*Hypatia* (2024), **39**, 363–384
doi:10.1017/hyp.2023.114

CAMBRIDGE UNIVERSITY PRESS

ARTICLE

# Naturalized, Fundamental, and Feminist Metaphysics All at Once: The Case of Barad's Agential Realism

Rasmus Jaksland

Department of Philosophy and Religious Studies, Faculty of Humanities, Norwegian University of Science and Technology, Trondheim, Norway
Email: rasjaks@hotmail.com

(Received 9 July 2020; revised 17 December 2021; accepted 8 February 2022)

**Abstract**

An apparent antagonism exists between fundamentality-focused mainstream metaphysics such as naturalized metaphysics—a metaphysics inspired and constrained by the findings of our best science—and feminist metaphysics whose subject matter is typically non-fundamental social reality. Taking Karen Barad's agential realism as a case study, this paper argues that these may not be in conflict after all. Agential realism is a metaphysical framework founded on quantum mechanics which shares the characteristic features of naturalized metaphysics. But Barad finds warrant to extend the scope of agential realism all the way to theorizing about our lifeworld as exemplified by her profound influence on feminist new materialism. Thus, this case study indicates that there does not have to be a division between fundamental and feminist metaphysics. The broad intended scope of agential realism is challenged by the success of Newtonian mechanics as an approximation of quantum mechanics, but certain aspects of agential realism promise to be robust under such approximation. If this is so, then Barad provides us with a metaphysics that is naturalized, fundamental, and feminist all at once.

In contemporary mainstream metaphysics, typical explications of metaphysics involve a description of the subject matter as the "systematic study of the most fundamental structure of reality" (Lowe 1998, 2) or "the study of ultimate reality" (Inwagen 2015, 1). Following such explications, mainstream metaphysics tends to focus on those entities and structures that ground everything else. These most fundamental elements of reality take priority in metaphysical investigations. However, metaphysicians focusing on fundamentality, Elizabeth Barnes finds, "have made the discipline increasingly hostile to the prospect of feminist metaphysics" (Barnes 2014, 347–48) whose interest is themes such as gender and social structure that are typically not regarded as investigations into ultimate reality (Barnes 2014, 340).

© The Author(s), 2024. Published by Cambridge University Press on behalf of Hypatia, a Nonprofit Corporation. This is an Open Access article, distributed under the terms of the Creative Commons Attribution licence (https://creativecommons.org/licenses/by/4.0/), which permits unrestricted re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

While the works of Sider (2011) and Schaffer (2009) serve as Barnes' primary examples of fundamentality-focused metaphysics, naturalized metaphysics—another prominent recent trend in analytic metaphysics—arguably falls into the same category. Naturalized metaphysics argues that metaphysics is only (epistemically) credible if it is inspired and constrained by the findings of our best science, physics in particular as signified by Ladyman and Ross' "Primacy of Physics Constraint" (Ladyman and Ross 2007, 38). In prioritizing physics (rather than for instance sociology), naturalized metaphysics sides with mainstream metaphysics following Mikkola's notion "that a major difference between feminist and 'mainstream' metaphysics pertains to our choice of what level of 'reality' we should ontologically privilege" (Mikkola 2017, 2445). While feminist metaphysics privileges the entities of our lifeworld, mainstream metaphysics including naturalized metaphysics finds these to be merely derivative from the metaphysically more important fundamental level of reality.

Attempts to reconcile feminist and mainstream metaphysics have all followed the pattern of recommending a more permissive attitude towards metaphysics than that characteristic of mainstream metaphysics. This approach is exemplified by Mikkola (2015), Bennett (2016), Sider (2017), Schaffer (2017), Hawley (2018), and Passinsky (2019), all of whom (though in various ways) find it appropriate for metaphysics to include both types of inquiry. This paper, however, will investigate a different approach whereby mainstream and feminist metaphysics are reconciled by denying the existence of the type of division suggested by Mikkola, Barnes, and Ladyman and Ross.

The investigation takes the form of an exploration of the work of Barad who engages seriously with issues of philosophical anthropology broadly construed and feminist metaphysics in particular while sharing the characterizing features of naturalized metaphysics. Barad's metaphysical[1] framework—known as "agential realism"—is based on quantum mechanics and proclaims its validity by this origin. However, agential realism has—on Barad's own initiative[2]—been very influential in social theory broadly construed, especially in queer theory, feminist new materialism, and posthumanism. As de Freitas writes: "She shows how quantum physics can inform our thinking about gender, racial, queer and other differences" (de Freitas 2016, 150). While these themes have a significant overlap with feminist metaphysics, they are notably absent from naturalized and other fundamentality-focused metaphysics. Thus, to the extent that agential realism succeeds as a quantum mechanics-based metaphysics, it challenges the claimed independence between naturalized metaphysics and philosophical anthropology and thereby offers a radical resolution to the tension between mainstream and feminist metaphysics. Rather than simply broadening the scope of metaphysics to include both fundamental and non-fundamental metaphysics, Barad can be seen as arguing that fundamental metaphysics—more particularly, the metaphysical consequences of quantum mechanics—already connects with the themes otherwise covered by feminist metaphysics.

Feminist scholars are, of course, not strangers to physics in general and quantum mechanics more particularly. Evelyn Fox Keller (1995), Helen Longino (1990), Barbara L. Whitten (1996), among many others have all variously discussed aspects of the meeting between quantum mechanics and feminism. However, in the taxonomy of Helene Götschel (developed specifically for the entanglements of gender and physics), these works focus on "Human actors in physics," "Work place cultures in physics," and "Knowledge production in physics" (Götschel 2011, 67). These issues of sociology and epistemology of science have likewise been the focal points in the broader field of feminist philosophy of science (see, e.g., Crasnow (2013), Nelson (2002), Richardson

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

(2010), and Wylie (2012) for reviews of this vast field of research). In comparison, Götschel argues that Barad's work—though also concerned with these other aspects—stands out when it sees "the inclusion of approaches coming from physics into the development of new theoretical and methodological concepts" (Götschel 2011, 67). Arguably also Haraway's (1992) concept of diffraction comes "from physics," but Barad's use of physics is importantly different since quantum mechanics serves as (part of) the *motivation and justification* of the feminist content of agential realism and not merely as a metaphor or analogy, as this paper argues. Barad's agential realism is fundamental, naturalized, and feminist metaphysics all at once. On Barad's construal, therefore, there is no antagonism between these since feminist metaphysics is fundamental and fundamental metaphysics is feminist.[3]

This paper is *not* meant as an assessment of the legitimacy of agential realism as an interpretation of quantum mechanics. Instead, the paper largely assumes the agential realist account of quantum mechanics and rather focuses on what warrants the role of this naturalized metaphysics in philosophical anthropology, i.e., how Barad argues that agential realism is relevant for theorizing about the lifeworld and thus how agential realism integrates fundamental and non-fundamental metaphysics. The primary concern here is, as such, metaphysical methodology and, more particularly, to use Barad's work—which has otherwise not been considered in this context—as an inspiration for how to reconcile fundamentality-focused mainstream metaphysics with feminist metaphysics. Barad's contributions to these fields will therefore only feature here to the extent that they illustrate this methodological point, and the same goes for discussions of other first-order content.

On Barad's methodological proposal, fundamental and feminist metaphysics must be approached diffractively by reading them through each other. This paper argues, however, that the success of this radical resolution of the tension between mainstream and feminist metaphysics depends crucially on the idea that some features in ontology do not admit metaphysical approximation. Whether there are such features remains, in my view, an open question. However, even in their absence, the discussion exposes that it is at most contingent that one can pursue philosophical anthropology including feminist metaphysics and fundamentality-focused metaphysics of physics independently of each other. If at all, the events of our lifeworld just happen to be autonomous enough from the details of fundamental metaphysics to be practically independent for purposes of social theorizing.

## Agential realism

Giving a full account of Barad's agential realism with all its subtleties is well beyond the scope of this paper. However, some of its central aspects concern the relation among entities, the ascription of properties, and the interplay of entities being studied and those studying them, for instance in performing a measurement. Based on arguments coming out of quantum mechanics, agential realism involves, in Barad's own words, the "disruption of the metaphysics of individualism that holds that there are discrete objects with inherent characteristics" (Barad 2007, 422), which, given a special emphasis on Bohr's interpretation of quantum mechanics,[4] "calls into question the dualisms of object-subject, knower-known, nature-culture, and word-world" (Barad 2007, 147) and requires a rethinking of "the notions of matter, discourse, causality, agency, power, identity, embodiment, objectivity, space, and time" (Barad 2007, 26). For present purposes, the focus will be on the metaphysics of individualism, the dualisms of subject-object and

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

word-world, and the notion of agency, and how these, according to Barad, are effected by quantum mechanics. The next section will then indicate how these connect to themes typically covered by feminist metaphysics such that they together can testify to the quantum origin *and* the very broad intended scope of agential realism.

In positive terms, agential realism is a type of radical relational holism whereby objects emerge from the whole, what Barad (e.g., 2003, 815) denotes 'phenomena'. This whole admits multiple separations into configurations of objects that have properties only relative to the whole. This is what leads Barad (e.g. 2007, 195) to the rejection of the metaphysics of individualism. The argument to this effect goes via the existence in quantum mechanics of complementary properties, an argument that will be recounted in some detail below, whereas the entailed rejections of the mentioned dualisms and how agency enters the picture will be treated more briefly afterwards.

In quantum mechanics, certain pairs of properties are mutually incompatible in the sense that the state of a quantum system, for instance the state of a particle, cannot be ascribed a definite value of both properties. This is signified by Heisenberg's indeterminacy principle,[5] which—in its perhaps most common form—expresses the reciprocal relation between the indeterminacy of position and the indeterminacy of momentum. Thus, a definite position entails completely indeterminate momentum and vice versa. This does not entail that one can find in experiments a quantum particle that is for instance smeared out in space, that is, measure the indeterminacy of position. Instead, the system will upon measurement be found in a state with a definite value of the property being measured. Doing a series of interchanging measurements of mutually incompatible properties, for instance measuring position then momentum and then position again, one will, however, not find a correlation between the measurements of the same property since the in-between measurement of momentum reinstalls a complete indeterminacy of position. In this sense, not only the properties but also the experiments measuring the properties are mutually exclusive. This leads Bohr to the notion of complementarity: "that the attribution of certain properties to quantum objects can take place only in experimental contexts which are mutually incompatible" (Zinkernagel 2016, 10). Bohr, in this sense, integrates concepts such as 'position,' the property that the concept refers to, and the measurement context. Bohr goes as far as to contend that properties entering in complementary pairs are only meaningful relative to an experimental setup that measures the property in question. As such, the conditions for the ascription of such properties in quantum mechanics depend both on the quantum object of interest *and* an experimental setup: "the ascription of [complementary] properties to the object as it exists independently of a specific experimental interaction is ill-defined" (Faye 2019). Furthermore, the mutual exclusion of complementary pairs entails that the measurement of the position of a quantum object renders the attribution of the concept "momentum" to that object entirely unintelligible, according to Bohr.[6]

Using the example of position, Barad gives the following summary of *her reading of* Bohr's point:

> "position" only has meaning when a rigid apparatus with fixed parts is used … And furthermore, any measurement of "position" using this apparatus cannot be attributed to some abstract independently existing "object" but rather is a property of the *phenomenon*—the inseparability of "observed object" and "agencies of observation."[7] (Barad 2003, 814; emphasis in original)

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Since a setup that measures, for instance, position is incompatible with a measurement of momentum, it is not the quantum object that can be ascribed a property in an experimental context, but rather the relationality of quantum object and experimental setup, the "phenomenon," that has the property. Importantly, the composition metaphor used here is only instructional and does not carry ontological significance. Rather, Barad argues that

> phenomena do not merely mark the epistemological inseparability of "observer" and "observed"; rather, *phenomena are the ontological inseparability of agentially intra-acting "components."* That is, phenomena are ontologically primitive relations—relations without preexisting relata. (Barad 2003, 815; emphasis in original)

The phenomena do not come into being through *inter*-action between independently existing elements: object and apparatus (agency of observation). Rather, phenomena form the ontologically primitive and "relata-within-phenomena emerge through specific intra-actions" (Barad 2007, 140). *Intra-actions*, in other words, produce the ontologically emergent object and apparatus including the place of their separation: "Reality is composed not of things-in-themselves or things-behind-phenomena but of things-in-phenomena" (Barad 2007, 140). Barad (2007, 140) describes such a separation between object and apparatus as an "agential cut" (more commonly known as a Heisenberg cut) and argues that no agential cut is an inherent distinction. Rather, agential cuts are constituted by specific intra-actions, such that other intra-actions constitute different cuts into object and apparatus (agency of observation).[8]

According to Barad, this refutes the "conventional (Newtonian) view of metaphysics, whereby there are individual objects with individually determinate properties, and measurements reveal the preexisting values of particular physical quantities" (Barad 2007, 262). In this way, agential realism abandons a "metaphysics of individualism" (Barad 2007, 195), where reality consists of objects between which there are relations. Without an inherent cut, all is phenomena and different cuts enact different individuals. Barad's metaphysics—agential realism—thus takes the form of a radical relational holism which Teller, also in the context of quantum mechanics, introduces as the view that there are "*inherent relations* … which do not supervene on the non-relational properties of the distinct individuals" (Teller 1986, 73). The relational holism of agential realism is radical since *only* the relational phenomena are ultimately real.[9] Cuts between objects, and between objects and agencies of observation, emerge from these phenomena and intra-actions within phenomena will change them. Likewise, any division into subject and object is emergent and changing. Indeed, Barad argues that the "*quantum dis/continuity* troubles the very notion of *dicho-tomy*—the cutting into two—itself" (Barad 2010, 246; emphasis in original).

From Bohr's reasoning that complementary properties are only meaningful relative to a specific experimental context, Barad also argues that meaning must be enacted by these cuts since the experimental contexts in turn are enacted via specific intra-actions: "It is through specific agential intra-actions that the boundaries and properties of the 'components' of phenomena become determinate and that particular embodied concepts become meaningful" (Barad 2003, 815). Barad thus does away with what she calls representationalism or word-world dualism: "the independently determinate existence of words and things" (Barad 2007, 107). Generalizing from Bohr's observation that complementary experimental contexts and their associated properties exclude one another (for instance measurements of position and momentum), Barad

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

furthermore argues that certain intra-acted configurations of boundaries, properties, and meanings exclude other such configurations: "Any particular experimental arrangement, which gives determinate meaning to a particular concept (for example, 'position') will, by necessity, always produce its constitutive exclusion (for example, 'momentum'), that is, an equally necessary, 'complementary' concept which is thereby left outside of the domain of intelligibility" (Barad 2010, 253). By this exclusion, the intra-actions are in a sense "agential" and a pervasive agency in all intra-actions therefore prevails in Barad's agential realism. Barad describes it as the "ongoing flow of agency through which part of the world makes itself differentially intelligible to another part of the world" (Barad 2007, 140). The seat of agency is not human beings or consciousness. Rather, without the subject-object and word-world (material-discursive) dualisms there are no principles with which to separate agency and (inanimate) matter: "In an agential realist account, agency is cut loose from its traditional humanist orbit" (Barad 2007, 177).[10]

In summary, Barad promotes phenomena as the fundamental ontological unit which immediately entails that objects (with determinate properties) only emerge from this whole. In treating individuals as ontologically non-fundamental, agential realism resembles other quantum mechanics-based ontologies that emphasize non-separability, for instance ontic structural realism (advocated by Ladyman and Ross 2007, among others). However, while ontic structural realism (typically) focuses on the intrinsic relationality in states of entangled particles such as that between electrons,[11] that is, on intra-level structures, agential realism emphasizes the inseparability between observer and observed, that is, inter-level relationality. Though the former should, in principle, imply the latter and vice versa, it is arguably this change in emphasis that propels agential realism towards its broader scope compared to other quantum mechanics-based ontologies such as ontic structural realism. Indeed, the next section will indicate how agential realism—especially due to its relational ontology and entailed new view on subject-object, word-world, and agency—has been more influential in feminist metaphysics and philosophical anthropology than in the fundamentality-based metaphysics that ontic structural realism belongs to.

## Agential realism as feminist metaphysics

Though offered in a somewhat polemic voice, Ladyman and Ross (2007) on their part go as far as to offer a kind of truce to philosophical anthropology by insisting that naturalized metaphysics makes no contact with the themes of philosophical anthropology:

> People who wish to explore the ways in which the habitual or intuitive anthropological conceptual space is structured are invited to explore social phenomenology. We can say "go in peace" to Heideggerians, noting that it was entirely appropriate that Heidegger did not attempt to base any elements of his philosophy on science, and focused on hammers—things that are constituted as objects by situated, practical activity—rather than atoms—things that are supposed by realists to have their status as objects independently of our purposes—when he reflected on objects. We, however, are interested in objective truth rather than philosophical anthropology. (Ladyman and Ross 2007, 5)

Philosophical anthropology is the field of subject of "Heiddeggerians" that study the world as constituted by our situated, human practices. This is a subjective reality that

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

is furnished by what is habitually or intuitively given to us as human beings in social interaction. Its elements depend on our interests and conceptualizations, and consequently it does not meet realists' requirements of a mind-independent reality. In studying this reality, philosophical anthropology is entitled to ignore the findings of our best (fundamental) sciences since they (presumably) have no bearing for the study of a life-world dependent on "our purposes," as Ladyman and Ross put it. Philosophical anthropology and naturalized metaphysics can therefore be pursued without mutual interference, the former being interested in social phenomena, whereas the latter is concerned with fundamental reality.

This type of division voiced by Ladyman and Ross is similar to that introduced by those commenting on the place of feminist metaphysics in metaphysical research. Mikkola finds that the distinction between fundamental metaphysics and feminist metaphysics can be seen as following the choice whether "to focus on the 'big', macrolevel phenomena or on the 'small', micro-level entities that ground the bigger picture" (Mikkola 2017, 2445) which seems to echo the difference in focusing on hammers or atoms proposed by Ladyman and Ross.[12] Barnes describes how feminist metaphysics "[a]ttempts to get to grips with social kinds and social structures—with the social world that shapes our daily lives" and argues "[t]hey are important questions in metaphysics that go beyond—and perhaps have nothing to do with—the fundamental" (Barnes 2014, 349). Given this characterization of feminist metaphysics, it seems to share (at least in part) the subject matter of philosophical anthropology (in Ladyman and Ross' construal of it). Furthermore, Barnes notes that such feminist metaphysics might be entirely independent of fundamental metaphysics. Explicating that in feminist metaphysics "the question 'What is gender?' turns on what the (non-natural) social world is like," Barnes (2014, 340) even seems to implicitly contrast feminist metaphysics with naturalized metaphysics in particular.

This alleged division between naturalized metaphysics and feminist metaphysics has, in a sense, already been questioned by Katherine Hawley (2018), when she proposes to generalize naturalized metaphysics to include social metaphysics by having it informed by the findings of the social sciences. However, Hawley's proposal is importantly different from that ascribed here to Barad. In admitting a role for the findings of the social sciences in naturalized metaphysics, Hawley is effectively alleviating the fundamentality focus otherwise found in naturalized metaphysics. Her proposal is, in other words, another example of the permissive solution to the antagonism between fundamentality-focused and feminist metaphysics. Barad's resolution of the division between naturalized metaphysics and non-fundamental metaphysics is very different since Barad instead argues that fundamental science, quantum mechanics in particular, is directly relevant for social metaphysics. As such, Barad continues the focus of naturalized metaphysics on fundamental science, the view that is otherwise an epitome in metaphysics of the fundamentality focus responsible for the tension with feminist metaphysics. However, Barad argues that the metaphysical implications of quantum mechanics as summarized in agential realism cuts across to the domains of philosophical anthropology including feminist metaphysics.

Barad is indeed very explicit that agential realism can and is meant to inform feminism, writing in the introduction that "agential realism can be useful for thinking about specific issues that have been central to feminist theory, activism, and politics" (Barad 2007, 34). One of these issues is the question of the interdependence of matter, agency, and discursive practices. As detailed above, Barad argues for the absence of any set

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

dualism between word and world. Rather, the material and the discursive are enacted together within phenomena as part of the configurations into elements that by complementarity will exclude other configurations. This was what Barad argued entailed a pervasive agency in the world not restricted to human beings and one that takes place as agential intra-actions. According to Barad, this does not merely echo themes found in feminism, but promises a revision of them:

> agential realism diverges from feminist postmodern and poststructuralist theories that acknowledge materiality solely as an effect or consequence of discursive practices. These latter approaches lack an account of materiality as an agentive and productive factor in its own right, thereby reinstituting the equation between matter and passivity that some of these approaches proposed to unsettle. (Barad 2007, 225)

In proposing such an integration of the material and discursive and in providing a framework in which matter becomes agential, Barad's work has resonated with and been particularly influential in new materialism (also denoted material feminism: Alaimo and Hekman 2008). New materialism is a multifaceted school of thought but might generally be characterized by the return of matter and materiality in a reaction to the linguistic turn in philosophy and critical theory[13] accompanied by a shift in emphasis from epistemology to an integration of ontology and epistemology (Gamble et al. 2019, 118). One aspect of this is that "new materialism pushes dualism into non-dualism, thus allowing for a non-reductive take on matter and language" (Dolphijn and Van der Tuin 2012, 113). It is particularly towards this end that Barad's agential realism has been influential in new materialism, not only in questioning dualisms, but also through the framework of agential intra-actions that has proven both theoretically and methodologically important for "[t]he argument in new materialisms that matter is generative, changing and agentic" (Coleman 2014, 41; see also Kirby 2017). It is exactly this agency in matter that Barad, in the quote above, takes agential realism to capture. Furthermore, by its origin in quantum mechanics, agential realism might be seen as providing a scientific sanctioning of these ideas in new materialism. While not put in quite those terms, agential realism's relation to quantum mechanics is noted in the new materialism literature. One example follows a discussion of the integration of ontology and epistemology and the pervasiveness of agency with the remark that "Barad provides a particularly compelling basis for such a view through her 'intra-active' account of the 'measurement problem' in quantum physics" (Gamble et al. 2019, 122).[14]

This is not the place for a detailed treatment of Barad's contributions to new materialism or other related fields, nor is it an attempt to justify or assess the merits of new materialism. Rather, the above hopefully testifies to the role of agential realisms in a recently influential branch of feminist metaphysics. As Fairchild and Taylor write of Barad, "her influence in the fields of new materialism, new material feminism, science studies, queer studies, and posthumanism has been profound" (Fairchild and Taylor 2019). With the wide reception in such fields, the question is perhaps not so much whether Barad's work can in part be regarded as feminist metaphysics, but rather in what sense it qualifies as naturalized and thus fundamental metaphysics. This is what we shall turn to in the next section that argues that Barad's work exemplifies several of the central tenets of naturalized metaphysics.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

## Agential realism as naturalized metaphysics

In the words of Anjan Chakravartty "[n]aturalized metaphysics is metaphysics that is inspired by and constrained by the output of our best science. Non-naturalized metaphysics is metaphysics that is not so inspired or constrained" (Chakravartty 2013, 33). While non-naturalized metaphysics runs wild and often astray,[15] according to the proponents of naturalized metaphysics, the (epistemic) legitimacy of naturalized metaphysics is secured by its deference to the findings of science (thus taking the form of a strict metaphysical naturalism in the sense of Kornblith 2016). A moderate fundamentality focus is already entailed in naturalized metaphysics by its deference to science in general. However, this fundamentality focus is amplified when this deference to science often explicitly prioritizes physics. This is prominently exemplified by Ladyman and Ross' "Primacy of Physics Constraint" according to which "evidence acceptable to naturalists confers epistemic priority on physics over other sciences" (Ladyman and Ross 2007, 37) and from which it follows that "for a metaphysical claim to be taken seriously it must relate to at least one specific scientific hypothesis of fundamental physics" (Ladyman and Ross 2007, 39). Similarly, Alyssa Ney argues that "[t]he best way to have science inform a project of metaphysics is for us to seek what sorts of representational devices are indispensable to physics" (Ney 2012, 76).[16] With this reliance on (fundamental) physics—arguably the science that can most rightfully be said to concern itself with fundamental reality—naturalized metaphysics seems to share Sider's view that for metaphysics "[t]he ultimate goal is insight into what the world is like at the most fundamental level" (Sider 2011, 1; cited in Barnes 2014, 336), the view with which Barnes exemplifies the emphasis on fundamentality in mainstream metaphysics. According to naturalized metaphysics, metaphysics must be informed and constrained by science and physics in particular, and any metaphysics not so constrained is illegitimate where the latter includes metaphysics informed by outdated science such as Newtonian mechanics.

The criticism of metaphysics based on outdated science is captured in Ladyman and Ross' disapproval of "philosophy of A-level chemistry" (Ladyman and Ross 2007, 24). Barad considers this theme, too, when she observes that even naturalistically inclined metaphysics is often embedded in an outdated Newtonian worldview. "What is needed is a reassessment of physical and metaphysical notions that explicitly or implicitly rely on old ideas about the physical world—that is, we need a reassessment of these notions in terms of the best physical theories we currently have" (Barad 2007, 24). Even though Barad here speaks only of "notions" that must be reassessed in the light of our best scientific theories, she elsewhere insists that her naturalism does require a general concession to the findings of science. This attitude, though, is not without qualification since Barad notes that "a suitably revised conception of naturalism takes seriously what our best scientific theories tell us while simultaneously holding science accountable for its practices, for its own sake as it were, in order to safeguard its stated naturalist commitments" (Barad 2007, 407). Thus, Barad seems to defend a moderate, naturalized metaphysics where metaphysics is inspired and constrained by science, but which also leaves a distinctive task for philosophers.[17] Nevertheless, Barad's approach to metaphysics exemplifies a form of metaphysical naturalism.[18]

In her account of the relation between agential realism and quantum mechanics, Barad corroborates the characterization of her as a moderate, naturalized metaphysician at least in that domain. "I argue that agential realism can in fact be understood as a legitimate interpretation of quantum mechanics" (Barad 2007, 94). Agential realism is not a

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

(wild) metaphysical speculation with some analog to quantum mechanics. It is a metaphysics that is *inspired* and *constrained* by quantum mechanics in such a way that it can serve as a legitimate interpretation (presumably among other legitimate interpretations). Agential realism offers a fundamental metaphysics based on quantum mechanics and is justified given the standards of naturalized metaphysics. An important question, however, is whether this naturalism extends beyond quantum mechanics, that is, whether agential realism as it applies to the domains of philosophical anthropology should still be regarded as a naturalized metaphysics based on and justified by quantum mechanics.

There are at least two alternatives to this conception of agential realism as a naturalized metaphysics. First, agential realism might be considered merely analogous to quantum mechanics.[19] When agential realism uses concepts and ideas that originate in quantum mechanics—entanglement, apparatus, phenomena, etc.—outside this context, they should be understood metaphorically or analogously to their quantum mechanical sense.[20] Observe that this conception is already in tension with Barad's insistence that agential realism is a legitimate interpretation of quantum mechanics and not merely an interesting analogy to some of the features of quantum mechanics. The second alternative conception of agential realism is to regard it as an overarching metaphysical template that is claimed to be instantiated by quantum mechanics and which may also be instantiated in other domains, for instance within the themes described under the heading of philosophical anthropology.[21] Agential realism would, according to this conception, merely entail a particular organization of things. Adopting a bit of imagery, agential realism would be a bowl admitting many different kinds of content. With this conception, the concepts and ideas in agential realism that originate in quantum mechanics would be content-neutral generalizations of their quantum mechanical counterparts and it is then these generalizations that are conjectured to apply also in the field of philosophical anthropology.[22] Barad, however, rejects both of these conceptions of agential realism, defending instead a conception of agential realism as naturalized metaphysics, that is, as a metaphysics constrained and justified by science irrespective of the context in which this metaphysics is applied.

In particular, Barad (2007, 6, 7, 18, 24, 70, 88; 2012a, 45) dismisses any conception of agential realism as analogy:[23] "I am not interested in drawing analogies between particles and people, the micro and the macro, the scientific and the social, nature and culture; rather, I am interested in understanding the epistemological and ontological issues that quantum physics forces us to confront" (Barad 2007, 24). Agential realism is not a suggestion to explore people, the social, culture, and generally the macroscopic world using analogies and metaphors from quantum mechanics. Rather, agential realism with all its consequences for philosophical anthropology comprises those epistemological and ontological lessons that "quantum physics forces us to confront." Similarly, to conceive of agential realism as a metaphysical template instantiated by quantum mechanics and with the possibility to be instantiated in the macroscopic domain would involve a, for Barad, illegitimate stratification of ontology into separate realms: "quantum mechanics is not a theory that applies only to small objects; rather, quantum mechanics is thought to be the correct theory of nature that applies at all scales. As far as we know, the universe is not broken up into two separate domains" (Barad 2007, 85).[24] Quantum reality is all the reality there is, and its metaphysics is described, according to Barad, by agential realism. This is why it is justified to apply agential realism even at the macroscopic domain. The macroscopic domain is not independent as required by the multiple instantiation conception of agential realism but rather derived from or grounded in the quantum world.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Thus, even in its application to the macroscopic domain, Barad argues that agential realism is a metaphysics justified by quantum mechanics. Knowing the ambition of Barad's engagement with the macroscopic domain, agential realism therefore promises to be a naturalized metaphysics that ventures deeply into the realm of philosophical anthropology, including when agential realism is utilized in for instance new materialism.[25] Barad thereby aspires to break the truce offered by Ladyman and Ross to the Heideggerians and, more importantly, she implicitly rejects any principled distinction between mainstream/fundamental metaphysics focused on small, micro-level, or fundamental phenomena and feminist metaphysics focused on large, macro-level, or non-fundamental phenomena ("like gender and social structure": Barnes 2014, 336). As Barad also concludes above, "the universe is not broken into two separate domains." There is only one level of reality, and it includes everything from the fundamental to the social world.

Before proceeding, however, it should perhaps be noted that using quantum mechanics as ground raises rather immediate issues relating to the authority and objectivity of science so well-known in both feminism and science studies (see, e.g., Haraway 1988; Harding 1986, 1991; Longino 1990; Nelson 1990). In the context of Barad's work, Trevor Pinch puts this issue as follows: "I find it deeply puzzling that Barad can call for a more situated account of science and at the same time fail to situate the very part of science she is talking about, while drawing in a realist mode upon experiments to support her position" (Pinch 2011, 439; see also Willey 2016). The issue, in brief, is how to negotiate the role of quantum mechanics as both source and subject for agential realism. Barad invokes complementarity with its entailed simultaneous "mutual exclusivity and mutual necessity" (Barad 2011, 444) as a reply. This invites a diffractive methodology that reads quantum mechanics as source and subject through one another. As Barad qualifies, "agential realism offers a possibility for thinking 'the social' and 'the natural' together in a way that is responsive and responsible to the world" (Barad 2011, 447), including being "vulnerable to empirical results" (Barad 2011, 446; see also 2012a, 45–46). It is "experimental meta/physics," as Barad (2014, 180) writes elsewhere. Whether Barad's reply to Pinch is satisfactory cannot be decided here (see, e.g., Ginev 2016 and Hollin et al. 2017 for further discussion). Instead, it will merely be noted that Pinch's worries are equally relevant for the present rethinking of the relation between feminist and fundamental metaphysics based on Barad's work.

Barad's reply to Pinch is again indicative of the naturalized character of agential realism. Like other naturalized metaphysics, Barad intends agential realism to be responsive to the findings of science and quantum mechanics more particularly, though science should, as qualified, also be responsive to agential realism. However, in contrast with other naturalized metaphysics, agential realism nevertheless aims to enter the domain of feminist metaphysics and feminism more generally. Extending the scope like this of a quantum mechanics-based naturalized metaphysics is not without its problems, as discussed in the next section. Barad, however, is never quite clear on how she meets these problems, and an important aim of the next section is therefore to piece together her argument.

## The possibility of metaphysical approximation

Barad's vision is to base her metaphysics in quantum mechanics and at the same time have it inform many of the themes typically within the range of feminist metaphysics. It seems, however, to be overextending the scope of a quantum metaphysics when it is

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

brought to bear on the macroscopic domain. This is so, even if we accept that this domain is ultimately an aspect of the one reality that is most truthfully described by quantum metaphysics. As Barad also recognizes, Newtonian mechanics is a very good approximation for quantum mechanics in the macroscopic domain, and Newtonian mechanics does not include the peculiar effects—entanglement in particular—that are so important for Barad's development of agential realism.[26] The quantum peculiarities are, in other words, washed out as we move to the length scales that we typically encounter in our lifeworld. As a consequence, one might argue that quantum metaphysics must similarly be irrelevant at these length scales and therefore be of no concern to, for instance, philosophical anthropology. Agential realism would, according to this argument, have no probative force in our theorizing about the lifeworld, contrary to what Barad claims.

Barad has no quarrel with the size of quantum effects:

> quantum effects are of the order of the ratio of Planck's constant (h) to the mass of the object in question (m). While electrons, atoms, and other very-small-mass objects have fairly significant h/m ratios, for macroscopic objects, like cats, the ratio of h/m is extremely small. It is not that we live our daily lives in a classical world, rather than a quantum one; the point is that we generally don't notice quantum effects because they are very small (too small to notice without special equipment). (Barad 2007, 279)

Obviously, if Planck's constant had been larger or we had been much smaller, then quantum effects would have been more significant. Thus, quantum effects could have been manifest even in our lifeworld, they just happen not to be since they are (typically) too small to notice. This can, in other words, not be Barad's reply to the view that quantum metaphysics is irrelevant at the length scales typically encountered in our lifeworld.

Before exploring why Barad nevertheless insists on the relevance of quantum metaphysics even in philosophical anthropology, it is worth pausing to observe how the role of Planck's constant offers the first modification of the claimed division between naturalized metaphysics and philosophical anthropology. It is the (apparently) contingent size of Planck's constant that ensures the immediate irrelevance of quantum metaphysics, that is, the metaphysics of our fundamental physics, in our theorizing about the lifeworld. Certainly, even "things that are constituted as objects by situated, practical activity" (Ladyman and Ross 2007, 5) would have had to be reconceived in the light of quantum metaphysics if Planck's constant had been much larger since quantum effects would then have been so significant that they would arguably influence both situatedness and practice. Of course, if Planck's constant had been much larger, then quantum metaphysics would have been manifest and philosophical anthropologists would therefore not have been prone to presume any other metaphysics. Thus, a larger value for Planck's constant is not a reason to expect that conflicts between naturalized metaphysics and philosophical anthropology would be more likely. To the contrary, through its study of this hypotheticalquantum influenced lifeworld, this alternate philosophical anthropology would instead become relevant evidence for the fundamental quantum metaphysics. Had Planck's constant been much larger, then the autonomy of philosophical anthropology and naturalized metaphysics would have been lost *in both directions*. In drawing their distinction in terms of those "interested in objective truth rather than philosophical anthropology," Ladyman and

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Ross (and likewise for Barnes and Mikkola) instead give the impression that this is a principled distinction. The present argument, however, suggests that this cannot be so. It is rather a contingent matter of fact—the size of Planck's constant—that ensures the independence of naturalized metaphysics based on quantum mechanics and philosophical anthropology.

Barad, however, seems to insist on the relevance of agential realism, that is, a quantum metaphysics, in all domains even with the actual small size of Planck's constant. One could suppose that this is because Barad regards it to still be large enough for quantum effects to be significant, but instead she dismisses the relevance of the size of the Planck's constant altogether. Speaking again of the ratio between Planck's constant and the mass of an object, Barad writes:

> the fact that this ratio is not strictly zero is the key point. In other words, the fact that Newtonian mechanics provides good approximations to the exact quantum mechanical solutions for many macroscopic situations is not evidence against the new epistemology or ontology suggested by my elaboration of Bohr's account. (2007, 416)

The epistemological and ontological implications of agential realism are unaffected by the size of Planck's constant, which suggests it to be a misconception to regard agential realism as a mere quantum metaphysics whose effects then carry through to the macroscopic domain with an intensity depending on the size of Planck's constant. While the smallness of Planck's constant explains "why we were fooled for so long into thinking that we live in a classical world and that the classical epistemological and ontological assumptions apply" (Barad 2007, 457), the fact that it is non-zero everywhere entails that Newtonian metaphysics does not apply anywhere.

Yet, without further argument, Newtonian metaphysics might still obtain as an approximation in the domain where Newtonian mechanics is a good approximation of quantum mechanics. While Barad rejects this reasoning, she only ever alludes to the argument resisting it. Her point, however, seems to be that the contents of agential realism—such as the rejection of the subject-object and word-world dualisms—are not features whose presence or absence will depend on the size of Planck's constant and, therefore, on the length scale at which a system is described. If the subject-object dualism is absent at the fundamental level, then how could it suddenly come into existence at a higher level of organization in the same reality? Or if representationalism (the word-world dualism) fundamentally fails, then how can it suddenly begin to succeed? The intuition seems to be that these are features of an ontology that are either there or not there. They cannot differ in magnitude and there is therefore no way for them to obtain as better and better approximations as we move to larger length scales. Barad, in other words, seems to argue that such features cannot gradually appear (or diminish) as we zoom out from the fundamental level of reality or when we consider only the larger objects of our lifeworld.

Consider again the case frequently visited by Barad where some agency of observation does a measurement on a quantum object. As already detailed, Barad's interpretation of quantum mechanics entails that neither the observed object nor the agency of observation including the measurement apparatus and the experimenter have independent existence. Rather, they are intra-actively produced within the ontologically primitive phenomena. They form a relational whole that is continuously differentially enacted. Attributing the insight to Bohr, Barad writes, "quantum physics teaches us

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

that the belief in an inherent fixed Cartesian distinction between subject and object is an unfounded prejudice of the classical worldview" (Barad 2007, 359). No subject-object dualism can be sustained in the quantum world or when doing measurements on quantum objects (again remembering that the composition metaphor is only instructional).[27] If we add a couple of neutrons, protons, and electrons to the system being studied, the same conditions will apply. If the subject-object dualism cannot be sustained for, say, a single electron then the same will be the case for a small collection of particles. Barad's monism, however, entails that everything is made up of such quantum particles (or rather the relational whole from which they emerge as particles). Barad's argument that there is no subject-object dualism at any level of description might therefore, as indicated above, be seen as relying on the absence of a good answer to the question of where the subject-object dualism is (re)installed as we move from studying these quantum systems to the entities of our lifeworld. Even if the entanglement between agency of observation and object is negligible for some practical purpose in the macroscopic domain, the entanglement is nevertheless still there. Indeed, Barad warns us not "to confuse practical considerations with more fundamental issues of principle" (Barad 2007, 110). If the entanglement remains, then the subject-object dualism never obtains. If this is so, then the features of agential realism —such as the absence of this dualism—will have to be considered even in our theorizing about the lifeworld assuming that there is only one reality with no ontological stratification. In other words, this (alleged) impossibility of metaphysical approximation is why the implications of quantum metaphysics can be relevant to philosophical anthropology in general and feminist metaphysics in particular.

Stating this in more general terms, if an ontology lacks/contains features that cannot appear/disappear as the result of approximation then these features will be absent/present throughout the ontology regardless of scale. No parameter controls these ontological features such that they can appear/disappear as we go from the fundamental to the higher levels of organization. These features are somehow all or nothing and therefore robust between different levels of ontology. The possible existence of such scale-independent elements of an ontology—possible examples including the mentioned dualisms, representationalism, and (joint carving) notions—is the second and more significant challenge to the truce between naturalized metaphysics and philosophical anthropology. If a naturalized metaphysics contains such features, then they will remain relevant even in theorizing about the lifeworld.

However, whether a metaphysics of individualism holds could similarly be regarded as a question of all or nothing. Either there are individuals, or there are not. Regardless, it seems immediately more agreeable to regard this as something that can obtain through approximation. Circumstances can be such that a fundamentally relational metaphysics can appear to be one of individuals (if they are separable enough). Intuition is perhaps helped here by the integration of Newtonian mechanics and a metaphysics of individualism. Thus, comprehending how Newtonian mechanics can obtain through approximation aids the grasp of a metaphysics of individualism as an approximation on its own. Perhaps subject-object dualism or representationalism could similarly obtain as approximations, though the way they do so remains more elusive.

A general argument favoring such approximation—however incomprehensible the approximation appears—can be to point, once again, to the acknowledged fact that Newtonian mechanics is a good approximation of quantum mechanics at the macroscopic domain. One might argue that the Newtonian metaphysics should consequently

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

also be a good approximation of quantum metaphysics. This could be seen as following from a type of no-miracles argument whereby the success of Newtonian mechanics would be a miracle if Newtonian metaphysics were not even approximately true. This argument can of course be resisted by accepting the miracle and insisting that Newtonian metaphysics is never a good approximation of quantum metaphysics and thus of the fundamental metaphysics, but without further specification this simply begs the question. With this "no metaphysical approximation" argument being only implicit in Barad's work, it is difficult to say how she would respond to this no-miracles argument for metaphysical approximations. However, the idea that metaphysical approximations are impossible (at least for elements such as the mentioned dualisms) serves as a way to argue that there can only be one metaphysics and thereby no principled divisions among branches of metaphysics for instance following a division of fundamental versus non-fundamental. If metaphysical approximations are impossible, then all metaphysics is integrated. This is the radical way in which Barad resolves the tension between mainstream and feminist metaphysics.

## The consequences of no division

Barad's agential realism promotes phenomena as ontologically primitive. These are inseparable wholes from which the objects of investigation and the agency of observation emerge. According to Barad, this holism undermines the metaphysics of individualism. It is intra-actions within phenomena that enact individuals, thus rendering individuals emergent. Furthermore, it challenges established dualisms such as subject-object, knower-known, and word-world.

Relational ontologies and the questioning of the mentioned dualism are arguably not news to feminist metaphysics nor to feminism more generally. Indeed, Barad explicitly mentions several predecessors including Butler (1993), Haraway (1997), and Kirby (1997). Barad's call to abandon the Newtonian metaphysics of individualism, for instance, thus appears less relevant to recent feminist theory, but it is perhaps instead directed at more traditional approaches in (social) metaphysics. Indeed, Maralee Harrell describes Barad as someone "who offers a metaphysical interpretation of quantum mechanics that takes into account not only the views of the theory's creators, but also much recent research in feminist science studies" (Harrell 2016, 27). Arguably, Barad's role in the advent of new materialism does testify to the interesting ideas that agential realism introduces.[28] However, in line with Harrell's remark, the present paper can be seen as arguing that one of Barad's important contributions is exactly of more methodological character when she attempts to integrate ideas already existing in feminism with the fundamentality-focus that quantum mechanics provides for.

Those of Barad's arguments that have been considered here are, as a consequence, not primarily concerned with first-order content of feminism. Rather, they strike this more methodological note in being concerned with the self-image of feminism in general and feminist metaphysics in particular. If feminist metaphysics makes contact with the fundamental metaphysics of quantum mechanics, as Barad argues, then feminist metaphysics does not have to defend its place in metaphysics besides the fundamentality-focused undertakings. Rather, feminist metaphysics is itself, in a sense, fundamental metaphysics and one that can be justified with appeal to quantum mechanics and fundamental science in general just like the traditionally fundamentality-focused naturalized metaphysics.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Barad, however, does not thereby argue that feminist metaphysics should abandon its analysis of the social lifeworld in favor of the details of quantum mechanics. "What is needed is an analysis that enables us to theorize the social and the natural together" (Barad 2007, 25). Indeed, if certain metaphysical features must be the same across all levels of description because they do not admit approximation, then these can arguably be identified and studied at any level. While Barad is mostly concerned with arguing that feminist metaphysics and social theorizing in general must therefore attend to the findings of quantum mechanics, she also seems to argue that fundamentality-focused metaphysics must likewise be sensitive to philosophical anthropology including feminist metaphysics. If careful analysis of our lifeworld for instance indicates that there is no subject-object dualism, then this would, by Barad's argument, be evidence that this dualism is absent at all levels of description, including that of fundamental metaphysics.

Barad's methodological proposal is, as such, that our approach to metaphysics and theorizing more generally must be genuinely interdisciplinary. Importantly, "interdisciplinary" must not here be understood through the "regime of the inter-," as Fitzgerald and Callard (2014, 15) call it, where disciplinary boundaries and disciplines' methods and subject matters (including their overlap) are assumed to be fixed. Rather, they develop, with explicit reference to Barad, a mode of interdisciplinarity—"experimental entanglement"—"where there are neither neatly bordered disciplines nor any clear dispensation regarding which 'objects' of study are appropriate for each" (Fitzgerald and Callard 2014, 16). Barad's argument might indeed be read as the proposal that theorizing must adopt this interdisciplinary mode of experimental entanglement. Adopting this methodology, however, is not a trivial matter. When Barad envisions that the mutuality runs all the way from quantum mechanics to social theorizing, this methodology requires a rather extraordinary degree of attentiveness and responsibility to the totality of inquiry, perhaps best exemplified by the scope of Barad's own work.

The profoundness of this methodology is somewhat precluded by how well Barad's interpretation of quantum mechanics aligns with existing ideas from feminism and feminist metaphysics more particularly. Inquiry, however, is open ended and the eventual vindication of, for instance, Bohmian mechanics (Bohm 1952)—another interpretation of quantum mechanics—is certainly still a possibility. This interpretation rejects the quantum indeterminacy, so central to Barad's interpretation, in favor of an entirely causal ontology of parts *with* well-defined positions, that is, in favor of a metaphysics of individualism.[29] The peculiar effects known from quantum experiments are instead accounted for through the disposition of each localized part of the world to move in ways determined by the position of every other part, a manifestly non-local effect (Esfeld et al. 2014).[30] This, in other words, provides for an inherently dispositional ontology. Where dispositions—such as an object being fragile—are typically regarded as grounded in categorical properties, some dispositions are irreducible according to this version of Bohmian mechanics.

Should our experimental entanglements eventually come to realize this version of Bohmian mechanics and reject agential realism, then material-discursive intra-activity is no longer the common theme of quantum mechanics and feminism. Rather, Bohmian mechanics might support more dispositional approaches to feminism, for instance, Jennifer McKitrick's (2015) dispositional account of gender. Furthermore, the need in Bohmian mechanics for a global sensitivity of the world on the place of its parts might hint at a qualified universalism. Thus, the methodology proposed by Barad—the dismantling of the boundary between the fundamental and the non-

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

fundamental—does have consequences for theorizing. The consequences, however, are dependent on the developments of integrated inquiry, and these developments will therefore determine how the consequences are felt within the traditional disciplinary boundaries. Importantly in this regard, Barad's methodology does not leave us the choice to later recompartmentalize inquiry in response to any unwelcome implications of this integrated inquiry. Metaphysics and theorizing more broadly must be integrated and approached by a diffractive, open-ended methodology that reads the fundamental and non-fundamental through each other. Barad's metaphysics is naturalized, fundamental, and feminist all at once.

**Acknowledgments.** I would like to express my gratitude to Jonathan Knowles, Astrid Rasch, James Ladyman, Claus Halberg, Lucy James, Baptiste Le Bihan, Ragnar Fjelland, and Tuomas Tahko for their valuable feedback on and helpful discussion of earlier drafts of this paper.

## Notes

**1** Ethic-epistem-ontological framework in Barad's own terms (2007, 90).

**2** The broad intended scope of agential realism is for instance exemplified when Barad argues how agential realism is "of interest to researchers in the fields of critical social theory, social and political philosophy, feminist theory, queer theory, political economy, physics, philosophy of physics, ethics, epistemology, science studies, and others" (Barad 2007, 69–70).

**3** Barad may, in this light, be seen as proposing a metaphysical analog of Nelson's (1995) reconciliation of feminist and mainstream epistemology.

**4** It is worth noting that Barad bases agential realism on Bohr's interpretation of quantum mechanics. Barad thereby takes a significant interpretive stand with respect to quantum mechanics and thus its metaphysical implications. Arguably, a similar project based on the many-worlds, spontaneous collapse (GRW), or a Bohmian interpretation of quantum mechanics would yield rather different results. However, this issue is immanent in any quantum mechanics-based naturalized metaphysics and it will therefore not be discussed further here (see Ney 2012 for a discussion of how it may be resolved).

**5** I use "indeterminacy principle" instead of the more common "uncertainty principle" since this signifies that the relations between pairs of complementary properties are not expressions of our lacking knowledge of the system under investigation. They are instead genuinely inscrutable indeterminacies as Barad also argues. See Faye (2019) for more on this distinction.

**6** It is worth pausing here to observe that this is how far consensus extends among Bohr scholars. It remains debated for instance how exactly Bohr viewed the wave function and, relatedly, why Bohr insists that complementary concepts are only meaningful in the relevant experimental context. However, as Faye and Jaksland (2021) find, even with this variety among Bohr scholars, Barad's interpretation of Bohr is rather different from all the other interpretations of Bohr found in the literature.

**7** Barad borrows the notions "phenomenon" and "agencies of observation" directly from Bohr, though she arguably bends their meaning for her own purposes.

**8** This agential cut is thereby different from a Cartesian cut where the separation between subject and object is fixed.

**9** In this respect, agential realism shares some similarity with the type of priority monism defended by Schaffer (2010) and Ismael and Schaffer (2016).

**10** Few other interpretations find that quantum mechanics has implications for meaning and agency, and none of the mainstream interpretations do so. The conclusions that Barad allegedly derive from quantum mechanics regarding meaning and agency should therefore be treated with some caution (see Jaksland 2021 for a discussion). However, as previously stated, the purpose here is not to evaluate the legitimacy of Barad's interpretation of quantum mechanics.

**11** In a few more words, discussions of ontic structural realism often revolve around entanglement and Leibniz' principle of the identity of indiscernibles in many-particle quantum states which are taken to suggest that the objects apparently featuring in the state are ontologically emergent from the whole (see for instance French 1998; Esfeld 2004; Ladyman and Ross 2007, chap. 3).

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

12 It should be noted here that Ladyman and Ross (2007, sec. 1.6) strongly object to "levels"-talk and the idea of a bottom level of reality. By the same reasoning they insist to "displace the micro/macro distinction" (Ladyman and Ross 2007, 57). The levels-talk will be kept here since it features both in discussion about the place of feminist metaphysics and in Barad's work. There are certainly subtle differences between divisions drawn by Mikkola, Barnes, and Ladyman and Ross, but these will not be pursued here. Relatedly, the micro/macro distinction here marks a difference in the typical length scale being studied. This divide is therefore very different from when, for instance, Nick Fox and Pam Alldred call for a new materialist social inquiry that is sensitive to both "the micro/macro scales of social production" (Fox and Alldred 2015, 408). While they distinguish "'micro' (e.g. a consumer transaction) and a 'macro' relation (e.g. a nation-state)" (Fox and Alldred 2015, 402), both are considered macro in the present context. This terminology, however, is not meant to carry any commitment to the relative importance of these levels of description.

13 See van der Tuin (2011) for a more nuanced reflection on this relation to the linguistic turn.

14 That the quantum origin—or perhaps rather the origin in our current best science—plays a role for the reception of agential realism in new materialism is also indicated by remarks such as: "Barad develops her problematization of representational thinking via a detailed account of the scientific apparatus through which reality is observed and measured in quantum physics" (Coleman 2014, 35) and "Karen Barad's (2012b) recent discussions with quantum field theory assist greatly in this endeavour to reconsider negativity" (Hinton 2017, 234).

15 For details about this criticism of traditional, non-naturalized metaphysics see for instance Ladyman and Ross (2007, chap. 1) and Bryant (2020).

16 Other examples of an (implicit) endorsement of this primacy of physics are for instance Maudlin (2007, 1–2) and Morganti (2013, 6–7).

17 In this regard, Barad parts ways with strict naturalized metaphysics as defended by Ladyman and Ross (2007, 27), Maudlin (2007, 1), and Ney (2012, 54) and adopts a more moderate, naturalized metaphysics as expounded by Morganti and Tahko (2017), though the intended role for the philosopher is somewhat different.

18 As Rouse (2004) observes, the commitments that Barad derives from this metaphysical naturalism are notably different from those of most metaphysical naturalists. In particular, she endorses a view of science as inherently normative due to the intra-active nature of the phenomena: "On [Barad's] account, science does not construct a representation of anormative nature but instead actively reconfigures the world as already conceptually articulated and politically consequential" (Rouse 2004, 156). This does *not* imply that Barad rejects metaphysical naturalism but rather that she extracts different conclusions from the deference to the findings of science entailed by metaphysical naturalism.

19 This conception is for instance implicit when Vetlesen asks "how representative, and thereupon generalizable, is the laboratory experiment that Barad continues to hold fast to?" (Vetlesen 2019, 133).

20 Such an analogy relation is exemplified by Haraway's (1992) development of the methodological concept of "diffraction" whose original context, optics, merely serves as analogy or metaphor.

21 This understanding of agential realism as a metaphysical template seems to be implicit in Hollin et al. as exemplified by remarks such as "[a]gential realism is *deployed* across a range of scales" (Hollin et al. 2017, 25; emphasis added), by their suggestion that concepts such as entanglement and diffraction "*travel* with Barad from physics" (Hollin et al. 2017, 936; emphasis added), and when they worry that "the rules that govern quantum realms must *also be deemed applicable* in macro contexts" (Hollin et al. 2017, 936; emphasis added). To the contrary, I shall here defend the reading that agential realism is only deployed and applied once, as an account of fundamental reality. It thus never leaves physics, but rather extends its scope from there to the macroscopic contexts.

22 This multiple instantiation conception is arguably how quantum mechanics is viewed in the generalized/weak quantum mechanics literature (see Atmanspacher et al. 2002; Filk and Römer 2011).

23 A similar observation is made by Hollin et al., when they write: "Quantum physics, for Barad, is resolutely *not* a metaphor but, rather, underpins agential realism's articulation of how the material world is brought into being" (Hollin et al. 2017, 935).

24 Even though Barad here refers to quantum mechanics as a "theory," this should not be considered an attempt to abstract away experiments and the scientific practice, as Longino (1987), for instance, has warned against. Indeed, Barad (2007, chap. 7) is very mindful of the experimental practice associated with quantum mechanics, as Ginev remarks, agential realism is very much an "ontology of knowing-within-practices" (Ginev 2016, 69).

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

**25** Aside from her commitment to these central tenets of naturalized metaphysics, it has elsewhere been argued that Barad endorses other naturalist attitudes including: "the continuity between philosophy and science; the insistence that philosophical explication of science be accountable to ongoing scientific practice; a thoroughgoing materialism (albeit in the sense of agential materiality, not a more traditional physicalism); and the rejection of any appeal to the magical or supernatural" (Rouse 2004, 156–57).

**26** Exactly how Newtonian mechanics is obtained as a limit of quantum mechanics is still shrouded in some mystery though the decoherence theory—pioneered by Zeh (1970)—has come a long way in explaining this transition (see Zeh 1996 and Schlosshauer 2007 for accessible introductions). The details are not important here, since the present concern is simply that that this quantum-to-classical transition does in fact occur, which is confirmed by the success of Newtonian physics in the macroscopic domain.

**27** Arguably, this and the other dualisms that Barad discusses are most commonly cast as epistemological rather than ontological dichotomies. However, the agentiality of composition and the materiality of meaning in agential realism (partially) collapses the distinction between ontology and epistemology or at least renders epistemological categories more sensitive to ontology (Hollin et al. 2017, 933).

**28** Readers more interested in Barad's first-order contributions rather than the methodological issues discussed here are referred to, e.g., Fairchild and Taylor 2019 and references therein.

**29** As Marij van Strien (2020) argues, the classicality of this interpretation is often overemphasized. Indeed, Bohm himself saw interesting commonalities between his interpretation and postmodernism (van Strien 2020, sec. 8).

**30** As Esfeld et al. write: "in virtue of standing in certain spatial or spatio-temporal relations, the particles have the disposition to move in a certain manner" (Esfeld et al. 2014, 790). Notice that there are somewhat different ways of rendering this global guidance of parts, see, for instance, Belot (2012) for a criticism of the disposition account and for some alternatives.

## References


Alaimo, Stacy, and Susan Hekman. 2008. Introduction: Emerging models of materiality in feminist theory. In *Material feminisms*, ed. Stacy Alaimo and Susan Hekman. Bloomington, IN: Indiana University Press.

Atmanspacher, Harald, Hartmann Römer, and Harald Walach. 2002. Weak quantum theory: Complementarity and entanglement in physics and beyond. *Foundations of Physics* 32 (3): 379–406.

Barad, Karen. 2003. Posthumanist performativity: Toward an understanding of how matter comes to matter. *Signs: Journal of Women in Culture and Society* 28 (3): 801–31.

Barad, Karen. 2007. *Meeting the universe halfway*. Durham, NC: Duke University Press.

Barad, Karen. 2010. Quantum entanglements and hauntological relations of inheritance: Dis/continuities, spacetime enfoldings, and justice-to-come. *Derrida Today* 3 (2): 240–68.

Barad, Karen. 2011. Erasers and erasures: Pinch's unfortunate "uncertainty principle." *Social Studies of Science* 41 (3): 443–54.

Barad, Karen. 2012a. Nature's queer performativity*. *Kvinder, Køn & Forskning* 0 (1–2).

Barad, Karen. 2012b. On touching—the inhuman that therefore I am. *Differences* 23 (3): 206–23.

Barad, Karen. 2014. Diffracting diffraction: Cutting together-apart. *Parallax* 20 (3): 168–87.

Barnes, Elizabeth. 2014. XV—Going beyond the fundamental: Feminism in contemporary metaphysics. *Proceedings of the Aristotelian Society* 114 (3/3): 335–51.

Belot, Gordon. 2012. Quantum states for primitive ontologists. *European Journal for Philosophy of Science* 2 (1): 67–83.

Bennett, Karen. 2016. There is no special problem with metaphysics. *Philosophical Studies* 173 (1): 21–37.

Bohm, David. 1952. A suggested interpretation of the quantum theory in terms of "hidden" variables. I. *Physical Review* 85 (2): 166–79.

Bryant, Amanda. 2020. Keep the chickens cooped: The epistemic inadequacy of free range metaphysics. *Synthese*, 197: 1867–87.

Butler, Judith. 1993. *Bodies that matter: On the discursive limits of "sex."* New York: Routledge.

Chakravartty, Anjan. 2013. On the prospects of naturalized metaphysics. In *Scientific Metaphysics*. Oxford: Oxford University Press.

Coleman, Rebecca. 2014. Inventive feminist theory: Representation, materiality and intensive time. *Women: A Cultural Review* 25 (1): 27–45.


https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Crasnow, Sharon. 2013. Feminist philosophy of science: Values and objectivity. *Philosophy Compass* 8 (4): 413–23.
De Freitas, Elizabeth. 2016. Karen Barad. In *Alternative theoretical frameworks for mathematics education research: Theory meets data*, ed. Elizabeth de Freitas and Margaret Walshaw. Cham: Springer International Publishing.
Dolphijn, Rick, and Iris Van der Tuin. 2012. *New materialism: Interviews and cartographies*. London: Open Humanities Press.
Esfeld, Michael. 2004. Quantum entanglement and a metaphysics of relations. *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 35 (4): 601–17.
Esfeld, Michael, Mario Hubert, Dustin Lazarovici, and Detlef Dürr. 2014. The ontology of Bohmian mechanics. *British Journal for the Philosophy of Science* 65 (4): 773–96.
Fairchild, Nikki, and Carol Taylor. 2019. Barad, Karen. In *SAGE research methods foundations*, ed. P. Atkinson, S. Delamont, J. W. Sakshaug, and R. A. Williams. London: SAGE. https://dx.doi.org/10.4135/9781526421036808757
Faye, Jan. 2019. Copenhagen interpretation of quantum mechanics. In *The Stanford encyclopedia of philosophy*, ed. Edward N. Zalta. Winter 2019 edition. https://plato.stanford.edu/archives/fall2014/entries/qm-copenhagen/
Faye, Jan, and Rasmus Jaksland. 2021. Barad, Bohr, and quantum mechanics. *Synthese* 199: 8231–55.
Filk, Thomas, and Hartmann Römer. 2011. Generalized quantum theory: Overview and latest developments. *Axiomathes* 21 (2): 211–20.
Fitzgerald, Des, and Felicity Callard. 2014. Social science and neuroscience beyond interdisciplinarity: Experimental entanglements. *Theory, Culture and Society* 32 (1): 3–32.
Fox, Nick J., and Pam Alldred. 2015. New materialist social inquiry: Designs, methods and the research-assemblage. *International Journal of Social Research Methodology* 18 (4): 399–414.
French, Steven. 1998. On the whithering away of physical objects. In *Interpreting bodies*, ed. Elena Castellani. Princeton: Princeton University Press.
Gamble, Christopher N., Joshua S. Hanan, and Thomas Nail. 2019. What is new materialism? *Angelaki* 24 (6): 111–34.
Ginev, Dimitri. 2016. *Hermeneutic realism: Reality within scientific inquiry*. Cham: Springer International Publishing.
Götschel, Helene. 2011. The entanglement of gender and physics: Human actors, work place cultures, and knowledge production. *Science and Technology Studies* 24 (1): 66–80.
Haraway, Donna. 1988. Situated knowledges: The science question in feminism and the privilege of partial perspective. *Feminist Studies* 14 (3): 575–99.
Haraway, Donna. 1992. The promises of monsters: A regenerative politics for inappropriate/d others. In *Cultural studies*, ed. Lawrence Grossberg, Cary Nelson, and Paula A. Treichler. New York: Routledge.
Haraway, Donna. 1997. *Modest−witness@second−millennium.femaleman−meets−oncomouse: Feminism and technoscience*. New York: Routledge.
Harding, Sandra. 1986. *The science question in feminism*. Ithaca, NY: Cornell University Press.
Harding, Sandra. 1991. *Whose science? Whose knowledge?* Ithaca, NY: Cornell University Press.
Harrell, Maralee. 2016. On the possibility of feminist philosophy of physics. In *Meta-philosophical reflection on feminist philosophies of science*, ed. Maria Cristina Amoretti and Nicla Vassallo. Cham: Springer.
Hawley, Katherine. 2018. Social science as a guide to social metaphysics? *Journal for General Philosophy of Science* 49 (2): 187–98.
Hinton, Peta. 2017. A sociality of death: Towards a new materialist politics and ethics of life itself. In *What if culture was nature all along?*, ed. Vicki Kirby. Edinburgh: Edinburgh University Press.
Hollin, Gregory, Isla Forsyth, Eva Giraud, and Tracey Potts. 2017. (Dis)entangling Barad: Materialisms and ethics. *Social Studies of Science* 47 (6): 918–41.
Inwagen, Peter van. 2015. *Metaphysics*. Boulder, CO: Westview Press.
Ismael, Jenann, and Jonathan Schaffer. 2020. Quantum holism: Nonseparability as common ground. *Synthese* 197: 4131–60.
Jaksland, Rasmus. 2021. Norms of testimony in broad interdisciplinarity: The case of quantum mechanics in critical theory. *Journal for General Philosophy of Science* 52: 35–61.
Keller, E. F. 1995. *Reflections on gender and science*. New Haven: Yale University Press.
Kirby, Vicki. 1997. *Telling flesh: The substance of the corporeal*. New York: Routledge.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Kirby, Vicki. 2017. Matter out of place: "New materialism" in review. In *What if culture was nature all along?*, ed. Vicki Kirby. Edinburgh: Edinburgh University Press.
Kornblith, Hilary. 2016. Philosophical naturalism. In *The Oxford handbook of philosophical methodology*, ed. Herman Cappelen, Tamar Szabó Gendler, and John Hawthorne. Oxford: Oxford University Press.
Ladyman, James, and Don Ross. 2007. *Every thing must go: Metaphysics naturalized*. Oxford: Oxford University Press.
Longino, Helen. 1987. Can there be a feminist science? *Hypatia* 2 (3): 51–64.
Longino, Helen. 1990. *Science as social knowledge*. Princeton: Princeton University Press.
Lowe, E. J. 1998. *The possibility of metaphysics: Substance, identity, and time*. Oxford: Oxford University Press.
Maudlin, Tim. 2007. *The metaphysics within physics*. Oxford: Oxford University Press.
McKitrick, Jennifer. 2015. A dispositional account of gender. *Philosophical Studies* 172 (10): 2575–89.
Mikkola, Mari. 2015. Doing ontology and doing justice: What feminist philosophy can teach us about meta-metaphysics. *Inquiry* 58 (7–8): 780–805.
Mikkola, Mari. 2017. On the apparent antagonism between feminist and mainstream metaphysics. *Philosophical Studies* 174 (10): 2435–48.
Morganti, Matteo. 2013. *Combining science and metaphysics*. London: Palgrave Macmillan.
Morganti, Matteo, and Tuomas E. Tahko. 2017. Moderately naturalistic metaphysics. *Synthese* 194 (7): 2557–80.
Nelson, Lynn Hankinson. 1990. *Who knows: From Quine to a feminist empiricism*. Philadelphia: Temple University Press.
Nelson, Lynn Hankinson. 1995. The very idea of feminist epistemology. *Hypatia* 10 (3): 31–49.
Nelson, Lynn Hankinson. 2002. Feminist philosophy of science. In *The Blackwell guide to the philosophy of science*, ed. Peter Machamer and Michael Silberstein. Oxford: Blackwell.
Ney, Alyssa. 2012. Neo-positivist metaphysics. *Philosophical Studies* 160 (1): 53–78.
Passinsky, Asya. 2019. Finean feminist metaphysics. *Inquiry* 64 (9): 937–54.
Pinch, Trevor. 2011. Karen Barad, quantum mechanics, and the paradox of mutual exclusivity. *Social Studies of Science* 41 (3): 431–41.
Richardson, Sarah S. 2010. Feminist philosophy of science: History, contributions, and challenges. *Synthese* 177 (3): 337–62.
Rouse, Joseph. 2004. Barad's feminist naturalism. *Hypatia* 19 (1): 142–61.
Schaffer, Jonathan. 2009. On what grounds what. In *Metametaphysics: New essays on the foundations of ontology*, ed. David Chalmers, David Manley, and Ryan Wasserman. Oxford: Oxford University Press.
Schaffer, Jonathan. 2010. Monism: The priority of the whole. *Philosophical Review* 119 (1): 31–76.
Schaffer, Jonathan. 2017. Social construction as grounding; or: Fundamentality for feminists, a reply to Barnes and Mikkola. *Philosophical Studies* 174 (10): 2449–65.
Schlosshauer, Maximilian. 2007. *Decoherence: And the quantum-to-classical transition*. Cham: Springer.
Sider, Theodore. 2011. *Writing the book of the world*. Oxford: Oxford University Press.
Sider, Theodore. 2017. Substantivity in feminist metaphysics. *Philosophical Studies* 174 (10): 2467–78.
Teller, Paul. 1986. Relational holism and quantum mechanics. *British Journal for the Philosophy of Science* 37 (1): 71–81.
Van der Tuin, Iris. 2011. New feminist materialisms. *Women's Studies International Forum* 34 (4): 271–77.
Van Strien, Marij. 2020. Bohm's theory of quantum mechanics and the notion of classicality. *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 71: 72–86.
Vetlesen, Arne Johan. 2019. *Cosmologies of the anthropocene*. London: Routledge.
Whitten, Barbara L. 1996. What physics is fundamental physics? Feminist implications of physicists' debate over the superconducting supercollider. *NWSA Journal* 8 (2): 1–16.
Willey, Angela. 2016. A world of materialisms: Postcolonial feminist science studies and the new natural. *Science, Technology, and Human Values* 41 (6): 991–1014.
Wylie, Alison. 2012. Feminist philosophy of science: Standpoint matters. *Proceedings and Addresses of the American Philosophical Association* 86 (2): 47–76.
Zeh, H. D. 1970. On the interpretation of measurement in quantum theory. *Foundations of Physics* 1 (1): 69–76.

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press

Zeh, H. D. 1996. Basic concepts and their interpretation. In *Decoherence and the appearance of a classical world in quantum theory*, ed. Erich Joos, H. D. Zeh, Claus Kiefer, Domenico Giulini, Joachim Kupsch, and Ion-Olimpiu Stamatescu. Berlin and Heidelberg: Springer Berlin Heidelberg.

Zinkernagel, Henrik. 2016. Niels Bohr on the wave function and the classical/quantum Divide. *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 53: 9–19.

**Rasmus Jaksland** has a PhD in philosophy from the Norwegian University of Science and Technology. He holds a BA and MA in physics and a BA and MA in philosophy, all from the University of Copenhagen where he is also currently a postdoc. His research focuses on the meeting between philosophy and science with a special emphasis on quantum theory. This includes more methodological work on how this meeting should be negotiated as well as first-order investigations into the philosophical consequences of quantum theory. Recent papers include "Barad, Bohr, and quantum mechanics" (Synthese) and "Norms of testimony in broad interdisciplinarity: The case of quantum mechanics in critical theory" (General Journal for Philosophy of Science).

**Cite this article:** Jaksland R (2024). Naturalized, Fundamental, and Feminist Metaphysics All at Once: The Case of Barad's Agential Realism. *Hypatia* **39**, 363–384. https://doi.org/10.1017/hyp.2023.114

https://doi.org/10.1017/hyp.2023.114 Published online by Cambridge University Press