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Distinguishing two (unsound) arguments for quantum social science

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Abstract

Quantum mechanics supersedes classical mechanics, and social science, some argue, should be responsive to this change. This paper finds that two rather different arguments are currently being used to argue that quantum mechanics is epistemically relevant in social science. One, attributed to Alexander Wendt, appeals to the presence of quantum physical effects in the social world. The other, attributed to Karen Barad, insists on the importance of quantum metaphysics even when quantum effects are negligible. Neither argument, however, is sound. Consequently, the paper concludes that neither of them offers compelling arguments for the view that quantum mechanics has epistemic relevance for social science.

Keywords Karen Barad · Alexander Wendt · Quantum mechanics · Quantum social science · Metaphysical approximation · Social theory

1 Introduction

Is quantum mechanics relevant for the social sciences and the humanities? If the absence of training in quantum mechanics among researchers in these fields is any indication, the received view is that this question can be answered in the negative. In recent years, however, several authors have advocated an answer in the affirmative: The humanities and social sciences must take quantum mechanics into consideration in their theorizing. More precisely, quantum mechanics has been used to justify certain approaches in social theory, and its relevance is therefore more than that of an interesting analogy.

Karen Barad (2003, 2007) and Alexander Wendt (2015) are arguably the two most prominent proponents of this view. Wendt's book *Quantum Mind and Social Science*

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had received more than 600 Google Scholar citations in May 2023 and Barad's *Meeting the Universe Halfway* more than 19,000. Both are revered as pioneers of "quantum social theory, which can be described as an emerging field of research that considers the wider, macroscale social implications of quantum theory" (O'Brien, 2016, 620). This paper, however, shows that they offer rather different arguments to the effect that quantum mechanics is epistemically relevant in social theory. Wendt argues that quantum physical effects play an important, but so far unnoticed, role in the unfolding of events in our lifeworld. In contrast, Barad, at least in one interpretation, offers the more principled argument that quantum *metaphysics* is the only proper starting point for all theorizing even where quantum physical effects are negligible for all practical purposes. The two arguments are partly reconstructions since both Barad and Wendt tend to defend their views with generic appeals to the progress of science and the fact that physicists regard quantum mechanics, and not for instance classical mechanics, as our current best description of the world. One contribution of this paper is therefore to explicate these arguments.

Section 3 explores Wendt's argument that there are quantum physical effects in the social world. Section 4 develops an argument from the impossibility of metaphysical approximation which is proposed to be Barad's principled reason why quantum metaphysics should be the starting point for all theorizing. In distinguishing between these two arguments, the paper finds that some of the existing criticism of Wendt is, in fact, more appropriately directed at Barad. But both of these arguments nevertheless face rather severe challenges. This is not to say that either of them can be dismissed entirely, but the present discussion suggests that neither of these arguments that quantum mechanics has epistemic relevance for social theory is currently compelling. As Section 5 shows, this is not the same as saying that the classical worldview is entirely vindicated. The paper does argue that social theory should restrict itself to the modes of communication and interaction between actors that are prescribed by classical mechanics. The paper, however, also argues that the metaphysics of classical mechanics and quantum mechanics, respectively, are on epistemic equal ground when it comes to informing our metaphysical background assumptions in social theory. Indeed, if metaphysical approximation is impossible, as Barad seems to argue, then neither classical metaphysics nor quantum metaphysics can claim any special status through their association with a successful scientific theory, contrary to what Barad intends with this argument. The metaphysical background assumptions in social theory must consequently be judged on the service they do in our account for the social world and not by some alleged origin in natural science.

In focusing on *why* quantum mechanics, according to Barad and Wendt, requires changes to social theory, this paper will not detail *what* Wendt or Barad is proposing should be different in social theory. Neither will the paper enter the debate to what extent social theory is actually currently dominated by a classical worldview. One can even rightly question whether classical mechanics has a foundational core that unambiguously determines what that worldview is (Wilson, 2013). Is it, at its core, a theory of point masses or rigid bodies? Does it include action-at-a-distance forces such as gravity? What about electromagnetism and fields more generally? When this paper nevertheless continues to use the term 'classical,' this is to capture the shared sentiment in Wendt and Barad's arguments that quantum mechanics requires that certain assumptions that they associate with the "classical" have to change. The discussion of their respective arguments will exemplify what they take to be central aspects of the original classical view. It can be mentioned already here, though, that the introduction of entanglement in quantum mechanics is crucial to both. Thus, one central difference, as they see it, is the failure of separability in quantum mechanics with its physical and metaphysical consequences which arguably is one, if not the most unambiguous difference between classical mechanics and quantum mechanics (see, e.g., Paneru et al., 2020).

Whether quantum mechanics could have relevance as analogy or inspiration for social theory is not considered either since the focus is variants of the claim that the success of quantum mechanics somehow forces us to adopt a particular kind of theory in social science, i.e., the claim that quantum mechanics can be an *epistemic* justification for a particular theory or theorizing (and, possibly, be evidence against competing theories). This is what will be meant here by quantum mechanics being *epistemically* relevant in social science.

2 Quantum social science

Both Wendt and Barad motivate their call to take quantum mechanics into consideration in social theory with the observation that, while quantum mechanics has long superseded classical mechanics, a largely classical worldview is still predominant in current social theory. Alexander Wendt recounts that.

> [b]y the early twentieth century the metaphysical assumptions of the classical worldview – materialism, determinism, locality, and so on – were deeply ingrained in the minds of social scientists. These assumptions were taken to be true of reality as a whole, and thus fundamental constraints on social scientific inquiry (Wendt, 2015, 12).

He goes on to show that this classical worldview has since then been a central part of social science despite the intermediate development of quantum theory. Wendt, however, argues that "if human beings really are quantum, then classical social science is founded on a mistake, and social life will therefore *require* a quantum framework for its proper understanding" (Wendt, 2015, 4, emphasis in original). What is needed, according to Wendt, is a "quantum social science" (Wendt, 2015, 1).

Karen Barad (2003, 2007) promotes a similar view when she argues that it is time for a "rethinking [of] our best social theories in terms of our best understanding of the nature of nature" (Barad, 2007, 30). It is in particular our underlying assumptions in social theory that must be revised: "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).[1] Our theorizing,

[1] It should be noted that Barad also finds a role for social theorizing in the understanding of science and its practice as indicated when she follows up the quoted remark with the qualification: "And likewise we need to bring our best social and political theories to bear in reassessing how we understand social phenomena, including the material practices through which we divide the world into the categories of the 'social' and the 'natural'" (Barad 2007, 24–25).

according to Barad, must be based on our current best physical theories and not on old or outdated physical and metaphysical ideas about the world. Focusing, like Wendt, on the shift from classical classical mechanics to quantum mechanics, Barad observes how "[q]uantum physics supersedes Newtonian physics; it does not merely supplement it" (Barad, 2007, 279). All domains of inquiry must therefore consider "*what* philosophical issues are raised and *what* concepts might need to be rethought if we take quantum physics seriously, even though this method may not help us to understand *how* the issues can be resolved and the relevant concepts reconceptualized" (Barad, 2007, 20, emphasis in original). Quantum mechanics does not eclipse other fields of inquiry – indeed Barad defends a mutual dependence between science and social theory – but quantum mechanics can show that some elements of our theorizing must be reconsidered.

According to Wendt and Barad, quantum mechanics is relevant for social theory, and quantum mechanics can therefore not be ignored in the social sciences and the humanities. Their reasoning, it seems, is that since quantum mechanics has superseded classical mechanics in physics, much of our social theorizing must be updated to avoid it being based on an outdated worldview. As discussed below, there are more ways to fill in the details of this argument which will reveal differences between Barad and Wendt's views. But this more generic formulation serves to capture the common commitment of those who have recently argued that quantum mechanics is relevant for social theory which, besides Wendt and Barad, includes Kirby (2011), Grandy (2010), and Nadeau and Kafatos (2001), Tamdgidi (2020), among others. They argue variously that social theory must somehow be responsive to (the larger) changes in physics, at least as they relate to the move from classical to quantum mechanics.

Importantly, this goes beyond the observation that developments in physics – such as quantum mechanics – can be an inspiration for social theorizing. Quantum mechanics can of course also be relevant and important as an inspiration. Donna Haraway (1992), for instance, introduces the helpful methodological concept 'diffraction' through an analogy to quantum optics, but the important difference is that Haraway does not invoke quantum optics as a justification or support for the use of this concept in social theory.[2] The truth of quantum optics (or Haraway's account of it) is irrelevant for diffraction as a methodological concept in social theory. In contrast, both Barad and Wendt insist that quantum mechanics in their accounts is more than an analogy. About his argument that human beings "are walking [quantum] wave functions", Wendt adds: "I intend the argument not as an analogy or metaphor, but as a realist claim about what people really are" (Wendt, 2015, 3). Barad is even more explicit that she is interested in *deriving* the consequences of quantum mechanics: "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

[2] Other examples of this inspirational use of quantum mechanics in social theorizing includes Haven and Khrennikov's (2013) use of ideas from quantum mechanics in decision-making and economics, Wegter-McNelly's (2011) explication of divine relationality through quantum entanglement, and Zohar and Marchall's (1990; 1994) work on the quantum self and quantum society.

quantum physics forces us to confront" (Barad, 2007, 24).[3] According to Wendt and Barad, the relevance of quantum mechanics in social theory goes beyond that of an analogy, metaphor, inspiration, or heuristic.[4] They argue that the relevance of quantum mechanics is epistemic in social theory. Quantum mechanics provides epistemic warrant for particular approaches and can show that other approaches are unjustified.

In all its forms, this argument is faced with the objection that the human and social domain, our lifeworld, comprises an independent level of reality. According to this view, quantum mechanics is entirely irrelevant for social theory since it concerns a different level of reality (Everth & Gurney, 2022). While Barad considers this possibility, and even explicitly rejects reductionism (Barad, 2007, 24), she argues that "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). Being "the correct theory of nature at all scales," quantum mechanics does (at least in principle) apply everywhere, also at the length scales typically considered in social and human science.[5] Appealing to the principle of the causal closure of physics,[6] Wendt similarly argues that "everything that exists and occurs in nature, including social life, is constrained by the laws of physics" (Wendt, 2015, 10). The ongoings in the lifeworld are, in Wendt's view, subject to the constraints coming from the laws of physics and thus from quantum mechanics. Since Barad and Wendt's arguments that quantum mechanics is epistemically relevant in social theory would otherwise be a non-starter, they will here be granted the assumption that reality is not separated into multiple causally insulated levels. Fundamental physics will therefore be assumed to partake in the explanation even of lifeworld phenomena. Part of the purpose of this paper is to show that even granting this assumption, their arguments for quantum social science are not compelling.

3 Quantum physical effects in the social world

Wendt finds that the classical Newtonian worldview has been and still is predominant in much of social theory, but this worldview, Wendt speculates, may be leading social scientific inquiry astray. In support of this claim, Wendt argues

[3] Some interpret Barad as only arguing that the same ethico-onto-epistemology, that of agential realism, can be applied to reveal unseen structures in many different domains those of quantum mechanics and social theory. I follow here, however, those who interpret Barad as making the stronger claim that quantum mechanics forces us, as this quote also suggests, to employ agential realism, also in other contexts (see, e.g., Everth and Gurney 2022; Faye and Jaksland 2021; Holzhey 2021).

[4] Focusing on quantum inspired approaches to international relations (like that of Wendt), Michael Murphy (2021) objects that casting the role of quantum mechanics as a dichotomy between actuality and analogy is too simplistic. However, since quantum mechanics appears to have no *epistemic* relevance in the additional uses of it in international relations identified by Murphy, this objection is of little consequence here.

[5] Barad does, however, add that "it's an empirical question whether or not there are different ontologies at different length scales, but at least so far there is no evidence that that is the case, and contemporary physics does not incorporate such a belief" (Barad 2007, 408).

[6] See Vincente (2006; 2011) for an introduction.

that there are several anomalies in contemporary social science: both problems or debates that seems to resist resolution and particular cases where central assumptions of social science appear to fail. As Sven Steinmo remarks in a review of Wendt's book, the latter claim can hardly be controversial among social scientists today observing that "once scientists began actually investigating how real people behaved, we discovered that the foundational models of much of modern social science were simply wrong" (Steinmo, 2017, 191). Wendt gives as an example the deviations from (alleged) rational behavior. While more traditional attempts to explain these anomalies have been ad hoc and at best partial on Wendt's view, "quantum decision theory shows that they are not anomalies at all, but precisely what we should expect" (Wendt, 2015, 4).

One example of these anomalies is experiments with the Prisoners' dilemma (Shafir & Tversky, 1992). The Prisoners' dilemma is a two-player game where each player can either choose to cooperate or defect. The experiment is structured in such a way that the monetary payoffs for each player are ranked as follows: First, the player defects and the other corporates; second, both players cooperate; third, both players defect; and fourth, the player cooperates and the other player defects. Knowing that the other player defects, a player will get the highest payoff by defecting as well. Knowing that the other player cooperates, a player will get the highest payoff by defecting. This is reflected in the results of the experiment: When told that the other player defected, 96% chose to defect as well, and when told that the other player cooperated, 84% chose to defect (Shafir & Tversky, 1992, 455). The anomaly is that when test subjects were not told what the other player did, only 63% chose to defect. This is anomalous because the same test subjects clearly preferred to defect irrespective of what they were told the other player did.

Quantum decision theory claims that this result can be explained by the presence of entanglement in the case where the choice of the other player is unknown (Yukalov & Sornette, 2013, 2014). Most straightforwardly, one could propose that the dichotomous choice of the two players were entangled. However, in the experiment, players were only *told* that they were playing with other players while they in fact were not. The entanglement must therefore be between different mental states *within* each test subject. The proposal is that the test subject's belief about what the "other player" did is entanglement with what the test subject intends to do. The presence of entanglement results in interference that can change the payoff structure compared to what is predicted by classical probability theory. Tinkering with the entanglement such that the quantum correlation between the mental states of each person varies around some mean, quantum mechanics yields the probability that 66% percent should defect when they do not know what the other player did (Yukalov & Sornette, 2014, 51). This is indeed very close to the 63% of the experiment, and this frequency of choices might therefore be explained by the presence of such quantum correlations that have no counterpart in classical probability theory. When told what the other player did, the classical result is still recovered because this information collapses the wave function relating to the test subject's belief about the other player's action whereby the entanglement disappears.

Quantum decision theory is an instance of weak quantum theory which employs a generalized quantum formalism beyond microphysics (e.g. Atmanspacher, 2013; Atmanspacher et al., 2002; Busemeyer & Bruza, 2012). However, weak quantum theory typically refrains from speculating whether the reason for the efficacy of the generalized quantum formalism in cases like quantum decision theory is ultimately quantum or classical. Wendt, in contrast, takes the (apparent) resolution of these anomalies by quantum decision theory as evidence for a new foundational framework: "While this 'as if' strategy has pragmatic attractions, it overlooks the fact that quantum decision theory's success at the behavioral level fulfills a key prediction of a controversial hypothesis about what is happening deep inside the brain: quantum consciousness theory" (Wendt, 2015, 5). The quantum consciousness theory is central for Wendt's claim that quantum mechanics is epistemically relevant in social theory. Inspired by work of Hameroff and Penrose (e.g. 1996a, b; 2014), among others, that describes consciousness as a quantum mechanical phenomenon, Wendt proposes that the conscious brain can serve as an amplifier of quantum effects to the macroscopic world: "Quantum brain theory hypothesizes that the brain can sustain quantum coherence – a wave function – at the macro, whole-organism level" (Wendt, 2015, 30). On this view, the brain can be in a superposition of, for instance, multiple mental states, and they can even become entangled (perhaps even with those of other brains); "human behavior should have quantum characteristics, which quantum decision theory bears out" (Wendt, 2015, 5). These quantum characteristics of human behavior would violate the prediction of classical probability theory, whereby any social scientific inquiry – where human behavior is a central object of study – would fall short if it were based on this classical worldview.

Wendt's argument is an instance of the most obvious proposal for how quantum mechanics can be epistemically relevant in social theory: that (part of) the field of subject of social theory features physical quantum effects that are incompatible with classical physics. The departure from classical physics is an important qualification. Much of what we see around us could be cast as quantum phenomena. Matter, for instance, would not be stable without the peculiar Fermi–Dirac statistics obeyed by fermions in quantum mechanics (Lieb & Seiringer, 2009). Thus, even the gathering of matter into (relatively) stable objects such as human beings is the result of effects peculiar to quantum mechanics and therefore, in a sense, a quantum phenomenon at the "macro, whole-organism level," as Wendt puts it above. However, this pervasiveness of macro phenomena that needs quantum mechanics for their explanation does not in itself entail that quantum mechanics is of any significance in social theory. Despite the intricate quantum mechanical effects that must be invoked to explain it, stable matter – such as enduring objects including human beings – is arguably already included in the classical worldview. In this case, quantum mechanics reproduces or recovers classical physics and explains why the assumption of stable matter in classical physics works at a sufficiently coarse-grained level of description. The stability of matter is not a "quantum characteristic" in Wendt's sense but a shared characteristic between classical and quantum physics. Wendt's "quantum characteristics" are rather those *physical* effects that violate classical physics. If there are quantum characteristics at the macro, whole-organism level, then "a classical CCP [causal closure principle] will misrepresent minds and society in the same way that classical physics misrepresents sub-atomic particles" (Wendt, 2022, 194).

What should be counted as quantum characteristics thus clearly depends on what is regarded as part of classical physics. Different physical effects will be considered quantum characteristics if classical physics is rigid bodies interacting via contact forces than if fields or action-at-a-distance are included. However, the effects of entanglement that much of Wendt's argument depends on are, if they are truly due to quantum entanglement, rather unambiguously non-classical, despite the existence of what has come to be known as "classical entanglement" (Paneru et al., 2020). Wendt's argument, in other words, is a good example of what will be denoted *the argument from quantum physical effects in the social world* in the following: that quantum mechanics is epistemically relevant in social theory because there are *physical* effects in the field of subject of social theory that are incompatible with the classical worldview. What might be other examples of this argument form will depend on what different people in social theory take to be part of the classical worldview, which echoes the ambiguity about the term 'classical' already mentioned in the introduction.

Nevertheless, it is, in a sense, rather remarkable if some of the instantiations of this argument are *not* sound. Taking an example from Sabine Hossenfelder, our body is kept upright by our bones, our bones are made of calcium atoms, (typical) calcium atoms are made of 20 electrons, 20 neutrons, and 20 protons where the latter two are again made up of quarks. However, we kept ourselves upright long before we discovered any of these facts: "much of the information from the smaller things, it turns out, isn't relevant to understanding the larger things" (Hossenfelder, 2018, 44). "Intuitively you have known this all your life [...]," as Hossenfelder notes in relation to the bone example and continues: "But conceptually this lack of influence is absolutely astonishing. Given the enormous number of individual constituents, why doesn't all this atomic substructure lead to behavior that's exceedingly difficult to pin down?" (Hossenfelder, 2018, 42). It is absolutely astonishing, as Hossenfelder puts it, that we can live and die without knowing anything of quantum mechanics and by implication, astonishing if no version of the argument from quantum physical effects in the social world is sound. This is worth keeping in mind in the assessment of Wendt's argument. There are no principled reasons why Wendt could not be right. Rather, it is a contingent circumstance if quantum physical effects prove to be irrelevant for social theory. When several authors rightly argue that Wendt's argument is most likely not sound, as outlined below, it is important to appreciate that it is the details of the physics that disprove Wendt and not general philosophical arguments that the proposal is ill conceived.

The criticism of Wendt's proposal that there are quantum physical effects influencing the social domain features three main themes: quantum decoherence, quantum decision theory, and the metaphysics of quantum mechanics. Quantum decoherence is central to the criticism raised by Dawid Waldner (2017), Daniel Little (2018), and Matthew Donald (2018), among others, that quantum effects are filtered out in open macroscopic systems like those studied in social science. Decoherence is the technical term for this process where a quantum system almost inevitably becomes entangled with its environment to the effect that interference between superposed states disappears and calculations of probabilities for the possible measurement outcomes can be based on classical probability theory (Schlosshauer, 2007). Wendt is well aware of this effect but speculates that the brain is somehow decoherence-free. However, as Waldner (2017, 225) in particular makes clear, there are several general reasons why we should be skeptical of this speculation. Since these are well-documented elsewhere, they will not be repeated here (see, in particular, Waldner, 2017). More recently, Kaushik Naskar (2021) has shown that also the specific example of the quantum Prisoners' dilemma transition to its classical counterpart in the presence of decoherence. The decoherence criticism does not amount to a rejection of Wendt's proposal, but it shows that this proposal "is based on a long series of low-probability wagers" (Waldner, 2017, 202), and these low-probability wagers will have to be made by any variant of the argument from quantum physical effects in the social world.

Thus, Wendt's quantum brain theory is highly unlikely from the perspective of what is known about how decoherence, and thus quantum mechanics, works in the actual world. Wendt, however, cites quantum decision theory as direct evidence that there is something quantum mechanical about our decisions and thus our brains. Already, Waldner, Little, and Donald argue that Wendt overstates the import of quantum decision theory. Most proponents of quantum decision theory merely regard quantum mechanics as an analogy (e.g. Busemeyer & Bruza, 2012). Indeed, as Little observes: "They explicitly deny that they find evidence to support the idea that consciousness is a quantum phenomenon at the sub-molecular level" (Little, 2018, 170; see also Waldner, 2017, sec. IV).

A comparison to microphysics can substantiate why the utility of quantum decision theory is insufficient as evidence for the quantum brain hypothesis and, more generally, as evidence of underlying quantum effects. In microphysics, the confidence that quantum mechanics radically departs from the classical worldview is based on experiments *dedicated* to eliminating the possibility that what appears to be distinctly quantum correlations can after all be explained classically (e.g. Aspect et al., 1982; Hensen et al., 2015). Such experiments are needed since numerous loopholes exist that allow for classical explanations of what are seemingly quantum correlations (see Larsson, 2014 for a review). This is well-illustrated by experiments that fake the violation of Bell-inequalities[7] – otherwise regarded as the most vivid sign of quantumness – by entirely classical means (Gerhardt et al., 2011). The explanation for how violations of the Bell-inequalities can be faked is instructive as a general warning against drawing quick conclusions from the apparent utility of aspects of the quantum formalism: "honest scientists are recording real measurement outcomes, performed by devices that seemingly work as they should. What is exploited is the fact that a physical device, even in its presumably normal state, may be sensitive to other degrees of freedom than the ones that are thought to be relevant" (Gerhardt et al., 2011, 1). A failure to monitor *all* degrees of freedom and

[7] First formulated by John Bell (1964), the Bell-inequalities capture the correlation between a series of particular measurements where quantum mechanics can violate the inequalities but classical mechanics cannot. The violation of the Bell-inequalities is for instance used to distinguish genuine quantum entanglement from other connectedness that might, however, still be classical (Earman 2015, 313).

their interactions can make correlations appear non-classical without them being so. Importantly, this failure is not the result of negligence, as Gerhardt et al. point out. Doing the exact same experiment more carefully will therefore not help. This is why ever more sophisticated microphysical experiments are continuously being devised to close the loopholes for classical explanations of seemingly quantum correlations. These experiments are, in other words, not exploring new types of quantum effects. Instead, they are dedicated to testing well-known effects with *new setups* that are less vulnerable to these loopholes, and it is these experiments that warrant physicists' confidence that quantum mechanics departs from the classical worldview. One recent example is a test showing that entangled particles violates the Bell-inequalities, i.e., they are (apparently) quantum correlated, even when 1200 km apart which eliminates the possibility that the correlation is due to unnoticed classical modes of communication between the particles (Yin Juan et al., 2017).

Similar experiments are needed to establish that the utility of quantum decision theory cannot be explained by classical means. As in the microphysics case, this cannot be established by merely collecting data samples that can be modelled using quantum decision theory. Instead, the experiments should be designed to close the various loopholes for how the decision theory anomalies might merely be instances where the quantum formalism *appears* to apply even though the underlying mechanisms are entirely classical. Versions of the quantum Prisoners' dilemma where the entanglement is between mental states within one and the same person are particularly prone to these loopholes because the states hardly qualify as space-like separated (in technical terms, the result of such experiments might therefore be explained by local hidden variables whereas only explanations in terms of non-local hidden variable are today regarded as viable for subatomic particles (Paneru et al., 2020, 6)). To my knowledge, all experimental tests of quantum decision theory are susceptible to these problems which shows that the inference from the utility of quantum decision theory to the existence of quantum physical effects in the social world is arguably premature. On these grounds together with the more principled issues due to decoherence, Wendt's argument for quantum physical effects in the social world is *currently* not compelling.

The starting point for Wendt's argument is the rejection of classical metaphysics, i.e., the classical view of the nature of reality. It is therefore not surprising that the interpretation of quantum mechanics – the question of what quantum mechanics implies about the nature of reality – also features in the discussions of Wendt's argument (e.g. Waldner, 2017, sec. I; Donald, 2018, 160). Based on considerations of the interpretation and metaphysics of quantum mechanics, DeCanio (2017) levels two related criticisms against Wendt's argument. First, DeCanio observes that there is no agreement about the interpretation of quantum mechanics despite its empirical success. What the quantum metaphysics is like is still an open question. Therefore, what the classical metaphysics should be replaced with is underdetermined by our current understanding of quantum mechanics. Second, DeCanio emphasizes that quantum mechanics is not a complete theory of reality. In particular, it remains unknown how quantum mechanics can be reconciled with the theory of general relativity. This poses problems for Wendt's argument according to Decanio: "A future physics that solves these puzzles will no doubt incorporate elements of today's quantum theory (and certainly will not invalidate the experimental results that give quantum physics its seemingly paradoxical qualities), but its ontology will very likely be different from that of present-day physics" (DeCanio, 2017, 125). While a physical theory that supersedes a previously successful theory must recover the experimental successes of its predecessor in an appropriate limit, there is no such requirement to recover its ontology or metaphysics (more on this in Section 4). The mechanical theory of heat had to explain the successes of the caloric theory of heat, but it did not have to show that there is a limit in which heat is, ontologically speaking, a weightless fluid. Likewise, even at the level of description where quantum physics is empirically successful, there is no reason, according to this argument, to expect that the ontological account of these successes according to a successor theory is even remotely like that provided by one of the interpretations of quantum mechanics. Thus, DeCanio argues that taking *metaphysical* lessons from an incomplete theory is inadvisable since the metaphysics of its successor might be radically different even at the level of description where the incomplete theory is successful. In summary, DeCanio argues that quantum mechanics does not provide a new metaphysics and even if it did, it would be inadvisable to take lessons from it.

In focusing on metaphysics, however, these criticisms at least seem to miss the part of Wendt's argument that is reconstructed here as the argument from quantum physical effects in the social world. Wendt is arguing that the brain can serve as an amplifier of quantum *physical* effects. What Wendt conjectures is that further scrutiny will reveal that quantum superposition, interference, and entanglement are important for understanding the social world just as they are for understanding the experiments that show that the Bell-inequalities are violated. These violations, if genuine, are incompatible with classical physics irrespective of how one interprets quantum mechanics (and classical physics for that matter). So, if the brain can amplify effects like those responsible for the breaking of Bell's inequalities, then quantum physics will be relevant to social theory in the same way it is relevant to the building of a quantum computer. If this is Wendt's argument, then it is of little consequence that there is no agreement about the interpretation of quantum mechanics since this does not result in a disagreement about the outcome of quantum experiments. If the social world features quantum effects in the same way that quantum experiments do, then quantum mechanics is epistemically relevant in social theory irrespective of what interpretation of quantum mechanics that is vindicated in the end. Likewise, if quantum physical effects play a role in the social world, then this fact will stand even when quantum mechanics is superseded for the same reason that the theory that supersedes quantum mechanics must be able to recover the results of experiments that show a violation of Bell's inequalities.[8] Wendt's argument from quantum physical effects in the social world has several problems, as discussed above, but the underdetermination of interpretation and the divergence of metaphysics in theory succession are not among them.

These two objections, however, are worth keeping in mind in the following since they apply readily to Barad's attempt to avoid the decoherence-based objections to the claim that quantum mechanics is epistemically relevant in social theory.

[8] The successor theory cannot find that Bell's inequalities are not violated after all, unless, of course, it turns out that all the different experimental tests of Bell's inequalities prove to be mistakes.

4 Quantum metaphysics and the social world

Like Wendt, Barad argues that quantum mechanics is epistemically relevant in social theory, but she also recognizes that quantum physical effects are negligible in the macroscopic domain. Thus, Barad's argument must be different from that attributed to Wendt above.

Barad describes how the size of quantum physical effects can (loosely and with exceptions) be estimated by the ratio of Planck's constant to the mass of the object or system of interest. Since Planck's constant is very small and the mass of macroscopic objects is relatively large, the difference between the predictions of quantum mechanics and classical mechanics will be miniscule, though still non-zero. Classical mechanics is a very good *approximation* for most macroscopic systems, including those of interest to social theory (at least if the argument from quantum physical effects in the social world does not bear out). However, referring to the ratio of Planck's constant to the mass of the object of interest, Barad writes: "the fact that this ratio is not strictly zero is the key point. In other words, the fact that classical mechanics provides good approximations to the exact quantum mechanical solutions for many macroscopic situations is not evidence against the new epistemology or ontology […]" (Barad, 2007, 416). Where Wendt argues that there are exceptions where the classical approximation fails, particularly due to the brain serving as an amplifier for quantum effects, Barad seems to be making the point that quantum mechanics cannot be ignored *despite* the utility of the classical approximation. Indeed, Barad indicates that the size of quantum physical effects and, relatedly, the exactness of the classical approximation are irrelevant for her point: "The epistemological and ontological issues are not circumscribed by the size of Planck's constant" (Barad, 2007, 70). For Barad, the relevance of quantum mechanics for social theory does not depend on the size of Planck's constant.

This marks a clear difference between Wendt's argument from quantum physical effects in the social world and Barad's argument. The soundness of Wendt's argument differs between possible worlds with a different value of Planck's constant. In the actual world, Wendt argues, Planck's constant is such that the brain can amplify quantum effects enough for them not to be negligible but not obvious either. In a world where Planck's constant is much larger, quantum physical effects will be significant also at the length scales typically dealt with in social theory. However, in that case we would of course never have adopted the classical worldview – as Wendt claims that we do in social theory – since a larger Planck's constant would have made classical mechanics a poor approximation even in the macroscopic domain. Finally, in a world where Planck's constant is much smaller, even the brain's alleged capacity to amplify quantum physical effects would be insufficient to make them relevant.[9] Thus, the size of Planck's constant is central for Wendt's argument, whereas Barad insists that it is entirely irrelevant for hers. Barad, in other words, is not

[9] This role for Planck's constant in determining the size of quantum physical effects provides another way of showing that there is no principled reason why Wendt argument from quantum physical effects in the social world in unsound.

seeking special circumstances where quantum physical effects carry through to the macroscopic domain but rather argues that the metaphysical consequences of quantum mechanics are nevertheless relevant.

Barad elaborates the claim that the size of Planck's constant, *h*, does not matter for her argument as follows: "Some people think that the fact that *h* is very small means that the world is just as Newton says on a macroscopic scale. But this is to confuse practical considerations with more fundamental issues of principle" (Barad, 2007, 110). Referring to the particular example of "discontinuity" or jumping in quantum mechanics – one of the striking ways quantum mechanics differs from classical mechanics – she continues: "the key point is the very existence of the essential discontinuity, not its size. To the best of our knowledge, *h* is a universal constant. In particular, as far as we know, it is not zero anywhere: or under any circumstances" (Barad, 2007, 110). If there is discontinuity on the fundamental level of description, then Barad sees this as relevant for social theory even though the effect of this discontinuity in the social world can be ignored as part of "practical considerations". The relevance of the discontinuity is not decided by the size of Planck's constant – and therefore utility of the classical approximation – but is rather a consequence of "more fundamental issues of principle."

Barad does not provide further details for this argument, but a possible explication of the difference between "principle" and "practical consideration" is in terms of a difference between underlying metaphysics and measurable physical effects. According to this reconstruction, Barad might be arguing that the quantum nature of reality, the quantum metaphysics, can be epistemically relevant in social theory and other domains of inquiry even though quantum physical effects are negligible. The utility of the classical approximation, this argument will have it, does not warrant the assumption of classical metaphysics in our theorizing. While classical mechanics can be a good approximation of quantum mechanics, it does not thereby follow that classical metaphysics approximates the quantum metaphysics[10]: The metaphysical and scientific approximation can come apart, or so Barad seems to argue.

That metaphysical approximation does not follow from scientific approximation could find support in DeCanio's observation above about metaphysics in scientific theory change. DeCanio argues that when one scientific theory supersedes another, then the successor theory must recover the empirical successes of the superseded theory, but there is no expectation – and indeed DeCanio suggests that this rarely is the case – that the metaphysics of the superseded theory will be recovered as well. The successor theory's metaphysical account of what happens in the cases where the superseded theory is successful can radically depart from the account of these cases in the superseded theory. In this sense, the superseded theory can serve as a good approximation, however, without its metaphysics being even approximately true as well. DeCanio might, in other words, be construed as arguing that the history of science shows that scientific and metaphysical approximation can come apart and that this has often been the case.

[10] Again, what to associate with classical mechanics and, therefore, with classical metaphysics is ambiguous, but Barad provides several examples of what she considers part of classical metaphysics, one of them being the metaphysics of individualism that is discussed further below.

Barad, however, does not appeal to the history of science. Instead, she hints at a more principled argument for the pervasiveness of quantum metaphysics when she emphasizes the important point to be "the very existence of the essential discontinuity." The emphasis on existence and non-existence indicates that Barad sees these elements of quantum metaphysics as binary: Either some metaphysical element is there, or it is not there; real or not real. Since Planck's constant is always non-zero, neither discontinuity nor any other element of quantum metaphysics ever disappears entirely. Their existence, one might argue, must therefore be reflected in the metaphysical background assumptions of our social theorizing regardless of the size of the associated physical effects. More precisely, Barad seems to argue that metaphysical approximation is impossible: If an element is either real or unreal at the fundamental level of description, then how can this status suddenly change as we move to another level of description? What would the metaphysics be like at an intermediate level if such changes were possible? While quantum physical effects can become less and less noticeable – whereby the classical approximation becomes more and more apt –, we cannot immediately tell a similar story for a binary metaphysical element that features as a background assumption of our theorizing. If metaphysical approximation is indeed impossible, then our metaphysical background assumptions in theorizing must always be those of the fundamental level of reality. Therefore, the metaphysics of the theories describing this fundamental level of reality will have epistemic relevance for social theory even if their associated physical effects are negligible. This will be denoted *the argument from the impossibility of metaphysical approximation.*

To illustrate this argument and how it might imply that quantum mechanics is epistemically relevant in social theory, consider Barad's claim that quantum mechanics rejects the classical "metaphysics of individualism" which holds "that the world is composed of individual entities with individually determinate boundaries and properties" (Barad, 2007, 195). In quantum mechanics, Barad observes, everything is strictly speaking entangled. For entangled entities, it is *in principle* impossible to describe them as two separate entities with determinate states that interact in some specified way. Rather, the entanglement requires the ascription of one state to the whole and excludes the possibility of any further subdivisions into subsystems. Quantum mechanics precludes the description of such systems as interacting individuals, and Barad therefore proposes to regard them as relational wholes with *intra*-actions from which individuals derive. Barad has much more to say about this relational holism and how it should impact our theorizing (see, respectively, Jaksland, 2023; and Hollin et al., 2017 for reviews), but this rejection of individualism will suffice to illustrate how quantum metaphysics might have a bearing on social theory independently of the size of quantum physical effects. Barad's claim could be this: If separable individuals with determinate properties and boundaries are absent in the fundamental metaphysics, then it is not warranted to construct a theory at any level of description that assumes such individuals. This would be so – and again this is admittedly something that is only implicit in Barad's own writings – if metaphysical elements such as individuals cannot obtain at any level of description, if they are absent at the fundamental level, i.e., if such metaphysical elements cannot obtain as approximations. Even in a domain where classical mechanics is a good approximation, it is not warranted to assume the metaphysics of individualism associated with this theory, because it is impossible – and therefore not meaningful to suggest – that the classical metaphysics of separable individuals approximates the underlying relational metaphysics. While a scientific theory can be approximately true, this is not so for a metaphysics if metaphysical approximation is impossible. Metaphysical approximation and scientific approximation are therefore *always* apart for principled reasons; an argument that is clearly stronger than DeCanio's suggestion that this separation is merely historically actual.

Kerry McKenzie (2020) has developed what can be considered a synthesis of DeCanio's and Barad's argument against metaphysical approximation, though she mentions neither. Like DeCanio, McKenzie observes that the successor theory will often recover the equations of a superseded theory as approximations in some limit while there is "no comparable story about progress that we can tell for our actual paradigmatic metaphysical claims—indeed, perhaps no similar story that could be told in principle" (McKenzie, 2020, 14–15). McKenzie includes the latter qualification since she, like Barad, argues that the approximation of metaphysical claims may be impossible because of their "dichotomous, crude, and 'all-or-nothing' character that obstructs the concept of approximation being meaningfully predicated of them" (McKenzie, 2020, 24). McKenzie proposes that this absence of a meaningful notion of metaphysical approximation explains why the metaphysics of a superseded theory is not approximated even where the theory itself is recovered as an approximation. It is, according to McKenzie, simply impossible to approximate a metaphysics and it does consequently not occur in theory change either. McKenzie's reasoning suggests, in other words, that DeCanio's *historical* argument that metaphysical and scientific approximations can come apart follows from Barad's *principled* argument that metaphysical approximation is impossible.

DeCanio's and Mckenzie's views might be seen as supporting Barad's argument from the impossibility of metaphysical approximations and therefore support the conclusion that quantum metaphysics is epistemically relevant in social theory. However, both DeCanio and Mckenzie intend their arguments as *challenges* to metaphysics that, like Barad's, is based on science. DeCanio's concern, as already sketched above, is that any current incomplete scientific theory will be succeeded by another theory, and this successor theory might have a radically different metaphysics. By this argument, it would be possible that one of our current best theories is superseded by a new theory that revives (parts of) the metaphysics of one of the theories that we currently consider to be outdated. Quantum mechanics is known to be an incomplete theory due to its failure to incorporate gravity, but it is therefore possible that the metaphysics of the successor to quantum mechanics could be more like classical metaphysics than it is to quantum metaphysics. The fact that quantum mechanics has superseded classical mechanics is not a good reason to prefer quantum metaphysics over classical metaphysics since both are incomplete theories. McKenzie describes this as metaphysics not taking part in scientific progress: "Since it is through *better approximations to the truth* that we take science to make epistemic progress, the fact that approximation seems inapplicable to canonical claims of metaphysics makes it very unclear how metaphysics could somehow inherit or participate in the progress enjoyed by science" (McKenzie, 2020, 8). The metaphysics of our scientific theories are not getting closer and closer to the truth since metaphysics does not admit approximation. Thus, if metaphysical approximation is impossible, then it would not even be meaningful to ask whether quantum metaphysics or classical metaphysics is the better approximation to the metaphysics of an imagined successor to quantum mechanics. Only a final complete theory can feature a metaphysics that can be considered true even in an approximate sense (disregarding here the problems there might be concerning the existence of this theory, let alone whether it entails only one metaphysics). Through this, McKenzie arrives at the same conclusion as DeCanio: that only the final complete scientific theory will serve as the guide for science-based metaphysics.

In directly linking the impossibility of metaphysical approximations to this conclusion, McKenzie's argument challenges Barad's defence of quantum metaphysics, at least as Barad's view is reconstructed here. Barad maintains that quantum metaphysics is epistemically relevant in social theory despite the utility of classical mechanics at the length scale typically considered in such theorizing because metaphysical approximations is impossible. However, as McKenzie finds, the impossibility of metaphysical approximation also entails that metaphysics cannot share in the epistemic progress of science whereby each successor theory is considered more approximately true that its predecessor. Thus, if metaphysical approximation is impossible, then quantum metaphysics cannot establish its epistemic superiority over classical metaphysics based on scientific progress. Indeed, if metaphysics does not share in the progress of science, as McKenzie argues, then this challenges any argument that the metaphysical basis for social theory should be sensitive to the central changes in science such as the move from classical mechanics to quantum mechanics. Only the metaphysics of an alleged final theory would have a different status. Since a final theory, by definition, would never be superseded, the metaphysics of that theory would share the epistemic credentials of the theory itself. On these grounds, the argument from the impossibility of metaphysical approximation establishes that social theory should be based on the metaphysics of the final theory. Any intermediate theory, however, has no such epistemic relevance. The problem for Barad, then, is that quantum mechanics, just like classical mechanics, is known not to be the final theory. Thus, if the argument from the impossibility of metaphysical approximation is sound, then the metaphysics of quantum mechanics is on par with that of classical mechanics; neither has any epistemic relevance in social theory. Conversely, if the argument from the impossibility of metaphysical approximation is *not* sound, then we have no reason to claim that the metaphysics of classical mechanics does not apply when classical mechanics does. In either case, quantum metaphysics can claim no epistemic superiority – at least with reference to the progress of science – over classical metaphysics in circumstances where quantum physical effects are negligible for all practical purposes.

Finally, also DeCanio's concern about the current interpretational underdetermination in quantum mechanics poses a challenge to Barad's argument. Some of the metaphysical consequences that Barad derives from quantum mechanics are peculiar to her ontological elaboration of Bohr's interpretation of quantum mechanics. Indeed, few, if not none, of the metaphysical consequences that Barad entertains are unanimous between all the competing interpretations of quantum mechanics.

Especially the metaphysics of the Bohmian interpretation of quantum mechanics shares little resemblance with that of Barad's interpretation (Faye & Jaksland, 2021; Jaksland, 2021). This is not the place to go into the details of these differences. The point is merely that these metaphysical differences between the interpretations are a problem for any argument that quantum mechanics teaches a specific metaphysics that must be taken into consideration in social theory. Though levelled against Wendt, DeCanio's criticism seems particularly apt in the case of Barad: "while the Babel of quantum interpretations can be taken as making room for one's own favored interpretation, that is not the same thing as saying that it requires or even favors a particular ontology, or that such an ontology should form the basis for a new type of social science" (DeCanio, 2017, 127). DeCanio, in other words, argues that the many available interpretations of quantum mechanics compromise any metaphysical import of quantum mechanics in social science. Even if we could show that the metaphysics of quantum mechanics, in principle, is epistemically relevant in social theory, the plethora of interpretations of quantum mechanics would highly underdetermine what this metaphysics is.

5 Conclusion: The classical worldview vindicated?

Both Wendt and Barad are motivated by what they regard as a reliance in social science on an outdated classical worldview. However, neither Wendt nor Barad's argument for the epistemic relevance of quantum mechanics in social theory is sound, as suggested here. Does this then imply that the classical worldview is vindicated? Both yes and no.

Wendt's proposal that there are quantum physical effects in the social world has only very speculative evidence in its favor and more principled reasons, especially those coming from decoherence, speak against it. This vindicates the classical worldview in the sense that it denies Wendt's claim that we must take, for instance, non-local entanglement effects between mental states into consideration in social science. Consequently, the considered modes of communication and interaction more generally between actors and other macroscopic elements of reality should remain those prescribed by classical mechanics (though perhaps corrected for the discovery of relativity theory that no signal can travel faster than the speed of light and modified to accommodate fields). This does not preclude that, say, quantum decision theory can prove to be empirically adequate in certain circumstances. It does, however, follow from this conclusion that the utility of quantum decision theory is not due to quantum correlations. This is not incoherent since also regular quantum correlations can be faked by entirely classical means. In this light, an inference from the utility of quantum decision theory to quantum social science would be premature until experiments have at least eliminated the most obvious loopholes for how these seemingly quantum correlations can after all be explained classically. In the absence of such experiments combined with the challenges due to decoherence, it seems more adequate to regard quantum decision theory as a preliminary way of modelling certain correlations that does not, however, provide an explanation of them. The arguments of this paper, in other words, vindicates the classical worldview in the sense that even correlations apparently captured by quantum decision theory should be expected to be explained by entirely classical mechanisms. Looking for these is then, of course, a highly relevant undertaking.

Classical *metaphysics*, however, is not thereby vindicated by association. If metaphysical approximation, as DeCanio and McKenzie argue, does not follow scientific approximation, then the utility of classical physics at the length scales typically considered in social theory does not warrant the assumption of classical metaphysics in our theorizing about that domain. Classical metaphysics, however, is still epistemically on par with quantum metaphysics but only because the impossibility of metaphysics approximation entails that no metaphysics shares in the epistemic success of an *incomplete* scientific theory. As a consequence, neither of them has any epistemic relevance in social theory if metaphysical approximation is impossible. In this case, the metaphysical background assumptions in our social theorizing must acquire their warrant from the service they do in our account for the social world. If metaphysical approximation is impossible, social theory can claim absolute independence from the metaphysics of incomplete science.

Whether metaphysical approximation is indeed impossible is, arguably, controversial. The verdict that classical metaphysics and quantum metaphysics are on epistemic equal ground when quantum physical effects are negligible remains, however, the same, though with one important difference. If metaphysical approximation is possible, then we can be more confident that a scientific metaphysics can inherit some of the epistemic credentials from successful science. In the cases where both quantum mechanics and classical mechanics are successful, such as at the length scales typically considered in social theory, both quantum metaphysics and classical metaphysics will receive some epistemic warrant. In having the same epistemic warrant, nothing in these cases prescribes the replacement of classical metaphysics with that of quantum metaphysics. But opting for another metaphysics would require an argument that this alternative metaphysics shared at least a similar degree of epistemic warrant. If metaphysical approximation is possible, then the independence of social theory from the metaphysics of successful science is challenged. One can of course resist this claim without endorsing the impossibility of metaphysical approximation. Instead, one might suggest that social theory is dealing with an ontological level that is independent from that of classical or quantum metaphysics. This view appears implicit when Oliver Kessler rhetorically asks of Wendt's account: "if we recognise quantum mechanics as the 'true' foundation of our ontology then, does the argumentation not follow the line of subsumption and do we not find ourselves back in the arms of positivism?" (Kessler, 2018, 85). Notice, however, that this response to Wendt (and Barad) amounts to simply rejecting at the outset that quantum mechanics or its associated metaphysics can have any epistemic relevance in social theory. This view, in other words, rejects the starting assumption made by both Wendt and Barad that "the universe is not broken up into two separate domains," as Barad puts it above.

The central point of this paper is rather that even granting Wendt and Barad this assumption, that physics could have some relevance for social theory in the first place, they neither establish that quantum mechanics nor quantum metaphysics must replace the classical counterparts in social theory. Social theory should be based on the modes of communication and interaction between actors prescribed by classical mechanics, and classical metaphysics is on epistemic equal ground with quantum metaphysics even though quantum mechanics supersedes classical mechanics. Neither Barad nor Wendt, in other words, provides compelling arguments that quantum mechanics or its associated metaphysics has any epistemic relevance in social theory.

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