Extended Dispositionalism and Determinism

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Modal dispositionalists hold that dispositions provide the foundation of metaphysical necessity and possibility. According to the kind of modal dispositionalism that can be found in the present literature, a proposition p is possible just in case some things are disposed to be such that p. In the first part of this paper I show that combining this classic form of dispositionalism with the assumptions that the laws of nature are necessary and deterministic and that all dispositions are forward-looking in time leads to the unattractive conclusion that every truth is necessary. I argue that the classic dispositionalist should be troubled by this result and in the second part of the paper I suggest a novel variant of dispositionalism that avoids it. This extended form of dispositionalism allows that some propositions are only indirectly underwritten by dispositions.

1. Necessary Deterministic Laws and Dispositionalism

The basic idea standing in the background of the dispositionalist accounts of metaphysical modality that can be found in the present literature is that it is possible that *p* just in case something is disposed to be such that *p*. Accounts of this sort have been proposed by Andrea Borghini and Neil E. Williams (2008), Jonathan Jacobs (2010), and Barbara Vetter (2015). The basic idea needs some refinement: Multiple things can jointly have a disposition that none of them has on its own. Furthermore, the most plausible variant of dispositionalism has it that some things are possible in virtue of dispositions of things that no longer exist or have lost the relevant disposition. Furthermore, it seems plausible that some possibilities are not directly grounded in a disposition, but in some thing's disposition to acquire a disposition. It is possible that Anna lifts 100 lb, not because she has the disposition to do so, but because she has the disposition to acquire the disposition to do so by working out.

Following Vetter, let us say that in such a case Anna has an iterated disposition to lift 100 lb. Furthermore, some dispositions are possessed to such a small degree that few people would be inclined to ascribe them in ordinary contexts. Stones can break, but they do not count as fragile in ordinary contexts. Dispositions possessed to extremely small degrees should nevertheless count as sufficient for grounding possibilities (like the possibility of the stone to break).[1] Taking all this into account, I introduce a dispositional operator such that '$\exists xx \blacklozenge_{xx} p$' says that there are, have been, or will be some things that are (iteratedly or non-iteratedly) disposed for it to be the case that p.[2] With this notation in place, the following biconditional that follows from the core tenet of classic dispositionalism can be given:

DISPOSITIONALISM $\forall p(\Diamond p \leftrightarrow \exists xx \blacklozenge_{xx} p)$

My reason for calling positions that yield this biconditional 'classic' is that it is the way dispositionalism is developed in the literature. I will later in this paper propose a variant of dispositionalism, *extended dispositionalism*, according to which the left-to-right direction of DISPOSITIONALISM fails.

The biconditional DISPOSITIONALISM is neutral with respect to the exact relation of dependence that holds between dispositions (or potentialities) and possibility. Dispositionalists will likely wish to say that dispositions ground, underwrite, back, or give rise to possibility. In this paper I do not deal with questions concerning the relation between possibilities and dispositions, although the proposal made in the last section might not allow holding that every possibility is *identical* to a disposition, for this seems to require the truth of the left-to-right direction of DISPOSITIONALISM. When writing about the relation between possibilities and dispositions, I will use various idioms of dependence (like 'grounds', 'backs', or 'gives rise to') indiscriminately.

I will now introduce four theses and show that they are jointly inconsistent with DISPOSITIONALISM. Afterwards I will contextualise the resulting problem in the literature and discuss which of these theses the dispositionalist should reject.

The first thesis to be introduced is that dispositions are forward-looking in time in the sense that nothing can have a disposition to change the past or the present. It follows from this thesis that if there is a first moment in time, then nothing ever has, had, or will have a disposition for the state of this moment of the world to be different. Let H be the proposition that the universe is in state s_1 at the first moment in time. The thesis can now be spelled out as follows:

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1. That dispositions possessed to a very small degree do not underwrite dispositionascriptions in ordinary contexts is one of the reason Vetter prefers to speak about 'potentiality'. I will use 'disposition' and 'potentiality' interchangeably in what follows.

2. In presenting the refinements and the resultant version of dispositionalism, I mainly follow Vetter (2015).

Fixed Origin $\neg\exists xx\blacklozenge_{xx}\neg H$

The second thesis is that the laws of nature are deterministic in the sense that the conjunction of the actual laws of nature L with H logically entails every true proposition concerning the state of the universe at any time.[3] Given that logical necessity entails metaphysical necessity, this yields

Determinism $\forall p(p \rightarrow \square((H \wedge L) \rightarrow p))$

The third thesis says that nothing ever has a disposition for the laws of nature to be different. It can be formalized as follows:

Fixed Laws $\neg\exists xx\blacklozenge_{xx}\neg L$

The last thesis says that there is some false proposition for whose truth there is a disposition:

Nonactual $\exists p(\neg p \wedge \exists xx\blacklozenge_{xx} p)$

The five claims (Dispositionalism and the four theses just presented) are jointly inconsistent, if it is assumed that metaphysical necessity is the dual of metaphysical possibility and that the modal logic of metaphysical modality is normal. Dispositionalism, Fixed Laws and Fixed Origin entail $\square(H \wedge L)$. Dispositionalism, Determinism and Nonactual entail $\neg\square(H \wedge L)$. This can be shown in more detail as follows:

> Fixed Origin and Dispositionalism yield $\neg\lozenge\neg H$. Given the duality of metaphysical necessity and possibility, this yields $\square H$. Fixed Laws and Dispositionalism yield $\neg\lozenge\neg L$. Given the duality of metaphysical necessity and possibility, this yields $\square L$. This gives us $\square H \wedge \square L$, which is equivalent to $\square(H \wedge L)$ in a normal modal logic. By the rule of existential instantiation, we can assume that an arbitrary new propositional constant 'Q' instantiates Nonactual, which gives us $\neg Q \wedge \exists xx\blacklozenge_{xx} Q$.[4] Together with Dispositionalism, this gives us $\neg Q$ and $\lozenge Q$. By the rule of universal instantiation, we can instantiate 'p' in Determinism with

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3. I take p to logically entail q just in case a contradiction can be derived from assuming both p and $\neg q$. Here and elsewhere I will fudge and in some contexts use 'p', 'q', 'H', 'L', ... in the position of singular terms referring to propositions (as in 'L is true') and in other contexts use them in sentence-position (as in 'the disposition to be such that $\neg H$').

4. If you like, you can let Q be the proposition that a particular glass that never breaks is disposed to break.

'¬Q'. This yields ¬Q→□(($H \wedge L$)→¬Q). Together with ¬Q, this yields □(($H \wedge L$)→¬Q). Applying the K-axiom yields □($H \wedge L$)→□¬Q. From this and ◊Q we can conclude ¬□($H \wedge L$). Contradiction.

The inconsistency of the five claims shows that (at least) one of them has to go, unless one is willing to sacrifice the duality between metaphysical necessity and possibility or the normalcy of the modal logic of metaphysical modality. The remaining question is which one. I will argue in the second part of this paper, which comprises the Sections 3–5, that the dispositionalist should give up the left-to-right direction of Dispositionalism and opt for an alternative way to provide a dispositionalist foundation for modality. The options of giving up Fixed Origin, Determinism, or Fixed Laws will be discussed in the second section. The option of denying Nonactual will not be discussed in detail. If the four other claims are upheld and only Nonactual is denied, one arrives at the unattractive position that every true proposition is necessarily true. I take it for granted that the dispositionalist wishes to avoid this conclusion. Furthermore, assuming that nothing has a disposition that never manifests includes claiming that no glass that will never break is fragile, that no match that will never ignite (e.g., because it will get wet) is inflammable, and that no tensioned spring that will never release (e.g., because it will become rusty and disintegrate) is disposed to do so.

The problem I presented is novel, but it is connected to various topics discussed in the literature. Vetter (2015) informally discusses a precursor of the problem and she thinks that the dispositionalist has a way out. She holds that "[e]ven in a deterministic universe individual objects will have potentialities to act otherwise than they do and are determined to act. They will just have no opportunities to exercise those potentialities" (Vetter 2015: 291) and that this is "enough for metaphysical possibility on the potentiality account" (Vetter 2015: 291f.). This remark, however, doesn't seem to touch the heart of the issue. It is indeed unproblematic for Vetter's position if some things don't have any opportunity to exercise some of their potentialities. The case at hand, however, is such that some things necessarily do not have any opportunity to do so. Only if either the starting-conditions or the laws could have been different can determinism be had without total necessitism (i.e., the thesis that every truth is necessarily true).

A similar line of thought is standing in the background of Samuel Kimpton-Nye's remarks concerning the possibility of Vetter's non-existence:

> It may also be the case that the *totality* of things considered jointly has no potentiality for Vetter not to exist because, all things considered, AV [some ancestor of Vetter] never has the opportunity to exercise its potentiality for Vetter not to exist. In this case, there would be a sense in which the

future would be *closed* to Vetter's possible non-existence. But an *individual* potentiality for p, or a joint potentiality of objects falling short of the totality of things for p, suffices for the *metaphysical* possibility that p. (Kimpton-Nye 2018: 126, emphasis in the original)

The distinction between having a potentiality all things considered and having an individual potentiality might be relevant in many contexts. However, it does not help with the problem at hand. Fixed Laws and Fixed Origin say that nothing has a disposition, or potentiality, to change the laws or the starting-conditions, neither in the sense of having an individual disposition, nor in the sense of having such a disposition 'all things considered'. Together with Determinism this already gives us the unintended result of total necessitism.

It should be noted that the potential problem for dispositionalism that some dispositions are necessarily masked, in the sense of being necessarily hindered from manifesting, is not new. It has (to my knowledge) first been articulated by Ralf Busse and is acknowledged (in talks and in personal communication) by Vetter. The above problem, or puzzle, has some structural similarities to and is inspired by Peter van Inwagen's argument to the conclusion that free will and determinism are incompatible (see van Inwagen 1975; 1983). This similarity will turn out to be fruitful, for in Sections 3 and 4 I will propose a solution to the problem that is inspired by a distinction David Lewis made in response to van Inwagen's argument (see Lewis 1981).

2. Who Is to Blame?

Classic dispositionalists will wish to retain Dispositionalism, for this claim is at the heart of their position. Denying Nonactual has been briefly discussed and discarded above. The remaining options to get around the problem are denying Fixed Origin, denying Fixed Laws, and denying Determinism. In the following three subsections I will discuss these options in turn.

2.1. Blame Fixed Origin?

The thesis Fixed Origin says that there is a first moment in time and that nothing has a disposition for the state of the world at this moment in time to be different. It is based on two assumptions, namely (i) that there is a first moment in time and (ii) that nothing is disposed to change the present or the past (or, more generally, that at no point in time *t*, anything is disposed to change what is the case at *t* or in the past of *t*). I will show below that the first assumption can be dispensed with.

The second assumption, however, has to be upheld for any thesis that plays the dialectical role of Fɪxᴇᴅ Oʀɪɢɪɴ to be true. I will start by discussing the second assumption before showing how the first one can be dispensed with.

Our mundane encounters with dispositions suggest that presently unmanifested dispositions are future-directed. They are dispositions for something to happen, rather than dispositions for the present or the past to be different. It seems advantageous for dispositionalists if they can pay justice to the principles about dispositions that emerge from our everyday encounters with modal reality, for this guarantees that the dispositionalist's modal primitive, dispositions, is a primitive we have an independent grasp on. It is maybe for this reason that Vetter is also inclined to tentatively accept that things only have trivial potentialities concerning the past, that is, potentialities for the past to be as it actually is (see Vetter 2015: §5.8).

Furthermore, giving up Fɪxᴇᴅ Oʀɪɢɪɴ does not automatically provide a solution to the puzzle. To solve it, the dispositionalist needs not only some backward-looking dispositions, but she needs backward-looking dispositions that are appropriately linked to all actually non-manifesting dispositions. Given Dᴇᴛᴇʀ-ᴍɪɴɪsᴍ and Fɪxᴇᴅ Lᴀᴡs, that a glass manifests its non-actualized disposition to break logically entails the falsity of H. Given that dispositions are closed under logical entailment (a claim that is crucial for classic dispositionalism being able to account for logically trivial possibilities and that Vetter vehemently defends, see Vetter 2015: §5.7), this yields the result that the glass that is disposed to break, but never breaks, also has the disposition to falsify H. It seems implausible that the glass, on its own, has this disposition. The dispositionalist might mitigate the charge of implausibility by responding that the disposition to break is an intrinsic disposition of the glass, whereas its disposition to change the past is extrinsic (see McKitrick 2003 for the distinction between extrinsic and intrinsic dispositions). Such a response, however, points to a coordination-problem: The extrinsic disposition arises in virtue of the dispositions of further things. How can the dispositionalist be sure that to every non-actualised disposition, there corresponds some thing's disposition for the past to be such that it leads to the manifestation of the disposition? What is needed is more than just a disposition for the past to be different in some way or other. We need dispositions for the past to be different in ways that allow for the manifestation of unactualised dispositions. Unless she can provide a positive reason for assuming that these dispositions are available, the dispositionalist should look for another way to deal with our problem.

Maybe the dispositionalist can try to defend the claim that the initial moment has all the dispositions needed to solve the problem.[5] This would be an instantaneous disposition (at the initial point in time) for the present to be different. A related claim is that there is an atemporal disposition of the world to have started

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5. I thank anonymous referees for suggesting this option.

differently. This way to spell out the position might even allow one to deny Fixed Origin without having to acknowledge past-directed or instantaneous dispositions. It seems reasonable for the classic dispositionalist to hope that there are such dispositions that solve the problem described in the first section. However, simply assuming that they exist would be an *ad hoc* manoeuvre. There seems to be no independent motivation for postulating such dispositions forthcoming. Furthermore, the initial-state-changing-dispositions would seemingly not be continuous with our everyday encounters with dispositions. Assuming them nevertheless would threaten to undermine the appeal of dispositionalism as a theory of metaphysical modality that is continuous to our everyday encounters with modal reality.

Finally I turn to the assumption that there is an initial moment. As it stands, Fixed Origin implies that there is a first moment in time. However, this assumption is not needed. A slight change in the way Fixed Origin is spelled out does without this assumption. In the above formulation, H was spelled out as the proposition that the universe is in state s_1 at the first moment in time. In a setting with an infinite past without a first moment in time, one can let $s_1, s_2, \ldots$ be the states the world was in exactly one year ago, exactly two years ago, and so on. Now let H_i be the proposition that i years ago, the world was in state s_i and Let H be the infinitely long disjunction $H_1 \vee H_2 \vee \ldots$. Now make the following two plausible assumptions: The first assumption is that for some things to have a disposition for a disjunction to be false, they have to have a disposition for each of the disjuncts to be false. The second assumption is that for some things to have a disposition for p to be the case, they have to have this disposition at some point in time (be it in the future, the past, or the present). Given the second assumption, if the *xx* have, had or will have a disposition for $H_1 \vee H_2 \vee \ldots$ to be false, they have to have this disposition at some point in time t. For some natural number n, t is less than n years ago. Given the first assumption, the *xx* have a disposition at t for H_n to be false. This yields the result that if some things are disposed for $H_1 \vee H_2 \vee \ldots$ to be false, then some things are disposed to change the past.

2.2. Blame Fixed Laws?

Does anything have a disposition for the laws of nature to be different? Dispositionalism with respect to metaphysical modality is naturally combined with a dispositionalist view of the laws of nature. In fact, one of the most discussed employments of primitive dispositionality in contemporary metaphysics is *dispositional essentialism*, the view that physical objects play their dispositional roles essentially and that these roles give us the laws of nature (see, e.g., Bird 2007; Ellis 2001; Mumford 2004). Providing a real definition of physical objects in terms of what they do and accounting for the laws of nature in terms of these

dispositional essences seems to be a natural move for the modal dispositionalist. On this view, the laws of nature turn out to be necessary, for they are grounded in the essential (and hence necessary) dispositional profiles of physical objects.

However, as natural as adopting a view of the laws of nature that is akin to dispositional essentialism might seem for the dispositionalist, doing so is in no way mandatory. She might also adopt a best system account of laws (as Vetter 2015: §7.8 observes) and she might have independent reasons to do so (as Heather Demarest 2017 argues).

However, simply adopting a best system account would not undermine my case. I formulated FIXED LAWS in terms of laws because this helps to draw out the analogy between the five inconsistent claims I presented and van Inwagen's famous argument for the incompatibility of free will and determinism. However, upon closer reflection it is not relevant to my case whether the sentence-letter '*L*' in FIXED LAWS really stands for a conjunction of truths which we are happy to call laws of nature. All I need is that they are true claims concerning how world-states develop that are such that nothing ever has a disposition to change them. They might be claims about the dispositional roles of fundamental physical entities. These dispositional roles might be understood as dispositions of fundamental physical entities concerning how they interact with other physical entities (e.g., the disposition of an electron to attract a proton with a particular force). Every friend of Neo-Aristotelianism should be happy to allow for such dispositional roles and it seems implausible to hold that something has a disposition to change them. An argument to the conclusion that nothing has a disposition for the dispositional roles played by fundamental physical entities to be different can be given from the following two premises: First, the dispositional roles played by fundamental physical entities cannot change over time. Second, nothing is disposed to change the present or the past. Now an argument analogous to the one given in the last subsection can be constructed, for these premises yield that at no time can anything change the dispositional roles of physical entities without changing the present or past, namely without changing the present or past dispositional roles of physical entities. An interesting feature of this argument is that no assumptions invoking a Neo-Aristotelian notion of essence are needed.[6] Only the immutability of the dispositional roles of physical entities is needed.

2.3. Blame Determinism?

The dispositionalist might agree that FIXED ORIGIN holds and they might also accept that the laws of nature (or some other truths that fit the bill) give us FIXED

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6. Yates (2012) argues that such a notion of essence is relevant for dispositional essentialism.

Laws. Still, it is a very strong assumption that Determinism holds, an assumption many dispositionalists might wish to reject. I do not aim to defend Determinism and I acknowledge that there might be weighty metaphysical arguments against determinism (see, e.g., Steward 2012 for a purely philosophical case against determinism).

I do not claim that Determinism is true, but I am also not sure that it is false and I assume that some dispositionalists (or philosophers sympathetic to dispositionalism) will join me in having this attitude to Determinism. The relation between the five claims shows that classic dispositionalism is dependent on metaphysical assumptions that go beyond the standard package accepted by all or most Neo-Aristotelian metaphysicians. Philosophers with certain convictions cannot buy into classic dispositionalism. At least from the perspective of these philosophers, it is a worthwhile task to investigate whether dispositionalism can be made consistent with the discussed claims.

Furthermore, simply denying Determinism is not enough to save the dispositionalist. She needs not only the logical compatibility of *some* non-actual truths *or other* with $H \wedge L$, she needs the logical compatibility of $H \wedge L$ with all possibilities. In particular, the classic dispositionalist has to assume that the following principle holds:

ND $\forall p(\exists xx \blacklozenge_{xx} p \rightarrow \lozenge(H \wedge L \wedge p))$[7]

This consideration is similar to the one concerning the coordination between intrinsic and extrinsic dispositions in the context of Fixed Origin. These considerations show that the dispositionalist is not only dependent on the falsity of certain claims that some might legitimately find implausible. She is committed to weighty positive claims about how these claims fail. I take this observation to motivate looking for an amendment of dispositionalism that does not incur this commitment. This is what I will do in the remainder of this paper. The next section will diagnose why classic dispositionalism incurred the given commitment and sketches a strategy to avoid it. The fourth section tries to develop this strategy.

3. A Lewisian Distinction

The five inconsistent claims above are inspired by van Inwagen's argument for incompatibilism. One of the most prominent responses to van Inwagen's argument is due to David Lewis (1981), who famously introduced two ways to read

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7. The falsity of ND together with Dispositionalism yields $\exists p(\lozenge p \wedge \neg \lozenge(H \wedge L \wedge p))$, which is jointly inconsistent with $\square H$ and $\square L$, given a normal modal logic.

the question 'Are we free to break the laws?'. Somewhat ironically, Neo-Aristotelians who wish to deal with the problem I developed in the first part of this paper can profit from making a distinction that is similar to this distinction made by the Arch-Neo-Humean David Lewis, or so I will argue.

In the first subsection I will introduce a Lewisian distinction in the context of dispositionalism. It will be shown that drawing such a distinction in our context requires denying that dispositions are closed under logical entailment. This move will be defended in the second subsection of this section.

3.1. The Strong and the Weak Thesis

Addressing the question whether anyone is able to break a law of nature, Lewis distinguishes the following two theses:

> (Weak Thesis) 'I am able to do something such that, if I did it, a law
>   would be broken.'
> (Strong Thesis) 'I am able to break a law' (Lewis 1981): 113).

Lewis's strategy is to argue that one can uphold the weak thesis and at the same time deny the strong thesis. He defines that an event (like, e.g., his raising his hand) falsifies a proposition(like, e.g., *L*) iff "necessarily, if that event occurs then that proposition is false" (Lewis 1981: 119). According to Lewis, someone is able to render a proposition false in the weak sense iff they are able to do something such that, if they did it, the proposition would have been falsified and someone is able to render a proposition false in the strong sense iff they are able to do something such that, if they did it, the proposition would have been falsified *either by their act itself or by some event caused by their act* (see Lewis 1981: 120). One of Lewis's crucial moves is to argue that even if the world is deterministic and he actually does not raise his hand, the act of raising his hand would not falsify the laws *L* (and it would also not cause an event that falsifies *L*). The reason is that his raising his hand and *L* are logically compatible. This allows him to hold that he cannot render *L* false in the strong sense (see Lewis 1981: 119f.). At the same time, Lewis is prepared to accept that his act of raising his hand "would falsify any sufficiently inclusive conjunction of history and law" (Lewis 1981: 119). The conjunction $(H \wedge L)$ logically entails that he refrains from raising his hand and consequently the proposition that he raises his hand entails $\neg(H \wedge L)$. For this reason, Lewis explicitly accepts that if determinism holds and he is able to raise his hand, then he is able to render $(H \wedge L)$ false both in the weak and the strong sense (see Lewis 1981: 120).

Lewis holds that in the context of his compatibilist defence of free will, it is acceptable that he is able to do something that falsifies $(H \wedge L)$, as long as he is neither able to do something that falsifies L, nor able to do something that falsifies H. Can the dispositionalist adopt an analogous attitude and (a) accept that something is disposed to be such that $\neg(H \wedge L)$ and (b) deny that anything is disposed to be such that $\neg H$ or disposed to be such that $\neg L$? I will argue for a negative answer in what follows.

Whatever has a disposition to be such that $\neg(H \wedge L)$ plausibly also has the (logically equivalent) disposition to be such that $\neg H \vee \neg L$ (an assumption that amounts to the claim that dispositions are closed under de Morgan equivalences). Consequently, the question asked in the last paragraph can be answered positively only if the following principle fails:

(Disjunction-Distribution) If x is disposed to be such that $p \vee q$, then x is disposed to be such that p or x is disposed to be such that q.

Disjunction-Distribution would allow to conclude that if something is disposed to be to be such that $\neg H \vee \neg L$, then it is disposed to be such that $\neg H$ or disposed to be such that $\neg L$. I defend its plausibility in what follows. First note that an analogous version of Disjunction-Distribution plausibly fails for abilities (which is why the strategy works for Lewis, who is concerned with abilities): My being able to draw a card that is red or black on request from a scrambled deck of covert cards does not give me the ability to draw a red card on request, nor does it give me the ability to draw a black card on request (see Kenny 1975: 137). To have one of the latter abilities, I needed control over the colour of the card I draw. However, for the notion of a disposition used by the dispositionalist, Disjunction-Distribution plausibly holds.[8] The dispositionalist holds that having any however miniscule tendency to be such that p is enough for something to have a disposition that p (this is what distinguishes the notion of a disposition at play from the notion used in ordinary disposition ascriptions and it is the main reason why Vetter prefers to use the word "potentiality"). If x has no tendency to be such that p, nor any tendency to be such that q, then x cannot have a tendency to be such that $p \vee q$. Furthermore, without Disjunction-Distribution the classic dispositionalist cannot account for the fact that metaphysical possibility distributes. If they were to hold that nothing has a disposition for $\neg H$, nothing has a disposition for $\neg L$, but something has a disposition for $\neg H \vee \neg L$, then they would end up with a non-normal modal logic in which $\Diamond(\neg H \vee \neg L)$ holds

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8. Disjunction-Distribution is also accepted and defended by Vetter for her notion of potentiality. See Vetter (2015: 162).

although none of $\Diamond \neg H$ and $\Diamond \neg L$ holds.[9] Hence, denying Disjunction-Distribution would make the account of modality proposed by the classic dispositionalist materially inadequate.

This discussion yields the result that if something is disposed to be such that $\neg(H \wedge L)$, then it is also disposed to be such that $\neg H$ or disposed to be such that $\neg L$. Dispositionalism cannot be saved by simply holding that although Fixed Laws and Fixed Origin hold, something is disposed to be such that $\neg(H \wedge L)$.

The dispositionalist who accepts Fixed Laws and Fixed Origin should hence also accept that nothing has a disposition to be such that $\neg(H \wedge L)$. Differently put, they should deny the following thesis:

> (Strong Dispositional Thesis) Something has an actually non-manifest-
> ing disposition to be such that $H \wedge L$ is false.

Accordingly, the dispositionalist can only use a distinction that is analogous to Lewis's if they argue that their denial of (Strong Dispositional Thesis) is compatible with accepting the following weaker thesis:

> (Weak Dispositional Thesis) Something has an actually non-manifesting
> disposition such that, if the disposition manifested, $H \wedge L$ would be false.

Accepting (Weak Dispositional Thesis) and denying (Strong Dispositional Thesis) requires maintaining that (a) for some proposition P: $\neg P$ and something has a disposition to be such that P and that (b) nothing has an actually non-manifesting disposition to be such that $\neg(H \wedge L)$. Given determinism, this requires giving up the claim that the notion of having a disposition is closed under logical entailment. Here is why: Assume $\neg P$ and that something is disposed to be such that P. Determinism yields that if it is the case that $\neg P$, then $H \wedge L$ logically entails $\neg P$. Contraposition yields that P logically entails $\neg(H \wedge L)$. The claim that the notion of having a disposition is closed under logical entailment gives us that if P entails $\neg(H \wedge L)$, then everything that has a disposition to be such that P has a disposition to be such that $\neg(H \wedge L)$. One can conclude that if $\neg P$ and something is disposed to be such that P, then (Strong Dispositionalist Thesis) holds. To avoid this conclusion, either determinism has to be given up or the assumption that the notion of something having a disposition is closed under logical entailment has to be dropped.

These considerations motivate the following questions: Is it feasible to hold that dispositions are not closed under logical entailment? How can the possibil-

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9. That $\Diamond(p \vee q)$ entails the possibility of one of p, q can be shown by using the *K*-axiom and the duality of necessity and possibility; see, e.g., Cresswell and Hughes (1996: 27).

ity of ¬($H \wedge L$) be underwritten by dispositions although nothing is disposed to be such that ¬($H \wedge L$)? The following Subsection 3.2 addresses the first question, the fourth section addresses the second question.

3.2. *Dispositionalism Without Logical Closure*

Is there a positive reason to hold that dispositions are closed under logical entailment? Presumably, most people's intuitions suggest otherwise. Most people will be happy to say that a champagne-flute is fragile, but few will be happy to accept that it is disposed to be such that snow is white or it is not the case that snow is white.

Vetter mainly defends the claim that dispositions (or, to use her term, potentialities) are closed under logical entailment by arguing that its purportedly implausible consequences are, upon closer inspection, not implausible at all. After briefly presenting some 'intuitive motivation', she writes: 'So much for the motivation; now on to the defence' (Vetter 2015: 171). I am happy to grant her that logical closure is defensible, my aim in this subsection is merely to argue that it is no downside for a variant of dispositionalism if it denies that dispositions are closed under logical entailment. For this reason, I only focus on the motivation she presents.

Vetter motivates logical closure as follows: 'Suppose that an object, x, has a potentiality to be Φ, and that being Φ, as a matter of logic, implies being Ψ. Suppose, further, that x manifests its potentiality to be Φ. Being Φ, x cannot then fail to be Ψ. So x cannot have lacked a potentiality to be Ψ' (Vetter 2015: 171). The problem with this consideration is that it remains unclear how it supports the conclusion that object x cannot have lacked a potentiality to be Ψ. The reason cannot merely be that x is disposed to be Φ and that being Φ logically entails being Ψ. This would only support the conclusion that x is disposed to be Ψ if it was presupposed that dispositions are closed under logical entailment. Maybe the reasoning is as follows: Assume that x is disposed to be a way such that if it were this way, then it would, as a matter of logic, be Ψ. According to DISPOSITIONALISM it follows from this that something is disposed to be such that x is Ψ. One might hold that something being disposed to be such that x is Ψ directly imbues x with a potentiality (an intrinsic or extrinsic one) to be Ψ. This reasoning has the problem that it crucially rests on the left-to-right direction of DISPOSITIONALISM as well as on a potentially controversial route concerning how x can get the potentiality to be Ψ on the cheap. It does not plausibly qualify as a convincing 'intuitive motivation', but is rather theory-laden.

Vetter's examples, which she gives after presenting the general motivation, also do not succeed in establishing the general conclusion that dispositions are

closed under logical entailment. One of her examples reads '[i]f I have a potentiality to read Middlemarch, then I have a potentiality to read something', another one reads 'if you have a potentiality to walk while singing, then you must have a potentiality to walk' (Vetter 2015: 171). Even if these are intuitively plausible examples, their plausibility falls short of establishing the desired conclusion. It is one thing to argue for the weak claim that in some cases it is plausible that x has a potentiality to be Φ, a potentiality to be Ψ, and being Φ logically entails being Ψ. It is another thing to argue for the stronger claim that dispositions are closed under logical entailment. Purported examples like a glass that is disposed to break and not disposed to be such that grass is green or not green suggest that intuitions do not support the stronger claim. Maybe Vetter would argue that the closure of dispositions under logical entailment is the best explanation for her intuitive examples. But it is at least unclear whether there is no other way to accommodate the intuitive examples while denying the unintuitive ones. Vetter discusses and dismisses some ways to restrict the closure under logical entailment (Vetter 2015: 172ff.). However, there might be further resources to develop a logic of dispositions, for example, by employing a notion of subject matter or by taking recourse to logical grounding (see, e.g., Fine 2017 for the notion of subject matter and Correia 2013 for the notion of logical grounding). How exactly the plausible examples can be obtained while getting rid of the implausible ones is a question that cannot be finally answered in this paper, but it would be premature to conclude that closure under logical entailment is the only way to get the plausible ones.

The modest conclusion I need to draw from these considerations is that it is not a major disadvantage for a dispositionalist theory of modality if it treats dispositions as not being closed under logical entailment. If dispositions are not closed under logical entailment, then logical entailment will be needed as a separate ingredient of a dispositionalist theory of modality. A theory of modality of this sort will be developed in the next section. It should be noted that there is some precedent for using logical entailment and a further metaphysical posit as separate ingredients of a theory of metaphysical modality. In a recent paper arguing that a generalised notion of identity can be used to explain metaphysical modality, Fabrice Correia and Alexander Skiles propose that '[a] proposition is necessary iff: it is a logical consequence of the true identities' (Correia & Skiles in press).[10] In their account, generalised identities provide us with some core necessities and logical entailment generates all the necessities from this core. The proposal I will develop in the next section has a similar structure: I will argue that dispositions provide us with some core possibilities and logical entailment will be used to generate a modal space that accommodates them.

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10. This is one of three intimately related accounts proposed by Correia and Skiles. The differences between the accounts do not matter for present purposes. They all agree on the important role of the relation of logical consequence.

4. Extended Dispositionalism

The central tenet of classic as well as extended dispositionalism is that every disposition gives rise to a possibility. Classic dispositionalists hold that every possibility is directly underwritten by a disposition. They hold that p is possible only if something is disposed to be such that p. The extended dispositionalist holds that some possibilities are only indirectly underwritten by dispositions. She holds that some proposition p is possible because this possibility is needed to accommodate the possibility of some disposition's manifesting, although nothing is disposed to be such that p. Concerning the problem discussed in §1–2, the extended dispositionalist can hold that $\neg(H \wedge L)$ is possible, not because something is disposed to be such that $\neg(H \wedge L)$, but because the possible falsity of $H \wedge L$ is needed to accommodate the possibility that non-actualised dispositions manifest.

Drawing the distinction between possibilities directly backed by dispositions and possibilities that are merely due to the accommodation of possibilities that are directly backed by dispositions gives us the Lewisian distinction between the (Weak Dispositional Thesis) and the (Strong Dispositional Thesis). But what exactly is it for a proposition to be needed for the possibility of some disposition's manifesting?

A tempting simplistic first idea is to hold that a proposition is possible just in case it logically follows from the manifestation of some disposition. The proposal I finally endorse has it that it is sufficient for a truth to be possible that it is entailed by a disposition manifestation. However, this criterion is not guaranteed to also yield a necessary condition. The reason is that a disposition's manifestation might entail the disjunction $p \vee q$ without entailing p or entailing q. Assume that no further disposition's manifestation entails p and that no further disposition's manifestation entails q. Now the simplistic proposal yields the result that $p \vee q$ is possible although neither is p possible, nor is q possible. This is a violation of the rule that possibility distributes over disjunctions (which has already been discussed in §3.1), that is, the rule that if $p \vee q$ is possible, then at least one of p, q is possible. This rule is intuitively plausible and holds in every normal modal logic.

Consequently, accepting disjunctive possibilities forces one to accept further possibilities, but sometimes it is left open which further possibility should be accepted. A way to deal with these interdependencies is to not add possibilities one by one, but to rather give the possibilities and necessities in a holistic fashion. A way to do so will be discussed in what follows.

To understand the spirit of my proposal, it might be helpful to think of dispositionalism as a position according to which necessity is the default. By default everything is necessary and the dispositions generate a modal space in which the possibilities they give rise to can be accommodated. The resulting question

is which necessities have to give way for the possibilities to be accommodated. This picture might provide some intuitive idea of why the following proposal proceeds by comparing candidates for the set of necessities.[11]

The following proposal will crucially involve a notion of logical necessity. Logical entailment directly gives one a notion of logical necessity. A proposition is logically necessary in this sense iff it is logically entailed by zero premises. I will use $\Box_L$ as a necessity-operator such that $\Box_L p$ is true just in case p is logically necessary.

The guiding idea is that Γ are the necessities of a candidate-modality just in case Γ are closed under logical entailment[12] and all the propositions among Γ are jointly logically consistent with the manifestation of every disposition.

Letting '$\bigwedge\Gamma$' stand for the conjunction of all and only the propositions among Γ, the following more formal definitions can be given:

- Γ are the necessities of a *candidate-modality* iff (i) $\forall q(\exists xx \blacklozenge_{xx} q \to \Diamond_L(\bigwedge\Gamma \wedge q))$ and (ii) Γ are closed under logical entailment.
- Γ are the necessities of a *maximal* candidate-modality iff (i) Γ are the necessities of a candidate-modality and (ii) for all Δ such that $\Gamma \subset \Delta$: $\neg\forall q(\exists xx \blacklozenge_{xx} q \to \Diamond_L(\bigwedge\Delta \wedge q))$.
- Γ are the necessities of a *uniquely maximal* candidate-modality iff (i) Γ are the necessities of a maximal candidate-modality and (ii) for all Δ, if Δ are the necessities of a maximal candidate-modality, then $\Gamma \subseteq \Delta$ and $\Delta \subseteq \Gamma$.

As usual, the possibilities corresponding to a candidate-modality are given by the duality of necessity and possibility: p is possible iff $\neg p$ is not necessary. If some things are disposed to be such that p, then $\neg p$ is not necessary, for $\neg p$ is not logically compatible with the manifestation of this disposition. Accordingly, we arrive at the result that dispositions are sufficient for possibility. However, the result that p is possible only if some things are disposed to be such that p is avoided. For example, logical necessities do not need corresponding dispositions.

Furthermore, the problem for the simplistic proposal presented above does not arise. A case in which $\neg(p \vee q)$ is not among the necessities (i.e., a case in which it is possible that $p \vee q$) cannot be a case in which both $\neg p$ and $\neg q$ are among the necessities (i.e., a case in which none of p,q is possible). If both $\neg p$ and $\neg q$ are among the necessities, then the condition that the necessities are closed

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11. The distinction between positions according to which necessity is the default and positions according to which possibility is the default is also drawn in §3 of the introduction of Wilson (2020).

12. If you feel uncomfortable with closure under logical entailment being a plural property of some propositions Γ, then you might read this as the claim that the set of all and only the Γ is closed under logical entailment.

under logical entailment yields that $\neg p \wedge \neg q$ (which is equivalent to $\neg(p \vee q)$) is also among the necessities.

That the necessities of every candidate-modality are closed under logical entailment guarantees that every logical truth is a metaphysical necessity. Furthermore, if both p and $p \rightarrow q$ are necessities, then the closure under logical entailment guarantees that q is a necessity. This gives us the modal axiom *K*. Accordingly, we arrive at a normal modal logic.

The *T*-axiom says that every necessity is true (i.e., that $\Box p$ entails p). It is guaranteed to hold if every truth is a possibility (i.e., if p entails $\Diamond p$).[13] Assume that every truth p is such that for some q, something is disposed to be such that q and p logically follows from q. This yields the intended result that every truth is possible (for its negation is incompatible with a logical consequence of some disposition and hence not necessary). The needed assumption is plausible, given that if things are a certain way and being this way is not just a matter of logic, then they are disposed to be this way.

This is enough to show that the proposal guarantees a normal modal logic in which the *T*-axiom characteristic of alethic modalities holds. The discussion of further modal axioms (like, e.g., the axiom 4 and the axiom 5) will be left for another occasion.

A further important feature of the definition of the necessities of a candidate-modality Γ is that the existence of a candidate-modality with a non-empty Γ is guaranteed to exist. If we make the plausible assumption that no things have a logically impossible disposition, the set of logical theorems is a candidate-modality. The set of logical truths is not only a candidate-modality, clause (ii) from the above definition (which demands logical closure) also guarantees that it is a subset of every other candidate-modality. Adopting any other candidate-modality as metaphysical modality will validate the plausible principle that logical necessity is stronger than metaphysical necessity, that is, that every logical necessity is a metaphysical necessity, but not *vice versa*.

However, it is not guaranteed that there is a *maximal* candidate-modality, as the following consideration shows: Assume that some disposition is logically incompatible with there being infinitely many stars (imagine an astronomer having the disposition to count all stars in a finite amount of time without counting more than 10 stars per second, if you like), but it is compatible with there being any finite number of stars. Let p_1 be the proposition that there is at least one star, p_2 the proposition that there is are at least two stars and so on. For every $n \in \mathbb{N}^+$, our disposition is compatible with every one of $p_1, \ldots, p_n$ being true. However, it is not compatible with every one of the infinitely many $p_1, p_2, \ldots$ being true.

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13. Assume that for every proposition q, $q \rightarrow \Diamond q$. This gives us that for every p, $\neg p \rightarrow \Diamond \neg p$. By contraposing one gets $\neg \Diamond \neg p \rightarrow \neg \neg p$, which is equivalent to $\Box p \rightarrow p$.

Structures of this sort might lead to the result that every candidate-modality is extendable, that is, that the set of its necessities is a proper subset of the necessities of a further candidate-modality.

It is also not guaranteed that every maximal candidate-modality is *uniquely* maximal. There might be cases where the dispositions logically demand that not both p and q are necessary. The problem discussed in the first part of this paper might be a case in point: Every non-actualized disposition entails that either H or L possibly fail. However, it leaves open which of them fails.

As a consequence, the extended dispositionalist has to prepare for dealing with the result that she can choose between different candidates for metaphysical modality. In the following three subsections, I will discuss three options for dealing with this situation.

4.1. Option I: A Uniquely Maximal Candidate-Modality

Although it cannot be proven that there is a uniquely maximal candidate-modality, it seems an epistemically open possibility (at the present stage of the debate) that there is one. What remains to be argued for is that in this case the uniquely maximal candidate-modality is the best candidate for the philosophical role of metaphysical modality.

The big picture standing in the background of dispositionalist accounts of metaphysical modality is that possibilities need grounds in actuality. Using a temporal metaphor, we start out with a modal space that comprises only the actual world. In this modal space, everything is necessary. Then dispositions enlarge the modal space by giving rise to non-actualised possibilities. However, the space of possible ways for the world to be only grows in virtue of being pushed outwards by dispositions. Propositions are by default necessary and they are possible only if a disposition accounts for their possibility. As a contrast to this picture, take the view of the essentialist. The essentialist starts out with a modal space in which everything is possible. Then essences shrink the modal space by generating necessities. For the essentialist, propositions are by default possible and they are necessary only if an essence accounts for their necessity.

If the view of modality is such that propositions are by default necessary and their possibility has to be underwritten by a disposition, then in cases where one has to choose between candidate-modalities, one should *ceteris paribus* choose the candidate-modality that allows for more propositions to remain necessary. If there is a uniquely maximal candidate-modality, then it is the candidate-modality that will be preferred by this principle, whichever other candidate-modality it is compared to.

A case in which the *ceteris paribus*-clause will become relevant will be discussed in the next subsection. There a consideration concerning the avoidance of arbitrary choices between candidate-modalities will be presented. The existence of a uniquely maximal candidate-modality guarantees that there is a non-arbitrary choice that can be made: The choice for the one set of necessities that cannot be extended.

4.2. Option II: Another Best Candidate

Assume that there is no uniquely maximal candidate-modality. Can there still be a fact of the matter which candidate-modality is best suited for playing the role of metaphysical modality? Differently put, is there a way to choose between different candidate-modalities that are not uniquely maximal?

In this subsection I present two types of considerations that can help to choose between candidate-modalities, even if none of them is uniquely maximal. The first one concerns cases like the one described above: Every finite and no infinite subset of $\{p_1, p_2,...\}$ can be a subset of the set of necessities of some candidate-modality. Here a consideration of non-arbitrariness might gain traction. If there is no criterion that can be used to chose between the finite subsets of $\{p_1, p_2,...\}$, then the only non-arbitrary choice is to give each of $p_1, p_2, ...$ the same modal status and to take none of them to be necessary. This consideration also helps to clarify the role of the *ceteris paribus*-clause from the last subsection. In cases where going for a candidate-modality with more necessities would lead to arbitrariness, there is reason to adopt a non-maximal candidate-modality as the best candidate for metaphysical modality.

Another type of consideration concerns the relations between necessity and further metaphysical posits. It might be of use to decide between two maximal candidate-modalities that disagree with respect to which of two propositions is necessary. I will discuss the case of essence as an example. Dispositionalists with respect to metaphysical modality might adopt a primitive non-modal notion of essence. Vetter (2021) has recently argued that such a notion of essence cannot be understood in terms of dispositions. Still, she argues that essences constrain dispositions (in the sense that nothing can have a disposition that goes against its essence) and that this allows to explain the necessity of essence. However, the argument that dispositions can explain the necessity of essence relies on the assumption that the absence of a disposition for $\neg p$ is sufficient for the necessity of p (i.e., the left-to-right direction of Dispositionalism). Nevertheless, the extended dispositionalist might take it to be an important theoretical desideratum that essences not only constrain dispositions, but that they also constrain possibility. This theoretical desideratum suggests preferring a candidate-modality according to which all essential truths are necessary.

What is the relevance of considerations concerning the philosophical role of metaphysical modality with respect to questions concerning the foundation of metaphysical modality? If, for example, the extended dispositionalist recurs to the posit of essence to choose between candidate-modalities, does this force her to accept that essences, alongside dispositions, are a source of metaphysical modality? The extended dispositionalist can maintain that only dispositions can give rise to non-actualised possibilities and that every non-actualised possibility is backed by dispositions. Further considerations only come in if dispositions leave it unsettled which non-actualised possibilities they give rise to. According to this view, dispositions are the only source of modal force, only dispositions open up a modal space that goes beyond the actual. Metaphorically speaking, essence and other posits only play the role of shaping the modal space dispositions create.

I take these considerations to show that there are ways to make principled choices between non-maximal candidate-modalities. I also take them to suggest that there are reasons to be optimistic about the prospects of making a choice for a singular best candidate-modality. However, I do not take the considerations to show that we can be sure that there will be a singular best candidate-modality. For this reason, it is worthwhile to ask whether the extended dispositionalist can live without one.

4.3. Option III: Modal Indeterminacy

The remaining option is that there is no candidate-modality that is the best candidate for the philosophical role of metaphysical modality. In this case we have various candidates, but it is not determinate which of them we talk about when we talk about metaphysical modality.

More precisely, if there is a class of candidate-modalities such that it is indeterminate which of them is the best candidate, then there will be those propositions that are necessary according to every candidate in the class, the determinately necessary propositions. Furthermore, there will be propositions that are not necessary according to any of the candidates, these will be the determinately non-necessary propositions. The other propositions inhabit the *modal twilight zone* and it depends on which candidate one chooses which modal status they have.

Without any doubt, this would be an unusual result. However, I do not see why it should be unbearable. The indeterminacy the extended dispositionalist might arrive at is not general. There will be clear cases: All logically necessary truths are determinately metaphysically necessary and every proposition p such that something is disposed to be such that p is determinately possible. Indeterminacy only kicks in when it comes to the question which further possible propositions should be added to accommodate the possibilities that are directly

backed by dispositions. The extended dispositionalist has a story to tell about how modal indeterminacy arises. Unless there are any arguments to the conclusion that there is no modal twilight zone, the extended dispositionalist might live with modal indeterminacy.

5. Applying Extended Dispositionalism

Extended dispositionalism formally solves the problem presented in the first section, because the derivation of the problem crucially involves the left-to-right direction of Dispositionalism, which the extended dispositionalist denies. However, an extended dispositionalist might be asked which necessity they are prepared to give up, the necessity of the laws of nature or the necessity of the origin of the world (or both). Which of $\Diamond\neg L$ and $\Diamond\neg H$ are they willing to accept? Different extended dispositionalists might give different answers and nothing I have said presupposes a particular way to go. To put my cards on the table, if I was an extended dispositionalist, I would probably accept $\Diamond\neg H$ and maintain $\Box L$. Here is why: In §4.2 I have presented a consideration in favour of choosing a candidate-modality that treats all essential truths to be necessary. Having some sympathies for dispositional essentialism, I take it to be plausible that L is a conjunction of essential truths. At the same time, it seems less plausible that H is an essential truth. That the origin of the world is necessary is a result that classic dispositionalists cannot avoid on pain of accepting backward-looking dispositions. It does not hold much independent plausibility. For this reason, many extended dispositionalists will be happy to get rid of it.[14]

Acknowledgements

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14. After submitting this paper I learned that Barbara Vetter and Ralf Busse provide a structural diagnosis of the kind of problem I discuss in Sections 1–2 (see Vetter & Busse 2022). They distinguish three types of potential solutions. Readers of my paper might wish to know whether extended dispositionalism belongs to one of these types. It seems to me that extended dispositionalism belongs to the type of solution they call 'No Mask', for solutions of this type are characterised by the claim that a potentiality for it to be the case that p is sufficient, but not necessary for it to be possible that p. However, when Vetter and Busse discuss what a No Mask solution might look like, they entertain the idea that not only possibilities, but also necessities need (what they call) positive grounds. The variant of dispositionalism I propose does not rely on the idea that necessities have positive grounds.

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