Extracting Ontological Commitments from Experimental Practice

Extraire nos engagements ontologiques de la pratique expérimentale

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ABSTRACT. – *In opposition to traditional approaches in metaphysics of science, Entity Realism proposes to extract ontological commitments from experimental practice instead of abstract theories, using an inference from manipulability to existence that would be continuous with everyday inferences regarding ordinary objects. A problem is that most accounts of ordinary artefacts make them mind-dependent or language-dependent, and so not real by philosophical standards. Furthermore, the functional kinds of biology and chemistry are not necessarily compatible with mind-independence either. It follows that Entity Realism is better understood within a pragmatist or deflationary alternative to standard metaphysics. The approach is beneficial for responding to sceptical arguments.*

KEYWORDS. – *Entity Realism; Experimentation; Artefacts; Functional Kinds; Pragmatism*

RÉSUMÉ. – *Contre les approches traditionnelles en métaphysique des sciences, le réalisme des entités propose d'extraire nos engagements ontologiques non pas des théories abstraites, mais plutôt de la pratique expérimentale, en inférant l'existence des entités à partir de leur manipulabilité d'une manière qui se veut être en continuité avec les inférences quotidiennes portant sur les objets ordinaires. Un problème est que la plupart des conceptions des artefacts ordinaires considèrent que ces derniers dépendent de nos représentations mentales ou linguistiques, et donc qu'ils ne sont pas réels au sens du philosophe. De plus, les catégories fonctionnelles de la biologie ou de la chimie ne sont pas non plus forcément compatibles avec cette "indépendance de l'esprit". Il s'ensuit que le réalisme des entités est*

mieux compris comme s'inscrivant dans une approche pragmatiste ou déflationniste distincte de la métaphysique standard. Cette approche a l'avantage de lui permettre de répondre à divers arguments sceptiques.

MOTS CLÉS. – *Réalisme des entités ; Expérimentation ; Artefacts ; Classes fonctionnelles ; Pragmatisme*

The metaphysics of science is often based on a conceptual analysis of the content of abstract scientific theories, assuming their truth, without much consideration for experimental practice. An exception to this approach is offered by Nancy Cartwright[1] and Ian Hacking[2]. They both argue that experimental practice provides us with a distinctive mode of justification for ontological commitments towards postulated entities, and that this does not require believing that abstract theories are true: a position known as Entity Realism. They claim, more precisely, that we can infer the existence of the entities, such as electrons or proteins, with which experimenters interact reliably in laboratories. The aim of this paper is to assess how far this kind of practice-oriented metaphysics can lead us. I will argue that the position is not as incoherent as has often been claimed, but that because of the way it is justified, and in particular, because of its overt continuity with everyday inferences regarding ordinary artefacts, Entity Realism is only viable within a pragmatic alternative to traditional metaphysics that deflates our notions of reality and existence. However, this deflationary attitude has the potential to bring more continuity between the scientific and the manifest image of the world.

WHAT IS ENTITY REALISM?

Nancy Cartwright and Ian Hacking independently defended Entity Realism, the view that we should believe in the existence of the unobservable entities with which scientists interact reliably in laboratories, such as electrons and proteins, but that we have no reason to believe that scientific theories are true. They thus stand in opposition to standard scientific realism, according to which the success of science warrants belief in the full content of our best scientific theories, including theoretical laws and the existence of entities that are not manipulated, but merely postulated for explanatory purposes.

This thesis presupposes that we can refer to unobservable entities independently of our theoretical descriptions of them. This can be secured by a causal theory of reference, such as that advocated by Hilary Putnam[3], mentioned by Hacking: theoretical terms would refer to the unobservable entities, whatever they are, that cause the various effects that scientists produce and stabilise in their laboratories by successfully manipulating these entities. Of course, manipulative (and referential) success requires some minimal descriptions and knowledge of the entities that are manipulated, but according to the entity realist, only low-level knowledge of the causal powers of these entities is required ("a modest number of home truths" for Hacking, "causal stories" and phenomenological

[1]N. CARTWRIGHT, *How the Laws of Physics Lie*, New York, Oxford University Press, 1983, chapters 4 and 5.

[2]I. HACKING, "Experimentation and Scientific Realism", *Philosophical Topics*, 1982, 13 (1), p. 71–87.

[3]H. PUTNAM, "Explanation and Reference", in *Conceptual Change*, ed. G. Pearce, P. Maynard, Dordrecht, Springer, 1975, p. 199–221.

laws for Cartwright), and such knowledge is relatively autonomous from full-fledged theories. It can be justified independently: in particular, we do not need to resort to the so-called theoretical virtues (simplicity, unification, explanatory depth, etc.) that are typically invoked by standard scientific realists. This is why Entity Realism would be relatively immune to the sceptical arguments that affect standard scientific realism, notably scepticism towards the idea that theoretical virtues such as simplicity or unification would be indicative of truth. However, Cartwright and Hacking's respective accounts of justification from practice differ slightly.

Ian Hacking's account is suggestive, but not very clear. He contrasts inferences to the best theoretical explanation, which are "necessarily inconclusive"[4] given the plurality of potential explanations, and a more immediate assessment or assumption of existence from experimenters, claiming that "their enterprise would be incoherent without it"[5]. When it comes to justifying the latter, he seems to invoke some sort of indispensability or transcendental argument[6], insisting in particular on the idea of using entities as tools, and not as mere objects of our inquiry: "The argument […] is not that we infer the reality of electrons from our success. […] We must be convinced of the reality of electrons in order to use them to investigate other parts of nature."[7] Corroboration by means of "a great array of interactions and interferences"[8] is also briefly mentioned.

Nancy Cartwright's account rests on a more standard inferential strategy, based on a version of inference to the best explanation that she calls inference to the most probable cause, and that she contrasts with inference to the best *theoretical* explanation, taken to be the cornerstone of standard scientific realism. She argues that experimental controls and interventions combined with statistical inferences are often sufficient to identify the actual cause of an effect inductively and, importantly, that a causal explanation is always unique.

Such "causal stories", associated with phenomenological laws, can be embedded in theoretical explanations that account for them by means of further postulates: they are derived from fundamental laws and from a theoretical description of the situation involved (what we could call a reductive or constitutive explanation[9]). However, she argues on the basis of case studies that contrarily to causal explanations, theoretical explanations are not unique: "'Competing' theoretical treatments […] are encouraged in physics, but only a single causal story is allowed."[10]

This "redundancy" of theoretical explanations implies that they are underdetermined by experience in a way that causal explanations are not. According to Cartwright, abstract theories do not really aim at truth anyway: whereas causal explanations directly describe what happens in the laboratory, the function of theories is rather to organise our knowledge.

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[4]I. HACKING, "Experimentation and Scientific Realism", p. 71.

[5]*Ibid*., p. 72.

[6]See B. MILLER, "What Is Hacking's Argument for Entity Realism?", *Synthese*, 2016, 193 (3), p. 991–1006 for various interpretive options.

[7]*Ibid*., p. 77.

[8]*Ibid*., p. 76.

[9]W. SALMON, *Scientific Explanation and the Causal Structure of the World*, Princeton, Princeton University Press, 1984.

[10]N. CARTWRIGHT, *How the Laws of Physics Lie*, p. 85–86.

> Explanations (at least the high level explanations of theoretical science […]) organize, briefly and efficiently, the unwieldy, and perhaps unlearnable, mass of highly detailed knowledge that we have of the phenomena. But organizing power has nothing to do with truth.[11]

This form of instrumentalism contrasts sharply with scientific realists and metaphysicians arguing that theoretical virtues such as simplicity and unification are truth conducive: Nancy Cartwright sides with empiricists such as Bas van Fraassen[12] in assuming that such virtues are merely pragmatic. She goes as far as claiming that organizing power is achieved at the cost of veracity. Theoretical laws are idealised ceteris paribus laws that only apply to imaginary systems, and so, they are not strictly true of anything real. They can be combined with other laws in order to build models of the phenomena, from which "causal stories" and phenomenological laws are eventually extracted, sometimes with the help of empirical data. These low-level descriptions, close to experience, more accurately describe reality, in particular stable experimental effects. But arriving at them is far from an algorithmic process, particularly when unknown factors are involved. These low-level descriptions survive theory changes, even if they are explained differently in light of different theories. This implies that our commitments to the entities that figure in them can survive theory changes as well: "[T]heoretical entities that have been warranted by well-tested causal claims like that are seldom discarded in the progress of science."[13]

As we can see, this defence of Entity Realism puts much emphasis on the autonomy of models and of model application from the theoretical frameworks that are used in their elaboration. This particular theme has been largely developed since then by philosophers inspired by Cartwright's work, following what has been dubbed the practice turn in philosophy of science. It has now become commonplace that models typically incorporate ad-hoc hypotheses, domain-specific knowledge and various distortions of theoretical laws in order to be applicable[14]. Their constructions and use rest on practical abilities acquired by trial and error or by training that are not entirely encoded at the theoretical level[15]. This autonomy from theories also concerns the experimental techniques and methodologies that operationalise theoretical models, as emphasised by Hacking, and more recently by Hasok Chang[16].

In light of this, we could view Entity Realism as an attempt to turn the usual Quinean indispensability thesis and no-miracle arguments on their head: abstract theoretical frameworks are not actually indispensable in science, nor to be credited for empirical successes, because they are replaceable. Low-level descriptions and experimental abilities, on the other hand, are indispensable, and more directly responsible for the successes of science, so, this is where our metaphysical commitments should lie.

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[11] *Ibid*., p. 87.

[12] B. VAN FRAASSEN, *The Scientific Image*, New York, Oxford University Press, 1980.

[13] N. CARTWRIGHT, *How the Laws of Physics Lie*, p. 98.

[14] M. MORGAN, M. MORRISON, eds., *Models as Mediators: Perspectives on Natural and Social Science*, Cambridge, Cambridge University Press, 1999.

[15] Something already noted in T. KUHN, *The Structure of Scientific Revolutions*, Chicago, University of Chicago Press, 1962, chapter 5.

[16] H. CHANG, *Inventing Temperature: Measurement and Scientific Progress*, New York, Oxford University Press, 2004.

Here is a reconstruction of Entity Realism along these lines[17]:

- The scientific models that are in direct contact with experimentation entail counterfactual dependencies between some entities and their properties. These dependencies can be exploited in order to produce and observe predictable effects during controlled experiments.
- When experimentation is reliable and robust, this gives us reasons to believe that the counterfactual dependencies that were exploited correspond to an actual causal structure of real entities: we can assume that these entities *exist*.
- However, empirical success is insufficient to infer that the content of abstract models and theories correspond to reality, since theoretical laws must be distorted and combined with contextual and informal ingredients in order to be applied. At best, it shows that they are reliable guides in more or less broad ranges of applications (which could induce a form of acceptance, as described by van Fraassen[18]).

This reconstruction could be made more precise with regard to the kind of experimental success that proves decisive. Nancy Cartwright and Ian Hacking both allude to corroboration from various experiments involving the same kind of entities. It is also plausible that being able to manipulate the presence or absence of the entity is important, beyond merely identifying its functional properties[19]. On the other hand, we might also want to incorporate black holes and gravitational lenses in our commitments, even though they are not manipulable[20]. But however this is fleshed out, the upshot is that we should associate our ontological commitments with the effective contributions of well-confirmed applied models instead of abstract theories.

What is interesting about this approach is that metaphysical posits are not rejected outright, as with some versions of empiricism, but it is requested that they be firmly grounded in concrete experience rather than on some alleged theoretical virtues. Instead of pursuing a hidden unity in nature, we should only assume the minimum that is needed to make sense of our experience in its diversity. This provides a distinctive methodology for the metaphysics of science, one that is a priori more open to pluralism. My aim here is to evaluate the prospects of this methodology through an examination of Entity Realism, and to see how much it departs from traditional approaches.

A DILEMMA FOR ENTITY REALISM

Entity Realism, in particular Hacking's version, has been subjected to many criticisms and it seems to have attracted few defenders[21]. A recurrent criticism is that the experiments

[17]It is also inspired by more recent work on mechanistic models and explanations, notably J. WOODWARD, *Making Things Happen: A Theory of Causal Explanation*, New York, Oxford University Press, 2004.

[18]B. VAN FRAASSEN, *The Scientific Image*, p. 88.

[19]For a detailed analysis of the historical case of G-protein coupled receptors that, I think, supports this idea, see A.-S. BARWICH, K. BSCHIR, "The Manipulability of What? The History of G-Protein Coupled Receptors", *Biology & Philosophy*, 2017, 32 (6), p. 1317–39.

[20]D. SHAPERE, "Discussion: Astronomy and Antirealism", *Philosophy of Science*, 1993, 60 (1), p. 134–50.

[21]Notable exceptions are S. CLARKE, "Defensible Territory for Entity Realism", *The British Journal for the Philosophy of Science*, 2001, 52 (4), p. 701–22 and M. SUÁREZ, 2010, "Experimental Realism Defended: How Inference to the Most Likely Cause Might Be Sound", in *Nancy Cartwright's*

performed in contemporary science, for example in particle colliders, are so finely tuned that they would be impossible without massively using theories[22]. According to these critics, this would make the position incoherent, because a commitment towards theoretical truth would be required in order to interact with entities, or to even know what we are interacting with. However, Entity Realism does not deny that theories are massively involved in experimentation. It only rejects the implication that we should take these theories to be literal descriptions of reality with universal scope, instead of useful guides to be applied more locally. After all, the scope of theoretical achievements is very often revealed to be restricted in light of new developments (far from heavy objects and high velocities for classical mechanics), and the fact that theories often change while being about the same unobservable entities shows that the way scientists refer to these entities is at least partly autonomous from theories, presumably because of a referential continuity rooted in experimental practice that is preserved in theory change.

Another line of criticism is more acute. Axel Gelfert[23] argues that manipulative success is not enough to infer existence, because we can successfully manipulate illusory entities. This is the case in particular of quasi-particles, such as phonons and magnons. Quasi-particles are collective effects of the configurations of materials that reproduce the characteristics of actual particles, to the point that they can be causally manipulated just like actual particles. From a theoretical point of view, some of them are akin to "holes" in a sea of electrons, others akin to quantised waves of perturbations that propagate without the substrate actually moving (magnons in particular are waves of perturbations of spin, and phonons are waves of mechanical perturbations). These perturbations can be induced in the material and detected by means of instruments just like normal particles. But, Gelfert argues, they cannot be considered real, not even by the standards of entity realists (putting aside our theoretical commitments, that is):

> [E]ven on the non-theoretical body of home truths that the entity realist is forced to admit, we know that solids consist of crystals formed by atoms and of electrons travelling through the crystal, rather than of a plethora of emergent quasi-particles.[24]

Do we? It is not very clear why we cannot at the same time assume that electrons and quasi-particles exist, even if the existence of the latter is somehow parasitic on that of the former. Taking the version of Entity Realism outlined in the previous section, there does not seem to be any particular reason why the counterfactual dependencies associated with these entities would be incompatible with each other. The tension likely stems from other metaphysical principles, presumably because quasi-particles owe their dynamical properties to the full system within which they emerge rather than to their internal constitution (Axel Gelfert briefly discusses the metaphysics of holes and absences). There might also be a tension between Entity Realism and experimentalists' overt commitments

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Philosophy of Science, ed. L. Bovens, C. Hoefer, S. Hartmann, New York, Routledge, 2010, p. 137–163.

[22] M. MORRISON, "Theory, Intervention and Realism", *Synthese*, 1990, 82 (1), p. 1–22, D. RESNIK, "Hacking's Experimental Realism", *Canadian Journal of Philosophy*, 1994, 24 (3), p. 395–411.

[23] A. GELFERT, "Manipulative Success and the Unreal", *International Studies in the Philosophy of Science*, 2003, 17 (3), p. 245–63.

[24] *Ibid*, p. 259.

in this specific case[25], and thus Entity Realism would fail to take scientific discourse at face value. However, this would deserve to be demonstrated more precisely: the name "quasi-particles" suggests that for physicists, they are not really *particles*, but not that they do not exist qua *entities*.

In any case, entity realists should not feel obliged to deny that quasi-particles exist, but they can acknowledge that this potentially pushes them towards revisionary positions, at least with regard to traditional metaphysics. This poses a dilemma for them. Shall they remain conservative, and specify their inference from manipulability to existence so as to exclude quasi-particles from their ontology? Or shall they "bite the bullet" and argue that a plethora of quasi-particles actually exist?

Let us take inspiration from Mauricio Suárez[26] in order to illustrate the first strategy. According to Suárez, Cartwright's inference to the most probable cause is a reliable, yet defeasible inference. Furthermore, its only defeaters are other inferences of the same kind, not inferences to the best theoretical explanation. An example of reference failure provided by Suárez is phlogiston: although Priestley was warranted in believing that phlogiston existed on the basis of successful manipulation, we now have collected much stronger evidence in favour of oxygen, and so, according to Suárez, causal warrant for the existence of phlogiston has been overturned by causal warrant for oxygen. This provides us with a potential way to handle the case of quasi-particles: perhaps this is a case where the inference is defeated by other inferences of the same kind. If really, as Gelfert claims, quasi-particles can be shown not to exist by the standards of Entity Realism, then perhaps this is because several applications of the manipulability to existence inference lead to conflicting results, but for some reason, some of these applications (the ones that concern atoms and electrons) have more strength. So long as cases like these are localised rather than ubiquitous, we can remain confident that our inference is generally reliable.

The question, in order to evaluate this strategy, is whether cases like these are really localised. In this respect, it is instructive to note that Hacking (as well as Suárez) pretends that there is continuity between the inference involved in Entity Realism in the case of science and our ordinary commitments: "[W]hy else are we (non-sceptics) sure of the reality of even macroscopic objects, but because of what we do with them, what we do to them and what they do to us?" (Hacking, "Experimentation and Scientific Realism", p. 76.)

I believe that this continuity with common sense is an important motivation for Entity Realism, or for any practice-oriented metaphysics. If so much emphasis is put on concrete experimental practice, this is probably because in a sense, it is where science truly connects with ordinary experience. This would put the position on firm footing: few people (except in metaphysics, we will come back to this) deny that macroscopic objects such as tables and chairs exist. Intuitively, we could think that the existence of unobservable theoretical postulates is less certain, because these postulates are used to explain the phenomena that we access more directly, and if scientific knowledge sometimes implies that part of our ordinary experience is illusory, this must be in order to

[25]This was suggested in M. MORRISON, "Theory, Intervention and Realism" in the case of quarks, although one could doubt that quarks were ever manipulated.

[26]M. SUÁREZ, 2010, "Experimental Realism Defended: How Inference to the Most Likely Cause Might Be Sound".

make sense of other parts of our experience. In other words, the illusions that science reveals cannot be massive, otherwise the empirical basis of scientific knowledge itself would become undermined, and the reasons to doubt ordinary commitments to start with would become moot: if microscopes and particle colliders do not really exist, then why trust physics at all? Or so one might think…

However, this stance, which consists in giving more credit to common-sense than to abstract theories, does not necessarily fit very well with contemporary (post-Quinean) metaphysics. From the point of view of the latter, there are many reasons to doubt that ordinary macroscopic objects *really* exist. Among them are various paradoxes of identity and constitution, such as the Ship of Theseus paradox, sorites paradoxes, problems of vagueness, problems of arbitrariness and causal exclusion arguments[27]. To give one example, there does not seem to be a fact of the matter regarding which exact collection of atoms essentially constitute a given table: removing one atom would not affect its identity. Furthermore, if we removed all atoms one by one, at some point we should say that the table is no more present, but any specific threshold in this matter would be arbitrary. So, it does not seem possible to identify the table with a specific material constitution. According to many metaphysicians, all this indicates that there are no tables, there are only "atoms organised table-wise", and so on for other ordinary kinds of objects. In sum, ordinary objects are pretty much all like quasi-particles rather than like electrons (particularly ocean waves, or holes in walls, which I take to be part of ordinary ontology). And yet they are manipulable, and we can have good knowledge of their causal powers, which, according to the kind of inference put forth by entity realists, gives us good reason to believe that they exist.

If ordinary objects do not "really" exist by philosophical standards, then it becomes difficult to quarantine problematic cases of the inference from manipulability to existence as mere local failures. It looks like the error is pretty massive after all, which casts doubt on the initial reasons we had to believe in the reliability of the inference. We could apply the same strategy that we proposed in the case of quasi-particles, and explain how sophisticated versions of the inference from experimental practice have more strength than ordinary versions of it, so as to exclude all ordinary objects from its scope (while still avoiding a commitment to theories, if possible). However, divorcing the inference from its everyday counterpart in this way means giving up on its intuitive appeal. Furthermore, sorites paradoxes, vagueness and causal exclusion arguments also apply to many biological or chemical entities with which scientists interact, so even this strategy might not be sufficient. All this strengthens our dilemma, and makes it more tempting for the entity realist to opt for its second horn.

In opposition to eliminativism, some metaphysicians have proposed permissivist views, according to which any arbitrary combination of objects (my nose and the Eiffel Tower) or any arbitrary kind can be said to exist. This gives us the freedom to pick whatever kind interests us for any local purpose, which could be thought to rescue Entity Realism from sceptical arguments and preserve its continuity with common sense. However, this option is hardly better, for it trivialises existence to the point that an inference from manipulative success to existence becomes quite useless. If we accept

[27]D. KORMAN, "Ordinary Objects", in *The Stanford Encyclopedia of Philosophy*, ed. E. Zalta, Stanford University, 2020.

permissivism, a commitment to there being an object (and even many objects) with which we interact is quite trivial. Unless we say more about the specific kinds that we pretend to pick by means of this inference: that there is an object of a certain kind is *not* trivial.

In this context, the question becomes whether it is possible to think of the ordinary entities the existence of which is warranted by manipulability as belonging to real (or natural) kinds in a sense that is at the same time non-trivial and fully compatible with the way metaphysics usually conceives of these notions, or if we are obliged to take a more revisionary stance. Ian Hacking insists that our commitment towards electrons depends on the fact that we use them as tools to investigate other parts of nature. In order to move forward, let us examine the accounts of ordinary artefacts, including *actual tools*, that have been proposed in the literature.

DO ORDINARY ARTEFACTS EXIST?

Asking if tables are real is not only asking if what we experience when apparently interacting with a table is the effect of something material that exists independently of us, whatever that be. It is also asking whether this something is rightly identified as an individual member of the kind "table", and whether this kind is real rather than nominal. By this, what is usually meant is that the kind has mind-independent boundaries. It does not correspond to a mere practical grouping of things that are similar enough for some human purposes; it does not stem from linguistic conventions, nor is it relative to a conceptual scheme. If "table" is a real kind, then the superficial similarities between tables are explained by a deeper common nature that all tables share, a nature independent from our representations of what they are. The kind constitutes a proper unit of the structure of reality.

The fact that we are causally responsible for the existence of tables (that we build them) is not necessarily a problem for their mind-independence. Our ability to produce hydrogen from water does not make hydrogen a nominal kind. Instances do not really count: what we cannot be responsible for, at least not intentionally, are the *conditions for belonging to the kind*. Arguably, what counts or not as hydrogen does not depend entirely on human decisions, at least not for a realist about hydrogen. Another way to say this is that in principle, everyone could ignore or be wrong about what hydrogen is (what the conditions are for belonging to the kind): the nature of hydrogen is up for discovery rather than stipulated a priori[28]. This is usually associated with a causal theory of reference: loosely put, we can point at a gas and say "this, we will call hydrogen", thus securing a referential relation to hydrogen by means of a causal relation, while still ignoring what hydrogen really is.

In this respect, the fact that a causal theory of reference is also invoked by entity realists such as Hacking is a good sign. But it is not necessarily enough, because reference failure is possible (a traditional example is jade, which can refer to two very different chemical substances with similar superficial properties).

Given that the existence of ordinary artefacts is presumably warranted by the inference put forth by Entity Realism, the question that occupies us is: are ordinary artefacts real by the standard just presented? Intuitively, it could be thought that they are

[28] A. THOMASSON, "Realism and Human Kinds", *Philosophy and Phenomenological Research*, 2003, 67 (3), p. 580–609.

identified functionally, by means of their causal profile: for example, a chair is something that we can sit on. On the face of it, this idea fits well with Entity Realism and its focus on causation. However, associating artefacts with an actual causal role would exclude all malfunctioning artefacts from the kind, but a broken chair is still a chair. Furthermore, many artefactual kinds do not have a unique function associated with them. Clothes, for example, can protect from the cold, or they can be decorative.

For these reasons, Amie Thomasson[29] has proposed that an artefact is essentially something that was intentionally produced under some description: roughly, an object *x* is an artefact of kind *K* if it is the result of a largely successful intent to make a *K*. This is the *essence* of the kind, what ultimately explains why all members share similar superficial properties. On this view, what counts as a *K* mainly depends on social norms or past usage known by makers. According to Thomasson, artefactual kinds have an essence, and so they are *real*, but their essence is not mind-independent. It does not belong to a perfectly natural order. It is not true that in principle, everyone could ignore or be wrong about what a chair is: chair makers at least must know it.

Amie Thomasson's view fits well with the way kinds are identified in everyday life, as revealed by cognitive science: the intentions of makers usually play a crucial role[30] (although they can be overridden by the conversational context in order to ease identification by the audience[31]). However, this account constitutes an explicit departure from traditional metaphysical conceptions of existence.[32] In our context, the question is: what would prevent us from saying the same about the entities with which experimenters interact in laboratories? Can experimenters be wrong about what it means to be an electron, given that (according to Hacking) it is the fact that electrons are used as tools that is decisive? At least, the case of ordinary artefacts shows that robustness of causal interactions is not enough to guarantee mind-independence. Something else is needed.

We could argue that scientific kinds, unlike artefacts, have instances in nature outside of our activities, and so, they are mind-independent. A causal theory of reference could be invoked again to that effect. But can we support this rationale without assuming that the theoretical explanations of natural phenomena involving these kinds are true? Scientific kinds are often embedded in theories that systematise classifications, account for their causal profiles, and indeed allow them to play an explanatory role outside of experimental practice. But by relying too much on theories and theoretical explanations in order to make its case, Entity Realism runs the risk of collapsing into standard scientific realism.

Another theory of artefacts takes inspiration from etiological theories of functions in philosophy of biology, according to which, roughly speaking, the function of a given trait

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[29] *Id*.

[30] P. BLOOM, "More Than Words: A Reply to Malt and Sloman", *Cognition*, 2007, 105 (3), p. 649–55.

[31] B. MALT, S. SLOMAN, "Category Essence or Essentially Pragmatic? Creator's Intention in Naming and What's Really What", *Cognition*, 2007, 105 (3), p. 615–48.

[32] Among other authors who manage to save ordinary objects from sceptical arguments by making them mind-dependent or language-dependent are E. HIRSCH, "Physical-Object Ontology, Verbal Disputes, and Common Sense", *Philosophy and Phenomenological Research*, 2005, 70 (1), p. 67–97, D. KORMAN, "Strange Kinds, Familiar Kinds, and the Charge of Arbitrariness", *Oxford Studies in Metaphysics*, 2010, 5, p. 119–44 and K. PEARCE, "Mereological Idealism", in *Idealism: New Essays in Metaphysics*, ed. K. Pearce. T. Goldschmidt, Oxford, Oxford University Press, 2017.

is the causal role for which the trait has been selected[33]. Crawford Elder[34] proposes that similarly, an artefact belongs to a kind associated with a specific function if it was copied from past instances because of this function. This view is also able to include malfunctioning instances into the kind, in so far as they are copied from functioning ones, but contrarily to Thomasson's theory, it makes artefactual kinds mind-independent. In global markets, artefacts can be reproduced for functions that are opaque to their makers, users, or both. This implies a potential gap between the way we identify artefacts in ordinary discourse, in particular the graining of our classifications, and what the real artefactual kinds are. As per the realist criteria, we can be wrong about the boundaries of these kinds. To say it differently, artefactual kinds would correspond to what alien anthropologists studying our civilisation would identify as the relevant kinds, by analogy with biologists studying biological traits, rather than to how we classify our own artefacts (although this does not preclude that the two match on most occasions).

This looks like the best option for the entity realist willing to stay conservative with regard to traditional metaphysics. If we accept this theory, we could defend the inference from manipulability to existence as follows: robust, reliable causal interactions in various circumstances are indicative that something exists, whose essence is responsible for the causal similarities observed in these various circumstances. This essence can be either a common constitution, as with water for instance, or it can be a functional essence grounded in a process of copy and selection, either socio-economical or natural. The view warrants the mind-independent existence of both artefacts and entities found in laboratories.

Note, however, that if functional kinds are real, their essences are not intrinsic, but relational. They lie in the social or natural environments that selected them: it is these environments that ultimately explain the common characteristics of their members, not a shared constitution. Functional kinds in biology often have their causal powers contextually: for example, the same molecule can be a gene in an organism, but not in another. They are often multiply realisable: very different molecules can belong to the same kind if they were selected for the same role. In this respect, functional kinds are not very different from quasi-particles, the identity of which is also relational rather than intrinsic (although the environment involved is more local in the case of quasi-particles). This already constitutes a departure from traditional metaphysical views.

More problematic is that whether the criteria of mind-independence can be sustained in the case of functional kinds, or whether the etiological account is correct, is debatable: there are reasons to think that many functional entities in biology or chemistry are introduced for explanatory purposes, by means of explicit definitions, in a way that does not correspond to a causal theory of reference, and that in consequence, theorists cannot really be wrong about what the criteria are for belonging to the category[35], not to mention the kinds of the social sciences, which seem to depend directly on our representations and, sometimes, on our values. Many philosophers of science understand scientific kinds in

[33]R. MILLIKAN, "In Defense of Proper Functions", *Philosophy of Science*, 1989, 56 (2), p. 288–302.

[34]C. ELDER, "Artifacts and Mind-Independence", in *Artefact Kinds*, ed. M. Franssen, P. Kroes, T. Reydon, P. Vermaas, p. 27–43. Cham, Springer, 2014.

[35]J. LAPORTE, *Natural Kinds and Conceptual Change*, Cambridge, Cambridge University Press, 2004, M. WEBER, "Reference, Truth, and Biological Kinds", in *Liber Amicorum Pascal Engel*, ed. J. Dutant, D. Fassio, A. Meylan, Geneva, University of Geneva, 2014, p. 422–48.

general as being relative to epistemic purposes, such as inductive practices: this the case, for example, of Richard Boyd's popular Homeostatic Property Cluster theory of natural kinds, which makes explicit reference to the practice of scientists[36]. All this is not very compatible with the standard understanding of existence in terms of mind-independence[37].

If we wanted to exclude functional kinds from our ontology, and only admit kinds with an intrinsic essence, which would be required if we agreed with Gelfert that quasi-particles do not really exist, then the question would become: how could we know that robust manipulations are indicative of a common constitution rather than of a common selection process, be it contextual, social or natural? And again, we would have to answer this question without resorting to the explanatory power of theories for Entity Realism to be sustainable. All this puts pressure on the idea that the inference from manipulability to existence that is at the core of Entity Realism is really compatible with traditional metaphysics.

PRAGMATIC METAPHYSICS

To sum up, it is not clear that ordinary artefacts exist mind-independently, thus casting doubt on the manipulability to existence inference championed by Entity Realism. In response, we could restrict the inference to scientific kinds. However, even assuming we could justify this restriction without resorting to theoretical truth (in order to stay coherent with Entity Realism), it is not clear that most scientific kinds can be considered real either by the criterion of mind-independence. In this context, our best option is to simply give up this criterion. The good news, if we do so, is that we can restore a continuity between common-sense categories and scientific categories, and thus do justice to what looks like the main motivation of practice-oriented metaphysics.

According to common sense, money exists, although it is very clear that it is a multiply realised, mind-dependent social construct. The difference between real and fake money does not come from the fact that the former would be mind-independent and not the latter. In this respect, the notions of "real" and "exist" entertained in metaphysics have not much to do with their ordinary counterparts. This might be the source of confusion: entity realists should be viewed as endorsing an ordinary meaning of these words that does not require any form of transcendence[38]. If so, then the mismatch between the practice-oriented approach championed by Entity Realism and the traditional approach based on theoretical virtues as guides to mind-independent reality runs quite deep.

It is likely that scientists share the ordinary meaning of existence and reality rather than the philosophical meaning (although this is an empirical claim that would deserve to be investigated). This means that the pretension of standard scientific realists and their "literal" interpretation of theories to side with common-sense or with the way scientists themselves consider their theories cannot be sustained, unless the semantic component of scientific realism is qualified. What we should opt for is a form of pragmatism, or

[36]See M. ERESHEFSKY, T. REYDON, "Scientific Kinds", *Philosophical Studies*, 2015, 172 (4), p. 969–86.

[37]For more arguments to that effect, see A. CHAKRAVARTTY, "Last Chance Saloons for Natural Kind Realism", *American Philosophical Quarterly*, 2023, 60 (1), p. 63–81.

[38]There are indications that this is the way Hacking views things: see I. HACKING, "Natural Kinds: Rosy Dawn, Scholastic Twilight", *Royal Institute of Philosophy Supplement*, 2007, 61, p. 203–39.

deflationism, or Fine's "natural ontological attitude", or any option that does not take "real" to imply mind-independent. Then Entity Realism starts to make sense.

We could, for example, start from a phenomenological apprehension of what it means to exist, rooted in ordinary experience, in our abilities to track objects, identify kinds perceptually (including socially constructed ones, such as letters) and interact successfully with our natural and social environment. We could then extend our existential attributions beyond direct experience, to remote, past and unobservable objects using ampliative inferences (but without resorting to theoretical virtues). On this view, the identity of objects and their causal powers can be relative to known or unknown contingent background conditions associated with a local or broad environment, with our position in the universe, with our cognitive constitution or with mere conventions that serve explanatory purposes. We would have no reason to think that our categories "cut nature at its joints" or that abstract theories are unrestrictedly true instead of being useful organisational schemes relative to more or less broad human perspectives.

The advantages of this approach are numerous. It allows to defuse many sceptical arguments against metaphysics, and to confront the traditional arguments against scientific realism, such as the pessimistic meta-induction on theory change. Since there is no particular reason to think that mind-independence is explanatory, this view does not necessarily fail to explain the empirical success of science. Finally, it promises to bring a desirable continuity between human sciences, natural sciences and common-sense representations. One question remains: does this view deserve the label "realism"? However, this might be a mere verbal dispute.

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