Artifact Dualism, Materiality, and the Hard Problem of Ontology: Some Critical Remarks on the Dual Nature of Technical Artifacts Program

Andrés Vaccari

Springer

Springer

RESEARCH ARTICLE

Artifact Dualism, Materiality, and the Hard Problem of Ontology: Some Critical Remarks on the Dual Nature of Technical Artifacts Program
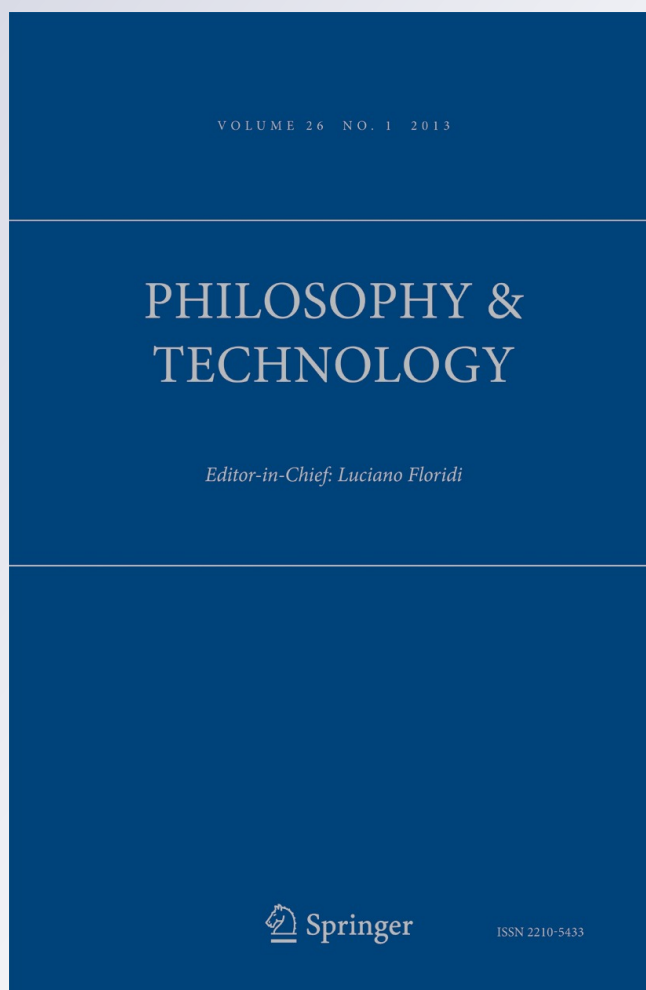
Andrés Vaccari

Abstract This paper critically examines the forays into metaphysics of The Dual Nature of Technical Artifacts Program (henceforth, DNP). I argue that the work of DNP is a valuable contribution to the epistemology of certain aspects of artifact design and use, but that it fails to advance a persuasive metaphysic. A central problem is that DNP approaches ontology from within a functionalist framework that is mainly concerned with ascriptions and justified beliefs. Thus, the materiality of artifacts emerges only as the external conditions of realizability of function ascription. The work of DNP has a strong programmatic aspect and much of its foray into metaphysics is tentative, so the intent of my argument is partly synthetic: to sum up these issues as they are presented in the literature and highlight some recognized problems. But I also go beyond that, suggesting that these problems are foundational, arising from the very way in which DNP poses the question of artifact metaphysics. Although it sets out to incorporate objective aspects of technology, DNP places a strong focus on the intentional side of the purported matter-mind duality, bracketing off materiality in an irretrievable manner. Thus, some of the advantages of dualism are lost. I claim that DNP is dualistic, not merely based on "duality", but that its version of dualism does not appropriately account for the material "nature" of artifacts. The paper ends by suggesting some correctives and alternatives to Dual Nature theory.

Keywords Ontology of artifacts · Ontology of systems · Dual nature theory · Intentionalism · Materiality

A. Vaccari (✉)
Macquarie University, Sydney, Australia
e-mail: andres.vaccari@mq.edu.au

1 Introduction

The ontology of artifacts has emerged as a key concern in the analytical philosophy of technology. A fundamental feature of this relatively recent body of work is a consensus on a basic axiom:

Artifacts are objects intentionally made to serve a given purpose (Baker 2004, 99).

An artifact may be defined as an object that has been intentionally made or produced for a certain purpose (Hilpinen 2004).

… it seems part of the very idea of an artifact that it must be the *product* of human intentions (Thomasson 2007, 52).

Artifacts, whatever exactly they are, belong to a genus of artificial entities. These are entities that are, in some sense, made—they are products of intentional behavior (Dipert 1995).

This view, which I will call 'intentionalism,'[1] admits of various flavors and degrees of ontological commitment. Minimally and essentially, it consists in the assertion that the ontology of artifacts is derivative of human intentionality. What an artifact *is*, its singular mode of being in the world, is determined by an intrinsic and constitutive reliance on certain mental states—intentionality being the *aboutness* of such states. This ostensible dependence has led realist philosophers to discount artifact kinds as somewhat ephemeral or uninteresting (see Thomasson 2003 for a discussion and critical reply). The difference between an artifact and an object (not just 'natural' objects but also those resulting from the accidental and collateral effects of human action) is that the former was designed with a purpose, i.e., a *function*. The notion of function is a linchpin of intentionalist accounts, acting as a mediating term between intention and the artifact (e.g., Thomasson 2007). In this way, a function can be expressed as a proposition, and this proposition applies to (and somehow shapes) the mode of being of that object in the world.

This paper will be concerned with the central thesis of the Dual Nature of Technical Artifacts Program (DNP), a philosophical project that has arisen, in part, as a critical response to intentionalism. Dual Nature (DN) theory makes some needed improvements on intentionalism, yet it has difficulties articulating a metaphysic of artifacts. My main claim is that DNP formulates ontological questions from within an epistemological framework that is inappropriate for such a task. This is because the DN framework highlights the intentionalist aspects of artifacts and approaches their material nature from the point of view of intentions. Materiality is figured in a negative way: as constraint or resistance. This theory does not concede enough ontological objectivity or autonomy to material aspects of artifacts.

The work of DNP has a strong programmatic current and much of its foray into metaphysics is tentative, so my argument is partly synthetic: to sum up these issues as they are presented in the literature and see where they lead. But I also go beyond that,

---

[1] Some key works in the literature of intentionalism are: Dipert (1993, 1995); Hilpinen (1993, 2004); Baker (1999, 2004) and Thomasson (2003, 2007).

suggesting that these problems are foundational, arising from the very manner in which DNP poses the question of artifact metaphysics.

For the purposes of this argument, I will take a minimal but strong view of ontology, to mean a type of *explanation* that makes substantive claims about what kind of entities there are, ultimately and objectively, in the world. This implies a minimal commitment to realism, which is evident in DNP's incursions into metaphysics. Following Searle's (1995) distinction, I argue that we should account for features of artifacts as both *epistemically* and *ontologically* objective. In an epistemic sense, "subjective" and "objective" are predicates of judgments; "Rubens is a great painter" is a subjective judgment, while "Descartes was born in 1596" is an objective one. Ontologically, the subjective–objective distinction applies to entities and types of entities. Pains are subjective entities because their mode of being depends on their being perceived by subjects. Mountains are ontologically objective, because their mode of existence is independent of mental states (8–9).

There is little discussion in the DNP literature about what a genuine metaphysical question is, or what a metaphysic should do; but there is a clear agreement on how metaphysical questions look like from within a DN perspective. For example, the distinction between function *ascription* and *real* features of artifacts denotes a consensus on where to draw the line between epistemology and metaphysics. My minimal, naïve realism will hopefully be broad enough to capture this common ground.

But what *should* a metaphysic of technology explain, exactly? Following DNP, I argue that it should address precisely what intentionalism leaves out. Some features of technology suggest an ontological objectivity, a sort of autonomy or quasi-agency beyond the grasp of human intentionality, always resisting it and exceeding it. The term "materiality" refers to the fact that technological phenomena (artifacts, machines, systems, techniques, media, instruments, processes of manufacture and production, etc.) are distinct from physical phenomena. In fact, the styles of variation and organization in the history of technology can be more closely compared to the properties of living organisms—the reason why philosophers, engineers, and theorists routinely scramble for biological metaphors to convey a sense of this complexity and apparent autonomy. Technology shows a distinct style of organization that follows characteristic patterns of development.

Palpable evidence of this independence from human ends is the unpredictable historical paths that many technologies follow. Not only are these paths unforeseeable to designers and users, sometimes they even turn against them; for example, by bringing about "revenge effects": disastrous unintended consequences that far outweigh the desired benefits (Tenner 1996). Another related phenomenon is "lock-in" (Arthur 1989): once a certain technology is established, it becomes almost impossible to replace it with a competing technology; even when the latter might be technically superior. Two well-known examples of this are the QWERTY keyboard I am using right now (much less effective than the DVORAK arrangement; see David 1985) and the use of light water as coolant for nuclear reactor technology (Arthur 2009, 103–4). At other times, important technologies arise as collateral, unforeseen outcomes of a parent technology; e.g., text messaging, which was originally a collateral functionality of mobile phones. Then, we also have serendipity, e.g., the accidental discovery of X-rays as a diagnostic tool; or Thomas Edison's stumbling onto the effect that bears his name, which lead to the development of the diode.

These last two cases are not necessarily closed off to intentionality based accounts; in fact, they could be seen as types of accidental functions that become fixed through repeated (intentional) use. But the important thing is that these phenomena put the spotlight on some of the blind corners of intentionalism; here, human intentionality and agency often seem to arrive late, and redirect or seize on something that was already in motion.[2] Bringing the focus to the more immediate phenomenological dimensions of artifacts, we also find evidence of this independence. Here, materiality refers to the horizon of possible "action schemes" (Illies and Meijers 2009) that artifacts open up by virtue of internal features such as physical organization and modes of operation. These material qualities constitute the source of specific causal powers or "capacities".

Materiality also has an important historical dimension. Non-intentionalist etiological theories have argued that artifacts owe their design not to preceding intentions but to a lineage of previous (similar or identical) artifacts (e.g., Elder's ontology of "copied kinds", Elder 2007). On his part, Arthur (2009) points out that this causal chain may not always be traced back to an original intention, as much as to *phenomena* that constitute the artifact's principle of operation (45–54). As Simondon (2008) argues:

> … the fact that the technical object belongs to the factical class of objects that respond to a given human need does not limit, and in no way defines, the type of physicochemical action that might be exerted in that object, or between that object and the world. The difference between the technical object and the physicochemical system as an object of [scientific] study resides only in the imperfection of the sciences; scientific knowledge … does not allow us to predict absolutely all the effects with a rigorous precision; this is the reason why there subsists a certain distance between the system of technical intentions that correspond to a defined finality and the system of scientific knowledge of the causal interactions that implement these ends; *the technical object is never completely known* … (57, emphasis mine).

These operations, effects, or "phenomena" (of which the artifact is both locus and vehicle) seem to be independent of intentions, and to develop out of a systemic, combinatorial logic that exceeds the agency of inventors and operators—more pronouncedly as the artifact increases in complexity. Our knowledge is essentially incomplete. Hence, since ancient times, technology has mostly been associated with empirical, concrete knowledge. And the project of modern technology is to bring this knowledge under the aegis of science; that is, to reach for method and completeness. Yet, the question remains: how are we to think of this gap, this difference? Part of my criticism is that DNP portrays materiality in a negative manner; yet, the reader might have noticed that some of the ways in which I have been characterizing materiality, so far, are also negative. The problem here is rather delicate and has to do, partly, with the very contradiction in terms implied in the notion of "thinking" materiality. In the philosophical tradition (beginning with Aristotle, who asserted that substance itself, the substratum of forms and qualities, could never be known), matter is usually

---

[2] Actor–Network theorists claim that materiality and agency should be treated symmetrically, but this point should be seriously contested (as does McGrail 2008, a paper that will be discussed in the conclusion). Other theorists ask us to embrace "material agency": see Kirchoff (2009), Knappett and Malafouris (2008), Pickering (1995), and Latour (1999 esp. chp 6).

characterized as a noumenal entity, categorically beyond representation. Of course, I do not claim to have solved this problem, and we need to develop a philosophical vocabulary appropriate for such a task. For now, we should keep in mind that materiality does not necessary equate with brute, formless "stuff", but implies some degree of organization and, already, of form. In the conclusion, I will draw attention to some of these, more "positive", organizational, and historical aspects of technology as a point of entry into the question of the relation ontology–technology.

In their efforts to bridge this gap, DN theory (as developed by DNP) begins promisingly: materiality should be considered an essential aspect of artifacts, along with intentions; yet DNP focuses nearly exclusively on these last. In what follows, I will argue two things: (1) that DNP is committed to a version of dualism, and (2) that this version of dualism does not adequately account for materiality.

The argument will be structured as follows: Section 2 presents the claims of artifact dualism and evaluates its status as an ontological position in the context of the epistemological concerns of DNP. Section 3 contains the bulk of the argument. It begins with an examination of how Dual Nature tackles the notion of "function" and the problems that arise from this. I argue that DNP is concerned with the elaboration of a normative theory of function ascription that can only address ontological aspects from *within* an epistemic framework; i.e., as a kind of constraint on ascription and use. I also point out to certain conceptual–rhetorical imprecisions in which epistemological claims are illegitimately extended into ontology. All this means that metaphysical aspects of materiality end up being swept aside, and claims about intentional features are surreptitiously predicated of real features of artifacts, such as capacities. Finally, the conclusion suggests some possible ways to reengineer dualism, while exploring some work on materiality in the context of technology.

2 Artifact Dualism: What Is It, Exactly?

The central thesis of DNP is that artifacts have a fundamentally *dual* nature; they are "both physical bodies that have geometrical, physical, and chemical characteristics, *and* functional objects that have an *intrinsic* relation to mental states and intentional actions" (Houkes and Meijers 2006, 119; emphasis mine). On one hand, the realization of the functions of artifacts "crucially depends on their physical structure." On the other, they are "intentionally produced" objects characterized by a *for-ness* that sets them apart from natural objects. Artifacts are, thus, *produced* both in a physical and intentional sense (Kroes and Meijers 2006, 1).[3] Technical functions have a role in the use, design, and production of artifacts. Vermaas and Houkes (2006), for instance, draw a distinction between various kinds of engagement with artifacts: passive using, idiosyncratic using, innovative using, expert redesigning, and product designing. Kroes and Meijers rightly criticize intentional theories on the basis that "the ascription of technical functions appears to depend on intentional states of affairs

---

[3] Despite a large body of work, the basic premises of DNP are consistent, so I will refer to it as one single "thesis." However, this does not mean that there are no differences of opinions and diversity of interests. The arguments of specific papers and authors will be indicated when appropriate.

only," and structural features are considered of no significance (2006, 3).[4] However, from the very start, DNP's position implies a partial commitment to intentionalism, inasmuch as it holds that intentionality is a necessary condition of artifactuality: "… the physical sense always involves the intentional sense, but not the other way around" (Kroes and Meijers 2006, 2). That is, if we take away intentionality, we are left with a thing ontologically indistinguishable from an ordinary object. DNP also borrows from intentionalism a focus on the "artifact" as the central unit of analysis in the philosophy of technology. Although this conceptual choice is very problematic, we will follow it for the sake of argument (but see Mitcham 2002 for some critical comments on "artifact").

On a first approach, this suggests an ontology that divides the world into objects and mental states, not unlike the ontology of intentionalism. The same way that intentionalism argues for the ontological respectability of artifacts on the shared common ground of Cartesian metaphysics, so it appears that Dual Nature theorists challenge the claims of intentionalism on this same ground, leaving the metaphysical furniture untouched. The definition of the material side of artifacts as "physical bodies that have geometrical, physical and chemical characteristics" does not draw a distinction between artifacts and natural objects (which presumably also have these characteristics) in terms of objective, fundamental features.

The main problem is how to reconcile these two aspects. "How can a function be explained in terms of its physical structure, given the conceptual gap between the kinds of descriptions involved …?" (Kroes 2002, 299). Now, in what sense, if any, is this a metaphysical question? In their presentation of the Program, Kroes and Meijers (2002) refer to these complementary views as two basic *conceptualizations*, or ways to think about artifacts (4). The Program's main task, then, would be to work out the logical coherence between two differing *accounts*.[5] So, if there are any metaphysical aspects involved, these concern at best the elucidation of a regional ontology. In other words, the task is "to clarify the ontological commitments that are involved in describing and using artifacts" (6). Here, Kroes and Meijers appear to be tacitly aligning DNP with a current in analytical philosophy (which has its beginnings in Kant, but which is associated mainly with Carnap and Putnam) according to which "ontology is a metadiscipline that is not concerned with the world itself, but only with theories, languages or systems of belief" (Smith 2007, 52).

---

[4] DNP uses "structural features," "physicochemical properties", and other terms interchangeably. I will follow this usage, adding "materiality" as a quick way to refer to the physical side of the duality. I leave this term deliberately vague to refer to the unfathomable, in-itself dimension of artifacts.

[5] According to Kroes and Meijers, the aims of the Project are: "… to give an indepth conceptual analysis of the notion of technical function; to compare this account with the accounts of function given in other areas, especially biology and the social sciences; to develop an account of the relation between technical function and physical structure, particularly the sense in which the physical structure constrains the technical function; to develop an account of the intentional aspects of technical functions and of their relation to the intentionality and actions of designers and users; to examine the epistemological consequences of these intentional aspects of functions; to investigate the normative judgments that apply to the functioning of artifacts and the origin of this normativity; to clarify the ontological commitments that are involved in describing and using artifacts; to develop an account of the process of designing technical artifacts and of the way the structural description of the artifact-as-physical-object and the functional description of the object-as-intentionally-formed-artifact are combined during this process; and to examine how technical explanations in design are related to the various types of explanation that are traditionally distinguished in the philosophy of science" (2002, 6–7).

However, DNP undoubtedly wants more. In a later paper, Houkes and Meijers make a stronger claim: the dual thesis "quite clearly and unabashedly addresses the ontology of artifacts. It reflects a metaphysical view about the *nature* of artifacts, namely that it is twofold" (2006, 119). Regardless of the boldness of this claim, it is clear that DNP presents this as a *problem*, rather than a fully developed theory. On itself, artifact dualism is a rather uninformative thesis; it would be more natural to think of it as an issue that metaphysics should resolve.

Yet, it is difficult to accept this as a realist, rather than a regionalist, problem. Firstly, as I said before, artifact dualism relies on a Cartesian division between intentional agents who "represent the world and act on reasons" (Kroes and Meijers 2006, 2) and a physical world describable in terms of the laws of physics. Houkes and Meijers (2006) acknowledge that this approach "may be akin to the mind–body problem that has plagued philosophy for centuries" (130)—a highly dispiriting prospect. The problem, then, would no longer be the mode of being of artifacts but dualism *itself*: "the question remains how these functions are related to the mental states of individuals …. It becomes somewhat mysterious how a function relates to the physical substrate in a particular artifact" (Kroes and Meijers 2002, 5). It follows that artifact dualism cannot be taken at face value, since it relies on a deeper ontology: a proposed dualism between agents and things rather than a dualism somehow constitutive of the artifact itself (i.e., a metaphysical view "about the nature" of artifacts). Of course, the very term "dual nature" already tells us that.

There has been at least one attempt (de Vries 2005) to "save" this dualism by claiming that it is simply a duality. "Does the observation of duality in ontology necessarily lead to a dualistic approach?" asks de Vries (67), and his answer is negative. I disagree, and I propose to show that dualism is at the heart of DNP's approaches to ontology. If DNP is merely advancing the duality view, my argument bears out: DNP is concerned with epistemic issues and uses duality as a heuristic framework; in which case, we have to enquire whether an ontology is necessary and about the price of relinquishing metaphysics.

But this is not the case. There is strong consensus that DNP must, at some point, address ontological issues as a way to support the claims of epistemology. I will show that an important reason for this is that DNP's theory of function ascription has an ontological condition of realizability, pinned on the artifact's materiality: its "capacities."

We can see this first push towards metaphysics clearly in early writings of the Program, such as the "Reply to Critics" (Kroes and Meijers 2002). On one hand, a retreat into duality saves us from facing the intractable problems of dualism, such as the ontological reducibility of the mental to the physical; yet, when asked to clarify what they meant by "two natures" of artifacts, Kroes and Meijers define them as "the fundamental properties of artifacts" and state that they intend "to focus on the fundamental character of artifacts, including their ontological characteristics." In what follows, we will enquire into this relation between intentions and fundamental properties. I will argue that:

1. Dualism is an organizing framework of DNP's approaches to ontology. The materiality of artifacts is approached from within the horizon of its functional–intentional aspects: as corresponding objective conditions of realization. It is also

possible that duality could be made to cohere with non-dualism; but the solutions proposed (such as De Vries 2005 attempt to ground the duality on Dooyeweerd's theory of the fifteen modalities) seem unnecessarily complex.

2. DNP's version of dualism is not convincing and does not achieve what it sets out to do: account for materiality and intentionality in a single DN theory. Because its concerns are strongly epistemological, DNP centers on intentional entities, and therefore does not give the two natures equal treatment.

Perhaps there is some, as yet unthought, version of dualism that can incorporate materiality and production in a more inclusive manner. Perhaps there might even be a satisfying version of intentionalism, although I cannot see how intentionalism can do this without becoming outright phenomenology. In any case, this is outside the scope of my argument.

The most intractable problem of all the versions of intentionalism that have been proposed so far arises from the central relationship between intended character and the internal constitution of the manufactured object. Although this connection is proclaimed as constitutive, it is described by the use of metaphors such as dependence, inherence, embodiment, and 'ties.'

When a person intends to make an object, his productive intention has as its content some description of the intended object: the agent intends to make an object of a certain kind. An author's intention "ties" to an artifact a number of predicates which determine the *intended character* of the object. The existence and some of the properties of the artifact are dependent on its intended character (Hilpinen 2004).

Artifacts cease to be philosophically interesting in their own right, insofar as intentions confer on them their principle of unity and of existence. Intentions appear devoid of context; they are baptismal acts in which intended character is instantiated in opaque and pliant matter. Thomasson, for example, speaks of the inventor "imposing" intended features on the object (2003, 597). Intentionalism argues that the ontology of artifacts should be subordinate to the metaphysics of mental events; that is, the philosophy of technology should employ concepts drawn exclusively from the philosophy of mind. In this manner, artifacts come to acquire a borrowed and derived mode of being. Dipert (1995) is quite candid about this problem, which amounts to passing the buck to notions that are controversial and on which there is little agreement:

> … there has been a tendency to 'explain' certain phenomena by stating analyses that casually invoke still less understood phenomena, such as cause, thought, belief, or action. In this vein, we might glibly assert that artifacts are objects that are intentionally made—without caring much about the further difficulties with 'object', 'intentionally', or 'made'. … Most article-length "disentangling" of rich philosophical phenomena are at best masterpieces of packaging, in giving superficially appealing analyses or theories that bury the difficulties in the use of terms that happen now to be widely accepted (such as "S believes X": but what is it, really, to believe?) …. Most of these notions are as yet poorly understood concepts about which there is extensive disagreement. Assent to my proposed definition of an instrument, or to richer notions of an artifact, thus constitute agreement only at a superficial structural level; indeed, when one is not agreeing to articulated characteristics of the underlying subconcepts, it is unclear what anyone is assenting to.

DNP's corrective is to insist that artifacts have a material dimension, while retaining parts of the conceptual machinery of intentionalism (particularly, as we shall see, the notion of belief). In certain respects, DNP is a variant of intentionalism: the focus is on intentionality while materiality manifests itself as a constraint, a resistance that remains at the edges of the analytical framework, never clearly conceptualized or experienced.

But let us proceed slower: artifacts, then, have two natures that are related in some way. As it is, this is not much of a theory, and Houkes and Meijers (2006) admit that it needs something more. Thus, they set out to assess two competing artifact ontologies with the aim of determining whether DN theory can be substantiated by any of them: *supervenience* and the *constitution view*. Here, Houkes and Meijers tend to employ the central thesis of DN theory as a basis for epistemic criteria that can be applied to the evaluation of both proposals. Thus, any convincing ontology of artifacts should "accommodate" inferences between intentional ("functional type") and material ("material structures or systems") aspects: the familiar two faces of artifact duality. They argue that there is a "two-way underdetermination" between function and structure: artifact types are multiply realizable while "a given material basis can realize a variety of functions." This double underdetermination places specific *constraints* on the "reasoning patterns" and "practical inferences" that can be carried out (120). After examining supervenience and the constitution view, Houkes and Meijers find both proposals wanting, since they fail to support at least one of these two inferential directions. The appeal of these views is, precisely, that they attempt to harmonize two levels of explanation, and thus might have provided the missing metaphysic that artifact dualism needs. But the criteria of Houkes and Meijers are exclusively centered on epistemic aspects, such as inferential processes and how to make conceptualizations cohere. In her reply to this paper, Lynne Baker, the chief architect of the constitution view, rightly observes:

> … it is unclear to me how a general ontology of artifacts generally could help us understand specific patterns of reasoning from function to structure. Surely, the content of such reasoning is not covered by any general theory, but depends on the specific function in question (Baker 2006, 134).

This "slippage" of epistemological claims into ontology[6] is common in the work of DNP whenever metaphysical issues are explicitly addressed. The bulk of DNP's output (and I include here work that is close to the project but not necessarily aligned with it) is concerned with epistemic aspects arising from the design and use of artifacts. At stake here are descriptions, explanations, and normative judgments, rather than any strictly metaphysical commitments or claims. For example, we have work concerned with function descriptions and ascriptions (Vermaas and Houkes 2003; 2006), the coherence of structural and functional explanations (Kroes 2006; Krohs 2009), the normative frameworks at work in technological practice (Vaesen 2006; DeRidder 2006), correspondence and consistency between physicalistic and functional descriptions (Krohs 2009), and epistemic aspects of design and use practice (Houkes 2006; Vermaas 2006). What we have is not a conceptualization of

---

[6] The term "epistemology" shall be employed rather broadly to refer to all aspects of the knowledge and beliefs about artifacts. Later, we shall see that DNP discusses a social, communicational dimension.

artifacts *per se*, as much as theories *about* the conceptualization of artifacts: the way designers and users recognize, describe, evaluate and understand artifacts, as well as communicate effectively their designs, among other intentional aspects of human interactions with technology. Papers explicitly concerned with metaphysical issues are scarce: Houkes and Vermaas (2004), Houkes and Meijers (2006, discussed above), Houkes and Vermaas (2009), and Carrara and Vermaas (2009). Also, Vermaas and Houkes (2006) and Vermaas (2009) deal more incidentally with metaphysical topics.[7] (All of these metaphysical papers will be discussed in what follows).

   Given the foundational claim of artifact dualism, there are two possible directions we can take. One is to reduce artifact dualism to its component assumptions and argue that it is not a metaphysic because it relies on deeper ontological commitments (a point that Mumford (2006) elaborates in detail, and to which we shall return in the conclusion). The other direction is to take DNP's version of dualism at face value, then see how it accounts for materiality and the link intention–structure or function–capacity. What specific problems arise from its application? We must keep in mind, also, that I will have to prove not only that DNP's version of dualism is unviable, but that DNP's proposal is, indeed, dualistic (and not a mere statement of duality for heuristic purposes).

3 Functions, Capacities, and Slippages: How Materiality Eludes DNP

Intentionalism argues that "function" is the bridge that connects the intentional and the physical nature of artifacts, effectively constituting artifacts as a distinct ontological category. Although Dual Nature theorists have a more complex position on this, they generally remain attached to a functionalist framework, to the point that it is not clear whether DN is a theory about artifacts *per se* (whatever they might be) as much as a theory about technical functions. In Kroes and Meijers (2002) argue that the "concept of function never appears in physical descriptions of the world" and "belongs to the intentional conceptualization" (5). The main function of "function" in Dual Nature theory is to translate intentional content and physical properties into comparable terms—the same language, so to speak. This enables us to establish coherence between the two aspects, "flattening" the duality by redescribing physical features as intentional content. The problem, again, is how to reconcile two *conceptualizations*.

   However, the central problem raised by DNP is that "real" artifact functions do not depend exclusively on mental states. So, function has a certain import for the ontology of artifacts, and Houkes and Meijers (2006) argue that the notion of function should act as a "bridge" between intentional and physical aspects, linking "higher order objects and their material basis" (120). One problem is that function is an essentially normative concept. "Function" may offer criteria on how to identify malfunctioning or unsuccessful artifacts; it might help explain how designers evaluate their products by applying certain conditions of success; but it is not clear how these normative criteria and conditions can (a) throw any light on the metaphysical nature

---

[7] There is also a forthcoming volume dedicated to these aspects, which, unfortunately, I will not be able to discuss here: Franssen. et. al. (forthcoming). The other papers will be discussed shortly.

of artifacts in general; (b) can reflect, refer to, or be bounded by, the real features of artifacts.[8] As Wouters writes, "a function is not necessarily something an item does, but rather something that it should do" (2005, 124); on the other hand, a capacity is an *effect* of the artifact, something the artifact does by virtue of its own constitution (not just a contingent effect, but a regular causal outcome of materiality). Intentionalism is clearly aligned with this first aspect: "The study of artifacts (*qua* artifacts) is intrinsically evaluative, since viewing an object as an artifact means viewing it in the light of intentions and purposes" (Hilpinen 2004). DNP is interested not so much in the normativity of function but on the normativity of function *ascription*. The questions "What is a proper function?" becomes "How do we properly assign a function?" In this theory, function (as mental content) is no longer the metaphysical condition of possibility of artifactuality, but is itself subjected to certain conditions of realizability that allow us to distinguish proper from faulty ascriptions.

For DNP, the link artifact function is regarded as constitutive from the perspective of the intentional side, but not from that of the object side. This break with intentionalism comes at a price: technical function becomes an exclusively epistemic concept with no direct ontological significance. Functions cannot be essential features of artifacts; from the point of view of its intentional history, an artifact may be "different for different agents, and one object may even play different roles at the same time" (Houkes et al. 2002, 308)[9]; but from a metaphysical point of view, "this is absurd: nothing is both *A* and not-*A* at the same time" (318). Thus, it follows that "technical functions cannot be easily interpreted as intrinsic or essential properties of artifacts" (Vermaas and Houkes 2006:8).

DNP can only approach ontological features from within a framework strongly centered on explanatory entities such as use plans, function ascription, and the communication of such plans. Let us look at these arguments in more detail. All metaphysical discussions in the literature are found in the context of the "ICE" theory of functions, which combines elements from intentionalist, causal role and evolutionist function theories. Houkes and Vermaas developed this theory as an important tool that aims to redress some of the problems that proper function theories encounter in their application to the phenomenology of use. The ICE function theory assigns use plans a central role:

The capacity to θ is ascribed as a function to an artifact x by an agent a, relative to a use plan p for x and relative to an account A, iff:

I.   The agent a has the belief that x, when manipulated in the course of the execution of p, has the capacity to θ, and the agent a has the belief that if this execution of p leads successfully to its goals, this success is due, in part, to x's capacity to θ.
C.   The agent a can justify these two beliefs on the basis of A and

---

[8] In addition, functional norms entail a drastic narrowing of the scope of "artifact" to exclude, for example, malfunctioning and broken artifacts, failed prototypes, artifacts with no practical function, working artifacts that are never used, found artifacts that are not designed, animal-made artifacts, and functional artifacts that are the cumulative result of unintentional, collective action (see Sperber 2007, 124–6).

[9] We should emphasize that, for DNP, the material side remains inert and changeless. "There appears to be no change on the object side, i.e., in the physical properties, of artifacts, but only on the designer- or user-side" (Houkes and Vermaas 2004, 56).

E.   The agents d who developed p have intentionally selected x for the capacity to θ
      and have intentionally communicated p to other agents u. (2004, 65)

In other words,

… an artifact function is any role played by an artifact in a use plan that is
justified and communicated to prospective users. Hence, functions are plan-
relative: it makes no sense to ascribe functions to an object that is not,
metaphorically speaking, embedded in use plans (66).

The ICE theory improves on intentionalist accounts by incorporating communica-
tional, socially sustained structures that ground the legitimation of belief. However, as
we can see, ICE theory relies exclusively on intentionalist entities; in particular, beliefs.
The theory not only underlines the normative aspects of functional ascriptions of
function, but it is also clearly normative itself: it consists of a set of conditional
propositions that must be satisfied in order to assign a capacity to a given item. Houkes
and Vermaas acknowledge that they have done little to solve the issue of the metaphys-
ical status of functions; what they have done is enunciate a theory of function *ascription*.
Nonetheless, they attempt to defend their position by suggesting that the gap between
ascriptions and "real" function is negligible because "the domain of technical artifacts
seems constituted by human actions and beliefs" (67). This is not as precise as it
should be. For a start, technical *functions* are constituted by actions and beliefs, not
artifacts; in fact, by DNP's own standards, a "real" function would be a contradiction
in terms (that is, a function is by definition an intentional content, not an objective
aspect of the thing). This appears to be a circular argument, although, in the final
analysis, it brings the limits of the framework into relief: function ascriptions are
informative about real functions insofar as real functions are constituted by function
ascriptions. The problem here is that we are trying to talk, from within an intention-
alist framework, about things that lie beyond that framework and that therefore
cannot be described in the same language (because the framework implicitly admits
that they are different in nature; i.e., it is a necessarily *dualistic* framework).

The ICE theory passes the metaphysical buck to the notion of justified belief called
upon in C—i.e., materiality has a *causal* role. At this critical point, the user must
effectively "prove" that the artifact can θ, and the ICE theory is left open to Dipert's
charges of vagueness and passing the *conceptual* buck. That is, the theory's success
would depend on a previous agreement on what "belief" and "having" a belief means, as
well as requiring a full theory of belief justification (more specifically, how experience
shapes belief). However, without doubt, the theory (especially as developed in Houkes
and Vermaas 2010) goes a long way in providing conceptual clarification of terms
such as "goals" and the structure of other belief contents relating to technology.

Vermaas (2009) sets out to extend the ICE theory into some firmer metaphysical
ground. The development of his argument is quite complex and makes many valuable
points on the way; however, what interests us mostly is that it leads to an "ontolog-
ical" ICE function theory:

Artifact x has the capacity to θ as a function relative to a use plan p for x, iff:

- x has the capacity to θ when manipulated in the execution of p;
- if this execution of p leads successfully to its goals, this success is due in part to
  x's capacity to θ; and

- the designers *d* who have developed *p* have selected *x* for the capacity to *θ* in *p*, and have communicated *p* to other agents *u* (79).

This modified version[10] is still liable to similar criticisms. Vermaas' extended ICE theory is a theory of *justifiable ascription* in which ontological concerns enter the picture insofar as the real features of artifacts place constraints on belief. This modified version retains the basic normative character of ICE, manifest in its concern with malfunction—which leads Vermaas to make a further distinction between *having* a capacity and *being able to exercise* that capacity (81–82). In the end, Vermaas claims a modest victory: the ICE theory determines technical functions as "epistemically objective and ontologically subjective" (82).

This ontological subjectivity is insufficient if we are to accept artifact dualism seriously as a metaphysic. Why? Because, according to this theory, an ascription will always be a belief. In Vermaas' extended ontological theory, the artifact's capacity is never more than this: a belief. Granted, this belief is ascribed as a result of an interaction with the artifact (a "manipulation" in the "execution" of a plan); but, before this interaction, there necessarily has to be a belief that artifact *x* might have the capacity to *θ*. This is as deep as we go. If we apply Vermaas' and Houkes' classification in (2006), the only "innocent", belief-free stage of our interaction with artifacts occurs in "idiosyncratic using", when the agent accidentally discovers the effect an "item" has. Of course, this effect is only meaningful in the context of the agent's previous beliefs, dispositions, and plans (that is, the capacity offers something useful in terms of some previous intentions). Vermaas and Houkes give the example of a gardener who finds out that spilled coffee grounds prevent cats from digging holes in her garden. The most interesting metaphysical point being made here is that the artifact makes a causal contribution to the success of the plan. Often, these imprecisions in language illegitimately overextend epistemic claims into ontological territory. For instance, Vermaas argues that the designers "have selected *x* for the capacity to *θ* in *p*" when, in fact, the designers have merely selected *x* because they have the *belief* that it can *θ*. Although the theory can vaguely point to material features ("capacities" that remain conceptually external to the framework), the theory itself is never about anything but beliefs.

In Houkes and Vermaas (2010), a more developed version of the ICE theory is presented, in which the process of belief justification is unpacked in more detail. Here, the ICE theory is called a "theory of *justifiable function ascriptions* to artifacts" (84). Different kinds of agents have different bases on which to justify belief. It is not necessary for the agents to have knowledge or true beliefs: it suffices that the belief can be justified on the basis of the use plan. For example, designers need to justify their beliefs on the basis of an account *A*, whereas passive users can do so on the basis of *testimony*. Meanwhile, "amateur" designers might justify beliefs on the basis of evidence and direct experience (similar to the idiosyncratic users in Vermaas and Houkes 2006). Although there are various ways in which beliefs can be justified, the beliefs concerning materiality and the capacities of the artifact fall, roughly, under the category of "physical-support belief", that is, the belief "that the manipulated objects

---

[10] In fact, Vermaas provides a number of extended or modified versions (a unified epistemic theory, a unified ontological theory, etc.) but the form just cited addresses the relevant, salient aspects of Vermaas' views in the context of our argument.

together, in the context of executing the plan, have the capacity to realize the goal state due to their physical and chemical structure (31)". This version of the theory is much clearer in both scope and particulars, but does not modify in any way the general framework of DNP's version of DN.

One of the central achievements of DNP is to show that artifact functions cannot be predicated willy-nilly on the basis of intentions, and that they are highly relational phenomena that depend on both physical and mental aspects; just for this, we can say that DNP have formulated the strongest *epistemological* theory of artifacts in the market. But there is an important metaphysical point lurking around here somewhere, and it remains essentially unintelligible as long as we stay within an intentionalist framework. All we can say is that is has something, somehow, to do with materiality. This materiality continually eludes DNP; it is captured only indirectly and obscurely: as capacities that place boundaries on beliefs, thereby justifying said beliefs in the context of plans. It seems that these beliefs are formed through experience (and, again, that is as deep as DN theory takes us). Functions are ontologically constitutive of artifacts, yet they are not (their "dual nature" presumably is what defines artifacts as ontologically unique). By focusing on function, yet denying any ontologically constitutive role to it, DN theory must take an extra step. For intentionalism, function (*qua* mental content) determines artifactuality *directly*; for DNP, this tie is broken, leaving us with the extra problem of how to link function and artifactuality. An artifact is an artifact only as long as it appears within the horizon of intentionality. Once it enters this horizon, it is brought forth or revealed (to use Heideggerian metaphors) as a capacity—and not even this: as a capacity belief (supposedly) formed through observation and experience.

What *is* an artifact, then? Houkes and Vermaas (2009) claim, quite correctly, that the general framework of ICE can be applied normatively to determine "whether an item is a member of an instrumental kind …" However, "it does not make instrumental kinds essentially artefactual" (409). Since functions are not essential properties, a "metaphysics (*sic.*) of artifacts based on technical functions and use", such as the one proposed by DNP, can do no more than "support some projectability" (409). That is, we can reasonably expect that members of instrumental kind K have a capacity to K. This projectability might work well as a predictive and normative framework for agents making ascriptions but, as Houkes and Vermaas acknowledge, it cannot be the basis for a metaphysic.

Despite these clear statements on the limits of DN theory, there are instances in which epistemological claims are extended into metaphysics through rhetorical and conceptual vagueness. We have already seen two examples of this. Here is another one:

> … it is meaningless to speak about technical function without a context of (human) action. This can be expressed *ontologically* by saying that some context of human action is *constitutive* for a technical function (Kroes 2002, 294–295; emphasis mine).

In what sense is the context of human action *ontologically* constitutive "for" a technical function? For DNP, a function is merely the content of a belief—albeit a belief that is complexly constrained and articulated. It is clear that a plainly epistemological assertion is disguised as a proposition with some ontological import, due to

a confusion (as far as I can make out) between function and capacity. Take the next passage:

> The concept of technical functions…. creates a conceptual bridge between the intentional and structural natures of artifacts; function ascriptions connect the intentional description of the use plan with a physical description of the artifacts themselves via the physical capacities of the artifacts that explain why this plan is effective (Vermaas and Houkes 2006, 16).

It is true that a theory of technical functions could provide a "bridge by which agents can connect the intentional and structural parts of *descriptions of* technical artifacts", yet to claim on this basis that technical functions "form a conceptual bridge between the intentional and structural *natures* of artifacts" (17, emphasis mine) is to overstretch the point. A use plan requires that a capacity be "highlighted" (Houkes and Vermaas 2004:67); but what is highlighted is never the capacity itself but a *belief about* the capacity. That is, the highlighting is itself a mental attitude. At best, we can say that there is a "capacity belief" that "refers to" the physical nature of artifacts (2006:11). When approaching the nub of the question, DN theorists end up reverting to the obscure language of intentionalism. What does "referring to" mean, exactly? What does it mean to say that function ascriptions "connect" intentional and physical descriptions "via" the (allegedly ontologically objective) physical "capacities" of artifacts? As Vermaas has argued, the strongest metaphysical claim that we could advance within this framework is that capacities are ontologically *subjective*. In this context, I have been using the term "constraint" because it best characterizes the fundamental mode in which materiality is conceptualized in DNP: a negative, external force that authorizes (somehow) certain beliefs. Again: is there any way that we can think of this model as *not* dualistic? I argue that, obviously, there is not.

Forays into aspects relating to the design and manufacture of artifacts also reveal an intentionalist bias towards reducing all productive work to the imposition of mental forms. In (2003), Vermaas & Houkes examine a range of etiological theories and evaluate them according to four desiderata that a good theory of function should satisfy:

D1. A good theory of functions should distinguish between proper and accidental functions.
D2. It should let us ascribe "proper functions" to malfunctioning artifacts (both types and tokens).
D3. It should account for the correlation structure–function: "for every function there exist structural conditions sufficient for its performance." The ascription of function should partially justify "the belief that the physical structure of the artifact satisfies such conditions."
D4. It should allow the ascription of functions to novel artifacts (265–266).

The most prominent etiological theories are found deficient, for each of them fails to satisfy at least one of the above desiderata. For instance, intentionalist theories do not meet D2 and D4. This is a restatement of DNP's familiar criticism of intentionalism: "a theory which ascribes functions to an artifact on the basis only of the intentions of the agents that designed it does not meet the *physical structure* desideratum" (286–7). A theory supposedly needs to account for the constraints of materiality. But how do we go about this?

At this key junction in the argument, the external constraints of physical structure are translated into the internal constraints of "technological and scientific knowledge." The action of the designer seemingly consists in the contemplation of alternative "geometrical and physicochemical forms"[11] in search of the one that fulfills the intended function. Although no DNP theorist would deny the importance of material conditions, the focus on mental entities skews the analysis towards an intentionalist bias. At some points, Vermaas and Houkes seem to imply that it is not materiality that introduces conditions on the work of the designers, but *the other way around*. This way, we neglect the (equally or more important) question of how materiality sets the conditions for knowledge:

> Not every geometrical and physicochemical form is suitable, *so technological and scientific knowledge already introduce conditions on the physical structure of the artifact* that is designed to perform the specified function (287, emphasis mine).

This leads us to an improved theory in which function is ascribed on three conditions:

> (1) the designers *intended* to design the artifact to have the function, (2) these designers *determined* the physical structure of that artifact on their basis of their technological and scientific knowledge, and (3) by means of this knowledge they can *provide explanations* as to why the artifact with the thus-determined physical structure can perform the function (287, emphasis mine).

This theory is etiological inasmuch as it "ascribes function on the basis of design history." The physical desideratum is met by demanding that the artifact satisfy "structural conditions" that are not real (substantially intrinsic to the artifact), but those of the surrounding epistemic structures—which come to "determine," precisely, this physical structure.

This tendency to approach materiality in the language of intentional content is also explicit in Houkes et al. (2002). The main purpose of this paper is to elaborate an "action-theoretical" account of artifact design and use. The framework has three main components: *intentions*, *plans*, and *practical reasoning*. According to this scheme, the activity of designers and users are circumscribed by certain standards of rationality, such as coherence between ends and means (304). The capacities of artifacts and components are reduced to beliefs and ascriptions in the context of plans. Engineering practice, in fact, has little of "practice"; seemingly consisting of the designer "determining," intending, checking, deciding, believing, explaining, etc. The "phenomenology of action" has little of phenomenology and even less of action: it is a case of a user ascribing a function to a given artifact. We should question whether this term is a misnomer and if there are any phenomenological aspects being addressed, since this model of technical action uses no action verbs that are not intentionalist.

4 Conclusion: Intentions, Materiality, and How to Combine Them?

Can we fix artifact dualism? And should we? I started the discussion by claiming that a central desideratum of a metaphysic of technology is that it should satisfy the

---

[11] The term is from Rozenburg and Eekels (1995), 53.

materiality condition. This desideratum partly overlaps with the founding intentions behind DN theory. However, I have argued that DN theory (as developed, so far, by DNP) does not adequately incorporate materiality, because material features can only be posited as correlatives of intentional features from within a framework where the latter are given exclusive conceptual privilege. Now, in addition to my brief opening discussion on materiality, I wish to expand on this desideratum, to incorporate aspects of (1) technical action, and (2) the metaphysics of materiality.

(1) The categories of production and mediation have been traditional concerns of the philosophy of technology, and are deeply related to issues such as technical agency, instrumentality, and technical rationality. Hilpinen (2004) states that this dimension of material production is central to the intentionalist view:

> The causal tie between an artifact and its intended character—or, strictly speaking, between an artifact and its author's productive intention—is constituted by an author's actions, that is, by his work on the object (Hilpinen 2004).

It is curious, then, to see little discussion of production and related concerns in the intentionalist literature. A dualistic approach can only tackle this issue in terms of mental causation, a most recalcitrant legacy of Cartesianism. Artifact dualism, then, can develop a theory of production by first posing the question of how mental events relate to matter and agents relate to the world. Intentionalism, so far, sees the causal chain as having one direction: from mind into matter. DNP sticks to this general framework: materiality is met at some point in the development of intentional schemes, but it has a weak role in initiating, shaping, or directing these schemes. The philosophy of action, encompassing the study of technical agency, suggests an alternative but much more arduous route into artifact dualism. How do we relate agents and events in the context of technical action? Is there a distinct metaphysical structure of technical action? What is its temporal, cognitive, cultural, material, and bodily topology? Do design, manufacture, mediation, and use require different models? We could envisage a future form of dualism that acknowledges materiality as the beginning of the causal chain. As Malafouris (2008) argues in his study of the potter's wheel, a "microtemporal" analysis of production reveals significant dimensions that remain below the level of mental representation, and in which matter seems to manifest a form of "agency," inasmuch as its substantial features (such as it microphysical structure) co-direct the process of production. The material and bodily dimensions of technical practice suggest a dynamic model[12] more correlated with process and becoming, rather than with static essences and fixed properties. It is a model in which the properties of matter (as they are manifested in tools, artifacts, and raw materials) co-determine the process of production.

Other recent work on technological production also highlights the role of materiality. In his study of a group of furniture designers, McGrail (2008)

---

[12] Malafouris speaks of a "chrono-architecture" and a "temporal anatomy of action" (32) based on feedback loops that take place at an interface between brain, body and matter. That is, agency and intentionality are a matter of perspective; below a certain spatiotemporal threshold, they cease to have any explanatory basis or power. Thus, we could easily conceive of the clay guiding the movement of the fingers, rather than the other way around.

observes that design is a process that goes "back and forth between concept and material: conceivable objects must be related back to these materials, which may, in the end, preclude their existence" (71). The finished product owes as much to the matter that informed it as to the intention that preceded its design. McGrail wants to rescue the concept of "substance" from purely relational ontologies (such as Actor–Network Theory). Materiality, McGrail argues, has its own specific "modal weight", which he conceives as an "*epiphenomenon of substance*" (80). Inasmuch "as an entity is real—existing in its own right—it will show itself as a feature characteristic of worlds in which certain events occur" (80). In principle, McGrail's analysis could be made compatible with DN theory; yet a significant difference from the DNP version is that it approaches the "duality" from the material side.

This is not a merely academic matter. Recent design practices are seeking to recover, precisely, this engagement with the materiality of techniques and design as the central features of the process of ideation and production. Architect Mark Burry, for example, advocates a philosophy of design that combines hi-tech and traditional methods, in which "each tool and each modus operandi is evaluated independently for merit, and retained or adopted accordingly" (2005, 31). His choice to use 1:1 models in his work on Gaudi's unfinished masterpiece, the Church of La Sagrada Familia, stems from a need to achieve a "connection with scale" and a "confrontation with materiality" (34). In this way, "considering built architecture in its possible fulfillments may work backwards to influence the ideation at a point where the physical manifestation of an idea is still hardly defined" (34). Likewise, Bob Sheil refers to

> the indeterminate nature of working with resistance and adapt to change accordingly … a process where outcomes are expected to evolve throughout the act of making the building rather than performing the process as a contingent event of a preceding design strategy (2005, 7).

Artifacts, then, may develop not from a design in mind but from a substance at hand. In other words, capacities can occasion action schemes, a point that the dualist framework of DNP has some trouble accounting for (although perhaps it would not take much adjustment). According to Arthur's theory of technological design, engineering consists in articulating expressions in the "language" of a domain that already furnishes certain choices of expression in the form of standard solutions, components, and "modules". Technology, according to Arthur, "evolves by combining existing technologies to yield further technologies" (89). In this case, materiality does not refer to the properties of substances, or to material and phenomenological dimensions of ideation, but to the way elements are combined by virtue of their "capacities" to form functional wholes.

(2) As I hope to have shown, DNP neglects the material side of the purported dualism of artifacts. As Mumford argues, DNP's view of physical nature could be "based on a faulty metaphysic" (2006, 78) in which nature is regarded as composed of "building blocks that are essentially causally inert, and which have their actions governed or determined by the laws of nature" (77). This view denies that there are intrinsic connections between the "existences" that make up an artifact; therefore, these connections have to be extrinsic, provided by "laws" that are imposed from

without (i.e., by human intentions).[13] Artifact dualism would require to be complemented by a metaphysic of substance that encompasses the aspects previously outlined in (1), as well as a theory of systemic functions; that is, of functions as intrinsic and real features of artifacts.[14] It would be an interesting intellectual exercise to develop a theory of artifact dualism that departs from the material, rather than the intentional, side.

Or perhaps what we need is a pluralist ontology, as Carrara and Vermaas (2009) suggest. What they suggest in this paper is an ontology with three identity criteria: functions, operational principles, and normal configurations (131). An appealing aspect of this argument is that it focuses on objective, non-intentional features of artifacts, such as their principles of activity and patterns of historical change. Although this pluralist proposal remains metaphysically uncommitted, seeking to address principles for determining identity criteria, it takes a realist approach to material and historical aspects of technology (operational principles and normal configurations, respectively.) Carrara and Vermaas argue that an identity criterion seeks to answer the question "what it is" by articulating sufficient and necessary conditions for a to be a K (127). Thus, it "expresses an essential property of the entities for which the criterion is given" (128). Carrara and Vermaas argue that identity criteria should be complex, consisting of "*conjunctions* of artifact functions and other features of artifacts" (131). The main problem with this proposal is that it is too broad; also, any pluralist ontology will find cases in which the criteria enter into conflict. For example, E. J. Marey's chronophotographic camera (an ancestor of the cinematographic camera) and a machine gun have different functions, yet they are historically related and share some principles of activity. This problem becomes more insurmountable as the technology in question grows in complexity and number of parts, and their principles of activity and historical configurations begin to diverge.

Although this proposal by Carrara and Vermaas raises, rather than answers, some problematic issues in the ontology of artifacts, its main virtue is that it "opens up" artifacts to ontological views that admit them as rich and textured composites of material and historical relations. In particular, it suggests that identity criteria may be grounded in principles of activity, "law-like norms of starting to exist, existing, and

---

[13] Mumford argues for an alternative, internalist metaphysic. This theory would be realist about causal powers and capacities, and would assume "necessary connections between distinct existences but which were internal to the distinct existences" (77). It follows that the distinction between a structure (with no intrinsic necessary connection to other things) and function would be "chimerical." Mumford writes: "A structure can be understood as a structure of functions, therefore—a structure of essentially functional elements—hence not as something that contrasts metaphysically with function. …. There is not necessarily a dual nature to be found here but only things of the same nature standing in different relations of realization" (78). This argument is presented as part of a larger argument, which claims that we need to understand capacities in terms of functions, since the last term is a "more wide-ranging" concept than disposition or capacity. However, Mumford's argument reveals a tacit bias in the underlying metaphysics of artifact dualism.

[14] Wouters defends such a systemic approach. Function is a relational type of explanation: a thing performs a function *in function* of what it does in the context of a specific organized assemblage. This view is aligned with what Wouters calls "organizational teleology." According to this understanding, "function talk derives its content from the way in which organisms are organized. Function talk is useful to explain the manner of organization, but it is not implied that the organization or its elements were brought about in order to perform that function" (129). And: "According to the systemic approach the function of an item is the role of that item in bringing about an activity or capacity of a complex system of which that item is a part" (135).

ceasing to exist by reference to which questions of identity and persistence can be arbitrated" (Wiggins, quoted in 128). Now, we could argue that these principles of activity should not be circumscribed to individual artifacts, and should apply to developmental patterns in the history of such artifacts. As Arthur (2009) shows, the history of technology displays a characteristic 'logic' that suggests law-like norms of development; Arthur argues that the unit of study should be "technologies" that come to be assembled into cross-pollinating lineages of artifacts through a logic of modularity, recursivity, and combination.[15] In his study of the evolution of nineteenth century French horns, Niles Eldredge (the architect, with Stephen Jay Gould, of the theory of punctuated equilibrium) also arrives to complementary results. Eldredge identifies *horizontal transmission* as the key mechanism that differentiates technical from biological evolution: the ability of a lineage of artifacts to co-opt components or modules from parallel lineages:

> The key difference is that biological systems predominantly have "vertical" transmission of genetically ensconced information (meaning parents to offspring). To be sure, there are some groups where hybridization (lateral blending of two species) occurs; remotely related bacteria are also famous for being able to exchange genetic information. But the neatness of evolutionary trees in general in biological systems stems from the compartmentalization of information within historical lineages. Not so in material cultural systems, where horizontal transfer is rife—and arguably the more important dynamic. Makers copy each other, and patents afford only fleeting protection. Thus, instead of neatly bifurcating trees, you would predict to find what is best described as "networks"—consisting of an historical signal of what came before what, obscured often to the point of undetectability by this lateral transfer of subsequent ideas (in Barnet and Eldredge 2004).

All this fits snugly with Carrara and Vermaas' definition of an "activity" as "a chain of internal and/or external causal interactions, a process determining the persistence of the object" (129). From this perspective, human intentionality ceases to be so central and decisive, to become one factor among many. The focus is on a larger process that has its own norms and principles, and which is primarily and decisively shaped by the internal necessities of artifacts as material entities. This approach suggests Simondon's philosophy of technology (see 1980, 2008). Simondon's theory proposes that the unit of study should be the "technical object," understood not an individual artifact but as a lineage:

> The petrol engine is not any particular, given engine in time and space; it is the fact that there is a sequence, a continuity, which extends from the first engines to those which we know and to those still in evolution. As a consequence, just as in the case of phylogenetic sequences, any particular stage of evolution

---

[15] Arthur argues that "technology is self-creating" and can be compared to "a living webwork that weaves itself out of itself" (2009, 189): "This account of self-creation of technology should give us a different feeling about technology. We begin to get a feeling of ancestry, of a vast body of things that give rise to things … In its collective sense, technology is not merely a catalog of individual parts. It is a metabolic chemistry, an almost limitless collective of entities that interact to produce new entities—and further needs" (188–9).

contains within itself dynamic structures and systems which are at the basis of any evolution of forms (1980, 19).

This calls for a shift to the ontology of systems rather than things. One important benefit of such an approach is that the scope widens to include any technological assemblage, a category that subsumes artifacts, symbolic technologies, instruments, and extended sociotechnical systems. This is an improvement, inasmuch as the narrow category of "artifact" is a rather restrictive foundation on which to build a more comprehensive philosophy of technology.[16] On the other hand, a fundamental requirement of such a theory is that it must offer a convincing definition of "system" as a bound unit; that is, it must determine the conditions of *ontological closure* for artifacts, extended sociotechnical systems and any technological "unit".

This systemic approach does not necessarily have to do away with human intentionality; rather, it suggests that the human element must be conceived in terms that are similar to and compatible with those we use to speak of artifacts. For instance, Scheele (2006) argues that functions are subject to human norms that are social in character. This means that the social context of use determines proper functions, as a stable pattern of action that is socially enforced (71). It is not far-fetched to regard these norms as, themselves, artifacts. Then, functional variations and the structural development of artifacts could be studied in reference to norms that are also shifting in relation to materiality. As Krohs and Kroes (2009) claim, human action has to be considered in a larger context in which functions "are relational with respect to the system in which they are used, for example, to a functionally organized sociotechnical system" (8). Functions and norms, then, can be regarded as cultural artifacts in the context of a system that places intentional aspects in the same ontological footing as material and historical aspects. Longy (2006) suggests that this cultural context is "as objective as a natural one. … This is something that can be studied by empirical means, the ones history and sociology currently draw on with no need for introspection" (84).

However, non-intentionalist theories still have some work to do. For a start, how does the concept of materiality and material agency map out onto the concept or artifact, or even technology? Are material agency theories also "passing the buck" to certain models of cognition, such as extended mind theory and phenomenology?

And how are these organizational "styles" and characteristic historical modes of development a feature of "materiality"? Are these features epiphenomenal manifestations of matter? Are we talking about one thing or many? These are some of the questions that a focus on materiality invites us to investigate. In any case, artifact dualism can open up a space of debate for these issues, leading, hopefully, to some progress in the metaphysics of technology. As I have suggested, a possible way to reengineer dualism would be to begin from the material side of artifactuality. Or perhaps dualism should be rejected altogether in favor of a materialistic "monism" based on the theory of developmental systems. Or perhaps we need a pluralist scheme that accounts for the heterogeneous aspects of technology (that startlingly difficult philosophical problem) without any hope of a unified theory.

---

[16] A further, general criticism that we might aim at the analytic tradition is that the term "artifact" cannot provide a general philosophy of technology that would account for phenomena such as techniques of the body (Mauss 1973), technologies of the self (Foucault 1988), and nature–culture hybrids.

References

Arthur, B. (1989). Competing technologies, increasing returns, and lock-in by historical events. *The Economic Journal, 99*, 116–131.

Arthur, B. (2009). *The nature of technology: What it is and how it evolves*. Washington: The Free Press.

Baker, L. R. (1999). Unity without identity: a new look at material constitution. *Midwest Studies in Philosophy, 23*, 144–165.

Baker, L. R. (2004). The ontology of artifacts. *Philosophical Explorations, 7*(2), 99–111.

Baker, L. R. (2006). On the twofold nature of artifacts. *Studies in History and Philosophy of Science, 37*, 132–136.

Barnet, B. & Eldredge, N. (2004). Material cultural evolution: An interview with Niles Eldredge. *Fibreculture* 3. http://three.fibreculturejournal.org/fcj-017-material-cultural-evolution-an-interview-with-niles-eldredge/ Accessed on 11th November 2007.

Burry, M. (2005). Homo faber. *Architectural Design, 75*(4), 30–37.

Carrara, M., & Vermaas, P. (2009). The fine-grained metaphysics of artifactual and biological functional kinds. *Synthese, 169*, 125–143.

David, P. (1985). Clio and the economics of QWERTY. *American Economic Review, 75*, 332–337.

De Vries, M. J. (2005). Duality or dualism? A reply to Johan Stellingwerff. *Philosophia Reformata, 70*, 64–69.

DeRidder, J. (2006). The (alleged) inherent normativity of technological explanations. *Techné, 10*(1), 97–116.

Dipert, R. (1993). *Artifacts, art works, and agency*. Philadelphia: Temple University Press.

Dipert, R. (1995). Some issues in the theory of artifacts: defining 'artifact' and related notions. *The Monist, 78*(2), 119–136.

Elder, C. (2007). On the place of artifacts in ontology. In E. Margolis & S. Laurence (Eds.), *Creations of the mind: Essays on artifacts and their representation* (pp. 33–51). Oxford: Oxford University Press.

Foucault, M. (1988). Technologies of the self. In L. H. Martin, H. Gutman, & P. H. Hutton (Eds.), *Technologies of the self: A seminar with Michel Foucault* (pp. 16–49). Amherst: University of Massachusetts Press.

Franssen, M., Kroes, P. & Vermaas, P. E. (Eds.) (Forthcoming). *The metaphysics of technical artifacts*. Synthese Library Volume.

Hilpinen, R. (1993). Authors and artifacts. *Proceedings of the Aristotelian Society, New Series, 93*, 155–178.

Hilpinen, R. (2004). Artifact. *Stanford Encyclopedia of Philosophy*. http://plato.stanford.edu/entries/artifact/ Accessed July 23rd, 2009.

Houkes, W. (2006). Knowledge of artifact functions. *Studies in History and Philosophy of Science, 37*, 102–113.

Houkes, W., & Meijers, A. (2006). The ontology of artifacts: the hard problem. *Studies in History and Philosophy of Science, 37*, 118–131.

Houkes, W., & Vermaas, P. (2004). Actions versus functions: a plea for an alternative metaphysics of artifacts. *The Monist, 87*(1), 52–71.

Houkes, W., & Vermaas, P. (2009). Contemporary engineering and the metaphysics of artefacts: beyond the artisan model. *The Monist, 92*(3), 403–419.

Houkes, W., & Vermaas, P. (2010). *Technical functions: On the use and design of artifacts*. New York: Springer.

Houkes, W., Vermaas, P. E., Dorso, K., & de Vries, M. J. (2002). Design and use as plans: an action-theoretical account. *Design Studies, 23*, 303–320.

Illies, C., & Meijers, A. (2009). Artefacts without agency. *The Monist, 92*(3), 420–440.

Kirchoff, M. D. (2009). Material agency: a theoretical framework for ascribing agency to material culture. *Techné, 13*(3).

Knappett, C., & Malafouris, L. (2008). "Material and nonhuman agency: an introduction.". In C. Knappett & L. Malafouris (Eds.), *Material agency: Towards a non-anthropocentric perspective* (pp. ix–xix). New York: Springer.

Kroes, P. (2002). Design methodology and the nature of technical artifacts. *Design Studies, 23*, 287–302.

Kroes, P. (2006). Coherence of structural and functional descriptions of technical artifacts. *Studies in History and Philosophy of Science, 37*, 137–151.

Kroes, P., & Meijers, A. (2002). Reply to critics. *Techné, 6*(2).

Kroes, P., & Meijers, A. (2006). Introduction: the dual nature of technical artifacts. *Studies in History and Philosophy of Science, 37*, 1–4.

Krohs, U. (2009). Structure and coherence of two-model descriptions of technical artifacts. *Techné, 13*(2), 150–161.

Krohs, U., & Kroes, P. (2009). Philosophical perspectives on organismic and artifactual functions. In U. Krohs & P. Kroes (Eds.), *Functions in biological and artificial worlds: Comparative philosophical perspectives* (pp. 3–12). Cambridge and London: MIT Press.

Latour, B. (1999). *Pandora's hope: Essays on the reality of Science Studies*. Cambridge: Harvard University Press.

Longy, F. (2006). Function and probability: the making of artifacts. *Techné, 10*(1), 81–96.

Malafouris, L. (2008). At the potter's wheel: an argument *for* material agency. In C. Knappett & L. Malafouris (Eds.), *Material agency: Towards a non-anthropocentric perspective* (pp. 19–36). New York: Springer.

Mauss, M. (1973). Techniques of the body. *Economy and Society, 2*(1), 70–88.

McGrail, R. (2008). Working with substance: actor-network theory and the modal weight of the material. *Techné, 12*(1), 65–84.

Mitcham, C. (2002). Do artifacts have dual natures? Two points of commentary on the Delft Project. *Techné, 6*(2).

Mumford, S. (2006). Function, structure, capacity. *Studies in History and Philosophy of Science, 37*, 76–80.

Pickering, A. (1995). *The mangle of practice: Time, agency and science.* University of Chicago Press.

Rozenburg, N., & Eekels, J. (1995). *Product design: Fundamentals and methods*. Chichester: Wiley.

Scheele, M. (2006). Social norms in artifact use: Proper function and action theory. *Techné, 10*(1), 65–80.

Searle, J. (1995). *The construction of social reality*. New York: The Free Press.

Sheil, B. (2005). Design through making: An introduction. *Architectural Design, 75*(4), 5–12.

Simondon, G. (1980). *The mode of existence of technical objects. [Electronic Version]*. London: University of Western Ontario.

Simondon, G. (2008). *El modo de existencia de los objetos técnicos*. Buenos Aires: Prometeo.

Smith, B. (2007). Ontología. In G. Hurtado & O. Nudler (Eds.), *El mobiliario del mundo: Ensayos de ontología y metafísica* (pp. 47–73). Mexico: Universidad Autónoma de Mexico.

Sperber, D. (2007). Seedless grapes: nature and culture. In E. Margolis & S. Laurence (Eds.), *Creations of the mind: Essays on artifacts and their representation* (pp. 124–137). Oxford: Oxford University Press.

Tenner, E. (1996). *Why things bite back: Technology and the revenge of unintended consequences*. New York: Alfred A. Knopf.

Thomasson, A. (2003). Realism and human kinds. *Philosophy and Phenomenological Research, 67*(3), 580–609.

Thomasson, A. (2007). Artifacts and human concepts. In E. Margolis & S. Laurence (Eds.), *Creations of the mind: Essays on artifacts and their representation* (pp. 52–73). Oxford: Oxford University Press.

Vaesen, K. (2006). How norms in technology ought to be interpreted. *Techné, 10*(1), 117–133.

Vermaas, P. (2006). The physical connection: engineering function ascription to technical artifacts and their components. *Studies in History and Philosophy of Science, 37*, 62–76.

Vermaas, P. (2009). On unification: taking technical functions as objective (and biological functions as subjective). In U. Krohs & P. Kroes (Eds.), *Functions in biological and artificial worlds: Comparative philosophical perspectives* (pp. 69–87). Cambridge: MIT Press.

Vermaas, P., & Houkes, W. (2003). Ascribing functions to technical artifacts: a challenge to etiological accounts of functions. *The British Journal for the Philosophy of Science, 54*, 261–289.

Vermaas, P., & Houkes, W. (2006). Technical functions: a drawbridge between the intentional and structural natures of technical artefacts. *Studies in History and Philosophy of Science, 37*, 5–18.

Wouters, A. (2005). The function debate in philosophy. *Acta Biotheoretica, 53*, 123–151.