

# Chapter 8

## Metaphysical and Epistemological Approaches to Developing a Theory of Artifact Kinds

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**Abstract** In this chapter, I examine whether the philosophy of natural kinds can yield useful clues for the development of a theory of the metaphysics and epistemology of artifact kinds. In passing, I explore the prospects for a unified account of kinds that applies to natural kinds as well as artifact kinds. As a generally accepted, satisfactory theory of natural kindhood is still lacking, both these prospects appear dim. I review parts of the recent history of philosophical work on natural kinds, particularly in philosophy of biology, and highlight a development that I call an “epistemological turn” in thinking about kinds. I argue that recent work following this epistemological turn shows promise when it comes to the development of a theory of artifact kinds but that there still are problems specific for the artifactual realm which theories of artifact kinds must address.

**Keywords** Artificial kinds • Artificial kind/Artifact kind distinction • Boyd, Richard • Epistemological turn • Essence • Engineering disciplines • Homeostatic Property Cluster Theory (HPC-theory) • Kind theories, metaphysics-oriented • Kind theories, epistemology-oriented • Locke, John • Mind-dependence • Natural kinds • Natural kindhood, criteria for • Species

### 8.1 Introduction

What is the nature of artifact kinds? What determines the kind identity of individual artifacts and the boundaries of artifact kinds? Which epistemic roles do references to artifact kinds perform in reasoning and knowledge production, and what enables us to use them in these roles? Although the topic of artifact kinds is increasingly

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receiving attention from philosophers, in particular in the domains of analytic metaphysics and the philosophy of science and technology, we are still far from a consensus on how questions like the aforementioned should be answered.

One way to address such questions about artifact kinds is to look for clues in the available literature on parallel questions that have been posed with respect to kinds in the natural domain. Philosophers have long been concerned with the metaphysics and epistemology of natural kinds in the various contexts in which these feature. Thus, one might hope that an account of natural kinds and related issues – such as classification and generalization in the sciences – is readily available for application in the artifactual domain. Perhaps even a unified account of kinds that applies to natural as well as artifact kinds could be achieved. At the very least, one would expect that the work philosophers have done on the topic of natural kinds can provide clues for the development of a theory of artifact kinds.

As a generally accepted, satisfactory theory of natural kindhood is still lacking, however, both the prospects for finding a readily applicable theory of kinds in the literature and for obtaining a unified theory of natural and artifactual kinds appear dim. In the present chapter, I shall explore to what extent such hopes and expectations are warranted. My aim is to draw lessons from the philosophy of natural kinds for the project of developing a metaphysical and epistemological theory of artifact kinds. Conversely, there probably also are lessons to be drawn from the case of artifact kinds for the ongoing natural kinds debate – but that endeavor will largely have to be left for future work.

I shall begin in Sect. 8.2 by examining the philosophical tradition of thinking about natural kinds in which metaphysical criteria for characterizing natural kinds are being sought. This search seems inspired by a commonly accepted dichotomy between natural and artificial kinds that in fact, I shall argue, has led the discussion on kinds in a wrong direction. In Sect. 8.3, I shall review some recent work on the topic of natural kinds – in particular from the philosophy of biology – and highlight a development that I call an “epistemological turn” in thinking about kinds. Due to problems that metaphysics-oriented approaches to developing a theory of natural kinds are confronted with, philosophers of science are increasingly approaching the issue by searching for criteria that characterize natural kinds from an epistemological point of view, instead of looking for the metaphysical criteria that distinguish natural kinds from other kinds of kinds. I want to suggest that this epistemological turn marks a more promising direction in the philosophy of kinds and classification, including artifact kinds. Here, the issue is approached by first elaborating epistemological criteria for natural kindhood and kind membership and then constructing a metaphysics that fits this epistemology best. In Sect. 8.4, I shall examine how the most prominent contemporary representative of this epistemology-oriented approach, Richard Boyd’s Homeostatic Property Cluster theory, would work out if applied to artifact kinds. In so doing, I shall point to some problems that arise specifically for kinds in the artifactual realm and will have to be resolved before such an epistemology-oriented approach can be successful. I shall close in Sect. 8.5 by highlighting some advantages of taking an epistemology-oriented approach to elaborating the metaphysics and epistemology of artifact kinds over taking a metaphysics-oriented approach.

## 8.2 Artifact Kinds: Not Natural, but Not Artificial Either

The philosophical concern with the nature of kinds and classification largely stems from two sources. First, there is the long-standing metaphysical quest to provide an account of what kinds of things there are in the world we live in – that is, what the “furniture of the world” (Bunge 1977) is made up from. Second, there is the epistemological interest in how our classifications of things, phenomena, events, etc. relate to the world “out there” and whether some ways of classifying better agree with the facts than others. These issues have been central questions of philosophy since its early beginnings (Plato and Aristotle have already addressed them), but with the rise of philosophy of science as a philosophical specialization, they have come to lead a life of their own in what is sometimes called the “philosophy of classification” (Ereshefsky 2001).

In both metaphysical and epistemological investigations of kinds and classifications, the contrast between on the one hand natural kinds and natural systems of classification and on the other hand artificial (or conventional or nominal) kinds and artificial systems of classification traditionally plays an important role. Here, natural systems of classification are thought to represent aspects of the actual state of affairs in nature, in contrast to artificial classifications that merely are groupings that we humans use because they suit our purposes.<sup>1</sup> This dichotomy has been an element of the philosopher’s toolkit at least since the appearance of Locke’s *Essay Concerning Human Understanding*, where the two kinds of kinds are contrasted with respect to their mind-(in)dependence.

In the *Essay*, Locke famously introduced the distinction between the real essences of things (“the very being of any thing, whereby it is, what it is”) and their nominal essences (“that abstract *Idea*, which the General, or *Sortal* [...] Name stands for”).<sup>2</sup> A thing’s real essence is something about the thing in itself that makes it to what it is, independently of the existence of knowing subjects that identify the thing as a particular individual or as something of a particular kind. In contrast, nominal essences are ideas or concepts in the minds of knowing subjects who use them to group things in ways that happen to be epistemically or practically useful to them. As Locke explains, knowing subjects use concepts to

enable themselves to consider Things, and discourse of them, as it were in bundles, for the easier and readier improvement, and communication of their Knowledge, which would advance but slowly, were their Words and Thoughts confined only to Particulars.<sup>3</sup>

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<sup>1</sup> Cf. the quest for a “Natural System” in biology that played a role in the *Origin of Species* (Darwin 1859, p. 413). For a historical account of the concepts of “natural kind” and “natural system,” see McQuat (2009).

<sup>2</sup> Locke, *Essay*, Book III, chap. III, §15.

<sup>3</sup> Locke, *Essay*, Book III, chap. III, §20.

For Locke, nominal essences played a much more important role in our classificatory practices than real essences, as on Locke's view the human cognitive faculties did not allow us to know the real essences of things.<sup>4</sup>

On Locke's dichotomy, any group of things is either a mind-independent natural kind or a mind-dependent artificial kind. Here, the notion of mind-independence refers to the factor that determines the kind-membership of an entity: for natural kinds, this is an intrinsic property of their member entities (i.e., a property these entities have independently of cognitive subjects), while for nominal kinds, this is a mind-dependent idea on the basis of which we group things together. Things that share the same real essence independently of human cognition objectively (that is, mind-independently) can be said to belong together because it is "Nature in the Production of Things" that has made them alike, independently of any classificatory activity of knowing subjects.<sup>5</sup> In the centuries following Locke's *Essay*, such kinds have often been identified with natural kinds as being precisely those kinds of things that exist "out there" in the world, independently of human cognition, human actions, and human interests. Consider, for example, the second sentence in the *Stanford Encyclopedia of Philosophy* entry on natural kinds: "To say that a kind is *natural* is to say that it corresponds to a grouping or ordering that does not depend on humans" (Bird and Tobin 2010). Artificial (or conventional or nominal) kinds, in contrast, fully are products of the "Workmanship of the Understanding"<sup>6</sup>: they are fully dependent on humans and their epistemic interests, against the background of which people group things under the various concepts they employ. Following this dichotomy, the philosophy of natural kinds is primarily a question of metaphysics, not epistemology: it is about finding out which criteria objectively make things to the kinds of things they are.

Note that if this traditional dichotomy between mind-independent natural kinds and mind-dependent artificial kinds is correct, it is unlikely that among the available accounts of natural kinds there will be an account that also applies to artifact kinds. Artifacts do not exist "out there" in the world independently of human actions and interests but are mind-dependent objects: they are conceived, designed, and made

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<sup>4</sup>Locke, *Essay*, Book III, chap. VI, §9; Book IV, chap. VI, §12. There exists controversy among Locke scholars on whether Locke actually embraced the view that there are real kinds in nature (e.g., Uzgalis 1988). While he might not have embraced that view, it did play an important role in his thinking about kinds. As such, his dichotomy between real and artificial kinds was more a starting point for his argument than a position he argued for in the *Essay*.

<sup>5</sup>Locke, *Essay*, Book III, chap. III, §13. Of course the identification of the real essences of things, the grouping of things with the same real essence into kinds, and the naming of kinds remain acts of knowing subjects. Nature just makes it so that multiple things have the same real essence. But it is in this sense – that a uniquely privileged basis for grouping things into kinds is given by nature – that a kind can be said to exist in nature and be mind independent.

<sup>6</sup>Locke, *Essay*, Book III, chap. III, §13. Thus, the principal difference with natural kinds is that here the basis for grouping things into kinds is not given by nature. There doesn't seem to be any privileged way of grouping things into kinds, so the ways in which things are grouped fully depends on human interests (or at least does so to a much higher degree than in the case of natural kinds).

by human beings who have particular purposes in mind (e.g., Verbeek and Vermaas 2009, p. 165; but see Sect. 8.4 for some nuances). By consequence, the same holds for artifact kinds: if artifacts are mind-dependent things, the ideas in the minds of designers, makers, and perhaps users are crucial factors determining the kind membership of artifacts (Franssen et al. 2009, Section 2.5). Both artifacts and artifact kinds are “creations of the mind” (Margolis and Laurence 2007) and, therefore, must be metaphysically distinct from natural kinds. Because “the very being of an artifact, whereby it is, what it is” depends on the minds of at least the artifact’s designers and makers and is not a mind-independent Lockean real essence, there is no reason to expect theories of natural kinds to apply to artifact kinds.

However, rather than accepting this conclusion, I take the case of artifact kinds as suggesting that there is something wrong with the traditional dichotomy. Although artifact kinds do not seem to constitute a subgroup of the natural kind category, it isn’t plausible either that artifact kinds belong into the artificial/nominal kind category. Surely artifact kinds are more than just groupings that, loosely quoting Locke, “enable humans to consider things in bundles for the easier and readier improvement and communication of their knowledge.” Once a particular kind of artifact has been conceived and the first members of the kind have been designed and produced, such a kind *does* have something close to the objective existence that characterizes natural kinds. From the perspective of individual human beings most kinds of artifacts exist as real kinds “out there” in the world just as natural kinds do: new human beings are born into a world the furniture of which consists as much of hammers, cars, nation states, etc. as it consists of electrons, gold atoms, tigers, and the like. Accordingly, several philosophers have come to count artifact kinds together with natural kinds as real kinds (e.g., Boyd 1999a, b, 2000; Millikan 1999a, 2000; Elder 2007; Thomasson 2007; Carrara and Vermaas 2009).<sup>7</sup> While not being natural kinds, artifact kinds seem metaphysically less distinct from natural kinds than is often thought.

The case of artifact kinds thus fails to fit a central part of the traditional – and today still widely accepted – metaphysical framework for thinking about kinds. While this might be taken to imply that much of what I have said above about artifact kinds is wrong and artifact kinds actually *are* nothing more than convenience-based groupings of things, I suggest that a better implication to draw is to think of the traditional dichotomy between mind-independent natural kinds (where mind-independence means that nature provides us with a privileged basis for grouping things into kinds) and mind-dependent artificial kinds as misconceived. Thinking of artifact kinds as merely convenience-based groupings seems inadequate to how we actually classify artifacts in a world in which kinds of artifacts are as much part of the furniture of the world we find in place as are kinds of naturally occurring things.

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<sup>7</sup>Boyd’s examples include money and political systems (feudalism, parliamentary democracy, monarchy, etc.). Although these are not typically counted as artifacts, it is unclear why they should not count as such (see Sect. 8.4 below). Millikan mentions car models such as the 1969 Plymouth Valiant 100 as real kinds. Losonsky (1990) made a similar point, arguing that both natural objects and artifacts have natures that characterize them and can be investigated scientifically.

Thus, one of the traditional metaphysical assumptions about what it is to be a natural kind that has shaped much of the philosophical discussion on natural kinds – i.e., that to be a natural kind is to be a mind-independent kind, in contrast to kinds that do depend (much more strongly) on (human) minds – seems to have to be discarded.

For this reason I am pessimistic about the prospects for success of a search for metaphysical criteria for natural kindhood – as we now have reason to consider one of the central tenets of traditional metaphysical accounts of natural kindhood to be defective – and want to suggest that a better approach might be to address the epistemology of kinds first and then go on to construct a metaphysics that fits the epistemology.<sup>8</sup> Indeed, a reorientation that is in accord with my skepticism is visible in recent work on natural kinds in the philosophy of science, constituting a development that opens up new prospects for thinking about artifact kinds too.

### 8.3 An Epistemological Turn in Thinking About Kinds

A central part of the metaphysical tradition that was problematized above is the assumption that the notions of “natural kind” and “real essence” are inseparably connected. Natural kinds, on this view, are kinds of things that all share the same essence: *all* members of a kind instantiate the kind’s essence and *only* members of the kind do so. Commonly, such kind essences are conceived of in terms of intrinsic properties of things (e.g., Aristotelian substantial forms, inner principles of existence and activity, material structure, material composition). Traditional examples of such natural kinds include the kinds of elementary particles, the chemical elements and isotopes and biological species of organisms (e.g., Bird and Tobin 2010). In present-day philosophy, this view of natural kinds continues to be endorsed, in particular among analytic metaphysicians, philosophers of language (especially those continuing Kripke’s and Putnam’s work on reference theory), and philosophers of science who defend strong versions of scientific realism.<sup>9</sup> Among many philosophers of science, however, the tradition has waned.

While criticisms of the tradition already appeared in the 1950s (an important such criticism was Nelson Goodman’s discussion of relevant kinds and projectible predicates – e.g., Goodman 1954), an important step in this respect was taken in the 1960s–1970s in the philosophy of biology, when it was noticed that a traditional example of natural kinds – biological species – did not fit into the essentialist framework. What could the kind essences of species be? It seemed obvious that the essential intrinsic properties of organisms should be their genes (as the underlying causes of organisms’ phenotypic features) and that accordingly species as kinds were to be

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<sup>8</sup>Elsewhere, I have given other reasons to be skeptical about metaphysics-oriented approaches to developing a theory of natural kinds (Reydon 2010).

<sup>9</sup>Among the most forceful contemporary defenders of scientific realism and natural kind essentialism are Ellis (2001, 2002), Oderberg (2007), and Devitt (2008, 2010).

defined by genetic essences.<sup>10</sup> However, not only had biology so far failed to identify any species-specific genetic essences (and, moreover, had never aimed to do so), but there also were good theoretical reasons to think that species don't have genetic essences. Species, after all, are subject to evolutionary change and open-ended genetic variation between the organisms of a species is not only the outcome of evolution but also a necessary requirement for evolution to occur.

These considerations led biologist Michael Ghiselin and philosopher David Hull to suggest an alternative view of the nature of species that could avoid the problems encountered by the view that species were essentialist natural kinds. Ghiselin and Hull argued that the failure of biologists to uncover the one true nature of *Homo sapiens* or the intrinsic essence that characterizes all and only *Arabidopsis thaliana* plants is due to a simple fact: there is nothing there to be found! According to Ghiselin and Hull, species are not to be understood ontologically as classes or kinds but as individuals (Ghiselin 1966, 1974; Hull 1976, 1978). That is, a species is not a kind with particular organisms as its members, but itself a concrete particular entity with organisms as its constituent parts. Species at most have individual essences but not kind essences (Okasha 2002). Ontologically, then, biological species should be grouped together with organisms, firms, and material objects, not with the chemical elements and the various kinds of elementary particles in the Standard Model. If this is correct, it was only to be expected that the quest for organismal properties (genetic or otherwise) that would constitute the kind essences of the species that organisms belonged to would be in vain: species just aren't the sort of things that have essences of the sort that natural kinds are supposed to have.<sup>11</sup>

Ghiselin's and Hull's suggestion apparently resolved the question about species essences and today most biologists and philosophers of biology seem to agree that species metaphysically belong to the category of individuals not natural kinds. However, one problem persisted: species names, such as "*Arabidopsis thaliana*," often function as kind terms in biological reasoning. Biologists commonly refer to species when making generalizations about groups of organisms and inferring from observations on a few members of the species to claims about all members of the species. As Millikan, for example, pointed out: "Inductions from one member of a species to the next often hold up for very good reason. Were this not so, there could be no science of biology" (Millikan 2000, p. 208). This epistemic function is a characteristic role of natural kinds.<sup>12</sup> The case of species thus presented a problem: species cannot be conceived of as natural kinds under traditional essentialist accounts,

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<sup>10</sup>A suggestion that appears in Kripke's and Putnam's work.

<sup>11</sup>However, there is a movement to return to essentialism about species – see Oderberg (2007), Devitt (2008, 2010), or the recent symposium on "The New Biological Essentialism" at the 21st biennial meeting of the Philosophy of Science Association in 2008 (for the four published papers of the symposium, see *Philosophy of Science*, volume 77, issue no. 5, 2010, pp. 648–701).

<sup>12</sup>On many accounts, this characteristic is explicated by connecting natural kinds to laws of nature. The claim then is that there are laws about all natural kinds and those kinds that feature in laws of nature are precisely the natural kinds that exist (Reydon 2010).



but nevertheless they perform a characteristic epistemic role of natural kinds. The question is how these two facts of the matter might be reconciled.

Recently, a number of philosophers have begun to address this question (most importantly, Boyd (1999a, b, 2000, 2010), Griffiths (1999), Millikan (1999a, b, 2000), Wilson (1999a, b, 2005), Keller et al. (2003), Brigandt (2009), Wilson et al. (2007)). According to these authors, because in biological reasoning species perform a characteristic epistemic role of natural kinds, they should be conceived of as natural kinds after all. In this approach to the problem of natural kinds, epistemology is more important than metaphysics: what distinguishes natural kinds from other sorts of groupings of things are their epistemic roles, rather than meeting particular metaphysical criteria such as being associated with kind essences.

Presumably, an important motivation behind this approach was the persistent failure of traditional accounts, which focused on assumed metaphysical criteria for natural kindhood, to yield a theory of natural kinds able to account for all the kinds that featured in the various sciences. Most theories accounted only for a few special cases and ignored most of the kinds that scientists actually used, using a priori metaphysical assumptions to separate “good” natural kinds from other sorts of groupings and resulting in the recognition of only a small group of kinds as natural kinds (Reydon 2010; see also Churchland 1985; Hacking 1991, 2007). A natural move thus was to reconceive of the problem of natural kinds as not being about what kinds of things the “furniture of the world” is made up from but about the nature of the kinds of things that humans refer to in reasoning and that investigations can provide knowledge about. As Boyd put it: “[i]t is a truism that the philosophical theory of natural kinds is about how classificatory schemes come to contribute to the epistemic reliability of inductive and explanatory practices” (Boyd 1999a, p. 146; 2000, pp. 55–56). And: “the theory of natural kinds *just is* (*nothing but*) the theory of how accommodation is (sometimes) achieved between our linguistic, classificatory and inferential practices and the causal structure of the world” (Boyd 2000, p. 66; emphasis added).

Basically, the approach taken by the abovementioned authors inverts the order of importance of different kinds of criteria for natural kindhood and in doing so redefines the problem from (previously) a metaphysical one into (now) an epistemological one. The principal criteria for being a natural kind used to be metaphysical: a kind is a natural kind if and only if it really exists in the world (whatever it may mean for kinds to exist), independently of human consciousness, human interests, and human practices, and is associated with a particular kind essence (however one exactly conceives of kind essences). On the alternative approach the principal criteria for being a natural kind no longer are metaphysical but epistemological: what counts is being useful in human epistemic practices, such as inference and explanation, by corresponding in some way (which is still to be explicated) to the state of affairs in nature. On this new approach, the metaphysical project of clarifying in what way the kinds referred to in epistemical practices reflect the state of affairs in nature comes into focus only *after* the kinds have been individuated on epistemological grounds. In this respect, this approach can be seen as exemplary of what I



call an “epistemological turn” in thinking about kinds: the principal criteria for distinguishing natural kinds from other sorts of groupings are epistemological, while metaphysical issues come second in line, leading to the recognition of many more natural kinds than was the case on metaphysics-oriented approaches.<sup>13</sup>

As on this view natural kinds are epistemically successful kinds – a given grouping of things is a natural kind if and only if it features successfully in human epistemic practices because of its being anchored in some way in nature – the principal question for a theory of natural kinds is what epistemic success consists in and in what ways reference to kinds contributes in realizing it. But reference to kinds can only be epistemically successful if there is something in the world that underwrites these epistemic practices. Thus, there is a metaphysical aspect to the problem too, namely, to explicate what about the world “out there” epistemically successful kinds refer to. The point is that this metaphysical issue comes second in line, after the epistemology of kinds has been sufficiently clarified.

Boyd attempted to resolve these issues by means of what has come to be known as the Homeostatic Property Cluster theory of kinds (henceforth, HPC theory), about which I shall have more to say in the following section.<sup>14</sup> At this point, I should only point out that by making natural kinds dependent on human epistemic practices HPC theory avoids the problem that was highlighted in Sect. 8.2. From the HPC perspective, there is no need to conceive of natural kinds as being necessarily mind-independent and to distinguish them from mind-dependent artificial kinds. On the contrary, natural kinds are mind-dependent groupings too, as they crucially depend on human epistemic practices.<sup>15</sup> In this respect,

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<sup>13</sup>While in the philosophies of the special sciences the turn can be located in the 1980s–1990s, with the elaboration and growing acceptance of Boyd’s theory of kinds, in analytic philosophy more generally the turn probably lies with Nelson Goodman’s insistence on kinds as the extensions of projectible predicates (Goodman 1954, 1984, p. 21; Boyd 1999a, p. 147; Griffiths 1999, p. 215). One might locate its roots at a much earlier time, for example, in mid-nineteenth century British Empiricism – where Hacking (1991, 2007) locates the origin of the philosophy of natural kinds – or even further back in time in Locke’s *Essay*. I have briefly addressed this issue elsewhere (Reydon 2010) but have to leave the historiography of the epistemological turn for future work.

<sup>14</sup>For details, see Boyd (1999a, b, 2000, 2010), Griffiths (1999), Wilson (1999a, b, 2005), Keller et al. (2003), and Wilson et al. (2007). My discussion of HPC theory in Sect. 8.4 is based on the discussion I provided in Reydon (2009).

<sup>15</sup>As one of my coeditors of this volume pointed out, two notions of mind dependency should be distinguished here: human intentions play a role in defining kinds *within* particular epistemic contexts and human intentions underlie these epistemic contexts themselves. In the case of natural kinds as mind-dependent groupings, both kinds of mind dependency are involved. In the traditional contrast between mind-independent natural kinds and mind-dependent artificial kinds, too, both notions of mind dependence were involved but not clearly distinguished. There, the central idea was that for mind-independent kinds nature provided a uniquely privileged basis for grouping things into kinds such that – even though the grouping of things into kinds is done by humans in the context of various epistemic practices – the outcome of grouping practices (when done correctly) does not depend on human intentions. For artificial kinds, no such uniquely privileged basis is available (either because it doesn’t exist or because we in principle don’t have epistemic access to it), such that the grouping of things into kinds always crucially depends on human interests.

the epistemology-oriented approach toward the problem of natural kinds might after all open up prospects to develop a theory of artifact kinds by taking recourse to an available theory of natural kinds.

## 8.4 Artifact Kinds as HPC Kinds?

To what extent are the hopes that HPC theory could account for artifact kinds or even that a unified account of natural and artifact kinds might be within reach by applying HPC theory to both kinds of kinds warranted?

HPC theory begins from the observation that most kinds used in the various special sciences do not collect things that are in every which way the same. Rather, many sciences use kinds of which the members are very similar to one another in theoretically important ways even though they vary in numerous respects. Furthermore, these kinds typically rest on the assumption that the members of a kind exhibit largely similar properties due to largely similar causes: they are alike because similar causes (have) operate(d) on them (Boyd 1999a, pp. 142–144). Accordingly, HPC theory assumes that natural kindhood and kind membership cannot be understood in terms of separately necessary and jointly sufficient essential properties that are exhibited without exception by all and only the members of the kind. Rather, the cluster of properties that are found to regularly, but not exceptionlessly, occur together in the members of putative kinds should come into play here. But if for a given natural kind there is no set of properties unique to and characteristic of all members of that kind, kinds cannot be individuated by property clusters alone: if there is considerable variation between the putative members of a kind, the relevant property cluster can only be identified after kind membership has been established comparatively well. Accordingly, HPC theory adds a second element to the definition – a set of causal factors that underlie the observed property clustering – and takes the combination of these two elements to uniquely determine a kind: a kind is determined by the properties that are found to repeatedly occur together in its members plus the underlying factors that cause this clustering. (Boyd calls these causal factors “homeostatic mechanisms” and emphasized that the term should not be read too literally.)

In order to do justice to the state of affairs in the world in which entities are hardly ever exactly alike, HPC theory conceives of the two elements of the definition of a kind in an open-ended manner. No property or combination of properties is necessarily unique to one property cluster, the property cluster associated with a kind may in time come to include new properties, and present properties may cease to be exhibited by members of the kind. Similarly, no causal factor or combination of factors is necessarily unique to the set of “homeostatic mechanisms” associated with a kind, and causal factors may begin or cease to operate on the members of the kind. If there were one fixed characteristic set of properties for every kind, HPC theory would merely be a form of traditional kind essentialism (albeit with less strict essences than on the traditional view) and as such not be able to avoid the

problems that confront essentialism. But by conceiving of property clusters and sets of “homeostatic mechanisms” as open-ended, HPC theory aims to constitute an account of natural kinds that is sufficiently flexible to accommodate all the various kinds that feature in the various special sciences, as well as the traditionally recognized natural kinds.

Consider, for example, the case of biological species. Species are products of evolution and during their existence subject to ongoing, open-ended evolution. Newly evolved traits can come to be widespread and old traits can be lost as time goes by, while there is no reason to assume that any particular core set of traits will be conserved throughout the entire species’ lifetime – other than developmentally deeply entrenched traits that are conserved over evolutionary timescales much longer than the species’ lifetime, that is.<sup>16</sup> Furthermore, in the case of a speciation event in which a new species branches off from its ancestor species, the member organisms of the two species will often continue to be characterized by the same family of properties for quite some time. The same holds for the causes underlying the presence of organismal traits. Traits that are deeply genetically entrenched will remain present for very long times, whereas not very deeply entrenched traits can cease to be present with a species’ members before the species itself has ceased to exist. If the relevant causal factors are environmental, the environment may change heavily during a species’ lifetime without speciation occurring or remain the same over the lifetimes of an ancestral species and a series of its descendants. Therefore, in order to be able to conceive of species as natural kinds of organisms, as Boyd (1999a, b) does, the theory of kinds must be sufficiently flexible and allow open-ended change in the property sets and sets of underlying mechanisms that are taken as determining kinds.

Elsewhere (Reydon 2009), I have suggested that this flexibility constitutes both a strength and a fatal weakness of HPC theory. In my view, HPC theory fails as an account of natural kinds because it does not actually provide any criteria for kind membership or for distinguishing between natural kinds and other sorts of groupings. By individuating kinds in terms of property clusters plus the causal factors that underlie this clustering, HPC theory only explicates why members of a *given* kind exhibit similar properties, such that reference to kinds can successfully ground inferences, generalizations, etc. But HPC theory does not explicate what makes a given thing a member of one kind rather than another and, accordingly, fails to fix the boundaries of kinds. Simply exhibiting many of the properties that recognized members of the kind possess won’t do, nor will exhibiting these properties due to causes similar to those that caused them to be present in recognized kind members. For the property clusters and sets of “homeostatic mechanisms” that in HPC theory determine, kinds are open-ended to such an extent that – given enough time – at

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<sup>16</sup>Many organismal traits are conserved over evolutionary timescales far extending the lifetimes of individual species. Consider, for example, the presence of a backbone in the Vertebrata. This trait occurs in all members of a species of vertebrates – all viable members of *Canis lupus* have a backbone – but it is not typical for one particular species and thus cannot serve to distinguish the species as a kind from the many other species in which the trait occurs too (Reydon 2006).

different times the same kind may be characterized by wholly different property clusters and underlying causes (making exhibiting the same properties for the same reasons not necessary for kind membership), while in principle (even though probably not often in practice) different kinds may in time come to be characterized by similar property clusters and underlying causes (making exhibiting the same properties for the same reasons not sufficient for kind membership).

According to HPC theory, natural kinds are not simply found “out there” in the world, nor do they emerge (as artificial kinds do) from any which way of classifying things we might find suitable to our purposes. Rather, as Boyd (1999a, 2000) – to my mind rightly – emphasized, natural kinds emerge from human interactions with nature in epistemic practices – in practices of gathering knowledge, explaining observed phenomena, predicting future events, etc. It follows that any theory of kinds should refer not to those properties of things that make them members of particular kinds, *period*, but to those properties that make things members of kinds *within some particular epistemic context*. Thus, the context under consideration determines which of the myriad properties of things determine kind membership and which are irrelevant in this respect.

However, while this is one of the principal insights underlying HPC theory, the relation of kinds to epistemic contexts is not part of the theory itself but is simply taken as a given in that HPC theory presupposes the definitions of the kinds to which the theory is applied to be provided by the relevant epistemic context. This means that HPC theory only accounts for one aspect of natural kinds, namely, their epistemology, but not for the metaphysics of individual kinds as it is left to the various scientific disciplines (and other epistemic contexts) to explicate the basis for the classification of their subject matter into kinds.<sup>17</sup> Scientists do not simply group things into kinds because they happen to have similar properties, but they group things on theoretical grounds. That is, scientists select those properties that they deem relevant against the background of the theoretical framework they use and group the things under study accordingly. (Often, these will be properties that feature in the explanations provided by a field of investigation.) This is illustrated by the classification of organisms: organisms can be similar in very many respects, but the similarities that count when grouping organisms into species and higher taxa are those that indicate closeness of ancestry (Darwin 1859, ch. XIII). Accordingly, Boyd and other proponents of HPC theory are concerned with kinds that feature in the various sciences, reaching from the physical sciences via the biological sciences to cognitive science, social science, and even the humanities. These epistemic contexts provide the groupings of things into kinds that in turn can be explicated in more detail by applying HPC theory to them.

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<sup>17</sup>HPC theory specifies at most a very superficial metaphysics of kinds. Elsewhere, I have suggested that precisely herein a possibility might lie for turning HPC theory into a full-blown theory of kinds that accounts for the epistemology *and* metaphysics of kinds: adding the factor that actually makes a kind epistemically important in a particular context as a third element to the two-part HPC definition of a kind allows the HPC definition to explain epistemic success as well as the metaphysical aspects of kind membership (Reydon 2009).

A similar situation obtains for artifacts: artifacts can be similar in numerous respects, but not all similarities have equal weight when grouping artifacts into kinds that serve the purposes of particular epistemic contexts. For the case of artifact kinds this brings up the question what might be the relevant epistemic contexts to examine when elaborating a theory of artifact kinds. One possibility is to look at academia – in the same way as proponents of HPC theory usually consider kinds in the various sciences – and take the various academic disciplines in which kinds of artifacts feature as the relevant contexts for a theory of artifact kinds. On this option, one should examine the kinds and classifications featuring in the sciences of artifacts, such as the various engineering disciplines found at polytechnic institutes, technical universities, and technical research institutes, as well as perhaps other fields that study artifacts (e.g., anthropology, archaeology, and museum studies). However, many if not most artifacts are conceived, designed, and examined not within academia but in such places as architects' offices, research and development departments of companies, etc., such that one might have to broaden the domain under consideration. But there is no *a priori* reason why one should limit the relevant epistemic contexts for theories of artifact kinds to this broader domain or even to take academic and other professional engineering and design contexts as relevant. One might also take “folk technology” and “folk” classifications of artifacts as the principal relevant context (Preston 2013).<sup>18</sup>

Depending on what one takes as the relevant epistemic contexts, different epistemic goals will move into focus. Probably the engineering disciplines and the non-academic design and manufacturing practices (and even “folk technology”) share many epistemic goals with the natural, life, and social sciences (e.g., achieving a body of reliable knowledge, realizing stable predictions, having a means to interfere with and control processes), but it is unlikely that they have *exactly* the same epistemic aims as are traditionally found in the sciences. At the very least, explanation and understanding often seem to come in different modes in engineering and design contexts on the one hand and in the natural sciences on the other hand. While the sciences strive to explain and/or understand given phenomena that hitherto have gone unexplained, in engineering and design, some level of understanding of the artifact must *precede* its existence as one needs some understanding of how the relevant phenomena work before one can design and make an artifact that is partly based on these phenomena. In addition, explanations here often have different targets from the scientific target (to explain regularities that are found in the world but aren't yet understood), such as explaining malfunction or the occurrence of unintended consequences (e.g., Pitt 2000, pp. 41–51).

I cannot elaborate on this issue here. A detailed analysis of the epistemic goals of engineering and design in comparison to the sciences is, to my knowledge, still unavailable, but it is at least *prima facie* plausible that, in engineering and design

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<sup>18</sup>Of course the same holds for natural kinds. Even though analytic metaphysicians and philosophers of science typically consider the theory of natural kinds in relation to those kinds that feature in the sciences, one might also take “folk” kinds and classifications as the relevant context for studying natural kinds. Indeed, cognitive psychologists often do (e.g., Keil 1989).

contexts, partly different epistemic aims play important roles from the ones that are central in the physical, life, and social sciences. This is not to say that the epistemic contexts in which artifact kinds feature are completely different from the ones in which natural kinds come into play; there will be overlap. My point is merely that when looking at artifact kinds, some of the important epistemic roles that they play are likely to be different from the ones that natural kinds play in the contexts in which these feature.<sup>19</sup>

The upshot is that for HPC theory or other epistemology-oriented approaches to be applied to the case of artifact kinds, the relevant epistemic contexts and the epistemic functions of referring to artifact kinds within these contexts need to be determined first. After all, on this approach, kinds are individuated by the reference that we make to them in successful generalizations, explanations, predictions, etc. In the case of natural kinds, philosophers often take the various sciences as the relevant epistemic contexts and think of natural kinds as just those kinds referred to in scientific reasoning. But, as pointed out above, for both natural and artifact kinds we seem to have a choice with respect to which epistemic contexts are deemed the relevant ones. Much of this choice, it seems to me, depends on what we are willing to consider as belonging into the general categories of “artifact” and “artifact kind” in the first place. We will only be able to examine the epistemic roles of reference to artifact kinds if we know at which kinds to look. Thus, it needs to be decided first about kinds *of what* we are seeking a theory when attempting to develop an account of artifact kinds. But here any project to elaborate an account of artifact kinds runs into problems, as there seems to be no general agreement among the specialists in the field about where exactly the boundaries of the category of artifacts lie.

As a first approximation, philosophers commonly think of artifacts as man-made objects (e.g., Franssen 2008, pp. 21–22; Franssen et al. 2009, section 2.5; Verbeek and Vermaas 2009, p. 165). Note, however, that having been made by people or being the product of human action cannot be sufficient to delimit the artifact category. Members of paradigmatic natural kinds can be made intentionally by humans too: the Higgs bosons that scientists hope to find in the Large Hadron Collider experiments at CERN constitute one example; the ultraheavy chemical elements created in laboratory setups are another (although here “making” presumably doesn’t have precisely the same sense as when one talks about the making of more paradigmatic artifacts such as hammers or laptop computers). Conversely, artifacts can also be naturally occurring objects that are selected by humans for a particular use. Thus, an appropriately shaped and sized stone used as a paperweight or a suitably large seashell used as an ashtray are sometimes seen as artifacts on a par with hammers or houses. Accordingly, philosophers of technology often employ a notion of “artifact” that covers objects *made* for a particular use as well as “objects that are intentionally or less intentionally *selected* to be used” (Verbeek and Vermaas 2009, pp. 165–166, emphasis added; see also Sperber 2007, pp. 124–125, for discussion),

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<sup>19</sup>But see Bunge (1966) for a view that the sciences and engineering disciplines actually *are* epistemically the same sort of endeavor.

although others prefer to place objects of the latter sort into the separate category of “naturefacts” (Oswalt 1973) in order to distinguish them from man-made things.

In philosophy of technology, however, not all made or selected objects are necessarily counted as artifacts: often the notion of “artifact” is limited to apply only to objects that are made/selected in order to serve a particular purpose. Things that were made or selected without having been meant by their makers/selectors to serve a specific purpose – such as unintended byproducts and waste products of production processes – tend not to be counted as artifacts (Franssen 2008, p. 22; Franssen et al. 2009, section 2.5; Verbeek and Vermaas 2009, p. 165). An additional restriction often imposed by philosophers of technology is that in order to count as an artifact, an entity should successfully *realize* or at least be *capable of realizing* the purpose that its maker had in mind when making it: if the maker fails in realizing his/her intentions, he/she hasn’t produced an artifact but only “scrap” (Hilpinen 2008, section 3; Verbeek and Vermaas 2009, pp. 165–166). The ideas in the minds of making subjects thus play a crucial role in determining whether a given object is an artifact and if so, of what kind.<sup>20</sup>

But this strict view of what it is to be an artifact a priori excludes some categories of man-made things from the category of artifacts that arguably should be included when trying to elaborate a philosophical theory of artifact kinds. For example, practices of classifying waste products and byproducts of industrial production processes are as ubiquitous and as important in everyday life as well as in the engineering disciplines as are practices of classifying “proper” artifacts. What could be a good reason to exclude kinds of non-purposefully created things like byproducts and waste from the realm of artifact kinds that is to be covered by the desired philosophical theory, focusing only on kinds of purposefully made objects?

The same seems to hold for things of which the purpose isn’t clear or is very difficult to specify, such as works of art or social institutions. Often the purpose of a work of art is unclear, but still there is much to say for counting works of arts as artifacts (e.g., Levinson 2007). And indeed, there are academic disciplines that study such artifacts and classify them: archaeology, art history, and cultural anthropology are among them. Furthermore, consider “things” that aren’t immediately tangible, material objects – such as the Internet, the Coca-Cola Company, or the European Union. For these sorts of things, too, there are sciences that study and classify them. Are these artifacts? Often, social institutions, firms, and “things” like the Internet are designed and created with well-specified purposes in mind but later assume a life of their own and serve different purposes than the ones they were originally created for. Still, they clearly aren’t naturally occurring objects but things intentionally created by humans and thus exhibit an important characteristic of artifacts. It seems strange not to count them as artifacts. Similarly, it is unclear why “scrap” and objects made or selected by animals should a priori be excluded from the artifact category. Indeed, some authors use a notion of artifact, according to

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<sup>20</sup>Cf. Thomasson’s claim that making an artifact of kind *K* must involve having a “substantive concept of the nature of *Ks* that largely matches that of some group of prior makers of *Ks*” (2003, 600; cf. 2007, 60–63; Chap. 4, this volume).



which the maker must accept the entity as something that *might have realized* his/her intentions, thus including defective artifacts. And if natural objects selected by humans to serve particular purposes are counted as artifacts, why not count birds' nests, termite hills, beaver dams, or the twigs and leaves that animals use as tools (e.g., Gould 2007)?

In all likelihood, it will be easier to achieve a theory that explicates the epistemology and metaphysics of technical artifact kinds – artifact kinds that feature in the engineering disciplines – than to develop a theory of artifact kinds that also accounts for byproducts, scrap, art works, social institutions, etc. Within the context of the philosophy of the engineering sciences one would probably only consider kinds of technical artifacts, in the same way as in the philosophy of science discussions on natural kinds are often limited to scientific kinds. But there is no a priori reason to limit one's considerations to kinds that feature in the established academic engineering disciplines while not also looking at kinds featuring in design and manufacturing practices outside academia (and even then one will presumably not have covered the entire domain of the artifactual). At any rate, a question that needs to be answered prior to attempting to devise a theory of artifact kinds inspired by HPC theory – or along the lines of any other epistemology-oriented approach to kinds – is how broad the scope of application of the desired theory should be and which epistemic and/or pragmatic contexts are counted as relevant.

## 8.5 Outlook

In the preceding sections, I have argued that traditional metaphysics-oriented approaches to elaborating a theory of kinds are on the wrong track, both when it comes to natural kinds and artifacts kinds, but that there has been an epistemological turn in the philosophy of kinds that looks more promising. The approach I favored involves addressing the epistemology of kinds before trying to elucidate their metaphysics. I have examined to some extent whether the most popular epistemology-oriented account of natural kinds, HPC theory, might be applied to artifact kinds and argued that some issues that arise in this context deserve attention:

1. A general problem faced by HPC theory, namely, that HPC theory fails to provide membership criteria for kinds
2. The question which epistemic roles references to artifact kinds perform
3. The question which epistemic contexts are relevant when examining the epistemic roles of reference to artifact kinds
4. The question how wide the scope of application of the desired account of artifact kinds should be, i.e., which things should be counted as artifacts and which should not

While the occurrence of these issues might be taken to suggest that epistemology-oriented approaches to developing a theory of artifact kinds will fare no better than metaphysics-oriented approaches, I think the former still are in a better position

than the latter. For one, metaphysics-oriented approaches tend to be more limited than epistemology-oriented approaches in their attempts to yield a unified account of natural and artifact kinds, as they often (but, to be sure, not necessarily always) invoke a priori criteria for what it is to be a natural kind – for instance, the traditional principle that mind-dependent kinds are fundamentally different from natural kinds that supposedly exist wholly independently from human cognition, or the principle that natural kinds are to be conceived of in terms of kind essences. Such a priori criteria typically are difficult to reconcile with the kinds humans actually refer to (cf. Hacking 1991, 2007; Reydon 2010), a prominent example (discussed above) being the case of biological species. By looking at epistemic rather than metaphysical criteria for what it is to be a natural kind and for how things should be allocated to kinds, epistemology-oriented approaches are in a better position to avoid this difficulty.<sup>21</sup>

But to my mind the most promising aspect of epistemology-oriented approaches is that they leave open the possibility to fill in the metaphysics of different kinds in different ways because kinds are individuated on epistemological grounds. Their metaphysics then is to be filled in on a case-by-case basis, leaving open what the metaphysics of the various sorts of kinds will look like and whether in the end a unified metaphysics for all kinds is achievable. In the case of artifact kinds, this feature of HPC theory and similar approaches is especially important, because of the variety of extant views of what the nature of artifacts consists in and what makes a given artifact the kind of thing that it is. The straightforward way is to characterize artifacts by their functions (e.g., Kornblith 1980, p. 112). However, it is now widely acknowledged that an artifact's function cannot fully determine its kind membership (Franssen et al. 2009, section 2.5). Better options might be to characterize them by functions plus other features (Carrara and Vermaas 2009) such as operational principles, by human actions involving artifacts in the contexts of use plans (Houkes and Vermaas 2004, 2010), or by means of a dual nature combining structure and function (Kroes and Meijers 2006; Kroes 2010). In this respect, epistemology-oriented approaches have an advantage over metaphysics-oriented ones, in that they don't need to wait for the discussion on the nature of artifacts to be decided before addressing the question of artifact kinds.

Any metaphysics-oriented approach to developing a theory of artifact kinds must begin by agreeing upon the *kind of metaphysics* that is sought – a metaphysics in terms of necessary and sufficient properties for kind membership, one that recognizes only structures as real, one that allows both non-sharply delimited kinds next to strict kinds, one that conceives of artifacts as being individuated only by functions, one that thinks of artifacts as having a dual nature, etc. Thus, on metaphysics-oriented approaches, as long as the nature of artifacts is an unsettled issue, the nature of artifact kinds must remain open too. Epistemology-oriented approaches, in contrast, can begin to explicate the epistemology of artifact kinds in the various contexts in which they feature, explore whether a unified epistemology

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<sup>21</sup> But see Elder (2007; Chap. 3, this volume) for an attempt at devising an account of mind-independent essences for artifact kinds that perhaps could avoid these difficulties.

is possible that covers all cases, and then go on to see whether an overarching metaphysics of artifact kinds is feasible or a pluralist metaphysics is required.

These advantageous features of epistemology-oriented approaches in the case of artifact kinds in turn provide additional support for the epistemological turn that is on its way in the philosophy of natural kinds.

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