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REALISM, FUNCTIONALISM AND THE CONDITIONAL ANALYSIS OF DISPOSITIONS

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I. THE CONDITIONAL ANALYSIS OF DISPOSITIONS

A disposition of a thing is the property of that thing to give a particular response R when put to a particular test T; or to give a response R_1 when put to a test T_1, and to give a response R_2 when put to a test T_2, and so on. A thing is water-soluble if it dissolves when it is immersed in water. A thing is magnetic if it attracts iron needles when brought into their vicinity, and if it induces electrical currents in coils when brought into their vicinity, and so on.

These statements are not intended to be definitions of particular dispositions, or definition schemata for particular classes of dispositions. Rather they serve as a starting-point for the considerations which follow. What one can learn from them is that for every disposition D there is either an ordered pair $<T, R>$ of a particular test (stimulus) T and a particular manifestation (response) R, or a class $\{<T_1, R_1>, <T_2, R_2>, ...\}$ of such pairs, to which it corresponds. Dispositions which correspond to a single test–manifestation pair are usually called *single-manifested*, dispositions which correspond to a class of (more than one) test–manifestation pairs are called *multiply-manifested*. I take it that for the first kind of disposition the correspondence is such that no two dispositions D_1, D_2 correspond to the same pair $<T, R>$. I confine myself here to the discussion of *non-probabilistic* ('sure-fire') dispositions. Otherwise two dispositions D_1, D_2, one of which is sure-fire and the other not, can of course correspond to the same pair $<T, R>$. As regards multiply-manifested dispositions, two sure-fire dispositions D_1, D_2 can correspond to the same class $\{<T_1, R_1>, <T_2, R_2>, ...\}$, since the importance and roles of the $<T_i, R_i>$ can be different.

There can be no doubt that the correspondence between dispositions and test–manifestation pairs, or classes of such pairs, along with the idea that the manifestation of a disposition is (in some sense) *subsequent* to the test, has led philosophers to the so-called *conditional analysis* of dispositions. According to this type of analysis, a dispositional concept can be defined in terms of conditionals whose antecedents refer to a particular test and whose consequents refer to a particular manifestation. In the case of single-manifested dispositions (which are often treated as paradigm cases in the literature on the subject) the most simple analysis is

1. Dx iff (if Tx then Rx).

However, the 'if ... then ...' on the right-hand side of this biconditional is still open to different interpretations. According to the historical development of modern logic, philosophers first tried to construe it in terms of material implication ($\supset$). As is well known, Rudolf Carnap started by trying the definition schema

2. Dx iff $(\forall t)(Tx, t \supset Rx, t)$

where t is a time variable, but he recognized immediately that this analysis leads to paradoxes.[1] Subsequent attempts to solve the problems connected with (2) by Carnap himself (by means of reduction sentences), and by Eino Kaila and Thomas Storer (by means of more sophisticated definition schemata), can also be classified as conditional analyses.[2] The same holds for Gilbert Ryle's 'open hypothetical statements' (or 'semi-hypothetical statements'), as well as for counterfactual interpretations of the 'if ... then ...' in (2), proposed by Nelson Goodman, and also for more complex analyses in terms of counterfactual conditionals proposed by Arthur Burks, Arthur Pap, Wilfrid Sellars, Elizabeth Prior, David Lewis and others.[3] All conditional analyses of dispositions have been challenged recently by C.B. Martin.[4] In the following two sections of this paper I shall discuss Martin's and related attacks on the conditional analysis of dispositions. On the basis

[1] R. Carnap, 'Testability and Meaning', *Philosophy of Science*, 3 (1936), pp. 439–44.

[2] E. Kaila, 'Über den physikalischen Realitätsbegriff', *Acta Philosophica Fennica*, 4 (1941), pp. 33–4; T. Storer, 'On Defining "Soluble"', *Analysis*, 11 (1951), pp. 134–8.

[3] G. Ryle, *The Concept of Mind* (London: Hutchinson, 1949); N. Goodman, *Fact, Fiction, and Forecast* (Harvard UP, 1955); A. Burks, 'Dispositional Statements', *Philosophy of Science*, 22 (1955), pp. 175–93; A. Pap, 'Disposition Concepts and Extensional Logic', *Minnesota Studies in the Philosophy of Science*, 2 (1958), pp. 196–224; W. Sellars, 'Counterfactuals, Dispositions and the Causal Modalities', *Minnesota Studies in the Philosophy of Science*, 2 (1958), pp. 225–308; E. Prior, R. Pargetter and F. Jackson, 'Three Theses about Dispositions', *American Philosophical Quarterly*, 19 (1982), pp. 251–7; D. Lewis, 'Finkish Dispositions', *The Philosophical Quarterly*, 47 (1997), pp. 143–58.

[4] C. Martin, 'Dispositions and Conditionals', *The Philosophical Quarterly*, 44 (1994), pp. 1–8.

of what will be said in §III, I shall in §IV suggest a different conditional analysis which is not vulnerable to these attacks. In the final two sections I shall argue that my conditional analysis is consistent with a realist and functionalist theory of dispositions.

II. THE CONDITIONAL ANALYSIS CHALLENGED

Martin rejects the conditional analysis by deploying some tricky examples. He starts with an alleged analysis of the statement

A. The wire is live

construed as a disposition ascription (*live* being the disposition in question), by the *analysans*

B. If the wire were touched by a conductor, then a current would flow from the wire to the conductor.

If this analysis were correct, (B) would be necessary and sufficient for (A). Martin (pp. 2–3) considers a case where

> The wire referred to in (A) is connected to a machine, an *electro-fink*, which can provide itself with reliable information as to exactly when a wire connected to it is touched by a conductor. When such contact occurs the electro-fink reacts (instantaneously, we are supposing) by making the wire live for the duration of the contact. In the absence of contact the wire is dead.... In sum, the electro-fink ensures that the wire is live when and only when a conductor touches it. First, consider a time when the wire is untouched by a conductor, for example t_1. *Ex hypothesi*, the wire is not live at t_1. But the conditional (B) is true of the wire at t_1.... Consequently *the conditional is not logically sufficient for the power* [*sc.* causal disposition] *ascription of which it is meant to be the analysans*.... We turn a switch on our electro-fink so as to make it operate on a reverse cycle, as it were. So the wire is dead when and only when a conductor touches it. At all other times it is live. At a time t_4 when the wire is untouched, the wire is live *ex hypothesi*, but the conditional is false of the wire at t_4.... Hence *the conditional is not logically necessary for the power ascription of which it is meant to be the analysans.*

David Lewis has recently claimed ('Finkish Dispositions', p. 144) that the dispositions considered by Martin belong to a particular kind of disposition; he calls such dispositions 'finkish', and defines finkish dispositions as dispositions 'which would straight away vanish if put to the test'.

Since Martin's electro-fink example has had an enormous impact on the discussion in recent years, the following remark may not be superfluous: as it stands, I do not find it completely convincing, since I doubt what seems to be Martin's most basic though only implicit presupposition, i.e., that *live* or *being live* is a disposition. A closer look reveals that *being live* is not a disposition, but rather a non-dispositional (*categorical*) property, and that conditional (B) states a testing procedure for that particular categorical property. To establish this, however, we need a criterion to distinguish between dispositional and categorical properties.

As Stephen Mumford has plausibly argued, this criterion can be found by focusing on the nature of the entailment relations which hold between disposition ascriptions and test–response conditionals on the one hand, and of those which hold between ascriptions of categorical properties and test–response conditionals on the other. While a disposition ascription *analytically* entails a particular (test–manifestation) conditional, an ascription of a categorical property entails an analogous (test–response) conditional only *contingently*.[5] Let us look instead at a wire which is *not* connected to an electro-fink or a similar machine, nor influenced by a divine agent nor by a sorcerer. What kind of entailment relation holds between (A) and (B)? The following conditional follows from the material implication (A) ⊃ (B):

B*. If the wire is live and if it is touched by a conductor, an electrical current flows from the wire to the conductor.

Is (B*) analytically or contingently true? Contingently (or because of the laws of physics), it seems to me. One might doubt that (B*) is logically equivalent to (A) ⊃ (B). But (B*) is certainly a logical consequence of (A) ⊃ (B), and so we need only show that the former is contingently true in order to show that the latter is also only contingently true. Although Martin's electro-fink example is therefore not completely convincing, he briefly mentions an analogous and more convincing example, a moleculo-fink that renders an ice cube's *fragility* a finkish disposition: see below.

Another example of a finkish disposition is mentioned by Mumford, who borrows the example from Mark Johnston.[6] A chameleon is sitting on a green baize cloth in the dark at some time *t*. The sentence to be analysed is

C. The chameleon is red

and the alleged *analysans* is

D. If the chameleon were irradiated with normal daylight, it would reflect light of wavelength *l*.

Suppose (C) is true. If the chameleon were irradiated with normal daylight, however, it would change its skin colour and would therefore not reflect

[5] S. Mumford, *Dispositions* (Oxford UP, 1998), pp. 87–91.

[6] Mumford, pp. 56, 83. Johnston's example is also mentioned in C. Wright, *Truth and Objectivity* (Harvard UP, 1992), pp. 117–19.

light of wavelength *l*. Hence (D) would be false. Consequently (D) is not necessary for (C).

Do these examples really refute the conditional analysis of dispositions?

III. IN DEFENCE OF THE CONDITIONAL ANALYSIS

At first glance Martin's finkish examples look strange and unnatural. It seems that usually we ascribe dispositions (to objects) under *normal conditions*, and that an object connected to a fink is not in normal conditions for the ascription of the corresponding disposition. This objection is many people's immediate response when confronted with Martin's examples, and I shall discuss it later. Another possible objection is to the notion of instantaneous causation (by a fink). However, as Lewis has shown (pp. 146–7), it is not necessary to suppose that the fink reacts instantaneously; a (small) time delay is admissible. The general rule for a finkish disposition D that corresponds to a test–manifestation pair $<T, R>$ seems to be this: if the Ting of an object x at time t causes x to R at $t + \delta_1$ and if the Ting of x at t causes x to lose D at $t + \delta_2$, then δ_2 has to be smaller than δ_1. Otherwise x would not be finkishly disposed at t. Lewis solves this problem of Martin's electro-finks by defining the manifestation R in the required way. Although he sets out to modify Martin's examples in order to make them acceptable for people who reject instantaneous causation, Lewis claims that he himself has no difficulties with the notion. However, he cannot accept instantaneous causation in *both* cases, i.e., in the case of the causal relation between test and manifestation *and* in the case of the causal relation between test and the vanishing of the disposition, as the arguments above show.

So what do we do about finkish dispositions? To take the chameleon first, although it is by no means uncontentious that colour predicates are dispositional predicates, the chameleon's being red is at least not a finkish disposition, even if it is a disposition. How do we know that chameleons are red in the absence of daylight? We know about it because their skin colouration does not change fast enough when exposed to daylight. In other words, δ_2 here is not small enough for the chameleon's being red to be a finkish disposition. What if it were? Then there would be no epistemic reason for us to ascribe the property of *being red* at some time t to chameleons.

The following discussion of the moleculo-fink example will shed further light on the chameleon example. In order to distinguish between dispositional and categorical properties in the way described above, Mumford too has to deal with Martin's examples. He suggests we should rely on the observation that we ascribe dispositions under particular conditions, 'ideal conditions', as he puts it. According to Mumford, a disposition ascription '*Dx*' (where *D* is a single-manifested disposition corresponding to a test–manifestation pair <*T*, *R*>) analytically entails a conditional which in both instances of the 'if ... then ...' is stronger than the material conditional:

3. If C_i, then if *Tx*, then *Rx*.

By referring to 'ideal conditions' Mumford tries to exclude Martin's electro-fink operating on a 'reverse cycle'. Yet Mumford does not proceed to a fully fledged conditional analysis of dispositions in terms of (3). Why not? He gives the following answer (*Dispositions,* pp. 87–91, and in correspondence). As Martin (pp. 5–6) has argued, we cannot specify the relevant *ceteris paribus* conditions in a non-trivial way. Nor can we give a *finite* list of all such conditions, since there is always the chance that a particular interfering background condition will render the conditional analysis false. Nor can we say that they apply when and only when an object which has the disposition *D* actually *R*s if *T*ed, since the alleged *analysans* would presuppose the *analysandum*. Moreover, the meaning of the expression 'ideal conditions' is context-dependent. What seems to be an 'ideal condition' in one situation or context may be less than 'ideal' in another. Hence an analysis in terms of 'ideal conditions' would in turn render the meaning and the extension of the dispositional predicate in question context-dependent too.

Is Mumford's answer conclusive? If we talk of 'ideal conditions' we may run into some of these difficulties. But do we really presuppose 'ideal conditions' when ascribing a disposition to an object? What most people are inclined to say when confronted with Martin's examples (see above) suggests that we do not presuppose 'ideal' but rather *normal* conditions. When we say a particular sugar cube is water-soluble, we mean that in normal conditions for water-solubility it dissolves if it is immersed in water. If the water is already saturated or the sugar is influenced by a divine agent, the conditions are not normal for an object's water-solubility. But is anything gained by this move? Are normal conditions not subject to (some of) the same difficulties as 'ideal conditions'? The key problem is this: can the normal conditions of an object's having a disposition *D* be specified without rendering them context-dependent or presupposing the meaning of '*D*'?

Before I answer this question it is important to make two remarks. First, the problem of specifying normal conditions (i.e., *ceteris paribus* conditions) and the problem of excluding interfering conditions are by no means specific problems to do with disposition ascriptions: they are just as much problems in connection with (causal) natural laws, for example. Secondly, it is one job of empirical science to specify the normal or possible interfering conditions and to provide a list of those conditions. The list may never be completed, but this is not a problem as long as the normal conditions of an object's having a disposition *D* are not specified in a context-dependent way or with reference to *D*. Can these problems be avoided?

In answering this question I am relying on a suggestion recently made by Wolfgang Spohn.[7] Though Spohn is not concerned with a definition schema for dispositional concepts but rather with reduction sentences, to some extent his considerations apply also to the former. According to Keith Donnellan's well known distinction, we can distinguish between an *attributive* and a *referential* interpretation of a particular definite description. If we give the definite description 'the normal conditions for an object's having the disposition *D*' an attributive reading, the extension of the dispositional concept '*D*' can change, to a surprisingly wide extent. If, for example, the normal conditions in another possible world w_1 are such that water is always saturated (with sugar), sugar cubes are not water-soluble in that world. However, a referential reading avoids such surprisingly large changes of the extension of '*D*' from one possible world to others. Under this reading the normal conditions in other possible worlds are the same as in our actual world. Since sugar is water-soluble in our actual world w_0, at least all those sugar cubes that exist in a different possible world w_1 are water-soluble in that world, which is exactly what we are inclined to say about the case. Spohn suggests we should therefore read the definite description in question in a referential way. Consequently, referring to the normal conditions of an object's having a disposition *D* does not make the meaning or the extension of '*D*' context-dependent. If empirical science provides us with a true list *L* of normal conditions for an object's having a disposition *D*, then the statement 'The normal conditions for an object's having *D* are *L*' is, in Kripke's terminology, necessarily true, though only *a posteriori*, and hence not analytically true. Therefore there is no need to worry about circularity in the definition.

The advantages of *normal* conditions over 'ideal conditions' are obvious. A Chinese vase is fragile at room temperature, a red rose is not. However, the rose is fragile at a very low temperature, say, at −272°C. What are the 'ideal conditions' for being fragile, then? The answer depends on the context of the ascription of 'fragility'. In the context of experimenting with a red rose at very low temperatures, 'ideal conditions' include very low temperatures. For the Chinese vase, to be in 'ideal conditions' does not require very low temperatures. For this reason Mumford (pp. 89–90) claims that

> what count as ideal conditions are determined by the context of the disposition ascription.... Disposition ascriptions are made for a reason.... In making an appropriate and

[7] W. Spohn, 'Begründungen *a priori* – oder: ein frischer Blick auf Dispositionsprädikate', in W. Lenzen (ed.), *Das weite Spektrum der analytischen Philosophie: Festschrift für Franz von Kutschera* (Berlin: De Gruyter, 1997), pp. 323–45.

useful disposition ascription I am saying that, *in ordinary conditions for the present context* [my italics], if a particular antecedent is realized, a particular manifestation usually follows.... A scientist may state that under such and such extreme conditions, a sample may be expected to exhibit such and such behaviour. He may, for instance, be theorizing about how certain objects will behave at extremely low temperatures approaching absolute zero, or about how objects might be expected to behave when entering a black hole.... The point is that in such cases the exceptional conditions will be fixed by the context of the ascription.

Some serious difficulties are raised by this position. (a) Almost any physical object is fragile at temperatures close to absolute zero. Consequently the 'ideal conditions' fixed by the context of the ascription can render the predicate 'is fragile' trivial, in the sense that it cannot be used to distinguish one object from another.[8] (b) Since the 'ideal conditions' may change from one context to another and yet, according to Mumford's analysis, are a component of the meaning of the dispositional predicate ascribed, one and the same dispositional predicate can have different meanings in different contexts. None the less Mumford seems to suppose that it is the same dispositional concept we are dealing with in different contexts.

Referring to the normal conditions for being fragile, however, precludes us from ascribing 'fragility' to red roses even though they break when dropped at −272°C. Red roses are *not* fragile (in normal conditions), notwithstanding that they are fragile at −272°C, or, say, fragile at temperatures below −100°C. I maintain that normal conditions define a wide range for the application of our ordinary and useful concept of fragility, and that outside this range it is up to science (and depends on its tasks) to define other useful concepts like 'fragile in particular condition(s) *C*', and to examine the normal conditions for having the respective dispositions (which will include *C* but will not be identical with *C*, of course).

My suggestion is, therefore, to build a reference to normal conditions into the conditional analysis of dispositions in order to block counter-examples like those mentioned by Martin. I claim that in any case where δ_2 is smaller than the *assumed* δ_1 (see the 'general rule' for finkish dispositions above), we would not say that the object in question is disposed to R at $t + \delta_1$ when Ted at t. I do not claim, though, that the notion of normal conditions raises no further problems. For example, referring to normal conditions leaves us with a certain vagueness; but empirical science can try to minimize that vagueness step by step. Nor do I claim that I have said everything there is to say about the notion: there is certainly more work to be done on it.

[8] Elizabeth Prior has even claimed that for any dispositional predicate '*D*' and any object *x* whatsoever there are 'ideal conditions' such that (in those conditions) '*D*' can be applied to *x*: see her *Dispositions* (Aberdeen UP, 1985), pp. 5–10.

IV. A SIMPLE CONDITIONAL ANALYSIS

'Simple' is a relative term. So if I set out to give a simple conditional analysis of dispositions in this section, I have to say what alternative there is in comparison with which my analysis is simple. A refined conditional analysis not exposed to the counter-examples of Martin, Johnston and others has been given by Lewis ('Finkish Dispositions', p. 157):

> Something x is disposed at time t to give response r to stimulus s iff, for some intrinsic property B that x has at t, for some time t' after t, if x were to undergo stimulus s at time t and retain property B until t', s and x's having B would jointly be an x-complete cause of x's giving response r.

This definition is backed up by the further explication (p. 156) of an x–complete cause as 'a cause complete in so far as havings of properties intrinsic to x are concerned, though perhaps omitting some events extrinsic to x'. Although Lewis' analysis is very sophisticated and avoids Martin's counter-examples, it is subject to other difficulties. I shall point out one of those difficulties here and deal with two other difficulties in §VI below.[9] The property variable 'B' over which Lewis' *analysans* quantifies is intended to take *bases* of dispositions as its values. (A basis of a disposition D correlated to a test–manifestation pair $<T, R>$ is the non-dispositional property responsible for a D-disposed object's Ring if Ted.) Therefore, as Lewis himself observes (p. 149), the analysis is confined to dispositions which actually have bases. Since it is not uncontentious that every disposition has a basis, and since a conditional analysis of dispositions is not supposed to settle whether a particular disposition has a basis or not, the fact that the analysis applies only to dispositions which actually have bases probably limits its value.[10] Moreover, there is a methodological point to make. Lewis' analysis *is* very complicated – an 'unlovely mouthful', as he concedes (p. 157) – and the concepts of an intrinsic property and of a cause have not been spelt out even

[9] Another argument against Lewis' analysis, based upon the notion of an *antidote*, has been put forward by A. Bird, 'Dispositions and Antidotes', *The Philosophical Quarterly*, 48 (1998), pp. 227–34, but it is unsuccessful: see my 'On the Conditional Analysis of Dispositions', forthcoming in U. Meixner and P. Simons (eds), *Metaphysics in the Post-Metaphysical Age* (Proceedings of the 22nd International Wittgenstein Symposium, 1999, Vienna: ÖLWG).

[10] Although Prior, Pargetter and Jackson have argued for the thesis that every disposition has a causal basis ('Three Theses about Dispositions', pp. 251–3), there are also authors who concede the possibility of baseless ('ungrounded') dispositions; see, e.g., Mumford, pp. 167–9; also G. Molnar, 'Are Dispositions Reducible?', *The Philosophical Quarterly*, 49 (1999), pp. 8–17. The existence of baseless dispositions of subatomic particles is the primary reason why Molnar rejects Lewis' analysis.

yet. (It is, however, clear that Lewis would spell out the latter concept in terms of his formal apparatus for counterfactual conditionals.) Therefore if a simpler analysis will work, it should be adopted.

It is my aim in this section to work out a definition schema for the most basic dispositional concepts. To make the nature of my analysis completely plain, I shall start by stating some adequacy conditions.

(i) The most basic dispositional concepts are time-dependent, i.e., are of the form *x has the disposition D at time t*.

As with other properties, objects can gain or lose dispositions over time. For example, an object can be non-fragile at some time t, but become porous over time and thus fragile at some later time t'. An object can be magnetic at time t_1, lose its magnetism at some later time t_2, and regain it at t_3. Such changes are not mysterious; they can happen in normal conditions. Therefore the most basic dispositional concepts are of the form mentioned above. Time-independent dispositional concepts can be reduced to time-dependent ones.

(ii) The *analysans* of a disposition D corresponding to a test–manifestation pair $<T, R>$ must not imply that T or R is actually realized at the time of the ascription of D.

An object may have a disposition over a (longer or shorter) period of time without being subject to the corresponding test or displaying the corresponding manifestation. A Chinese vase may have been packed at some Chinese factory a week ago and correctly labelled as 'fragile', then may be shipped to England and may arrive there without having been dropped or broken. A particular sugar cube may have been water-soluble for years while being stored in someone's cellar without being immersed in water or dissolving.

(iii) The *analysans* of a disposition D must not imply that an object cannot have D while displaying the corresponding manifestation.

A Chinese vase that actually breaks undoubtedly loses its fragility; a sugar cube that actually dissolves loses its water-solubility. But is a haemophiliac no longer a haemophiliac while actually bleeding? (At least, everyone who concedes that the disposition of being a haemophiliac has a basis, i.e., deficiency of globulin, and that a victim does not lose that basis while actually bleeding, has to agree to (iii).) I take it to be an empirical question whether an object loses a particular disposition while it is displaying the corresponding manifestation, and I agree with Hugh Mellor's claim that we should 'beware ... of accepting any account [of dispositions] with the absurd consequence that glasses cannot be fragile while they are actually breaking'.[11]

(iv) The *analysans* of a disposition *D* must not imply that an object that has the disposition in question cannot display the corresponding manifestation for a reason other than undergoing the corresponding test.

A Chinese vase which is fragile can break without being dropped, for example, because an explosive (which would also have broken a non-fragile chunk of wood) was detonated beneath it.

(v) Dispositions are causal properties; the *analysans* of a disposition *D* must state some kind of causal relation between the corresponding test and the corresponding manifestation.

An object's having a disposition *D* corresponding to a test–manifestation pair $<T, R>$ consists in having the property of displaying a manifestation *R* *because* of undergoing the test *T*.[12] A (fragile) vase breaks *because* it has been dropped (*if* it has been dropped and no other possible cause is present).

(vi) Dispositions are first-order rather than second-order properties.

There are two points that should be considered here. (a) On our ordinary use of dispositional concepts, if I say that a particular Chinese vase is fragile I do not mean by this statement that the vase has some non-dispositional property *B* (e.g., a particular molecular structure). The ascribed disposition *may* have a basis, but my ascription is not meant to be an answer to the question whether it actually does or does not have a basis. (b) It can be seriously doubted whether second-order properties can play a causal role. Consequently an analysis of dispositions which construes these as second-order properties casts serious doubts on their causal powers. I shall say more about this point in §§V–VI below.

There are two reasons for the 'technicalities' which now follow: I need to be as precise as possible, and to show that my analysis is completely spelt out even though it is simpler than Lewis' way of doing things. Taking (i) and (ii) as a starting point, I claim that the *definiens* of a dispositional predicate *Dx*, *t* must contain the following counterfactual:

[11] D.H. Mellor, 'In Defense of Dispositions', *Philosophical Review*, 83 (1974), at p. 169.

[12] The only obstacle to this claim that I am aware of is so-called 'abstract dispositions' discussed, for example, by Mumford (pp. 9–11, 165–7). His only example for such a disposition is *divisibility by 2*. However, this is simply not a disposition. Nor is there a corresponding test worth its name, nor a corresponding manifestation. *Divisibility by 2* is a property of abstract objects (numbers) which is derived from the relation *x is divisible by y*. Mumford may have been misled by a long since abandoned anthropomorphic conception of mathematical operations (functions).

4. If Tx, t were the case, then Rx, $t + \delta$ would be the case.

The reason for writing Rx, $t + \delta$ instead of Rx, t is to avoid presupposing instantaneous causation. The value of δ depends on the particular causal relation between T and R.

So far I find myself in agreement with early counterfactual analyses, though not much is explained yet; the counterfactual (4) is itself in need of explanation. I shall give the required explanation by defining its truth-conditions. In doing so, I shall rely on Lewis' general analysis of counterfactuals.[13] Since for my current purposes counterfactuals with impossible antecedents are not relevant, $\Box\!\!\Rightarrow$ will be the counterfactual connective of choice.[14] Thus (4) is to be translated as $Tx, t \Box\!\!\Rightarrow Rx, t + \delta$. But this is not sufficient to cover the meaning of Dx, t. The reason is that, according to Lewis' analysis of counterfactuals, for $Tx, t \Box\!\!\Rightarrow Rx, t + \delta$ to be true it is sufficient that Tx, t and Rx, $t + \delta$ are both true. But the joint truth of Tx, t and Rx, $t + \delta$ could be a random coincidence. Some different condition must be added to $Tx, t \Box\!\!\Rightarrow Rx, t + \delta$ in order to exclude cases of random coincidence. One might suggest, for instance, that we require what Lewis calls a *causal dependence* between Tx, t and Rx, $t + \delta$, spelt out as $(Tx, t \Box\!\!\Rightarrow Rx, t + \delta) \wedge (\neg Tx, t \Box\!\!\Rightarrow \neg Rx, t + \delta)$.[15] But this requirement is too strong, since it is in conflict with (iv). In order to avoid the conflict, one might suggest confining the second conjunct to cases where $Tx, t \wedge Rx, t + \delta$ is true. However, even $(Tx, t \Box\!\!\Rightarrow Rx, t + \delta) \wedge ((Tx, t \wedge Rx, t + \delta) \supset (\neg Tx, t \Box\!\!\Rightarrow \neg Rx, t + \delta))$ is too strong, because Rx, $t + \delta$ could be caused by some different sufficient cause $T'x$, t' if it were not caused by Tx, t. So adding $(\neg Tx, t \Box\!\!\Rightarrow \neg Rx, t + \delta)$ or $(Tx, t \wedge Rx, t + \delta) \supset (\neg Tx, t \Box\!\!\Rightarrow \neg Rx, t + \delta)$ seems to be the wrong way.

However, the objection raised against the latter condition leads in another direction. Counterfactuals do not imply their contrapositives, i.e., the law of contraposition does not hold for counterfactuals. Therefore it is not redundant to add the contrapositive of (4) to (4), in order to preclude cases of random coincidence of Tx, t and Rx, $t + \delta$. The resulting statement

5. $(Tx, t \Box\!\!\Rightarrow Rx, t + \delta) \wedge (\neg Rx, t + \delta \Box\!\!\Rightarrow \neg Tx, t)$

obviously satisfies the adequacy conditions (i)–(iv) and (vi). Moreover it states some kind of causal relationship between Tx, t and Rx, $t + \delta$; thus it also satisfies adequacy condition (v).

[13] Lewis, *Counterfactuals* (Oxford UP, 1973). A similar account is presented by R. Stalnaker, 'A Theory of Conditionals', repr. in F. Jackson (ed.), *Conditionals* (Oxford UP, 1991), pp. 28–45.

[14] See Lewis, *Counterfactuals*, pp. 24–6. A counterfactual $A \Box\!\!\Rightarrow B$ is true in a world w iff some A-world where B holds is more similar to w than is any A-world where B does not hold.

[15] See Lewis, 'Causation', repr. in his *Philosophical Papers*, Vol. II (Oxford UP, 1986), pp. 159–72.

Finally, a reference to normal conditions has to be built into (5), in order to preclude electro-finks, moleculo-finks, sorcerers, etc. Let $C_{ND}x, t, t+\delta$ be short for *x is from t to t* + δ *in the normal conditions for having D*, where the expression *the normal conditions for having D* is a rigid designator. It is not necessary for ascribing a disposition that the normal conditions in question must actually apply. We can ascribe a disposition *D* to an object *x* while considering only how *x would* behave if it *were* in normal conditions. For this reason, I suggest the following definition schema for a dispositional concept '*D*' (corresponding to a test–manifestation pair $<T, R>$):

6. Dx, t iff $C_{ND}x, t, t+\delta \;\Box\!\!\Rightarrow ((Tx, t \;\Box\!\!\Rightarrow Rx, t+\delta) \wedge (\neg Rx, t+\delta \;\Box\!\!\Rightarrow \neg Tx, t))$.

Definition schemata for multiply-manifested dispositions can be derived from (6) by modifying the consequent of the counterfactual on the right-hand side of the biconditional.

Let us now try some examples. (a) A moleculo-fink manipulates an ice cube *x* in such a way that it does not break when suitably dropped. Is *x* fragile? To decide this question, we have to ask: if normal conditions for being fragile applied, that is, if *x* were not being controlled by a moleculo-fink, would it break when dropped? The answer is 'Yes'. (b) A 'reverse' moleculo-fink manipulates a chunk of wood *y* in such a way that it does break when dropped. Is *y* fragile? Here we have to ask analogously: if normal conditions for being fragile applied, would it break when suitably dropped? The answer is 'No'. (c) A *D*-disposed object *z* is subject to a test and to an intervening antidote at some time t', where $t \leqslant t' \leqslant t+\delta$. Is the right-hand side of (6) true of *z*? Since $C_{ND}x, t, t+\delta$ is false because of the intervening antidote, there is at least no reason to assume that the right-hand side of (6) is false. The paradox has vanished.

V. IS THE CONDITIONAL ANALYSIS ANTI-REALISTIC?

A conditional analysis of a dispositional concept '*D*' is a *conceptual reduction* of '*D*'. The meaning as well as the extension of '*D*' are reduced to the meanings and extensions of the expressions which occur in the *analysans*. As in the case of (6), '*D*' is, in a particular way, reduced to 'C_{ND}', '*T*' and '*R*'. One might think that if a particular conceptual analysis of a property expression '*P*' succeeds, an *ontological reduction* of the designated property *P* is accomplished as well (but not *vice versa*). Mumford, for example, follows this line of thought. He claims that dispositional properties would not be properties in their own right if dispositional concepts (disposition ascriptions) could be analysed in terms of conditionals. Since he takes an ontologically realistic standpoint as regards dispositional properties, he tries to show that the strategy of analysing dispositional concepts in terms of conditionals cannot be successful.[16]

But is there really this opposition between realism about dispositions and the conditional analysis? The answer to this question depends on two things: the concepts which serve as basic in the conceptual reduction of dispositional concepts, and the particular kind of dispositional analysis found to be appropriate.

A necessary condition for a positive answer is that there must be no infinite regress, that we do not analyse dispositional concepts in terms of dispositional concepts (circular analyses are to be rejected anyway). The conditional analysis of dispositional concepts is opposed to realism only if there is no such analysis in terms of other dispositional concepts at all, or if the *basic* concepts in the analytical regress are exclusively non-dispositional. Let us for the sake of argument assume that this condition is fulfilled, and move to the second point.

As regards the early empiricist analyses of dispositions in terms of *material* conditionals, Mumford is certainly right. Suppose we had a list of all individuals in our actual world and a complete account of the (non-dispositional) properties they do and do not have as well as of the (non-dispositional) relations in which they do and do not stand to one another. Then, just from that description of the actual world and the conditional analyses of dispositional concepts, we could decide which dispositions do apply to the objects on the list and which do not. Because material conditionals are truth-functional, there would be no need to assume that there are dispositional properties in our world over and above the non-dispositional properties and relations. An ontological reduction of dispositional properties to non-dispositional properties would also result from Lewis' analysis, if it were adequate. According to Lewis, an object's having a disposition D simply consists in that object's having a particular non-dispositional property B. So on this account too there would be no need for dispositional properties over and above non-dispositional properties.

However, the conditional analysis given in the preceding section is not in terms of truth-functional operators, nor does it rely on non-dispositional bases; the relation between $C_{ND}x, t, t+\delta$, Tx, t and $Rx, t+\delta$ stated on the right-hand side of (6) is not truth-functional. Even if for an object x (at time t) $C_{ND}x, t, t+\delta \wedge Tx, t \wedge Rx, t+\delta$ holds (i.e., if x has all the relevant non-dispositional properties), x does not necessarily have the corresponding disposition D (at t).

[16] See Mumford, *Dispositions*, pp. 22, 63, 74.

To say that an object *x* has the disposition *D* (at time *t*) whereas an object *y* does not have *D* (at *t*) points to a difference between *x* and *y* (at *t*), i.e., a difference in their *properties*. To state this difference between *x* and *y* is just like stating a difference between other objects *a* and *b* by asserting that *a* has a non-dispositional property *P* while denying that *b* has it. To say that *x* has the disposition *D* (at *t*) means roughly that *x* has that property which (in normal conditions) together with an occurrence of a Tx, t event causes the occurrence of an Rx, $t + \delta$ event. One must not confuse disposition ascriptions with law-like statements, nor assimilate the two notions. A law-like statement might state that (in normal conditions) *T*-type events cause *R*-type events; but this does not necessarily point to a difference in any object *x*. A disposition ascription Dx, t states that, if a Tx, t event occurs, then *x* brings its nature to bear, and thereby causes, together with the Tx, t event, an Rx, $t + \delta$ event. Another object *y* that does not have the disposition *D* (at *t*) cannot do this; it cannot bring its nature to bear and jointly cause the same kind of effect. The reason why a chunk of wood *y* does not (usually) dissolve when immersed in water is that it does not have the nature, or, to be exact, the property, which jointly with being immersed in water causes dissolving (i.e., the property of water-solubility). A sugar cube, however, (usually) does. I conclude therefore that a dispositional property *D* of an object *x* plays a particular causal role that cannot be reduced to the causal roles of C_{ND}, *T* or *R* respectively. (Although dispositional explanations are not my topic here, I should like to add that just for this reason dispositional explanations are neither trivial nor vacuous, but provide information about why some object *R*ed when *T*ed. The information provided by this explanation is that the object has the nature or relevant property to do so, as opposed to some other object *y*, for example, which does not have that nature or property.)

A popular ontological criterion for the existence of non-abstract properties is the *criterion of the causal role*:

CCR. For any intrinsic (i.e., non-relational) property *P*, *P* exists if there are circumstances in which the instantiations of *P* have causal consequences.[17]

I do not want to discuss the adequacy of (CCR) here, since this is not my

[17] See, e.g., D. Armstrong, *A Theory of Universals* (Cambridge UP, 1978); E. Fales, *Causation and Universals* (London: Routledge, 1990); S. Shoemaker, 'Causality and Properties', in P. van Inwagen (ed.), *Time and Cause* (Dordrecht: Reidel, 1980), pp. 109–35; Mumford, *Dispositions*, p. 122. Mumford restricts the criterion to non-abstract properties, but formulates it as a biconditional. For the purposes of this paper, however, it is sufficient to state the uncontroversial weaker version and omit the 'only if'-part. Thus a restriction to non-abstract properties can be omitted as well.

topic. However, I take it that (CCR) is highly plausible. As regards what has been said above, there can be no doubt that dispositional properties do exist according to (CCR) despite their being conceptually analysed in terms of conditionals. Consequently a realistic ontology of dispositions is not threatened by a proper conditional analysis. It is not true that conceptual reductions always imply ontological reductions.[18] Therefore my conditional analysis is a conditional analysis of dispositional concepts, rather than of dispositional properties.

VI. FUNCTIONALISM

Functionalism was developed in the 1960s by Putnam and Fodor as a theory in the philosophy of mind. Its primary task was to avoid the difficulties of semantic physicalism, while still maintaining the idea that mental states can be reduced to physical states. Functionalism in the philosophy of mind, therefore, embraces among other claims the following:

(i) Mental states (properties) are functional states (properties), i.e., states (properties) which are characterized by their causal role
(ii) Functional states (properties) are second-order states (properties)
(iii) Functional states (properties) *are* realized by physical states (properties); one functional state (property) *can* be realized by different physical states.[19]

Claims (ii) and (iii) are strongly connected with each other and with the idea of reducing mental states to physical states. Claim (i), however, may be regarded as the core of functionalism, i.e., the claim from which functionalism got its name; it is logically independent of (ii) and (iii). The idea that functional states are realized by physical states has an analogy in the theory of dispositions, namely, the idea that every disposition has a (categorical) basis. If, however, the latter idea is false, or at least not uncontentious, then a functionalist theory of dispositions can omit claims that are analogous to (ii) and (iii) and still be functionalist, as long as it embraces a claim analogous to (i).

[18] Serious doubt against this alleged implication is also raised by Alex Oliver in his state-of-the-art article 'The Metaphysics of Properties', *Mind*, 105 (1996), pp. 1–80. See also my 'Begriffliche Analyse und ontologische Reduktion von Eigenschaften', forthcoming in *Metaphysica – Zeitschrift für Ontologie und Metaphysik*.

[19] See, e.g., N. Block, 'Functionalism', in S. Guttenplan (ed.), *A Companion to the Philosophy of Mind* (Oxford: Blackwell, 1994), pp. 323–32; A. Beckermann, *Analytische Einführung in die Philosophie des Geistes* (Berlin: De Gruyter, 1999), pp. 141–80.

A functionalist theory of dispositions is, I take it, characterized by three main claims:

(i′) Every disposition D corresponds either to a test–manifestation pair $<T, R>$ or to a particular class $\{<T_1, R_1>, <T_2, R_2>, \dots\}$ of such pairs each of whose elements plays a particular role for D

(ii′) Dispositions are causal, and thus functional properties, in the sense that they are to be explained by reference to a causal relation between the T_i and the R_i

(iii′) Dispositions are efficacious properties of objects.[20]

I have endorsed all of these claims above: (i′) in §I, (ii′) in §IV, and (iii′) in §V. All of these claims are consistent with the conditional analysis suggested in §IV. However, not all conditional analyses are consistent with all of these claims. In a handbook entry Brian McLaughlin has claimed that 'The leading theory of dispositions today is the *functionalist* theory, a realist theory according to which a disposition is a second-order state of having a state with a certain causal role'.[21] As has been shown above, McLaughlin's characterization fits Lewis' refined conditional analysis. It also fits the analysis presented by Prior, Pargetter and Jackson.[22] Besides the fact that I cannot see why a (strong) realistic theory has to construe dispositions as second-order properties, such a theory is at odds with claim (iii′) above. Lewis has commented on this difficulty in an earlier paper:

> I take for granted that a disposition requires a causal basis: one has the disposition iff one has a property that occupies a certain causal role.... perhaps we should distinguish the disposition from its various bases, and identify it rather with the existential property.... But this alternative has a disagreeable oddity of its own. The existential property, unlike the various bases, is too disjunctive and too extrinsic to occupy any causal role. There is no event that is essentially a having of the existential property; *a fortiori*, no such event ever causes anything.... So if the disposition is the existential

[20] Mumford, who has recently presented a new functionalist theory of dispositions, seems to think that (ii′) implies (iii′), or at least fails to make a clear distinction between (ii′) and (iii′): see his *Dispositions*, pp. 196–9. However, (ii′) does not imply (iii′). We can derive from a general causal law in Dretske-form, say, *F*ness causes *G*ness, the open statement *Gx because Fx*, and take this to define a new predicate *Kx*. Obviously the designated property *K* is a causal property in the sense of (ii′); but it is not efficacious in the way dispositions are. *K* does not contribute to an object's *G*ing when *F*ed, since any object whatsoever *G*s when *F*ed. An object's being *F* is causally sufficient for its being (becoming) *G*, and there is no causal role whatsoever for *K* to play.

[21] B.P. McLaughlin, 'Disposition', in J. Kim and E. Sosa (eds), *A Companion to Metaphysics* (Oxford: Blackwell, 1995), at p. 123.

[22] Cf. 'Three Theses About Dispositions', p. 255: 'for the strong realist, dispositions will be second-order properties. The property of being fragile will be identical with the property of having a property or property-complex (causal basis) responsible for breaking (in the right way) on dropping.'

property, then it is causally impotent. On this theory, we are mistaken whenever we ascribe effects to dispositions.[23]

Even if someone could be convinced that second-order properties can be efficacious, there would still remain another difficulty with a definition such as Lewis' version. If dispositions are efficacious, i.e., if a disposition *D* of an object *x* jointly with the stimulus *T* causes the manifestation *R* of *D*, and if the causal basis *B* of *x* does exactly the same, then *R* would be over-determined. (This is the reason why Prior, Pargetter and Jackson claim that dispositions are impotent: see pp. 255–6.) But one cannot evade this problem by identifying *D* and *B*, since *D* is supposed to be a second-order property while *B* is supposed to be a first-order property of *x*.

Lewis is certainly right on the consequences of an analysis of dispositions that construes them as second-order properties. However, in view of what has been said in the preceding section of this paper, claim (iii′) is also true. Consequently an analysis of dispositions that construes them as second-order properties is not adequate. The analysis presented in this paper is not subject to that difficulty, and it seems to avoid the problem of finkish dispositions just as effectively as Lewis' analysis does. Taken in the sense of claims (i′)–(iii′), my analysis is a functionalist analysis, although, as I have argued in the preceding section, it does not imply an ontological reduction of dispositions.[24]

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[23] Lewis, 'Causal Explanation', in his *Philosophical Papers*, Vol. II, pp. 223–4.

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