzypek, 2019; Wiggins, 2016, p. 213).

Processes, when conceived as individuals, are also understood to bear numerical identity, allowing them to be counted (cf. Table 3). Yet, the notion of numerical identity varies depending on the theory of persistence adopted. In perdurantist processualism, the different temporal parts of the process are the ones that have numeral identity. The identity of the process derives from the sum of those temporal parts (DiFrisco, 2018). In contrast, endurantist processualism, which holds that processes persist by being *wholly present* at every moment of their existence, assumes that numerical identity is a primitive. In this sense, the numerical identity of the process is maintained despite the continuous change in their properties. Although accepting the primitive character of numerical identity is the extended view among endurantist processualism, some authors have questioned this idea on the basis that, if given *a priori*, then numerical identity cannot serve as a sufficient criterion for individuating processes (Seibt, 2018).

Despite their disagreements, both processualism and neo-Aristotelian substantialism move identity away from any fixed list of properties (mass, charge, etc.) toward some form of diachronic organization. Thus, while a perdurantist talks about genidentity, or causal cohesion across parts (DiFrisco, 2018), an endurantist talks about formal, functional or mereological integration (Meincke, 2025; Seibt, 2018). Either way, numerical identity is not primary; rather, it depends on the organizational continuity of an entity, not on unchanging properties.

Causal and Functional Individuation Criteria

Another criterion employed by processualists for individuating processes is the appeal to causal relations. However, there is no consensus on the interpretation of causation itself. Some authors adhere to a classical, standard model of causation, characterizing it as a sequence of discrete events connected by regularities; whereas others advocate for dispositional theories, viewing causation as the continuous manifestation of inherent powers that shape the unfolding of a process or the essence of a substance.

The *standard model* conceives causality as a contingent link between sequential events, traceable through the transmission of marks —be it information, structure, or influence (Dowe, 1992; Salmon, 1984, pp. 154-157). John Dupré (2021b), as well as upholders of perdurantist processualism, favor this model of causation. For instance, according to DiFrisco, "the right approach to understanding biological processes is to be found in the causal cohesion account of individuation" (2018, p. 84). Similarly, Guay and Pradeu argue that, in relating genidentical events, "[o]nly causal chains that could be said to relate events characterizing states of the same thing should be considered." (Guay & Pradeu, 2015, §16.2.2).

However, this perdurantist characterization of causation is neither accepted by all processualists nor by all substantialists. In this regard, there are authors who appeal to other accounts of causation that do also allow for the individuation of processes without implying a perdurantist ontology (Meincke, 2020). For instance, the dispositional paradigm treats causation as the manifestation of powers: a seed germinates because its biochemical dispositions activate in moisture; muscles contract when their latent tensile power is stimulated (Molnar, 2003; Mumford & Anjum, 2011). Some processualists prefer this model because it captures the continuity of change without atomising it into snapshots (Meincke, 2020). In this view, processes are not just collections of states but continuous developments where causes flow into effects over time. Dispositions shape and direct this flow, giving processes structure and coherence.

Proponents of both the standard and dispositional models of causation frequently supplement causal criteria with *functional criteria* to individuate processes (DiFrisco, 2018; Dupré, 2021a; Guay & Pradeu, 2015; Meincke, 2021; Seibt, 2018). Broadly speaking, functionality refers to activities, capabilities, roles, or behaviors that guide the development of processes, focusing more on the *outcome* of an activity rather than the physical attributes that ground the activity itself. According to the functional criterion, therefore, entities performing identical functions within a system are essentially the same, regardless of their form or material composition. Nonetheless, the functional properties used for individuating entities depend on the type of entity and the disciplinary context where it is studied. In biology, for instance, self-maintenance is often invoked as the ultimate function individuating the processes and activities constituting a living being (Meincke, 2021; Moreno & Mossio, 2015), while in physics, individuation might focus on the operations of systems that produce regular, law-like behavior (Cartwright, 2002). This disciplinary-specific methodology ensures that the individuation of processes is both precise and reflective of the specific properties of the entities analyzed.

Causal and functional criteria are also employed to individuate substances. In particular, neo-Aristotelian metaphysics typically favors the dispositional model of causation (Austin & Marmodoro, 2017; Groff & Greco, 2013). Far from marking a divide, powers and functions operate as a shared *lingua franca* between the two metaphysics. This convergence between neo-Aristotelianism and process metaphysics has been especially noted in the philosophy of biology (Austin & Marmodoro, 2017; Skrzypek, 2019). A clear example is the concept of organismal unity, which is understood by neo-Aristotelians in terms of structural dispositions (Austin & Marmodoro, 2017). These dispositions are inherently processual, enabling the vital

activities necessary for survival. In this way, both frameworks affirm the central role of action in grounding life, revealing an important conceptual overlap (cf. Table 3).

Formal Criteria

In addition to causality and functionality, processualists and substantialists utilize formal criteria for individuation. Formal criteria refer to the persistence of a structure, form, or activity over time, enabling an entity to be identified as a distinct unit despite its internal variations. This structure is not necessarily static but it may be a dynamic pattern that is continuously maintained and reconfigured through change. For processualists, formal criteria individuate processes by tracing a pattern of activity rather than a fixed structure of matter (Meincke, 2021, 2025; Seibt, 2018). These criteria gain particular significance when interpreted through the lens of trajectories in phase space (Seibt, 2018). In this framework, the form of a process is not defined by a static configuration, but by the path it traces over time, encompassing linear, non-linear, and chaotic behaviors, as well as feedback loops. Drawing on concepts from dynamical systems theory, Seibt introduces the notion of an "attractor" (i.e., a state or set of states toward which a process tends) as a central tool in the formal individuation of processes.

Meincke (2021) extends the formal criterion by stressing that the form is the outcome of a self-stabilizing trajectory, continuously shaped by interactions with both internal and external processes. Accordingly, the identity of a process resides not in its material substrate but in its capacity to sustain a consistent *pattern of activity* over time. This perspective is also elaborated by Skrzypek (2019), who conceptualizes form not as a passive structure but as a constitutive activity—a process in which matter is perpetually engaged. In the framework of *hyloenergeism*, form-as-process underpins both synchronic unity (the unity of the process at a given moment) and diachronic unity (its persistence over time), thereby ensuring the individuation of the process through the continuity of its trajectory, even amidst material transformation.

As it occurs in the case of causal and functional criteria, formal criteria for individuation are not exclusive of processualism. Within the substantialist framework, dynamic conceptions of form can also be found. For instance, David Wiggins (2016) argues that the identity of living beings is not grounded in a static structure but in the sustained activity of life, such as metabolism. In this view, form is understood as an enduring activity, a pattern of organized processes, closely paralleling the processualist emphasis on temporal trajectories and systemic self-maintenance (cf. Table 3).

Mereological Criteria

Mereological criteria have traditionally been applied to substances but have recently been extended to processes, recognizing that these also have spatial and temporal parts (Seibt, 2015, 2018). Mereology is the discipline that explores how parts and wholes relate, providing composition criteria for determining the identity of entities (Varzi & Cotnoir, 2021). Mereological approaches are distinguished between classical and non-classical. *Classical mereology* (hereafter CM) considers the relation of "being part of" as reflexive, antisymmetric, and transitive. Within this framework, any object A can be a part of itself (reflexivity); if A is part of B and B is part of A, both are identical (antisymmetry); and finally, if A is part of B and B is part of C, then A is part of C (transitivity). In addition, CM assumes *unrestricted composition* —any collection of objects forms a whole— and *uniqueness of composition*, whereby two collections with identical parts constitute the same whole. Thus, even disparate elements, such as a beam from the Eiffel Tower and the handle of a cup, have a fusion according to CM. *Non-classical mereologies* refer to proposals where one or more principles of CM are broken. For instance, anti-extensionalism rejects the principle of proper part extensionality, allowing two objects with the same parts not to be necessarily identical; whereas non-universalism does not accept that any collection of objects forms a whole.

Different kinds of mereological criteria can be found in contemporary processualism and substantialism, and therefore, different kinds of mereology (classical or non-classical) depending on how the persistence of entities through time is conceived. Classical mereology aligns naturally with *perdurantism*, whether applied to processes or substances: entities can be decomposed into temporal as well as spatial parts, and the whole simply results from the fusion of all slices composing it (cf. Table 3). Under this view, numerical identity reduces to parthood: an entity just is the sum of its spatial–temporal parts.

However, *processual* and *substantialist endurantists* often reject CM in favor of non-classical mereologies, noting that transitivity fails to capture the hierarchical organization of many systems. For instance, although a ribosome is unquestionably part of a cell, it is not meaningfully a direct part of the liver as a whole; its functional role is mediated through intermediate structures. Because CM treats parthood as strictly transitive, they argue that it cannot adequately capture this kind of hierarchical nuance.

Within process metaphysics, Johanna Seibt's (2015) "Leveled Mereology" (LEM) exemplifies this non-classical approach by modifying the axioms of transitivity and introducing concepts that account for hierarchical and context-dependent part–whole relations. This framework

allows parts to belong to different levels within a system and to vary in relevance depending on the analytical context. In a biological system, for instance, the nucleus plays a central role in cell division but is marginal to cellular respiration. LEM thereby rejects transitivity, enabling finer-grained descriptions of entities whose parts interact dynamically across multiple scales, as in photosynthesis, where chloroplasts, sunlight, and water yield emergent properties like energy conversion.

Substance metaphysicians run into the same complexity whenever they analyse composite organisms or intricate artefacts. An organism may include a liver as one of its standard organs, yet it also relies on mutualistic bacteria that are not made of the organism's own cells. To capture this composite unity, neo-Aristotelians introduce stratified mereologies and potential parts (Cotnoir, 2013; Inman, 2018; Koslicki, 2007) that acknowledge multiple, partially overlapping layers of parthood.

Seen from this angle, process philosophers and substantialists converge on the need for non standard mereology accounts of entities' parthood. Process theorists deploy it to highlight the porous boundaries and mutual interpenetration of ongoing activities, while substance theorists adopt similar tools to preserve the idea of a unified thing without ignoring its empirically messy, multi-layered architecture. The shared reliance on a more supple part–whole logic thus offers a point of overlap: despite their disagreement over whether the basic furniture of reality is fundamentally processual or substantial, both traditions end up using a similar flexible framework when they grapple with the tangled, multi-scale organisation characteristic of living systems and sophisticated machines (cf. Table 3).

3.3. Compatibility and originality of individuation criteria

In the previous sections we have argued that the traditional framing of the discussion between processualists and substantialists —as if these were two mutually exclusive and opposing accounts of individuation— is ultimately misleading. On the one hand, in response to the critique that substantialism treats identity and individuality as preconditions for change and persistence —thereby rendering identity a fundamental property and promoting a static view of reality— we have shown that this interpretation is not universally accepted among substantialists. Neo-Aristotelian approaches, for example, conceive of substances as *composites* of matter and form that are capable of undergoing substantial change over time (Corkum, 2025; Feser, 2019; Oderberg, 2007). Within this framework, identity is not treated as a primitive numerical fact but rather as something that emerges from a unifying principle —whether structural, functional,

or rooted in continuous activity. Accordingly, the identity of a substance cannot be fully accounted for by enumerating its properties or decomposing it into simpler components, as processualists suggest.

On the other hand, substantialist metaphysicians have often criticized processualism for its alleged inability to provide clear definitions of entities or robust criteria for identity (Austin, 2020; Wiggins, 2016). Moreover, when such criteria are proposed within the processualist framework, they are said to closely resemble those found in substantialist metaphysics. However, our analysis reveals that process metaphysics does in fact offer a rich set of individuation criteria. While processualists reject any criterion grounded in static properties for identifying entities, they nonetheless share conceptual tools with neo-Aristotelianism –such as the appeal to dispositions, as well as formal or functional principles of individuation.

Against the redundancy objection, processualism does not seem to be reducible to substantialism, as it relies on fundamentally different ontological entities. Unlike substances, processes are not confined to fixed spatiotemporal locations; they may unfold across diverse temporal scales, recur, and persist beyond any single spatial instantiation. This detachment from rigid boundaries allows processes to be conceived as temporally extended patterns of activity rather than discrete objects. Moreover, their individuation by trajectories—the dynamic paths they trace through time—provides a distinctive formal criterion central to processualist metaphysics, offering novel insights about change and persistence.

4. Conclusions

While the debate between substantialism and processualism has often been marred by mutual caricatures and oversimplifications, these metaphysical frameworks do not represent monolithic viewpoints. Rather, they encompass a spectrum of positions on key metaphysical issues such as fundamentality, persistence, and individuation. In this paper, we have uncovered conceptual areas of compatibility and discord between specific interpretations of processualism and substantialism across these domains.

Regarding *fundamentality*, we distinguished between fundamentality as *independence* and as *primacy*. While both substance and process frameworks reject simplistic models of *dependence*, they each allow for nuanced forms of ontological independence—such as rigid ontological independence –that make it possible to consider both substances and processes as fundamental entities. Moreover, the debate over *primacy* reflects how seemingly opposing metaphysical views —such

as monism and pluralism— can coexist or complement one another when analyzed through the relational lens of targets and units. In the case of *persistence*, our analysis showed significant overlap between perdurantist and endurantist variants of both substance and process metaphysics. Notably, processual perdurantism shares static assumptions with particularist substantialism, while processual endurantism converges with neo-Aristotelian views in treating change as intrinsic to persistence. Finally, on the issue of *individuation*, we identified overlapping positions concerning both the individuality and the identity of entities. Concerning individuality, there is an internal disagreement among processualists that allow to establish alliances with some substantialist positions in this regard: some view processes as countable, spatiotemporally located entities capable of persistence and change, while others see them as non-individual temporal masses—uncountable, unowned, and not tied to specific locations. Regarding identity, we have countered the substantialist critique that processualism lacks clear individuation criteria, showing that there are overlapping criteria of individuation, such as formal, functional, and mereological criteria.

Together, these analyses demonstrate that the divide between substance and process metaphysics is less rigid than often assumed. The disparities between substantialism and processualism can only be elucidated by examining specific theories about particular metaphysical problems within these frameworks. For instance, perdurantist processualism diverges significantly from neo-Aristotelian substantialism, despite sharing similarities with particularist substantialism. In contrast, processualist endurantist models align more closely with Aristotelian views than with perdurantist processualism. This confluence permits to argue for a metaphysical approach that allows for the flexible integration of criteria from both frameworks, tailored to the metaphysical problem at hand, and the kinds of entities under investigation.

The metaphysical problems discussed in this paper are the subject of extensive and technically nuanced literature. Philosophers of science working on these questions often approach them through polarized, overarching frameworks. By systematically comparing accounts of fundamentality, persistence, and individuation in substance and process metaphysics, this paper provides philosophers of science with a richer conceptual framework to advance ongoing discussions within specific scientific contexts, such as those concerning biological individuality or the nature and persistence of biological species.

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