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Kinds and Essences: Rescuing the New Biological Essentialism

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Abstract: After the rise of Darwin's theory of evolution it seemed that the much-feared ghost of traditional essentialism had disappeared from biology. However, developments of the last century in analytic metaphysics (Kripke, Putnam, Wiggins) appear to have resurrected the Aristotelian monster in various forms. The aim of this paper is to investigate the revival of the essentialist doctrine as applied to biological species, namely the thesis that organisms belong to a particular natural kind in virtue of possessing certain essential properties, and examine to what extent these new biological essentialisms are sustainable. For this purpose, I intend to analyze these proposals in both their forms, *relational essentialism* (Okasha, LaPorte) and *intrinsic essentialism* (Devitt), and confront them with their main anti-essentialist criticisms. The answer, I advance, is that natural kind essentialism as applied to biological taxa is, not only tenable, but theoretically adequate. Yet not in its typical variants. I contend that understood as *HPC kinds* (Boyd, Wilson), organisms possess clusters of co-occurring properties that are caused by various mechanisms which in turn determine the shared similarities that define membership to species. Such an approach encompasses both the intrinsic and relational mechanisms that make species members be what they are. However, this theory faces criticisms regarding circularity and the problem of polymorphism (Ereshefsky & Matthen). I suggest that reinterpreting the HPC theory as *informationally-connected property clusters* (Martínez) solves the objection posing an improved version of the HPC theory and providing what I believe is a theoretically adequate and explanatorily robust version of biological essentialism.

Keywords: Anti-essentialism, new biological essentialism, HPC theory, HPC kinds, ICPC kinds, natural kinds, intrinsic essentialism, relational essentialism, species.

Introduction: State of play

The classical idea that biological taxa have essences that determine their membership to a species has been widely rejected by most twentieth-century philosophers of biology. The advent of Darwinism along with the progress in methods of biological classification seemed to have shown that traditional essentialism was little more than metaphysical verbiage. Authors such as Ernst Mayr (1963), David Lee Hull (1965, 1978), and Michael T. Ghiselin (1974) famously defended the view that essentialism about species contradicted both evolutionary theory and modern taxonomy. Until not long ago this had been the dominant position in the species debate. However, Putnam's (1973, 1975) and Kripke's (1980) metaphysical revolution showed that essentialism was not only a fairly intuitive theory but also a position worth defending. Thus, the debate gradually resurfaced giving rise to new forms of essentialism as applied to species. Philosophers like Samir Okasha (2002) Joseph LaPorte (1997, 2004) and Paul Griffiths (1999) have rejected the traditional account advocating a relational approach to essentialism. Some, like Denis Walsh (2006) and Michael Devitt (2008) have criticized these approaches staying faithful to the intrinsic-type essentialism, while others such as Richard Boyd (1999) and Robert Wilson (1999) have proposed to understand natural kinds as *homeostatic property clusters* (HPC). Yet anti-essentialism remains combative, Marc Ereshefsky (2007, 2010a) has raised multiple objections to each of these theories. The purpose of this article is to analyze these new forms of biological essentialism and confront them with their criticisms. My task will be to determine if natural kind essentialism as applied to biological species is plausible or if, on the contrary, anti-essentialists are right and biology would do well to abandon such metaphysical relic. The answer, I advance, is affirmative, biological essentialism is worthy of defence.

The first section will be dedicated to clarify some of the essentialist notions and differentiate traditional essentialism from that which we ought to examine. This will be in line with one of the theses I stand by, scilicet that we must abandon the traditional sense of essence if we are to accommodate an appropriate metaphysics of biology. In section two I will proceed to enquire into the classic anti-essentialist criticisms. I will investigate the ontological question of biological taxa and present the *species as individuals' concept* (SAIC) defended by Hull and Ghiselin. Eventually I argue that the SAIC theory has no real impact on the species and natural kind debate. The reasons for considering species as individuals are not critical to essentialism, and additionally, the SAIC theory poses an inadequate model of natural laws and scientific procedure. So, the benefits are none and yet the costs many. Once this is done, we will go on to analyze the new forms of biological essentialism. In section three I present Okasha's and LaPorte's relational essentialisms as well as Devitt's response in terms of his new intrinsic essentialism. Eventually, we will see that relational essentialism does not hold and that Devitt's position, although adequate to our project, requires a little more precision. With this in mind in section four I will introduce the HPC theory, which extends over Devitt's notion of property cluster and accounts for species as natural kinds encompassing both the intrinsic and relational mechanisms that make species members be what they are. Nonetheless, as we will see the HPC theory faces relevant criticism regarding circularity (Ereshefsky) and the problem of polymorphism (Ereshefsky & Matthen). I face those criticisms and propose that rather than abandoning the theory, what we need to do is reinterpret it. Specifically, I argue that reinterpreting HPC kinds as *informationally-connected property clusters* (ICPC) in the way Martinez (2015) does allows us to solve the objections paving the way for what I believe is a theoretically adequate and explanatorily robust version of biological essentialism.

1. A preliminary note on essentialism

Essentialism is historically and philosophically linked to Greek and Medieval philosophy. In its original form it is derived from the Platonic characterization of the forms, a notion that would later take the shape of the scholastic debate of universals between realists and nominalists. However, the notion of essence is particularly rooted in the Aristotelian notion of substance and *"what it is to be"* something[1]. Later the concept of essence would freely navigate the seas of metaphysics until encountering Darwin, the post-Popperian philosophy of science and Quine. The tale goes like this: Under the influence of classical philosophy pre-Darwinian biology maintained a traditional essentialist concept of species. Natural kinds, of which biological organisms were believed to be part, were defined by the possession of underlying intrinsic properties that determined membership to specific groups. Traditional metaphysics believed essences to be eternal and immutable since these were the necessary and sufficient conditions of "what it is to be" something. This resulted in the *typological species concept* of pre-Darwinian taxonomy. Species were understood as static groups whose members shared some characteristics that differentiated them from other species. As one may guess Darwin's evolutionary theory proved typologists wrong. If species mutated and evolved over time, they could not be defined by eternal intrinsic properties. Biological variability was at odds with traditional kind essentialism. This led to the post-Darwinian population thinking and the development of different classificatory theories such as phenetics, cladistics and evolutionary taxonomy[2]. However, a metaphysical revolution that would bring back the much-feared ghost of essentialism was about to take place.

During the late 70's at the centre of a debate in principle far from the philosophy of biology Saul Kripke and Hilary Putnam proposed their semantic theories regarding reference and meaning. Both authors argued in favour of the existence of a posteriori necessities and semantic externalism. According to them the reference of natural kind terms does not depend exclusively on internal factors, but also on external ones. In *Naming and Necessity* Kripke worked through the famous example of Hesperus and Phosphorus, arguing that identity statements are, if true, always true. This led him to the consequence that the reference of certain type of terms which Kripke labelled rigid designators is fixed through all possible worlds. These terms, which include proper names and natural kind terms, designate the same object in all possible worlds in which that object exists. Applied to natural kind terms such as "gold" or "water" we get that

[1] It is worth to note, as Wilkins (2013) does, that the word "essence" was never properly used by Aristotle. The word was popularized after the reinterpretation of Averroes and Avicena and the later latinization of the Aristotelian work.

[2] Phenetics and cladistics differ in that pheneticists ignore phylogenetic relationships and classify biological organisms based solely on morphological similarity, whereas cladists categorize organisms in groups based on their most recent ancestor. Evolutionary taxonomy appeared after the development of the evolutionary theory and combined both offspring relationship and degree of evolutionary change. For a better approach to these taxonomic theories and their respective disagreements I recommend reading Hull (1988).

statements such as "gold = the element with the atomic number 79" or "water = H_2O" are, if true, necessarily true. Virtually this implied that any substance designated by the term gold must necessarily, and thus *essentially,* possess the property of being composed of the element with the atomic number 79. Putnam's twin earth experiment went in the same direction demonstrating that the reference of the term "water" is fixed and, what is more important, that this reference is determined by the essential property of being composed of H_2O. The important thing to keep in mind when it comes to the species debate is that Kripke and Putnam both argued that these underlying properties play a causal-explanatory and semantic role. We individuate natural kinds in virtue of a series of contingent characteristics, such as being yellow, shinny, melting at 1.064 °C, etc. in the case of gold. These characteristics are caused by internal properties that are inductively explanatory and determine what things belong to what kind. As far as the chemical kinds are concerned this is not so controversial, but as one might expect the revival of essentialism had a major impact on the debate concerning biological taxa. The issue is further accentuated if one considers that both Kripke and Putnam made use of biological examples such as tigers and lemons to argue in favour of a posteriori necessities and kind essentialism.

That being said, before continuing, two clarifications must be made so as not to lose our way. First of all, there is an important and often neglected difference between individual and kind essentialism. Individual essentialism has to do with the properties that make a certain individual be what it is, properties without which it would cease to exist as the *kind* of thing it is. In other words, whereas individual essentialism claims that there is a property according to which an individual belongs to a certain kind, kind essentialism holds that it is the kind that possesses the essential properties that determine membership. The difference is subtle but crucial. The first claim strongly suggests the second while the second, although consistent with the first, does not imply it[3]. Wiggins (1980, 2001) has defended an essentialism along these lines[4]. This work delves in the question of kind essentialism and its relation to the species debate, and although interaction between these two doctrines will emerge, they should not be confused. The second clarification is that it is important to distinguish traditional essentialism from new biological essentialism. The distinction is important because much of the anti-essentialist consensus is a direct consequence of the confusion of these two positions[5]. Wilkins (2013) is right in stating that the stagnation of the pre-Darwinian concept of essentialism is largely due to Mayr and Hull's treatment of biology in terms of traditional essences. Specifically, Hull's criticism of typology under Popper's notion of methodological essentialism. Hull (1965) listed the three essentialist tenets of typology as "(1) the ontological assertion that Forms exist, (2) the methodological assertion that the task of taxonomy as a science is to discern the essences of species, and (3) the logical assertion concerning definition." (Hull, 1965: 317). But as

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[3] To be precise, individual essentialism does not necessarily imply kind essentialism. But it is difficult to argue that individual entities possess the property of belonging to a kind without assuming that those same kinds have a list of conditions that determine membership.

[4] According to Wiggins the essence of an individual I is his necessary belonging to a kind K. The classic example is that being human is a necessary property of Socrates insofar as human, otherwise Socrates would cease to exist as the individual he is. Wiggins' idea has to do with how individuate objects making use of generic concepts known as *sortals* such as "human".

[5] Aristotle's essentialism does not consider essences to be properties, instead the essence of something is what determines the very being of that substance. That's why essences are understood as being eternal and immutable. Aristotle described essences as the *cause of being* of individual substances. His primary interest was the question of what is responsible for the existence of an actual individual substance, rather than the question of why we classify individual substances in the way we do.

Wilkins notes, “these are not all the same, or even necessarily related, ideas, and it is not the case that these views must travel together as Hull insisted.” (Wilkins, 2013: 12). Traditional essentialism is ontological and definitional, it affirms that natural genres have intrinsic, eternal, ahistorical and immutable essences that make an object what it is. The new biological essentialism is not committed to these theses. Instead, with what it is committed is with the claim that there are internal properties that are relevant in understanding and explaining the causal processes that make an organism develop the traits that determine membership to a natural kind[6].

2. Old school anti-essentialism

2.1 Natural kindness and species individualism

As I said the canonical rejection of species essentialism followed from the advent of the Darwinian theory of evolution. Darwin proved that biological organisms were the product of natural selection and speciation processes. Biological variability was introduced and qualitative features were no longer considered to be necessary and sufficient for species membership. After the Darwinian revolution population thinking was stablished and species began to be understood as constant changing units. The evolutionary concept of species was inherited by Mayr (1962, 1969) who confronted typologist presenting his *Biological Species Concept* (BSC). The BSC defined species as sets of organisms that can successfully interbreed. Mayr's idea is interesting because, as opposed to traditional intrinsic essentialism, he stated that higher taxa are defined by extrinsic relational factors such as their ability to interbreed and generate fertile offspring. An idea that would later be rescued by relational essentialists. However, the BSC would not go unpunished and several criticisms would be launched at the reproductive notion of species mainly for assuming that organisms that cannot interbreed do not form stable lineages[7].

Darwin and Mayr’s work would lead several authors to question the ontological status of species. Among them stand out Ghiselin (1974) and Hull (1978) who denied the natural kindness of species advocating for the *species as individuals concept* (SAIC), a theory that has often been cited by contemporary anti-essentialists as a compelling reason to discredit biological essentialism[8]. Ghiselin would be the first to formulate the idea, although it was Hull

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[6] For a better analysis of the genealogy of essentialism and the difference between contemporary and traditional essentialism I recommend Wilkins (2013) and Witt (1980) respectively.

[7] The BSC excludes both fossil organisms and asexually reproducing taxa from forming species. In addition, it assumes that hybridization produces sterile offspring, but there are known cases of fertile hybrids such as the tuco-tuco resulting from the cross-breeding of female *Ctenomys minutus* and male *Ctenomys lami* or hybrid orchids resulting from naturally crossed *Epidendrum fulgens* and *Epidendrum puniceolutem*.

[8] In fact, the idea seems to be anchored in Darwin’s own thought who seemed to be a species antirealist. He believed that the distinction between species and varieties was purely arbitrary and that in so far as natural selection was the only process governing taxonomic differences there was no reason to believe in the existence of a realist species concept. More on the debate over the ontological status of the species category in Ereshefsky (2010c).

who expanded the SAIC theory to the historical kind concept of species. Ghiselin would argue against the reality of the species concept arguing that classes are incapable of evolving because they are abstract entities which are said to possess immutable essences. If species evolve and mutate, they must be individuals, since individuality is a necessary condition for change. Thus, if Darwin was correct and species evolve, species must be individuals. Moreover, "multiplicity does not suffice to render an entity a mere class" (Ghiselin, 1974: 536). The logical treatment of species in terms of individuals would make Ghiselin deny essentialism to the point of questioning relational notions such as Mayr's BSC. Not only he argues that species do not have intrinsic essences but that they lack any essence at all. If species are individuals they cannot be defined by a list of necessary and sufficient properties, neither intrinsic or extrinsic. Simply put, insofar as it was an accident that the class of mammals gave rise to horses or echidnas relational accounts of species pose properties that are accidental and therefore not necessary. Hull would argue in a similar way stating that if species vary over time mutation would render internal properties contingent making them susceptible of being modified during speciation. This would lead Hull to embrace Ghiselin's theory claiming that species and higher taxa must be individuals insofar as they are spatio-temporally restricted entities. Species are recognizable as evolutionary units because they share certain traits, traits that become prominent on a given species by selection. Genetic hereditary relations require lineages to be causally and hence spatiotemporally connected. Selection causes traits to become prominent in species only if that trait is passed down. So, if species evolve and change they must be spatiotemporally continuous historical entities.

2.2 Is the SAIC theory truly relevant?

The consequences of endorsing the SAIC theory are several and yet I believe its benefits are unclear. One of the most cited implications of species individualism is that there cannot be scientific laws about particular entities. Hull himself embraced this consequence as a positive contribution of his theory. He stated that one of the main reasons that lead him to differentiate species as historical entities from natural kinds is the different role that each of these categories plays in science. According to Hull in the classical analysis "Scientific laws are supposed to be spatiotemporally unrestricted generalizations. No ineliminable reference can be made in genuine law of nature to a spatiotemporally individuated entity." (Hull, 1978: 337). The distinction is key to understand the difference between genuine laws of nature such as Newton's law of universal gravitation, and evolutionary generalizations like "all organisms in dry habitats develop water conserving mechanisms" which happen to be accidentally true. At first glance the idea that laws of nature cannot make reference to individual entities may seem like a satisfactory conclusion since there seems to be no universal generalizations in biology that apply to particular species. However, I think this conclusion is hasty and fails to appreciate how models of scientific laws operate. Let me explain:

The idea reverberating through Hull's thought is that scientists dedicate themselves to discovering the regularities that govern nature theorizing them as laws that operate at the level of physics. I believe this idea to be only half right. It is true that one of the main, (if not the fundamental) purposes of scientific practice is to formulate generalizations of natural patterns that allow us to give causal explanations and make inductive predictions about the world. But we should not fall into the error of extrapolating the model of physics to other scientific disciplines like biology, sociology, or psychology. Such a model stems from the classical idealization of universality and reducibility of natural laws to axiomatic theoretical systems. Philosophers like Nancy Cartwright (1980, 1983) and Marc Lange (1993) have challenged the Newtonian idea that the universe is an organized system governed by exceptionless regularities. In particular, Cartwright argues that scientific laws are not exceptionless generalizations but statements describing causal processes that operate in highly localized scenarios. That's why scientists formulate them as *ceteris paribus* generalizations in which a given system turns out to be a certain way *other things being equal.* But if this is so, scientific laws such as Newton's gravitational principle are not true laws, for if we drop the ceteris paribus clause, we drop the exceptionless component[9], "[T]he fundamental laws of physics do not describe true facts about reality. Rendered as descriptions of facts, they are false amended to be true, they lose their fundamental, explanatory force." (Cartwright, 1983: 54). Nevertheless, scientific laws are not less explanatory for not being exceptionless, moreover it is precisely the ceteris paribus clause that renders them explanatory. The universe has a certain order, yet contrary to what it was thought to be, it is local, more diverse and less absolute.

Now if we go back to the no-reference-to-individuals objection, laws of nature make claims about how certain objects of the world, such as celestial bodies or elementary particles behave. It is a central requirement of scientific explanations that reference can be made to how these concrete objects of the world behave (or should behave) under certain circumstances. Biological generalizations regarding evolutive behavior provide good instances of such explanatory laws. That the typical formula of the fundamental laws of physics is general does not restrict the fact that their scope could be particular. LaPorte (2004) offers a good example when quoting Lange's (1995) point of how on Dirac's conjecture the constant of gravitational force is inversely proportional to the time since the Big Bang. Clearly such a claim would require reference to a particular and restricted time. What is relevant here is that "Dirac's conjecture may be false, but it's hardly apparent that because it refers to particular time it could not have been a law." (LaPorte, 2004: 14). Thus, it seems precipitate to conclude that it follows from the very nature of laws that scientific laws could not refer to particular individuals. Besides, we should not forget that even if Hull's point is correct, it does not follow that biological species are in fact individuals. As LaPorte argues it could very well be the case that biological taxa are natural kinds without fundamental laws, and still the explanatory requirement would remain intact.

To close up I want to mention two further points regarding the SAIC theory. First of all, it seems to me that Ghiselin's thesis that natural kinds cannot undergo any change because they are abstract concepts is a poorly thought objection. Upon reflection it should be clear that when we talk about *Archaeopteryx* having evolved into organisms of the *Confuciusornis* family we are not referring to the natural kind "Archaeopteryx" in the abstract sense. What we mean is that some members of the species Archaeopteryx underwent some speciation process that made them evolve into a new type of organism that classifies into a new species kind. In other words, concrete members of a species kind came into existence after old instances of another species

[9] Carwright (1980) argues that the Newtonian gravitational principle is not an exceptionless regularity because, as most scientific principles, it is true only in ideal isolated systems. The principle states that the force between two bodies is equal to the product of their masses divided by the distance between them squared ($F = Gmm'/r^2$). However, this force is influenced by other several properties like their charge.

kind underwent mutation. Second, and more importantly, as Wilson (1999) and LaPorte (2004) argue, even if Ghiselin and Hull are wrong, and species are not individuals, there is really no need to refute the SAIC theory, for species-individual talk can be translated to species-kind talk. To understand this, let's take a look at LaPorte's argument: There is a kind for every property regardless of what property that is, and it is the possession of that property that determines kindness. This may initially sound like a regressive point, but it is not. An easy example: the property of being wooden determines wood-kindness in that possession of that property is linked to the kind "wood". In other words, the individual spatio-temporally restricted wooden entities that are members of the wood-kind are so in virtue of the essential mark that is to possess the property of woodness. Now setting aside artificial kinds and focusing on individual-species, there is a property for each individual that determines membership to that individual-kind, since for every property there is a corresponding kind regardless of how trivial that kind is. Applied to species there is a property for every species-individual that determines species-kindness in virtue of which individual entities possessing that property are members of a species-kind. So, in the end talk about species as individuals could be reconstructed as talk about species as kinds and the SAIC theory is of little relevance to the species as natural kinds debate.

3. New Biological Essentialism

Despite the intuitive criticisms of traditional anti-essentialists, after the Kripkean and Putnamian revolution several authors have tried to resurrect biological essentialism based on current research programs. These programs are grouped into what is known as the *extended evolutionary synthesis*, a group of different research lines that examine additional causative factors beyond genetics[10]. Philosophers of the new biological essentialism have focused their attention on how processes such as embryonic development, the influence of ecological factors, construction of niches, reproductivity between individuals, evolutionary history and ancestor lineages could explain the common characteristics that differentiate species. Since these new taxonomic approaches did not explain evolutionary development in strictly genetic or intrinsic terms, many authors have rethought the possibility of accepting essentialism defining essences as non-intrinsic relational properties. Still, others have remained faithful to the core ideas of traditional essentialism defending the causal-explanatory relevance of internal mechanisms in speciation processes. In this section I will review some of the most relevant theses of these new biological essentialisms, as well as the criticisms they have faced.

[10] Some of these non-genetic factors are *multilevel selection* (the idea that natural selection operates at the group level rather than at the individual level), *transgenerational epigenetic inheritance* (chain transmission of epigenetic markers from parent organisms to child organisms that affects the traits of offspring without alteration of the DNA), *evolutionary developmental biology* (molecular analysis of embryology and comparison of developmental mechanisms in biological organisms to infer ancestry relationships), and the evolutionary influence of ecological factors such as ecosystems or the creation of niches.

3.1 The rise of relational essentialism

According to relational essentialism organisms belonging to different species are defined by a series of extrinsic relations that they share with members of their taxa. Relational approaches rescued the essentialist idea that there are lists of necessary and sufficient conditions delimiting boundaries between species. However, defining these conditions in terms of relation based species concepts avoids the classic anti-essentialist criticism offering the possibility to accommodate biological variation as well as the different taxonomic schools. Transferring essences to extrinsic properties such as being descendant of a particular ancestor, being part of an interbreeding population, or occupying a particular ecological niche fits in with post-Darwinian taxonomy. But as we will see this comes at great cost, namely that of abandoning the causal-explanatory role of essential properties. Of course, there is also the further debate about which type of classification theory is the most appropriate, or if, on the contrary, biology should move past beyond the monistic attempt to identify a single correct species concept adopting a pluralistic approach[11]. Nonetheless, these are questions regarding the adequacy and explanatory functionality of our taxonomic approach, truth is that regardless of which position we decide to embrace, monistic or pluralistic, relational essentialism can, in principle, account for both.

Okasha's a-causal relational essentialism:

Okasha's article *Darwinian Metaphysics: Species and the Question of Essentialism* has already become a classic for being one of the first articles to analyze relational essentialism in light of the semantic theories of Kripke and Putnam. In his paper Okasha emphasizes an idea that is important to understand the essentialisms that derived from this theories, namely the idea that essential properties must play a semantic and causal-explanatory role. For example, in the case of water, the property of being composed of two atoms of hydrogen and one of oxygen is what determines both the macrostructural properties shared by all true samples of water and the reference of the natural kind term "water". Intrinsic essentialism places these two roles in the microstructural properties of natural kinds, the atomic structure of gold is the property that determines surface characteristics such as color, melting temperature or its malleability, as well as the extension of the term "gold". The immediate idea that comes to mind when considering the strategy of a relational essentialist is to replace this *hidden structure* with relational properties of the type mentioned above. However, Okasha cautions, this only half saves the Kripkean/Putnamian essentialist model, for relational properties are unable to account for the causal processes that led organisms of certain species to possess certain traits. Whatever approach we take, phylogenetic, morphological, ecological or interbreeding, none of these properties meets the causal-explanatory role. Organisms belonging to the species of *Equus*

[11] Pluralism argues that the monistic project of species is fundamentally wrong and that the progress of modern evolutionary synthesis shows us that the question is not about which concept is correct, rather it concerns the question of how legitimate the different species concepts are. For different versions of pluralism I recommend reading Kitcher (1984), Dupré (1993) and Ereshefsky (2001).

quagga (plains zebra) share a number of relational properties such as inhabiting treeless grasslands and savanna woodlands, being highly social, nomadic and non-territorial, having evolved from a common ancestor, and being able to interbreed. But none of these properties *explains why* common zebras have stripes. However, Okasha argues, there is no a priori reason to believe that the same property should play both roles. Such a notion of natural kindness is extrapolated from chemical kinds like gold in which having atomic no. 79 play's both the role of determining something being gold and explaining why all the samples of gold share [12]. But there is no reason why the same should happen with biological kinds.

> It is perfectly possible that the extension of a kind term should be determined not by superficial characteristics but by "something else", just as Kripke and Putnam say, without it being true that that "something else" causally explains the presence of the superficial characteristics. Simply because atomic structure performs both roles in the case of chemical elements does not mean that the two roles must always be played by the same thing. And if we apply the Kripke/Putnam model to biological species in the way I have recommended – by replacing Kripke's and Putnam's "hidden structure" with whatever relational property we think determines species membership – we do sever the semantic and causal/explanatory roles. (Okasha: 2002: 203)

However, things do not end here. Okasha does not only sever the semantic and causal-explanatory roles, he goes even further claiming that we should abandon the idea that classificatory concepts in biology must be relevant when making inductive predictions. This idea, he says, is valid in disciplines like chemistry where the causal and semantic roles are co-instantiated, but in disciplines such as biology where this does not occur, this account of what determines the value of scientific classifications is not necessarily adequate.

I disagree, and I think the reason why Okasha claims this is that his attempt to replace the hidden structure with relational essences places him in a dilemma. If species have relational essences that do not play any inductive causal-explanatory role it follows that either (1) formulated in such a way species do not have any scientific value, or (2) scientific generalizations do not determine the value of a species concept. Okasha bites the bullet and goes for the second horn of the dilemma disguising the first by the fact that it seems strange to affirm that the concept of species does not have any scientific value, this would go against taxonomic practices. But it seems even stranger to state that without any causal-explanatory power something could be considered a scientific concept. Isn't it precisely the purpose of taxonomy to make predictive generalizations that allow us to group organisms under the same species concept? The dilemma only occurs because Okasha deprives essential properties of the explanatory requirement. Ereshefsky criticizes this point arguing that "if the relations that serve

[12] In an unpublished article Gorriñobeaskoa (2019) expands upon Okasha's point arguing that the causal-explanatory factor of the internal mechanisms of chemical kinds such as gold are not as clear as one might initially imagine. It might seem that the atomic structure of gold is what determines its surface characteristics, however the color of gold is due to a special property of electrons that in turn depends on the atomic structure. This property determines in which orbit and in which order electrons are placed around the nucleus, causing them to absorb and refract certain spectra of light.

as the identity conditions for a taxon are not central in explaining the typical traits among a taxon's members, then such relations are not essences" (Ereshefsky, 2010: 683). Okasha's essentialism is empty of essences because it lacks the causal role that characterizes essentialism. Devitt is on the same line of attack, he rejects relational essentialism for being unable to answer the causal question of traits, *Why do members of species S typically have trait T?* Explanations that merely cite relations may explain *how* a trait is maintained across the members of a species, but are insufficient when it comes to explaining *why* zebras typically have stripes. Essences, understood as relations do not suffice.

LaPorte's historical essentialism:

Linked to his critiques of species individualism LaPorte (2004) has proposed that species are defined by historical essences. LaPorte draws upon the phylogenetic concept of species arguing that ancestry relations are the real essential properties of biological taxa[13]. The difference with Okasha's essentialism is that historical essences are what render species kind causally explanatory as compared to other natural kinds. He argues that the naturalness of a kind consists in its explanatory value, thus amending the objection posed against Okasha[14]. It is precisely because natural kinds have explanatory value and are inductively useful that they provide the basis of scientific classification. Adducing to historical properties allows us to explain biological similarities between *Ursus maritimus* (polar bears) and *Ursus arctos* (brown bears) in genealogical terms. In the same way, it allows us to explain why polar bears are able to swim long distances in icy water while brown bears aren't. The explanation is evolutionary in the sense that some organisms in the previous bear population survived better than other members of the same species because they could swim in icy water. This in turn provides a satisfactory explanation of the genetic inheritance that caused the trait to perpetuate in the lineage. Simply put, under LaPorte's account the essence of a species is its location in the evolutionary tree. The members of a given species must have the relevant relations to their ancestors, and it is this evolutionary history that allows us to explain the important shared features associated with members of species.

> Kripke and Putnam wrongly suppose that [...] "internal structure" is what binds the members of a biological kind like species into a common kind. In general [...] biologists do not delimit species and other taxa on the basis of intrinsic properties like these. Biologists generally place organisms into taxa on the basis of shared ancestry [...] This error about how to characterize the essences of taxa can nevertheless be easily remedied, as I have suggested in earlier chapters. Given that biological kinds are delimited historically, the essences of kinds simply become historical. (LaPorte, 2004: 64)

[13] Phylogenetics, also known as cladistics, addresses species from the point of view of evolutionary history and ancestry relations. The hereditary traits of species are explained in terms of lineage and genetic inheritance and give rise to phylogenetic trees that show the evolutionary relationships of different species.

[14] LaPorte holds that natural kindness comes in degrees and varies in function of the explanatory value of particular kinds. In certain contexts, terms like "green", "trash" or "toothpaste" are said to constitute natural kinds with certain explanatory value, whereas in other "fairly strict contexts" they don't.

The main advantage of historical essentialism is that it accounts for species historicity and evolutionary change while keeping the explanatory requirement. Moreover, nothing prevents the defender of the SAIC theory from embracing such a conception of species, since, as we saw, is compatible with the thesis that species are individuals. However, there are also problems with LaPorte's approach for historical essentialism presupposes that species are lineages and that their evolutionary history is an uninterrupted continuity. Yet, this is false, species do not constitute lineages themselves, but rather they are segments of the lineages. Breaks in the lineages determine phylogenetic trees, these ruptures occur in the speciation processes in which the essential properties resulting from the ontogenetic processes arise. Those properties are the ones defining the membership to different species of same lineages. At some point in history some members of *Ursus etruscus* ceased to be members of that taxa becoming members of the new *Ursus arctos,* from which later on *Ursus maritimus* evolved. However, the same lineage splitted giving rise to *Ailuropodinae*, better known as the panda bear. Historical essentialism cannot account for the segmentation of lineages for it classifies only in terms of ancestry relations. It lacks the explanatory power that ontogenetic mechanisms bring to our theory. Relations provide information about the external conditions that triggered the speciation processes, but they do not explain how they occur. LaPorte's historical essentialism too falls prey to Devitt's causal question of traits, historical essentialism is informative rather than explanatory. Something else is needed, namely reference to the internal processes that cause speciation.

3.2 The return of intrinsic essentialism

Michael Devitt is surely the person who has contributed most to reigniting the debate about the death of essentialism. In an article appropriately titled *Resurrecting Biological Essentialism*, Devitt argued that it is crucial to differentiate between two questions when considering essentialism: "What is it to be a member of any group that happens to be a species?" and "What is it for a group to be a species?" (Devitt: 2008: 349). Relational approaches have to do with the second question, whereas essentialism has to do with the first, and it is precisely the conflation between these two questions what has lead so many philosophers to reject essentialism in pursuit of a more relational theory. Biologists group organisms under certain labels depending on particular generalizations, these generalizations can be morphological, behavioral, ecological, etc. but Devitt reminds us:

> Generalizations of this kind demand an explanation. Why are they so? Why, for example, is there this difference between the Indian and African rhinos? Such questions could, of course be seeking an explanation of the evolutionary history that led to the generalization being true. Set that aside for a moment. The questions could also be seeking an explanation of what makes the generalization true. Regardless of the history of its coming to be true in virtue of what is it now true? What are the mechanisms? (Devitt: 2008: 352)

Devitt points out a difference that is crucial, the difference between *what led to the generalization being true* and *what makes the generalization true.* Relational explanations answer the question of what led the species of *Rhinoceros unicornis* (Indian rhinos) to develop a single horn while the *Cheratotherium simun* (African rhinos) developed two. As we previously saw explanations that refer to relational factors lack causal-explanatory value, they are only informative and as such they are not complete explanations. After all, when we ask ourselves why African rhinos have two horns, we are not interested in knowing their relations of ancestry, evolutionary history or the ecological niches that they inhabit. Rather, we are interested in knowing what mechanisms are *causing* this species to develop such a characteristic. In other words, the relevant question has to do with what are the genetic bases and ontogenetic processes that lead an adult African rhino to have two horns. If we focus only on relational factors we lose the explanatory force. Causal explanations are structural, while relational factors constitute historical explanations. The problem with Okasha's and LaPorte's essentialism is that they confuse structural explanations with historical ones. But "at bottom, structural explanations will advert to essential intrinsic, probably largely genetic, properties" (Devitt, 2008: 354).

The most important criticism to Devitt is offered by Ereshefsky (2010a). Ereshefsky is sympathetic to Devitt's critique of relational essentialism. He also considers that to understand correctly why species share biological generalities it is necessary to pay attention to the ontogenetic mechanisms that give rise to these particularities. Otherwise we would not be looking at the causal factors that explain the possession of those traits. However, Ereshefsky considers that this does not necessarily imply any essentialism. The criticism is simple, there may be organisms of a species that lack this internal mechanisms, that do not possess the necessary genes or go through the stage of embryonic development required to form a specific trait, and yet they would still be members of that species. In its embryonic state zebras have an ontogenetic mechanism that causes them to develop stripes. That mechanism is hardly a necessary nor sufficient condition for membership to the species of *Equus quagga*, since members of this species may lack the cited mechanism that causes the trait to appear. And, more importantly, this ontogenetic mechanism is not unique, other mammals such as cats also have it. Thus, the internal mechanisms that cause biological traits to appear do not coincide with species boundaries. Another important point is that "relations are explanatory prior in explaining taxon identity, not intrinsic properties" (Ereshefsky, 2010: 681). Despite the fact that internal mechanisms play a relevant role in explaining certain characteristics, relationships are more fundamental. Zebras may fail to have the ontogenetic mechanism that causes them to be striped, but they gene pool could not have been other as well as they could not have failed to belong to one species lineage. However, this does not force us to embrace relational essentialism, since, as we saw, relations fail to offer explanatory answers. The obvious conclusion is to reject essentialism.

I think Ereshefsky's criticism is misguided and aims in the wrong direction. I grant the claim that Devitt's internal mechanisms are not stable enough to be considered essences in the traditional sense. But that is precisely the point of his new biological essentialism. He does not intend to postulate a single property or mechanism that fulfills the role of traditional essences, that would fall back on the error of pre-Darwinian biology. Instead this new biological essentialism postulates essences as sets or *clusters* of properties that vary through history causing species to develop the traits by which they are typically characterized. The disjunctive set of these properties is what constitutes the essence of a species kind.

> [...] it seems as if the consensus should be simply that the crude idea that there is, say, "a tiger gene" is wrong. But to reject that crudity is not to reject the idea that a certain cluster or pattern of underlying, largely genetic, properties is common and peculiar to tigers. So my third main point in defense of Intrinsic Biological Essentialism is: an intrinsic essence does not have to be "neat and tidy". (Devitt, 2008: 371)

Two things are relevant in this excerpt. The first we just mentioned, anti-essentialists seem to be anchored in the idea that essences have to be monadic properties, but they need not. If biology intends to make metaphysics properly, it must go beyond traditional essentialism. If we understand essences as disjunctive sets of various co-occurring properties, biological variability does not pose an insurmountable problem and much of the anti-essentialist rejection fades. The anti-essentialist has no reason beyond metaphysical prejudices for not accepting essences. They may push the point further claiming that they do not consider clusters of variable properties as full-on essences, however the discussion here is terminological. Whether they want to call them essences or not they have to agree that it is a set of internal properties and ontogenetic mechanisms that lead the members of the zebra species to share a series of biological characteristics. If we can accommodate by the notion of disjunctive cluster the fact that some of these properties do not manifest or occur across various taxa, there is no reason to abandon the idea. Yet someone could argue that this weakens the notion of essence as applied to natural kinds that Kripke/Putnam essentialism promotes. Besides, although the anti-essentialist concedes, it could be claimed that it is still difficult for Devitt to delimit which properties constitute the variable and disjunctive set. This connects with second point, the claim that intrinsic essences do not have to be neat and tidy.

The way I see it there are two possible answers. First there is the obvious answer that the question of what is the essence of a natural kind is an empirical and epistemological question. When we appeal to natural kinds such as gold or water we do so because our scientific knowledge has reached a degree of sophistication such that it allows us to carve nature at its joints. That we have not reached such a degree of sophistication in biology is not necessarily an indicator that what we seek does not exist. This only points to an epistemic gap in our understanding, not to a metaphysical deficiency in our theory. After all, the complexity of biological organisms is an epistemological factor to consider, we must not forget that we are dealing with the intricacy of life itself. Moreover, the development of molecular biology and contemporary research programs such as the genome project aim precisely at the resolution of these gaps. The second position, towards which I incline, is more interesting and is linked to LaPorte, who holds that essences are not discovered, but stipulated. According to Kripke and Putnam, as science advances, essences are discovered and scientists correct the misuse of natural kind terms. However, the discovery of essences does not change the meaning of the terms. LaPorte disagrees, his objection is that natural kind terms are not associated with a single hidden structure that scientist discover and baptize, instead kinds are associated with a number of such theoretical criteria[15]. As science advances, some of these criteria are discarded as inadequate, "but this is by fiat, not discovery" (LaPorte, 1998: 50). Accordingly, there is a constant component of indeterminacy and vagueness in the way we determine the extension of our natural kind terms to the entities of the world. The conclusion is that natural kind terms are not connected to a specifiable essence, instead they are associated with an indeterminate cluster from which some characteristics are theoretically and progressively discarded[16].

4. The HPC theory

Now that we have seen both sides of the essentialist debate I want to introduce a theory that I think has been too easily dismissed and can offer a solution to the problems of relational essentialism as well as a greater concretion of the Devittean proposal. Richard Boyd's HPC theory of natural kinds. My intention is to argue that intrinsic essentialism can be easily accommodated within Boyd's theory of natural kinds offering us a better theoretical framework that accounts for the intrinsic essentialist intuitions. However, the theory faces some problems that threaten the project. In the next sections I will argue that these problems, despite not being fatal pose major complications. This complications can be saved but at the risk of sacrificing the explanatory power that we seek. The solution I suggest is to reinterpret Boyd's theory, abandoning the homeostatic assumption.

4.1 Homeostatic mechanisms, property clusters and relations

The HPC theory was presented by Boyd (1999) under the influence of the causal theory of reference. The development of Kripke and Putnam's semantic theories pointed to a realistic notion of science. Expanding upon the notion of property clusters we could say that the HPC theory characterizes natural kinds as clusters of co-occurring properties underpinned by homeostatic mechanisms that cause and sustain the property clusters. Species members share many, but not necessarily all, properties that are the product of various relational mechanisms, such as sharing a common ancestor, sharing an ecological niche, gene exchange, or common developmental mechanisms. Thus, the HPC theory retains the requirement of causal similarity of intrinsic essentialism while accounting for the relational mechanisms that perpetuate the appearance of those mechanisms. At the same time the view allows for the possibility of intraspecies variability as in the case of stripeless zebras. There are three virtues to the HPC theory:

First, it accounts for the heterogeneity of the natural world. Unlike traditional essentialism, the HPC theory is flexible, it does not require a closed set of properties that identify and define organisms as a members of a natural kinds. The property cluster is flexible enough to allow membership conditions without the need to postulate a particular set of properties. This enables

[15] One of the main consequences around which LaPorte's work revolves is that if the essence of a natural kinds is stipulated rather than discovered the meaning of natural kind terms do change.
[16] I thank professor Díaz-León for drawing my attention to this last point.

the HPC theory to adequately accommodate Devitt's thesis of disjunctive sets. The essentialist notion of necessity deflates in favor of the adequacy of the theory. As Wilson, Barker, and Bringandt (2007) indicate “Each kind member necessarily instantiates some subset of the properties that typically cluster together. [...] not just one particular subset of properties in an individuative cluster is sufficient for kind membership.” (Wilson et al. 2007: 197). This metaphysical flexibility allows for variability in the instantiation of particular properties, thus accommodating Ereshefsky's criticism. It remains for scientific determination that the property subset is so causally relevant as to be taken into account. This will have to do with the explanatory virtues and the predictive power of this subset of properties.

The second virtue is scientific. Boyd claims that what is at stake in establishing the reliability of inductive and explanatory practices and what representation of phenomena in terms of natural kinds makes possible is the accommodation of our inferential practices to the relevant causal structures. We are able to identify generalizations in science because we are able to accommodate our inductive practices to the causal factors that sustain them. Otherwise stated, our ability to make inductive generalizations is due to the fact that we presuppose certain causal factors that determine the phenomenon being observed. When describing and explaining these generalizations we need a vocabulary that adapts to the causal structure that we presuppose in our inductions. This lexicon is constituted by the natural kind terms. Boyd stands with LaPorte in that the naturalness of a natural kind is its suitability for explanation and induction. This, as he points out, is remarkably observable in our generalizations about chemical kinds. When we add sodium salt to a flame we observe that it turns yellow and we generalize that all sodium salt produces a yellow flame when burnt. The natural kind terms used in this generalization help us identify the causal relationships that hold up our inductive generalizations. That we know that an organism O is a member of *Ceratotherium simum* allows us to predict that it will have two horns among other things. The case of biological species would only be a special and particularly complex case of these generalizations where we have not had sufficient inductive success to clearly identify all the relevant causal structures. However, that we are not able to make the inductive generalizations required due to the epistemological difficulty imposed by complex cases such as borderline species does not imply that the causal structure does not exist, but that we have not been able to access it.

Finally, the HPC theory does not necessarily imply essentialism[17], but it is highly compatible with it. The HPC theory, I argue, is a form of lowered essentialism in that HPC kinds play the inductive and causal-explanatory roles that traditional intrinsic essentialism attributes to essences. Additionally, HPC kinds consist of entities that share sets of properties induced by that kind's homeostatic mechanism. This mechanisms are responsible of the similarities found among the members of that kind. Thus, the HPC theory provides a more fine grained account of biological species than brute essentialisms. HPC kinds need not have a common essential property, what is essential is the co-instantiation of a variety of properties, so traditional criticism is avoided. Furthermore, the theory allows external relations to play a significant role in inducing similarity among the members of a species kind. Whereas raw intrinsic essentialism assumes that essences are monadic internal properties such as the atomic structure of gold or

[17] In fact, authors like Martinez (2017) suggest that one of the virtues of the HPC theory is that it makes room for inductive generalizations without the need to postulate intrinsic essences.

the DNA of tigers. The HPC theory is more inclusive, it recognizes that both internal mechanisms and external relations are important causes of the species similarities.

4.2 Circularity, the challenge of polymorphism and ICPC kinds

But not everything is perfect, as anticipated the HPC theory is not without criticism. Anti-essentialists are persistent and have highlighted some problems with Boyd's proposal. Here I shall mention two, which I consider are the most pressing objections. The first is posed by Ereshefsky (2010a) and stresses the indeterminability of the mechanisms of the particular HPC kinds:

> The members of an HPC kind can have a cluster of co-occurring similarities that vary at a time and over time. And HPC theory allows that the causal homeostatic mechanisms that cause such similarities can vary at a time and over time. Thus HPC theory is consistent with the variability found in species. But if the homeostatic mechanisms of a HPC kind vary at a time and over time, how do we decide which mechanisms are the mechanisms of a particular HPC kind? (Ereshefsky, 2010a: 677)

It seems that unless one is very strict on how to individuate the property clusters and their underlying causes the theory has a problem in determining how many properties are enough to consider an entity a natural kind. Ereshefsky points out that one way to determine properties could be to look for those mechanisms that cause the appearance of a stable cluster of similarities associated with the natural kinds. But if the similarities are variable as the HPC theorist argues the argument is regressive. That said, Ereshefsky proposes a way out of the circle that leads the essentialist to a dead end. In determining which organisms and internal mechanisms belong to a particular species we need to focus on phylogenetic inheritance and ancestry relations. "Genealogy is the glue that binds the various organisms and their mechanisms with a particular taxon." (Ereshefsky, 2010: 677). The problems with this approach are the following. First, it leans the HPC theory toward LaPorte's historical essentialism inheriting its criticisms. Second and as Ereshefsky clarifies, the historical approach abandons the main reason why the HPC theory was formulated namely to account for the internal mechanisms that characterize natural kinds in terms of similarity. If the classifying factor becomes phylogenetic and ancestry relations gain explanatory primacy, we abandon internal similarity.

I disagree with the implications of this problem. To begin with, I don't see why HPC theorist has to abandon the similarity thesis in favor of relational factors. It is true that relational properties such as the ability to interbreed, sharing a common ancestor or genetic inheritance help us to identify the ontogenetic mechanisms that cause similarity. However, similarity remains capital when it comes to the causal-explanatory factors of the traits found among the members of a species kind. Also, the similarity of this clustered properties is still what allows us to make the inferential generalizations that account for the structure of those causal factors. The point is made clear by Wilson et al. "Such individuative features of species promote the species evolution, but also promote phenotypic unity among species members, which conforms the desideratum that an appropriate notion of a natural kind ought to yield kinds with natural integrity." (Wilson et al. 2007: 210). A second consideration derived from this criticism is that Ereshefsky seems to believe that by focusing in both internal mechanisms and property clusters the HPC approach denies that species are historical entities. This is just false, the HPC theory does not commit to biological species being historical individuals, but insofar as the property clusters are sustained by means of external relations its analysis of natural kinds is compatible with them being so. Polar bears and brown bears are species of the same lineage that share a gene pool. Such relational factors are what led these two species to share a number of properties in their corresponding property clusters. Additionally, it is also the case that variations in external factors such as the genetic pressure exerted by isolation during glaciation forced natural selection leading to speciation.

The second criticism is perhaps the most mentioned in the discussions about HPC kinds, namely its inability to properly account for stable polymorphism. The HPC theory is on par with the classical theories of natural kinds in that delimits natural kinds through the possession of shared similarities among members of a kind. Under this account particular instances of HPC kinds will share a number of relevant properties clustered by homeostatic mechanisms. However, the centrality of the concept of homeostasis and shared similarities prevents the theory from accounting for the stable polymorphisms that we find in different species such as sexual dimorphism in mammals. This criticism was posed by Ereshefsky & Matthen (2005) who argued that in addition to being homeostatic, species are also heterostatic. This means that in addition to the stable similarity induced by internal homeostatic mechanisms, species are also defined by a recurrent variability product of other mechanisms labelled heterostatic. They accuse Boyd's theory of privileging similarity explanations over phenotypical polymorphism and explicitly argue for the need to incorporate additional mechanisms that account for stable morphic variability within species.

> A proper approach to taxonomy must recognize such differences. Moreover it should explore the relations that produce and maintain differences. So in addition to Boyd's "homeostatic" mechanisms we need to recognize "heterotic" mechanisms that produce variation, and "heterostatic" mechanisms that maintain it. (Ereshefsky & Matthen, 2005: 10)

The solution I suggest is provided by Martinez (2015) who explains why the usual HPC approach to polymorphism would not suffice to answer the question, and thus, the theory must be modified. According to him, the HPC theorist could rebut the objection arguing that we should think of polymorphisms as cases of imperfect homeostasis. However, despite being imperfect similarity still prevails in such a degree that we can differentiate and classify the members that present morphic variabilities within a species kind. In other words, polymorphic organisms are not distinct enough to threaten the integrity of the HPC theory. As we saw the HPC theory allows variability and polymorphic species share enough properties of the cluster to be considered HPC kinds. If this is so then why does Martinez consider it a bad solution? The problem with the solution is that it sacrifices explanatory power in pursuit of accommodation making "polymorphism indistinguishable from, say, mere statistical phenotypic variation" (Martinez, 2015: 4). Ereshefsky and Matthew argue that this is a major stumbling block. Martinez and I are more optimistic, we believe that the problem of hetereostasis points to a potential improvement of the HPC theory.

The solution is to reinterpret property clusters so that they can articulate this 'stable, discrete phenotypic variability' as well as the similarity among polymorphic species. The mistake is in assuming that co-instantiation of properties must be in terms of temporal space continuity. In order to account for morphic variability we require an informational connection between the different properties of the clusters. Reinterpreting co-occurrence in terms of *informationally connected property clusters* (ICPC) allows us to predict the instantiation of property groups. Otherwise stated, "instantiations of properties in the cluster of an HPC are signals that carry information about instantiations of other properties in the same cluster" (Martinez, 2015: 10). The examples provided by Martinez reinforce the explanatory force of the ICPC kinds, in the case of caste polyphenism in ants (whether larvae develop into queen, worker or soldier ants) the presence of a queen ant signals the presence of soldier and worker ants in the same colony. Informational connections hold between properties that are co-instantiated in certain *locations* and other groups of properties that co-occur in different locations, the locations in the second group being a function of the ones in the first group[18]. Translating this to species morphs accommodates the problem of polymorphism. Roughly, if we find that a property P_1 is instantiated in an organism, homeostatic mechanisms increase the probability of a property P_2 being co-instantiated in the same organism. At the same time this increases the probability of a property P_3 being instantiated *within the range* of that organism. And P_3 increases the probability of a property P_4 being co-instantiated in the same place. As Martinez indicates the result is two informationally connected morphs, one made out of the co-instantiation of P_1 and P_2 and the other made out of the co-instantiation of P_3 and P_4[19].

4.3 So, is there any essence after all?

Curiously enough Martinez seems to want to move away from the essentialist route that authors like Devitt have proposed. He states that the HPC theory provides us with an adequate theoretical framework through which to make scientific inferences without the need to postulate intrinsic essences. Being so, why defend the applicability of HPC / ICPC kinds to the new biological essentialism? The answer recovers part of the reflection that I anticipated in the introduction and that I have been doing throughout this article. That is, that we must abandon the traditional sense of essence if we want to accommodate an appropriate metaphysics of biology.

Despite so much metaphysical drift my proposal is simple: Essences need not be monadic as anti-essentialists seem to assume. Post-Darwinian biology along with the development of taxonomic theories has shown that species kind cannot be delimited solely by reference to a

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[18] We should clarify that although location of the properties can be understood spatio-temporally (as in Martinez's example of the skeletal system) this need not be the case. Informationally understood location can refer to any group of properties carrying information of other groups. Certain temperatures for example are informationally connected to the presence of some HPC kinds in that they carry informational signals about the probability of other properties being present.

[19] Of course co-instantiation of properties in the clusters can include more than two properties.

‘hidden structure’ in the way Kripke and Putnam argued. However, relational factors do not account for the causal-explanatory role of the properties that cause intraspecies similarity. If species are defined by variable sets of relationally determined properties that co-occur in homeostatic clusters, these co-occurrence of properties becomes essential. If we can articulate the relational factors that determine the clusters, the evolutionary variability and the stable polymorphism within our theory making use of the informational connections between the properties within the clusters, essentialism is safe from criticism. Yet, someone could argue that much of the essentialist appeal has been lost along the way. If the properties that we consider essences are variable to the point that it is allowed to alter the conditions of the cluster, is there something truly essential in them?

Once again, such an objection misconceives the nature of our essentialism. What is essential is not the particular set of properties that are clustered in a certain entity making it belong to a kind. Neither it is the extrinsic factors that determine the clustering of the properties. Rather, what is essential is the variable but stable co-occurrence of the properties that determine species kindness. Whether you want to call this essentialism or not is of little importance if in the end species kinds are defined by some regularly shared set of properties that are causally and explanatorily relevant. The ICPC theory expands upon the notion of disjunctive sets of properties providing us a way to understand the co-instantiation of properties in terms of informational connectedness. This help us to determine the way in which internal properties are to be determined offering us a robust and theoretically adequate framework from which to defend the new biological essentialism, complementing Devitt's essentialism and sharpening Boyd’s theory.

5. Conclusion and corollary

We have come a long way so let's recap. In the first section I introduced the essentialist thesis and stressed the importance of distinguishing classical essentialism from the new essentialism of natural kinds that Kripke and Putnam inaugurated. I have also advanced the idea that part of the anti-essentialist consensus in biology is due to the conflation of the pre-Darwinian concept of essence with the analytical one. In section two we presented the traditional anti-essentialism of Mayr, Hull and Ghiselin, and we addressed the SAIC theory. I argued that the advantages of embracing species individualism are few and its consequences serious. Nonetheless, even if one chooses to embrace this theory the essentialist can easily accommodate species-as-individual talk to species-as-kinds talk. In part three I have presented the two essentialist positions, the relational essentialism of Okasha and LaPorte and Devitt's new intrinsic essentialism. Two conclusions were drawn: First, relational essentialism, although initially closer to modern classificatory practices is insufficient in its defence of essentialism for being unable to account for the causal-explanatory role of essential properties. Second, Devitt’s revival of intrinsic essentialism modifies the essentialist theses enough to account for the variability and historicity of species although this devalues the metaphysical weight of essentialism in relation to its classical predecessor.

Finally, in section four we expanded Devitt's notion of property clusters introducing the HPC theory. The theory accommodates an intrinsic Devitt-style essentialism, accounting for the internal properties caused by similarities in terms of co-occurrence, simultaneously recognizing the important role of external relations in determining evolutionarily developed ontogenetic mechanisms. This, in turn, provides us with a suitable inferential framework for our scientific generalizations, accounting for what actually makes natural kinds relevant. Namely, their adaptability to the causal structure that we presuppose. However, two anti-essentialist critiques remained, the explanatory circularity and the problem of polymorphisms. Ultimately, we have seen that there is no such circularity, but polymorphism is indeed a major obstacle to HPC theory. Nonetheless, I have argued that the problem is not insurmountable, and that Ereshefsky and Matthen's demand for heterostatic mechanisms can be properly addressed if we broaden the notion of co-instantiation of properties. For this I have argued in favor of Martinez's notion of ICPC kinds. This accounts for morphic variability without sacrificing explanatory strength, allowing us to articulate a better defense of the new biological essentialism.

Throughout this work I have tried to defend the widely rejected idea that as natural kinds species possess essential properties that characterize membership of organisms to biological taxa. I also held that if these properties are to be counted as essential, they must be causally explanatory of the characteristics typically shared among the members of species. Anti-essentialism is in part product of the rejection of the metaphysical ghosts that fuelled positivism. I believe that if biology intends to keep paths with philosophy it shouldn't be afraid of metaphysics.

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