Dispositional Arrays:
Why So Scared of Possible Worlds?

Lorenzo Azzano

University of Santiago de Compostela

Abstract

Some philosophers believe that powers are more acceptable, naturalistic, non-*ad hoc* and actualist-friendly candidates to replace possible worlds (PWs) in a dispositionalist analysis of modality. However, such a swift opposition between powers and PWs is both unwarranted and problematic. Furthermore, there is at least one power-based ontology of PWs, which in turn offers a power-based applied PW-semantics for dispositionalists. On this account, first briefly suggested in Vetter 2015, a PW is taken to be a dispositional array, viz., a power for the entire universe to be so-and-so. I discuss several features of this proposal, from the nature of dispositional arrays, to the *true-at* relation, to the range of possibilities countenanced by the semantics—and in doing so I will show that there are many advantages for those willing to countenance dispositional arrays in their ontology. Finally, I will illustrate a fascinating correlation between this PW-semantics and the usual power-based semantics envisioned by the dispositionalist, which will bear crucial consequences concerning the ultimate source of modality.

Keywords: Powers, Possible worlds, Modal ontology, Modal semantics.

1. Introduction

Recent years have not been kind to possible worlds (PWs). As accounts of PWs became increasingly complex, people began to express dissatisfaction with the notion altogether. The reasons are numerous: the ontological baggage of the *ersatzist* is often unclear and at best dubious, while Lewis' plurality of worlds, albeit metaphysically clearer, is outright outlandish. The dissatisfaction is reinforced by the persistent influence exerted by the charge of irrelevance: although it is notoriously difficult to articulate an object against PWs along these lines (as in Divers 2002: 124-33), many still believe there to be a nugget of truth in such attempts (e.g., Jacobs 2010). Relatedly, there also is the worry that PW-ontology is immediately read off the formal semantics, with little to no independent motivation—which is, one may argue, a very *ad hoc* way of doing ontology (Borghini and Williams 2008: 25, Jubien 2009: 67-68, Vetter 2015: 6).

There are, of course, several ways of using PW-semantics without commitments to PWs themselves, and by that I do not mean the "cheaters" who brandish PW-semantics while shying away from its ontology, the kind of attitude criticized in Martin and Heil (1999: 38-39); I am rather referring to those who actively construct a theory in order to avoid ontological commitment to PWs in their deployment of PW-semantics. The "ontological commitment" I am referring to is the one conveyed through existential quantification according to standard Quinean meta-ontology; if the diamond operator is interpreted as an existential quantifier over worlds, as long as there is a single true possibility statement in the object language, the meta-language of PW-semantics will be ontologically committed to PWs. Yet there are many ways to escape such a commitment. First, one may consider a non-factualist stance on modal discourse (sometimes formulated relatively to modal statements involving possibility and necessity, rather than their PW-involving interpretations), which has a venerable tradition in modern and contemporary philosophy—especially before the birth of modal logic—and has been recently revitalized in Thomasson 2020. Alternatively, one can accept PW-semantics but reject any commitment to PWs by its formulas, manipulating their logical form until any such commitment is eliminated. The conditionalist position (Sider 2002) and the fictionalist position (Rosen 1990) both fall in this category. Finally, assuming such a stance to be stable, one can decide to employ a PW-semantics but still remain agnostic, in some way or another, about its objects (Divers 2004, 2006).

That said, some have something more radical in mind: they would prefer a new analysis of modality entirely, both in the form of a new modal ontology, and a new interpretation of modal discourse that does not crucially hinge on Leibnizian biconditionals, viz. semantic clauses for box and diamond as quantifiers over worlds. Many of them are "anti-Humeans", adversaries of neo-Humean metaphysics, at least in the vague sense that they believe there to be something inherently modal about this world, which would immediately undermine the need to outsource modality through other worlds.[1] Amongst them, there are some who also believe there to be independent reasons to accept genuine powers, or dispositions (for the purposes of this paper, these terms are synonymous), in one's ontology: for them, powers are the right tools for a new analysis of modality. This is not an entirely new approach, not even in contemporary metaphysics; some antecedent can be found in Mondadori and Morton 1976, and, since then, it has been intermittently advocated, e.g., in Martin and Heil (1999: 49-50), Ellis (2001: 245), Pruss (2002: 329-30), Molnar (2003: 223), Mumford (2004: 168-70), and Bird (2007: 218, fn. 146). However, this approach has only been recently explored, mostly in Borghini and Williams 2008, Jacobs 2010, Contessa 2010, and Vetter 2015. That what is possible or necessary depends on powers, abilities, and capacities of worldly objects, is something that the layperson may find very intuitive, as opposed to the baroque constructions of PW-ontology. More to the point: as an ontology of modality, it has the virtue of being independently motivated, given that powers are already needed elsewhere (viz., in the debate about causation, laws of nature, the nature of properties, and so on), and it is not merely extracted from a convenient formal semantics. Some of the supporters of this

---

[1] The correlation between PW-ontology and neo-Humeanism is however not as straightforward, given that some supporter of *ersatz* PWs might put forward claims that are incompatible with neo-Humeanism; David Lewis is, most of the time, the preferred target.

powers-based approach take pride in being actualists (viz., unrestrictedly every-thing is actual: no merely possible individual, or PW, that does not actually exist), and "naturalist", in the loose sense that they do not posit anything over and be-yond the physical realm of this, the actual world.

As for the semantics, a power-based ontology of modality should pave the way (or perhaps follow, depending on the approach) a suitable power-based se-mantics for modal discourse that does without the Leibnizian biconditionals—although the formal work has only recently started (notably, Vetter 2015). This ontology-cum-semantics project has been pursued in a variety of different ways, which I will refer to collectively with the umbrella term *modal dispositionalism*, or *dispositionalism* for short. It is one of the many projects falling within the scope of the so-called "hardcore actualism" (Contessa 2010) or "new actualism" (Vetter 2011), insofar it does not engage with PW-ontology, and avoids PW-semantics altogether; similarly, to highlight its actualist aspect, Eagle (2009) calls modal dis-positionalism "dispositional actualism".

In this paper I will argue that, while dispositionalism is a worthwhile project, such a swift opposition between powers and PWs—as candidates is one's modal ontology—is both problematic and unwarranted. Furthermore, it hides a poten-tially interesting story to be told; for there is (at least) one power-based ontology of PWs, which can provide the dispositionalist with a power-based PW-semantics.

Here is the plan of the paper. In section 2, I will argue that the opposition between powers and PWs is both problematic and unwarranted. In section 3 I will develop my power-based ontology of PWs—by introducing and discussing the notion of a *dispositional array*, discussing its correlation with certain *ersatzist* positions, and articulating the true-at relation needed to get the semantics off the ground. Section 4 will offer some considerations of range, while in section 5 I will make some crucial remarks about PW-ontology that will help framing my pro-posal in the existing debate; more specifically, I will connect the PW-semantics involving dispositional arrays with the dispositionalist's usual non-PW-semantics in a unified framework. Finally, I will offer some concluding remarks in section 6. Since this is a fairly original topic, many issues will only be briefly touched on, and will be left for further exploration.

Before starting, allow me to introduce an assumption and a restriction. The assumption is realism about modality, in the loose sense that there is an objective and mind-independent modal reality—thus, there should be at least one applied modal semantics equipped with a domain of entities one should be ontologically committed to; I will assume that the modal dispositionalist is a realist about mo-dality as well: although it is rare to find dispositionalists who explicitly claim to be realists in this sense, I think that it is a background assumption. The restriction is that in what follows, I will only deal with the interpretation of propositional modal logic; this is unfortunate, for I believe that there is an interesting story to be told about powers and PWs relatively to the *de re/de dicto* distinction of modal discourse; but this will be the job for another time.

2. The Opposition between Powers and PWs

2.1 A Problematic Opposition

At this stage, the theoretical virtues and sheer formal power of PW-semantics has not been matched by any alternative, and surely not by any alternative involving

powers. The most detailed power-based semantics for modality, to be found in Vetter 2015, explicitly postpones this important confrontation to another time. On the contrary, PW-semantics is still widely used, sometimes by dispositionalists themselves (Vetter included), in light of its versatility; dispositionalists usually claim that they keep the semantics in the loop as an heuristic tool to help us in the difficult field of modal inference, even though it does not really reflect the nature of modal reality; Vetter (2015: 10) perfectly encapsulates this line of reasoning: "[p]ossible-world talk has its place, of course, as a formal model in some areas, and perhaps as a descriptive and heuristic tool. But we should not make the mistake [...] of thinking that 'possible worlds' are genuine worlds". Even more starkly, the dispositionalist can embrace materially adequate PW-semantics while rejecting any commitment to PWs (in one of the ways suggested above), while refusing to give anything as strong as a definition of the modal operators through Leibnizian biconditionals.[2]

This means that, as long as this state of affairs continues, dispositionalists will be working with a semantically inferior framework; this is what, I believe, Jacobs (2010: 240) has in mind when he claims that

> [t]he most powerful objection [...] to any version of the properties-based theory of modality is the lack of any developed alternative to the powerful, possible worlds semantics of modality.

This is not, *per se*, a crippling flaw of the position; after all, the dispositionalist is upfront about the fact that their power-based semantics has not been devised to be technically superior, but only to represent more clearly the modal reality; and trades-offs between ontology and semantics are a familiar occurrence for anyone theorizing around modality. But there is a real danger for the dispositionalist here, albeit not one usually recognized. This stems from the fact that the dispositionalist is still a realist about modality, at least in the loose sense that they believe there to be an objective modal reality. In general, an instrumentalist about modality will be skeptical about the ontological and metaphysical value of modal semantics—if not outright rejecting modal truths. But dispositionalists are realists about modality, and believe that some modal semantics somehow maps on certain features of reality. As such, they *should* be moved by the usual line of reasoning that the powerfulness of PW-semantics indirectly lends support to the existence of PWs—just like a scientific realist (unlike an instrumentalist) will believe that the theoretical virtues of certain scientific approaches lend support to the existence of certain particles. But this is not the case. Dispositionalists find themselves in a bit of a pickle: the failure of dispositionalist' semantics to match the virtues of PW-semantics forces them to conclude that the arguably best interpretation of modal discourse is a formal device that fails to map unto anything—even though there is another, less virtuous, interpretation that does. In simpler terms: the best interpretation of modality is not the right one.

This is, to my eyes, a methodologically confused situation. It reminds me of those creationists how believe that God has put dinosaurs' bones in the ground to test their faith: for them too, the best explanation for the presence of dinosaur's bones in the ground (viz. that there were dinosaurs) is not the right one. Keep in

---

[2] E.g., I believe dispositionalism to be compatible with "timid fictionalism" about PWs (Rosen 1990: 354), although I am not sure which benefits such an association would bring.

mind that this is not meant to be a knockdown argument against modal dispositionalism—I have much sympathy for the position, and I do not wish to see it fail. It is more of an observation. To confine PW-semantics to a merely heuristic tool forces the dispositionalist in an uncomfortable spot: that of believing that a substantially correct description of modal reality can only be delivered through a technically suboptimal tool.

2.2 An Unwarranted Opposition

We have seen how the opposition between powers and PWs may be problematic; but why is it unwarranted? A better way to frame this question might be the following: is there some (insofar unexplored) conception of PWs that the dispositionalist might find acceptable? Or, on the contrary, do dispositionalists have problems with PWs in general, viz., with the very notion of a possible world?

These are hard questions to settle; part of the difficulty lies in the fact that, for all the attention that PWs have received throughout the years, it has hard to find a "minimal" characterization of PWs, and PW-ontology, of which every PW-ontology is an elaboration. This is why one will almost never find top-down expositions of PW-ontology, but rather, bottom-up expositions, presenting the most famous alternatives (usually starting by opposing Lewisian concretism to *ersatz* PWs), with a *proviso* that this is by no means intended as an exhaustive list of positions. In other words, the logical space of PW-ontology is, to this day, still largely unmapped.

The distinction between *pure* and *applied* PW-semantics might be relevant for our current purposes. A pure semantics is concerned with any set-theoretically well-behaved collection of entities; it is committed, at best, to the set-theory needed to properly formulate Kripkean frame triples <W, @, R>, whereas members of W may be PWs, dolphins, or rocks, as the case might be. Applied semantics is, on the other hand, any semantic theory that is properly applied to the interpretation of modal discourse; in an applied semantics, members of W are PWs.[3] For simplicity, we may consider a Kripkean frame triple, in an applied semantics, to be a PW-ontology; viz. a set of worlds, including a privileged one, and a dyadic relation imposed upon them. The set of applied semantics thus comprises the set of all PW-ontologies; this might seem like the perfect place to look at for a minimal characterization of PWs and PW-ontology. Unfortunately, the defining feature of this set of applied semantics is the one I just offered: that members of W are PWs. This is hardly informative, if our goal is a minimal characterization of PWs, for it presupposes what we are searching for: the thin line that separates the set of PWs from any other W set.

Alternatively, one might claim that the right restriction from pure to applied semantics is one that selects all Kripkean triples that are somehow relevant for the

---

[3] That said, it is also possible to have an applied PW-semantics, in which members of the W set are not PWs; this is notably the case of Humberstone (1981) and his notion of *possibilities*, viz. incomplete worlds. Similarly Divers (2006: 196, fn. 12) claims that it is perfectly sound "to hold that the right things to be W-members, if we are to achieve semantic illumination of modality, are entities other than possible worlds"; yet what he means, following Plantinga (1974: 250), is simply that "one might […] take talk of possible worlds to be a mere *façon de parler* or a heuristic device to aid the imagination. One is then obliged to give meaning to "□" […] in some other way—possibly in terms of speakers of natural languages (or some favourite fragment of them) and their linguistic commitments".

interpretation of modal discourse, thus effectively skimming off modally irrelevant, but set-theoretically well-behaved, collections of entities. It thus follows that any pure semantics that is modally relevant in this sense, can provide a PW-ontology; and thus, the members of its W set, are PWs. But this strategy, as barebones as it is, does not lend any support to the dispositionalist, for nothing has been said as to why PWs, in this very general sense, are suspicious ontology; furthermore, it makes it impossible—by virtue of a mere stipulation—to object to the relevance of PWs in matters of modal ontology. In short, by simply claiming that PWs are modally relevant entities in a pure Kripkean semantics, we will have learned nothing on their nature and their supposed shortcomings.

There is, of course, a very broad and somewhat intuitive characterization of a member of W in any applied PW-semantics, one that we can extract considering the Leibnizian biconditionals in such a semantics; a member of W is some kind of alternative scenario, or "global possibility" for things to be; some different way things could be—complete or incomplete as it may be (see Humberstone 1981)—something not dissimilar to what we entertain in truth-tables (Fitting & Mendelsohn 1998: 12). One could then try to argue that this general conception of PWs is already metaphysically problematic for the dispositionalist, for example by suggesting that PW-semantics itself is deeply embedded with broadly neo-Humean "reductionist" premises, in the sense that (e.g., Jubien 2009: 75)

> what passes for necessity is in effect just a bunch of parallel "contingencies". The theory provides no basis for understanding why these contingencies repeat unremittingly across the board […]. What looks superficially like an analysis is really just the flip side of the central tenet: *Of course* if something is necessary, *and* there really are all these "possible worlds", then the something that is necessary will be true in each of them. But that doesn't tell us *why* it is true in each of them, in other words, what its necessity consists in.[4]

There is much I wish to concede to this (admittedly very general) point. But one thing is worth stating. Jubien's worry is one concerning a presumably non-causal explanation of necessities—viz. the "ultimate source" of modality. But seeking out this source of modality is not the concern of a modal semantics, not even an applied one: it seems to me perfectly acceptable to employ an applied PW-semantics, and thus accept ontological commitment over PWs, without also believing that the semantic clause for the box operator provides the "ultimate source" of necessities in terms of quantification over worlds. E.g., one may be ontologically committed to the entities in the W domain set of an applied PW-semantics, while reading Leibnizian biconditionals in the opposite direction: not as explaining p's necessity in terms of p's holding at all worlds, but the other way round (deRosset 2014). In most cases, where the source of modality will be found will depend on the nature of the things taken to be PWs: that PW-ontology lacks the "modal oomph" (Jubien 2009: 66) to properly account for modality is a criticism best suited to Lewisian accounts of PWs in which reality is ultimately non-modal. But not all PW-ontologies are like that. In principle, some PW-semantics or ontology

---

[4] For a similar point, see Vetter (2013: 15). Relatedly, Rosen (1990: 333-34) expresses this point by noting that a full expression of Lewis's ontology is not equivalent with the expression of modal realism, until we add the explicit stipulation that maximal mereological sums of worldmates *are possible worlds*.

may be able to accommodate Jubien's intuition: as we will see shortly, my account will do just that.

3. Dispositional Arrays

3.1 Meet Dispositional Arrays

I now introduce the notion of a *dispositional array*. A dispositional array is a power of the entire universe to be so-and-so; perhaps as it already is, or perhaps in a different way. Dispositional arrays are constructed from other powers to be found in smaller regions of the universe, perhaps individual powers possessed by its inhabitants.

When it comes to the treatment of modality, the basic idea is that a dispositional array can function as a PW. The set of dispositional arrays can therefore function as a W set in a Kripkean frame triple, and a PW-semantics proceeds as usual, starting from the Leibnizian biconditionals. The actual world is a power of the whole universe to be as it is. This is but an extension of the intuition of certain dispositionalists about *de re* modalities: certain dispositionalists think that the possibility for Socrates to be so-and-so is constituted by a power of Socrates to be so-and-so; thus, a PW, which can be understood as a possibility for the entire universe to be so-and-so, is just a power of the universe to be so-and-so. So understood, the notion of a dispositional array is not entirely original; for one, Vetter (2015: 263-67) very briefly suggests that "possible worlds can be construed […] as a certain class of unmanifested potentialities of the world". Not much else is said to expand on this conception (but I will offer some comments on Vetter's stance on the topic in the final section of the paper).

This is where this paper comes in. There's much to be said about the nature of these dispositional arrays, but I would like to concentrate on three crucial points. Firstly, one should keep in mind that, as I understand them, dispositional arrays are complex beasts: we should think of their manifestations as both maximal and maximally fine-grained: every matter of fact of this alternative scenario, as small or big as it might be, needs to be decided by such a manifestation. This is simply because dispositional arrays must be able to function as elements in an applied PW-semantics, thus semantics for a language in which the ◊ operator can be attached to any meaningful sentence, from "Sophia has black hair" to "there are three planets in the solar system": all such possibilities must be accounted for though the existence of a dispositional array. For this reason, there's no simple and natural way to express this special power of the universe in natural English; for most intuitive candidates fail both with respect to maximality and grain. E.g., one may think about humankind's disposition to finally solve global warming in some way or another—but this doesn't decide what happens on Betelgeuse, nor (presumably) the hair-color of every person on Earth. For the moment at least, we should resign ourselves to the thought that we will not be able to give simple names to dispositional arrays with the conceptual resources provided by natural languages.[5]

Secondly, we should also say something about how these dispositional arrays function. By definition, they cannot have completely distinct mutual partners: if a dispositional array is a disposition of the entire universe, it cannot be manifested

---

[5] I will say more on dispositional arrays and their manifestations in subsection 3.3, where the true-at relation will be discussed.

through the collaboration with something wholly distinct from it, instantiating a dispositional partner for a mutual manifestation. In this sense, dispositional arrays are spontaneously manifested: but they are not spontaneously manifested in the sense that they have no triggering conditions. Dispositional arrays are activated whenever their bearers find themselves in a specific internal configuration. This is not such a peculiar claim, after all; consider John's disposition to go on a date with Sophia if he likes her well enough, and Sophia's disposition to go on a date with John if she likes him well enough; together they construct a disposition, possessed by John and Sophia, to go on a date if they like each other well enough; the triggering condition of that disposition is not external to it and does not require further partners; it merely requires the internal components of its bearer (John and Sophia) to stand in certain relations. The same goes here: dispositional arrays are a (presumably causal) disposition of the universe to be in a certain internal state when in another internal state.[6]

This also suggests the following point: the universe instantiates several dispositional arrays at time. Consider this highly abstracted situation in which the universe is in state A in t_1, in state B in t_2, and in state C in t_3. In t_1 the actual world is a dispositional array whose manifestation is A (call it d_1); but it also instantiates a dispositional array to B if A (call it d_2), and another one to C if B (call it d_3). In t_1 d_2 is activated, which leads to the universe being in state B in t_2, which in turn activates d_3; so in t_3, the universe is in state C. Because reality is constantly undergoing qualitative change, which possible world is actual changes from instant to instant (this is by no means a peculiarity of my account, the same goes for all *ersatzist* proposals). I called this situation "highly abstracted" for two reasons: one, I am working under the simplified assumption that dispositional arrays are triggered in one instant and manifested in another, and two, I am not clarifying in which kind of metaphysical category manifestations fall into; many details depend on these hotly debated issues, but we need the foundations first.[7]

Thirdly, and finally, there is an important issue concerning the *metaphysical novelty* of dispositional arrays with respect to their component powers. The articulation of a full and detailed theory concerning the composition of dispositional arrays vastly out-scopes the purpose of the current paper, and will have to wait for another occasion; that said, we are in a position to make some a *prima facie* claim that will prove to be particularly useful in the rest of the paper. More specifically, I think that there is enough evidence to support the claim that dispositional arrays constitute an irreducible ontological addition with respect to their component powers.[8] We might start by noticing that, in a very simple sense, our

---

[6] However, dispositional arrays are hardly as disjointed entities as John and Sophia—they are something more unified. I will come back to this shortly.

[7] These matters are however introduced in subsection 3.3, where the true-at relation is characterized.

[8] Incidentally, based on the two criteria of maximality and maximally fine grain put forward, there is something we can already say on *which* powers get to compose dispositional arrays. To formulate a highly abstracted scenario, France's power to win the war, coupled with Germany's power to lose it, are not sufficient to compose a dispositional array; you also need more specific powers dictating the behavior of the individual French and German soldiers (perhaps this dispenses for the previous powers, perhaps not); but you also need other powers dictating the behavior of other nations. Of course, dispositional arrays must also be internally consistent, so one should not add too many powers; before the

surroundings abound with powers which obviously constitute some kind of metaphysical novelty with respect of their component powers; perhaps the most famous example (as in Mumford & Anjum 2011: 103), involves sodium chloride, viz. everyday table salt, whose mild and benign features could hardly be predicted by considering the highly flammable nature of one of its component, sodium, or the dangerously toxic nature of another, chlorine. Occurrences such as these are in fact so widespread that it is not uncommon amongst philosophers to define the very notion of (strong) emergence as the occurrence of such fundamentally novel powers.[9] More generally, the undisputed irreducibility of special sciences, and the existence of emergent macro-behaviour, lends credibility to the idea that any disposition of a system encompassing enough will constitute a metaphysical novelty over the dispositions of its components.[10] So, if we assume that there are dispositional arrays, then it is more than reasonable to believe that they would involve some genuine novelty with respect to its component powers. Once more, one needs to appreciate the internal complexity of dispositional arrays: again, if a dispositional array has to function as PW in a semantics, it needs to "know" everything. Which means it surely has emergent component powers (e.g., the dispositions of a tornado, or the dispositions of a nation), but not only that. After all, the disposition of a tornado does not settle what every grain of dust is disposed to be, nor the dispositions of a nation can decide the dispositions and behaviour of each inhabitant, or part of inhabitant. So there will be both emergent and non-emergent component powers in a mutual interaction to produce a certain output; e.g. the universe being a certain way might be the result of the complexity interplay between lower-order and higher-order phenomena, say, Macedonia being prosperous and Alexander being charismatic (assume this is indeed a case of inter-level interplay between emergent powers; other cases abound if one is dissatisfied by this one; e.g. the interaction, as imperceptible as it might be, between a grain of dust and a tornado). But given the complex nature of inter-level causal interactions, we cannot expect emergent and non-emergent components to interact in the cookie-cutter way in which, say, Vetter's joint potentialities interact, e.g. John's potentiality to play a duet with Sophia's potentiality to play a duet. This may be betrayed by the fact that in the latter case, but not the former, the resulting potentiality is ascribed to the "John and Sophia" entity—if an entity at all—which can be straightforwardly factored in the bearers of the original potentialities.[11]

beginning of the war, France both had the power to win the war, and the power to lose the war, but these two powers cannot contribute to compose a dispositional array, because at no world France both wins and loses the war.

[9] More recently, see Paolini Paoletti 2020 and Wilson 2021.

[10] For an up-to-date survey on such systems, see O'Connor 2021.

[11] I suppose that, since Vetter (2015) allows expressions of any arbitrary complexity in the scope of her potentiality operator, in her account one could also claim that John possesses a potentiality to play a duet with Sophia; with a little more fantasy, we may also ascribe John the potentiality for the entire orchestra to play Dvořák's *New World Symphony*. Pushing things to the extreme, perhaps we may also ascribe to a hydrogen atom the potentiality for the entire universe to be so-and-so—and so we wouldn't need dispositional arrays at all. I don't think the resolution of this point is terribly important; this problem merely stems from Vetter's (2015) "path of least formal resistance" concerning the logical form of potentiality. If a hydrogen atom indeed has such a potentiality, then that will presumably depend on a dispositional array, viz. a potentiality of the entire universe, just as John's potentiality

Before we move on, I would like to discuss another issue. I said before "if we assume that there are dispositional arrays…", which straightforwardly raises the question: why should believe that there are dispositional arrays in the first place? Of course, one could claim that pre-existing belief in powers indirectly lend credibility that there are dispositional arrays as well. But this is a weak argument; it is one thing to believe that (some) things have powers, but another thing entirely to believe that the universe itself has powers—if anything because that would entail having direct arguments for the existence of the universe as a one-of-a-kind entity.[12]

Rather, the reasons for accepting dispositional arrays as PWs are primarily those presented in section 2: they allow the dispositionalist to avoid a problematic and unwarranted opposition between dispositions and PWs. The "problematic" part: by providing the dispositionalist with an applied PW-semantics, dispositional arrays might just earn their keep, by allowing them to use the theoretically more virtuous theory as a clear reflection of the modal reality, instead of a formal tool to be employed for heuristic purposes only. The "unwarranted" part: dispositional arrays, as a special kind of powers, are not categorically different from what we can find in our surroundings—as the *ersatzist*'s worlds—nor completely isolated from our spatiotemporal *continuum*—as Lewis' worlds. Built from powers, dispositional arrays should escape the aforementioned criticisms against PWs, such as irrelevance, non-naturalness, *ad hoc*-ness, thus making them the subject of an acceptable applied PW-semantics in the dispositionalist's lights. Furthermore, as genuine powers, they have the "modal oomph" occasionally required by those wary of the reduction and extensionalization of modality proper of Lewisian modal metaphysics; dispositional arrays, as PWs, are not a "bunch of parallel contingencies" (to use Jubien's expression again)—rather, they are genuinely modal feature exhibited by reality. In conclusion: there is thus some ground to the idea that a dispositionalist, who already believes in powers and wants to take ontologically seriously PW-semantics, is not very far off from accepting dispositional arrays as well.

3.2 Dispositional Arrays and Ersatzism

Following an actualist and *ersatzist* tradition about PWs, on my account there is a difference between what the world is and the way the world is. Technically speaking, "us and our surroundings", the "universe", or "reality", is not a PW on this account; PWs, dispositional arrays, are rather powers for the universe to be some way or another. The actual world is the dispositional array that brings about things as they currently are; given that the universe is only one way, and given that dispositional arrays are maximal and maximally fine-grained, there is only one actual world; the actual world can also be characterized as the only dispositional array that is manifesting. This has an interesting consequence, as the notion of *actualization*, which has been known to be problematic in many *ersatzist* PW-ontologies, can now be fully cashed out in terms of the manifesting of a power—more precisely, a dispositional array. A world being actualized, on this account, is but a power being manifested.

---

for the entire orchestra to play Dvořák's *New World Symphony* depends on the potentialities of the various elements of the orchestra.

[12] See Bigelow, Ellis, and Lierse 1992, and Ellis 2001.

Furthermore, an interesting comparison can be made between PWs as dispositional arrays and the family of *ersatzist* positions according to which PWs as "world-natures" (as in Divers 2002: 177-78). In both cases, PWs are property-like entities instantiated by the reality as a whole; the difference lies in the resort to powers. According to the theory of world-natures (roughly), PWs, as complex properties of a special kind, are ways the universe is, or could be (were they to be instantiated). But on my account, PWs are ways the universe is *disposed* to be. A crucial difference between the two accounts is that according to the world-natures account of PWs, only one PW is instantiated, while all the others are uninstantiated; for the universe is, of course, only one way at a time. This is supposedly a problem for the theory, who is often formulated in terms of properties *qua* universals (Forrest 1986); for universals are not sufficient for the task: uninstantiated universals are needed, viz. Platonic universals. This complication is completely solved in the dispositional variant of the position: there can be more than one dispositional array instantiated at a given time, as it is perfectly acceptable to have co-instantiated powers with mutually incompatible manifestations. Therefore, dispositional arrays constitute an excellent way for this brand of *ersatzism* to escape the Platonic entanglement in which they are currently stuck.[13]

3.3 True-at

A crucial item that will need to be defined is the *true-at* relation between a proposition and a PW: I must define what it is for a sentence to be true with respect to a dispositional array. Intuitively, *p* is true at a certain dispositional array if and only if, were that dispositional array to be manifested, it would be the case that p. Remember that dispositional arrays must be very fine-grained, as they must account for all possibilities, local or global as they might be: from Sophia's hair-color to the going-ons on Betelgeuse. This simple definition accomplishes that.

Yet the reader might reasonably be worried by the deployment of an inherently modal characterization. (Incidentally, I have no hope of producing a reductionist account of modality: dispositional arrays, just like powers, are inherently modal entities; but it would still be preferable to minimize the number of modal primitives.)

---

[13] Here is a legitimate worry: wouldn't dispositional arrays as PWs also require something in the vicinity of Platonism? After all, the universe instantiates many unmanifested dispositional arrays (viz., many non-actual worlds), and all such dispositional arrays have manifestations that could be thought as constituting suspicious ontology just as, if not more so, than Platonic universals. This is a worry whose pertinence is difficult to assess, given how unclear power metaphysics is on the nature of (unmanifested) manifestations, and the individuals and properties they involve (see section 3.3 for some additional detail on this topic); there notably is a widespread "Meinongian worry" amongst power metaphysicians, which can be addressed in more than one way. There famously is a Platonic option (Tugby 2013) which would nullify my account's advantage over standard world-nature *ersatzism*; but it is important to notice that this is only one option on the table; others prefer to think that powers, and therefore their (pseudo-)relation with manifestations are "built into properties" (e.g. Heil 2003: 124) and thus do not constitute an independent and potentially problematic piece of ontology. Many options are on the table. Thus, a crucial difference is that the original *ersatizst* version of my view is committed to Platonism, whereas here it is only a small portion of the logical space: this is the advantage of "going dispositionalist" for the *ersatzist* (of course, this requires thinking dispositional properties are preferable to Platonic universals, but that is another question entirely).

A better way to proceed revolves around the notion of the manifestation of a power. There is widespread disagreement in the literature on the nature of manifestations; when it comes to the correlation between powers and propositional modal semantics, the easiest way is presumably that of taking a power's manifestation to be something like a state of affair (e.g. Borghini and Williams 2008), or at least something which can be referenced, directly or indirectly, through a propositional constant as opposed to a predicate; Vetter (2015), who deals at length with matters of logical form, expresses potentialities through a predicate modifier, but massively deploys lambda-calculus to sneak sentences in its scope. Just like her, I am interested in a "path of least formal resistance" (Vetter 2015: 141) to get the job done; therefore, I will use the expression "dφ" to simply mean "the dispositional array whose manifestation is φ"; once again, there is no straightforward natural language paraphrase to express this notion, but the idea should be clear enough: dφ is a power of the universe such that, when manifest, it is the case that φ; given that dispositional arrays are to be maximal and maximally fine-grained, this is a path of least formal resistance also in the sense that I allow φ to be of any arbitrary length and logical complexity: such a detailed description of a way for the universe to be is a complicated affair! To cash out the true-at relation is now a relatively straightforward affair: given a sentence p and a dispositional array dφ, p is true at dφ if and only if φ entails p. Please note that this is another way in which this account is inherently *ersatzist*: to be true at a world is not technically a way to be true at all. It is one thing for a proposition to be true, but an entirely different thing for it to be actually true, viz. true at the actual world: but truth and actual truth co-vary because the actual world is the dispositional array which brings about things as they currently are.

4. Range of Possibilities

Taking dispositional arrays to be PWs suggests some very interesting considerations of range. Leibnizian biconditionals quantifying over dispositional arrays allow us to preserve a vast range of possibilities, from the more ordinary ones to the most remote. Interestingly enough, if one assumes that dispositional arrays constitute a genuine novelty over their constituents, we could easily account for those possibilities which cannot seemingly be traced to any specific individual powers.

Examples here abound. E.g., the possibility that no contingent object exists. After all, we can easily find individual powers accounting for the possibility that this or that contingent object never existed—let's call them "annihilating powers". But just as no collection of instances can ground a universal quantification on its own, no collection of annihilating powers can account for the possibility of no contingent entity ever existing; after all, in expanded worlds it may very well be the case that all such annihilating powers exist and are properly instantiated, and yet some additional contingent object exists; and so, putting such powers together, so to speak, would not yield the possibility that no contingent object exists. We can however think that, in very special circumstances (viz., when they are exhausting of what exists), certain collections of annihilating powers compose something metaphysically novel, viz. a power for the entire universe whose manifestation entails that no contingent object exists. Some efforts have been made to countenance possibilities such as these, but the solution based on dispositional array is admittedly a far simpler solution; e.g., Vetter (2015: 275-77) struggles to countenance the weaker possibility that no *actual* contingent object exists, but her

solution is conditional on the peculiar stipulation that the very first entities in the history of the universe are necessary existents. No such stipulation is allowed if one would instead to claim that it is a power of the universe itself that it potentially contains, and never contained, none of the actual contingent objects.

The pseudo-contingency of physical laws can also be treated very well through dispositional arrays (I use the term "pseudo-contingency" as in standard dispositionalism, law statements, while necessarily true, are only trivially true in many worlds). If physical laws are somehow encoded or grounded in the powers and powers of some inhabitant or subregion of the universe, then it becomes difficult to account for the possibility that such properties and laws were different (standard toy example: that they possess *schmass* instead of *mass*, which obeys a mathematically different law of universal gravitation). Even more dramatically, there are global symmetry and conservation principles whose modal status does not seem to be accounted for by any individual power. Could such principles have taken a mathematically different form? The dispositionalist would be hard-pressed to say no: after all, for them laws depend on powers. But which powers? Things become easier once we accepted dispositional arrays: the universe could have a power for things to behave according to different principles (remember that powers with mutually incompatible manifestations can be co-instantiated by the same entity!). That is to say, in certain assumptions, nomic pseudo-contingency, of any kind, could simply be a consequence of the multitude of dispositional arrays instantiated by the universe.[14]

In conclusion, there may be what we may call "irreducibly global possibilities" which become more easily treatable once we accept dispositional arrays. But I would like the reader to appreciate a very subtle point: this does *not* mean that the PW-semantics associated to dispositional arrays outstrips the usual dispositional semantics. The reason is simple: if dispositional arrays are powers (albeit of a special kind), then they can be used in a standard dispositionalist's semantics, such as Vetter's. In Vetter's semantics, one can account for an irreducibly global possibility by quantifying upon a world and ascribing a dispositional array to it. No need for PW-semantics. So, irreducibly global possibilities may offer a reason for accepting dispositional arrays in the dispositionalist's ontology, but they are not reason enough to accept a PW-semantics based on them. The reasons for accepting dispositional arrays as PWs are rather already presented before: because dispositional arrays are inherently suitable to be taken to be taken as PWs, this allows us to use the machinery of applied PWs semantics as well: so we have two different conceptual machineries—and one of them theoretically more virtuous—to pick up the same modal reality in a realist, as opposed to a purely instrumentalist spirit (see section 2).

There is a different issue of range which needs addressing as well. Because the ultimate building blocks of this PW-ontology are powers (powers of a specific kind, but still, powers), there are inherent limitation of range concerning the PW-semantics which may be transmitted from more ordinary powers to dispositional arrays. For example, if dispositional arrays can easily account for physically (or, at best, metaphysically) possible ways for the world to be, they could struggle to account for those modal spaces delimited by, say, laws of mathematics or logic.

---

[14] Bigelow, Ellis, and Lierse (1992) in fact believe that symmetry and conservation principles justify the belief in an empowered world as a one-of-a-kind entity. Also see Bird (2007: 213-14).

Normally, we would think that we can easily get such modalities simply by relaxing restrictions in world-quantification; but if PWs are dispositional arrays, this may not be the case. These restrictions are very similar to the ones commonly accepted by dispositionalists (e.g. Borghini and Williams 2008, fn. 2), yet they may now may strike the reader as even more problematic, since dispositional arrays are taken to be PWs: what is the point in claiming that my proposal can give back to the dispositionalist the full power of PW-semantics, if the semantics is in fact so woefully restricted?

We could of course try to offer a piece-meal solution through some metaphysical restructuring: e.g., we could try to reconstruct logical modalities by postulating "abstract" or "non-causal" powers as four's divisibility by two—as in Mumford (1998: 9-11); but this is not the kind of solution I have in mind.

This objection, I take it, rests on a grave misconception. Every ontologically serious study of PWs hampers with the theoretical power of PW-semantics. Consider the following: just like dispositionalists struggle with the possible inexistence of actual contingent objects, Lewisian PWs struggle with the possibility of island-universes (Lewis 1986: 71-72) and nihilism (Lewis 1986: 73-74, Divers 2002: 284-85); both limitations are due to the nature of PWs according to Lewis' concretism. Something similar is going on with dispositional arrays PWs: because of how the modal ontology is constructed, some limitations are imposed on the semantics. More generally, whenever we descend from pure modal semantics to the murky waters of ontology and metaphysics (an unavoidable descent for a realist about modality), we are bound to lose some possibilities. This descent, coupled with a general indecision surrounding the epistemology of modality, generates a confusing dialectic (e.g., "do I really want to preserve the possibility of nihilism, or do I prefer Lewis' concrete realism about PWs?")—yet is nothing specific about my account of dispositional arrays *qua* PW. For good or ill, one must learn to live with one's own metaphysics. This, incidentally, has wide-ranging consequences on the set-theoretical arrangement of modalities, and the viability of the thought that we can get different modalities simply by imposing or relaxing restrictions in the quantification over PWs. Whether you can get, say, mathematical or logical possibility simply by relaxing restrictions in quantification over PWs crucially depends on what you take PWs to be—dispositional arrays or not. In general, I don't think that it is possible to produce a neat arrangement of the varieties of modalities without going into the nitty-gritty details of modal/PW ontology/metaphysics; and, in conclusion, the dispositionalist has much more leeway in this context than the objection would claim.[15]

5. Global and Local Semantics

Finally, I would like to dispel a worry the reader might have, and illustrate an interesting correlation between this PW-applied semantics and one power-based

---

[15] It is my opinion that an appealing strategy for the dispositionalist is to deny that all non-normative modalities can be neatly arranged set-theoretically one inside the other, as the received opinion would want. For there are good reasons to believe that, say, physical/metaphysical modality is an entirely different beast from mathematical or logical modality, and, from a metaphysical standpoint, these two should be treated in a profoundly different way. It seems to me that Borghini & Williams (2008, fn. 2) have a similar outlook, but I will not discuss this point further.

semantics usually offered by dispositionalists. This will suggest some final considerations concerning the source of modality in this account.

I have suggested that a dispositionalist, who believes in powers and their role in modal theorizing, can use dispositional array to keep an applied PW-semantics in the loop. But the dispositionalist *already has* a semantic, without PWs and presumably based on the correlation between potentiality and possibility (or perhaps, dispositions and counterfactual conditionals, see Jacobs 2010). This might constitute a problem: the dispositionalist is, once again, a realist about modality, so they believe the domain of some applied modal semantics to belong to an objective and mind-independent modal realm. But what if there are two distinctly different semantics? Ultimately there cannot be two distinct realities our modal discourse is about: if only because one is sufficient to get the job done for the purposes of interpreting modal discourse, and the other would be ontologically redundant. The simplest solution would probably be to reject any ontological commitment from one of the two. The question is: which one? The modal dispositionalist shouldn't reject ontological commitment to powers, that is barely worth saying; so perhaps they should reject ontological commitment to PWs, even while using PW-semantics; this, however, would undermine this whole paper as an attempt to make PW-ontology *kosher* for the dispositionalist.

This difficulty is only apparent. To put matters more clearly, consider that possibilities can be divided in two camps; those that are irreducibly global and those that are not. Let's start with the former, irreducibly global possibilities which require dispositional arrays to be treated. As discussed in section 4, this treatment can both take the form of a PW-semantics or a standard dispositionalist semantics; here we have no problem, as we have two conceptual machineries (one technically more virtuous than the other), which point to the same modal reality. When treating an irreducibly global possibility by a power of the world to be so-and-so, the standard dispositionalist's semantics is in a way "mimicking" the global aspect of PW-semantics; but it's no matter—for we have the real deal at our disposal as well, viz. an applied PW-semantics which quantifies over dispositional arrays.

Let's now discuss the latter possibilities, viz. those that are not irreducibly global, and which do not need dispositional arrays to be treated. These need not be complicated possibilities as those discussed by metaphysicians or philosophers of science; something as simple as "possibly, Sophia has black hair" falls in this category. It would seem that some power of Sophia is all we need to get the job done; this is all well and good, but remember that such a local possibility can also be accounted for through a dispositional array (dispositional arrays have to be fine-grained enough to provide a PW-semantics, so semantics for a language in which the ◊ operator can be attached to any meaningful sentence, "local" or "global" as it might be). This is the interesting case, for which is the ultimate source of this possibility? Sophia's powers, or some dispositional array/possible world? One could argue that some form of overdetermination is taking place here; we have two powers accounting for the same possibility, viz. Sophia's power(s) and some dispositional array.

I agree that this is a case of overdetermination, but it seems to me a harmless overdetermination. The dispositional array is constructed from the individual power, albeit perhaps irreducibly so—remember that all dispositional arrays are, to some degree, metaphysical novelty over its component powers. Thus it is no surprise that for local possibilities we incur in a "duplication" of sources. This

kind of overdetermination is similar of the harmless overdetermination of existential quantification (interestingly, both PW and non-PW modal semantics of the dispositionalist treats possibility as a form of existential quantification): "Sophia has black hair" and "John has black hair" are both full grounds for "Someone has black hair"; and similarly an individual power of Sophia, a fundamentally novel dispositional array of the entire universe (built from that power), are full accounts for "possibly, Sophia has black hair".[16] Furthermore because, again, dispositional arrays are a special kind of powers, this resulting modal reality will not be entirely inhomogeneous. On the contrary, exactly because dispositional arrays are constructed from powers—or, alternatively, powers are deconstructed from dispositional arrays—there is an interesting correlation between the two interpretations. Loosely speaking, PW-semantics is a "global" semantics, while the non-PW-semantics usually put forward by the dispositionalist is its "local" counterpart. As in Vetter (2015), the "possibility" in a PW-semantics is a global matter, about the whole universe, while the "possibility" or "potentiality" of non-PW-semantics is a matter of localized potentialities, viz. powers instantiated by objects in specific subregions of space-time. When we say that p is possible, PW-semantics takes it as saying that the entire world is such that p is within the range of its possibilities, while non-PW-semantics claims that some localized power is responsible for that possibility.

We are finally in a position to address the problem concerning the "source of modality" first raised in subsection 2.2. Even under the assumption of realism about modality, taking ontologically seriously a semantics of modality involving PWs does not entail that we take PWs to be the ultimate source of modality. But the same could be said for the usual power-based or potentiality-based semantics. Some priority has to be established among them to decide which one, so to speak, comes first. In some cases (irreducibly global possibilities) only a global source of modality will be found; in other, perhaps more ordinary cases, we will find both a global and a local source of modality, and thus we will have a choice to either operate a "localization"—viz. by shifting from a PW-semantics to a non-PW-semantics—or a "globalization"—viz. the other way around. But crucially, in doing so one is not using these two semantics to point at two completely irrelated modal realities. In a way, whether one adopts one rather than the other to interpret a specific modal statement, one is always looking at the same things, but at different levels (either a low-level individual power, or a higher-level emerging dispositional array).

Such a mixed approach could also help answering the question:

> [w]hy bother with the potentialities of individual objects if we could just ascribe the suitably maximal potentialities to the world itself and be done with it? (Vetter 2015: 199);

for Vetter the answer lies in the fact that the universe, as a composite, is such that its potentialities depend on the potentialities of its inhabitants:

---

[16] One may object: the individual power of Sophia is a component of a dispositional array, novel or not as it might be! But this doesn't seem to be problematic to me. Consider an object a, which is P; a is a part/component/emergence-base of another object b, which is also P. So "something is P" is overdetermined by a being P and b being P, although a is a part of b. The same thing happens here with individual powers and dispositional arrays.

> [t]hus it is true that the world in this sense has a potentiality to be such that I am sitting. However, the world has that potentiality in virtue of my having the potentiality to be sitting, not *vice versa* (*ibid*).

But here it seems to me that Vetter is cherry-picking her examples. Dispositional arrays are not simply a potentiality of the world "to be such that I am sitting"—whose manifestation does not strike me as neither maximal nor maximally fine-grained as required—but a far more complicated fundamentally novel with the tools to account for irreducibly global possibilities that low-level powers can only laboriously deal with (ask this: what would the universe be like, from the vastest galaxies to the tiniest particles, if you were sitting? That is a manifestation of a dispositional array).

6. Conclusions

Is Nature testing our faith in dispositionalism by making PW-semantics so appealing? Luckily, thanks to dispositional arrays—special powers for the universe to be so-and-so, which can function as PWs in a semantics-cum-ontology analysis of modality—we do not need to have faith.

The notion of a dispositional array is fairly original, and there is still much to be said about its nature, composition, and role as a PW; but whereas their addition is generally in line with the dispositionalist's usual ontological commitments, the benefits to be reaped after such an addition are numerous. Most importantly, dispositional arrays would provide the dispositionalist with an applied PW-semantics, thus bringing an end to a problematic and unwarranted opposition between powers and PWs. In fact, the notion of a PW as a dispositional array is decidedly less worrying than its non-dispositional *ersatzist* counterpart: one the one hand, they escape the usual dispositionalist's criticisms against PWs, while on the other they eschew commitment to uninstantiated world-natures. The actualization of a world can now be understood as its manifestation. Furthermore, although there are inherent limitations of range due to the nature of our ontological building blocks (dispositional arrays, namely powers), we have also shown that such limitations constitute are part of a vastly orthogonal issue with respect to my proposal, viz. the trade-off between semantics and metaphysics in the context of an analysis of modality.

Finally, I have suggested that there is no need for the dispositionalist to choose between PW and non-PW semantics; as dispositional arrays are somehow constructed from powers, the two are interestingly correlated. While in the case of some irreducibly global possibilities, there is no source of modality but a possible world, in certain—possibly more mundane—cases we can either find a local or a global piece of power-based ontology to account for possibilities, and thus have two modal semantics that we can take in a realist spirit, viz. as pointing to the same modal ontology: powers.[17]

References

Bigelow, J., Ellis, B., and Lierse, C. 1992, "The World as One of a Kind: Natural Necessity and Laws of Nature", *British Journal for the Philosophy of Science*, 43, 3, 371-88.

Bird, A. 2007, *Nature's Metaphysics: Laws and Properties*, Oxford: Oxford University Press.

Borghini, A. and Williams, N.E. 2008, "A Dispositional Theory of Possibility", *Dialectica*, 62, 1, 21-41.

Cameron, R.P. 2008, "Truthmakers and Modality", *Synthese*, 164, 2, 261-80.

Contessa, G. 2010, "Modal Truthmakers and Two Varieties of Actualism", *Synthese*, 174, 3, 341-53.

deRosset, L. 2014, "Possible Worlds for Modal Primitivists", *Journal of Philosophical Logic*, 43, 1, 109-31.

Divers, J. 2002, *Possible Worlds*, London and New York: Routledge.

Divers, J. 2004, "Agnosticism about Other Worlds: A New Antirealist Programme in Modality", *Philosophy and Phenomenological Research*, 69, 3, 660-85.

Divers, J. 2006, "Possible-Worlds Semantics Without Possible Worlds: The Agnostic Approach", *Mind*, 115, 458, 187-226.

Eagle, A. 2009, "Causal Structuralism, Dispositional Actualism, and Counterfactual Conditionals", in Handfield, T. (ed.), *Dispositions and Causes*, Oxford: Oxford University Press, 65-99.

Ellis, B.D. 2001, *Scientific Essentialism*, Cambridge: Cambridge University Press.

Fitting, M. and Mendelsohn, R.L. 1998, *First–Order Modal Logic*, Amsterdam: Kluwer.

Forrest, P. 1986, "Ways Worlds Could Be", *Australasian Journal of Philosophy*, 64, 1, 15-24.

Heil, J. 2003, *From an Ontological Point of View*, Oxford: Oxford University Press.

Humberstone, L. 1981, "From Worlds to Possibilities", *Journal of Philosophical Logic*, 10, 3, 313-39.

Jacobs, J.D. 2010, "A Powers Theory of Modality: Or, How I Learned to Stop Worrying and Reject Possible World", *Philosophical Studies*, 151, 2, 227-48.

Jubien, M. 2009, *Possibility*, Oxford: Oxford University Press.

Lewis, D.K. 1986, *On the Plurality of Worlds*, London and New York: Blackwell.

Martin, C.B. and Heil, J. 1999, "The Ontological Turn", *Midwest Studies in Philosophy*, 23, 1, 34-60.

Molnar, G. 2003, *Powers: A Study in Metaphysics*, Oxford: Oxford University Press.

Mondadori, F. and Morton, A. 1976, "Modal Realism: The Poisoned Pawn", *Philosophical Review*, 85, 1, 3-20.

Mumford, S. 1998, *Dispositions*, Oxford: Clarendon Press.

O'Connor, O. 2021, "Emergent Properties", The Stanford Encyclopedia of Philosophy (Winter 2021 Edition), Edward N. Zalta (ed.), URL = <https://plato.stanford.edu/archives/win2021/entries/properties-emergent/>

Paolini Paoletti, M. 2020, "Emergent Powers", *Topoi*, 39, 5, 1031-44.

Plantinga, A. 1974, *The Nature of Necessity*, Oxford: Clarendon Press.

Pruss, A.R. 2002, "The Actual and the Possible", in Gale, R.M. (ed.), *The Blackwell Guide to Metaphysics*, London and New York: Blackwell, 317-33.

Rosen, G. 1990, "Modal Factionalism", *Mind*, 99, 395, 327-54.

Sider, T. 2002, "The Ersatz Pluriverse", *Journal of Philosophy*, 99, 6, 279-315.

Thomasson, A. 2020, *Norms and Necessity*, New York: Oxford University Press.

Tugby, M. 2013, "Platonic Dispositionalism", *Mind*, 122, 486, 451-80.

Vetter, B. 2011, "Recent Work: Modality Without Possible Worlds", *Analysis*, 71, 4, 742-54.

Vetter, B. 2013, "'Can' Without Possible Worlds: Semantics for Anti-Humeans", *Philosophers' Imprint*, 13, 16, 1-27.

Vetter, B. 2015, *Potentiality*, Oxford: Oxford University Press.

Wilson, J. 2021, *Metaphysical Emergence*, Oxford: Oxford University Press.