MUST DISPOSITIONS HAVE A BASIS?

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In this paper I shall defend a controversial thesis concerning the analysis of dispositional attributions. According to this thesis, which I call the entailment thesis (ET), it is a necessary truth that if a physical object x has a disposition d, then x has some intrinsic characteristic or characteristics in virtue of which it has d.

In recent years philosophers have raised three important objections to ET. Two of these are due to J. L. Mackie. The first is that it is possible for there to be two objects with all the same intrinsic properties but different dispositions, and that this possibility is incompatible with ET. The second is that the possibility of action at a distance is incompatible with ET.[1] The third objection, which has been independently voiced by William Alston and D. M. Armstrong, is that the possibility of there being basic physical objects is incompatible with ET.[2]

There is a short way of answering these objections: one can simply deny the possibilities on which they are premised. Those who take a Humean or generalist view of causation and of natural laws would probably reject out of hand the possibility of there being two objects with all the same intrinsic characteristics but different dispositions. Certainly, the possibility of action at a distance is controversial, and anyone who rejects it would be on ground at least as firm as someone who accepts it. Finally, many philosophers have found it implausible that there could be basic physical objects; these philosophers have usually thought that there must be an infinity of kinds of particles.[3]

In the present paper I shall not take the short route in any of the three cases described above. Instead, I will argue that even if one grants the possibilities on which these three objections to ET are based, it does not follow that ET is false. Hence, none of these objections are sufficient to refute ET.

In the first section of this paper I shall explicate ET. In the second section I will show that none of the objections described above are sufficient to refute ET.

Finally, I will argue that since none of these objections succeed, and since a limited version of ET which applies only to standard cases of dispositional attribution is clearly true, our acceptance of ET is warranted.

I

We may distinguish several different kinds of dispositions. A first distinction is between deterministic dispositions, or dispositions which are unfailingly manifested in the appropriate circumstances, and probabilistic dispositions, which are only sometimes manifested in the appropriate circumstances. A second distinction is between dispositions which may be manifested in several different ways and dispositions which may be manifested in only one way. In this paper, in order to simplify matters, I shall concern myself only with deterministic dispositions which are singly-manifested. Similarly, while dispositions may be attributed to individuals in varying degrees of specificity, I shall presuppose that an ideal specification has been made of (i) the circumstances C which are sufficient for the manifestation of a disposition d of an individual x, and (ii) the process ψ which x undergoes when in C. According to the view which I will defend, if x has a disposition d to ψ-in-C, then there is a law of nature L which is expressed in terms of ψ and C, and which subsumes x. Therefore, C and ψ are ideally specified just when they are specified to the degree required to fully state L.

Consider the following schema:

(1) At t, x is disposed to ψ-in-C.

In (1), 'x' 't', 'ψ', and 'C' are schematic letters. 'x' is to be replaced with a proper name denoting a physical object, 't' with the name of a time, 'ψ' with a process-predicate, and 'C' with an expression describing a set of circumstances.[4] I take (1) to be the paradigm form of dispositional attribution.

If an object has a (deterministic) disposition, then there is a law of nature in the offing. In other words, dispositional attributions entail laws of nature or statements of physical necessity.[5] Such laws of nature are typically statements of the form, '□(y) (if y is φ in C, then y ψ's)',[6] where '□' means "it is physically necessary that", and where 'φ' designates an intrinsic property of a physical object. Since dispositional attributions entail laws, and since these laws provide nomically sufficient conditions for the dispositional attributions which entail them, it is a necessary truth that there is a nomically sufficient condition for a particular object's having a particular disposition.

I need not commit myself here to any interpretation of nomic or physical necessity, but it is important that I make clear how one's understanding of the physical modalities has a bearing on the concerns of this paper. In what follows, I shall draw a distinction between general and non-general laws of nature, a distinction I will make use of in explicating ET. I will also show how this first distinction is related to a distinction between de dicto and de re statements of physical necessity.

On one view of laws of nature, which we may call the Humean or generalist view, it is a necessary truth that all laws of nature are general. Roughly speaking, a law of nature is general just when it can be expressed by a universally quantified sentence which makes no reference to any particular individual. Conversely, a law of nature is non-general just when it can only be expressed by a sentence which makes reference to some particular.

On what may be called a realist view of laws of nature, we can quantify into causal contexts. An adequate interpretation of the resulting quantified causal logic implies that for every de dicto statement of physical necessity there is a corresponding statement de re.[7] For example, corresponding to the de dicto schema above is a schema de re: (y) (y is physically necessarily such that: if y is ϕ in C, then y ψ's). A statement of physical necessity de re explicitly attributes a nomic property or properties to some individual or class individuals.

In the following discussion I will draw a distinction between two different relations in which laws of nature can stand to particulars. This distinction will then be used to distinguish two types of non-general laws. The first is the familar relation of nomic subsumption. It can be defined as follows:

(D1) A law of nature L subsumes an individual x = df. (i) any English sentence expressing L is logically equivalent to a sentence of the form '$\Box$ (y) (if y is ϕ in C, then y ψ's)', and (ii) it is physically possible for x to be ϕ in C.

The second relation holds whenever we have a non-general law of nature. Such a law makes reference to a particular individual or set of individuals, and for this reason may be said to involve these individuals:

(D2) A law of nature L involves an individual x = df. Any English sentence expressing L contains a singular term which denotes x.[8]

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On what may be called a realist view of laws of nature, we can quantify into causal contexts. An adequate interpretation of the resulting quantified causal logic implies that for every *de dicto* statement of physical necessity there is a corresponding statement *de re*.[7] For example, corresponding to the *de dicto* schema above is a schema *de re*: (y) (y is physically necessarily such that: if y is ϕ in C, then y ψ's). A statement of physical necessity *de re* explicitly attributes a nomic property or properties to some individual or class individuals.

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(D1) A law of nature L *subsumes* an individual x = df. (i) any English sentence expressing L is logically equivalent to a sentence of the form '$\Box$ (y) (if y is ϕ in C, then y ψ's)', and (ii) it is physically possible for x to be ϕ in C.

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(D2) A law of nature L *involves* an individual x = df. Any English sentence expressing L contains a singular term which denotes x.[8]

I shall now show that given a realist interpretation of laws of nature, there is no reason to question the existence of non-general laws of nature of a certain kind, namely, laws which are non-general with respect to the class of individuals which they involve and which are derivable from general laws. I call a law of this kind a derivable, non-general law of nature (DNL). The notion of a DNL can be defined with the help of the concepts of subsumption and involvement. Consider a non-general law L, which is of the form '□ (if x is ϕ in C, then x ψ's)'. L is a DNL if and only if there is a corresponding general law L' which is equivalent to a statement of the form '□ (y) (if y is ϕ in C, then y ψ's)'. Hence, any DNL can be logically derived from the conjunction of a general law and an existential statement asserting the existence of some particular individual or individuals which the DNL involves and which the general law subsumes. For this reason, if one is willing to countenance general laws of nature interpreted along realist lines, then one should also affirm the existence of DNLs.

However, it is important to distinguish DNLs from non-derivable, non-general laws of nature (NNLs). An NNL would be a realistically interpreted non-general law which was not derivable from a general law conjoined with an existential statement of the sort described. In other words, if a non-general law of the form '□ (if x is ϕ in C, then x ψ's)' were true, but there were no corresponding general law of the form '□ (y) (if y is ϕ in C, then y ψ's)', then the former would be an NNL. For this reason, the possibility of NNLs cannot be inferred from the existence of realistically interpreted general laws.

ET says that it is a matter of necessity that every disposition of an object have a basis in its intrinsic characteristics. For this reason it is important to have an understanding of the notion of an IC or intrinsic characteristic of a physical object. I shall say that an IC P of a physical object x is either (i) an essential property of x, or (ii) a contingent property of x which is necessarily such that x acquires or loses P if and only if x undergoes a change in parts or in arrangement of parts, i.e., in its structural/compositional properties. This implies that the property of being next to something, for example, is not an IC of any physical object, for the location of another individual may entail that x acquire or lose this property.

ET says that if a physical object has a disposition d, then it has d in virtue of having an IC. The following is a definition of the in virtue of relation:

(D3) At t, x is disposed to ψ-in-C in virtue of having an IC ϕ = df. (i) at t, x has ϕ; and (ii) $\Box(y)$ (if y is ϕ in C, then y ψ^{T}s) v $\Box$ (if x is ϕ in C, then x ψ's).

Clause (ii) of (D3) is a disjunction because just what kind of law of nature is entailed by an objects's having a disposition depends on whether or not NNLs are possible. Suppose that

(2) At t, x has the disposition d to ψ-in-C, and that

(3) At t, x has d in virtue of having an IC ϕ.

If NNLs are impossible, then the conjunction of (2) and (3) entails

(4) $\Box(y)$ (if y is ϕ in C, then y ψ's).

On the other hand, if NNLs are possible, then one cannot infer from x's having d in virtue of being ϕ that it is a law of nature that every object which is ϕ has d. In other words, if NNLs are possible, the conjunction of (2) and (3) entails

(5) $\Box$(if x is ϕ in C, then x ψ's),

but not (4). For these reasons, if NNLs are impossible, then the analysandum of (D3) entails that there are general laws of nature, while if NNLs are possible, then the analysandum of (D3) entails that there are non-general laws of nature.

The thesis which I shall defend in the following sections (the entailment thesis) is that

(1) At t, x is disposed to ψ-in-C (where d = the disposition to ψ-in-C)

logically implies that at t, x has some IC in virtue of which it has d.[9]

II

In this section, I will consider and refute three objections to ET. The first objection, which is Mackie's, is the claim that it is possible for there to be two physical objects with all the same ICs but different dispositions, and that this possibility is inconsistent with ET.

Mackie appears to presuppose the impossibility of NNLs in voicing his first objection to ET (Mackie, p. 133). He distinguishes between dispositions and what he calls "minimal dispositions" (Mackie, pp. 127-28).

Mackie seems to be saying that an object x has a minimal disposition d if and only if (i) x has d, and (ii) x does not have d in virtue of having any property or properties other than d. Mackie argues that minimal dispositions are possible, and in support of this claim he describes the following state of affairs:

> There are two glasses a and b, both made at time t_1, which not only look alike but are alike in all their intrinsic features. At time t_2, each is knocked hard in the same way; a breaks and b does not. Moreover, this would have happened if they had both been similarly knocked at any time between t_1 and t_2. (Mackie, p. 130)

Let us call this state of affairs S1. Mackie's argument is that since S1 is possible, minimal dispositions are possible; and if minimal dispositions are possible, then ET is false.

If glass a were to have a minimal disposition d to break-when-knocked-hard, that a would not have d in virtue of having any property other than d--this much follows from the concept of a minimal disposition. Mackie seems to think that S1 implies that a has a minimal disposition d because (i) by hypothesis, a does not have d in virtue of having any non-intrinsic property, and a's having some non-intrinsic property is not a nomically necessary condition for a's having d,[10] and (ii) since, also by hypothesis, a and b have all the same ICs and a and d but b does not, therefore a does not have d in virtue of having any IC or ICs.

The trouble here is with the inference that Mackie draws in (ii). If NNLs are possible, then glass a's having d in virtue of having some IC or set of ICs ϕ is consistent with glass b's having ϕ and not having d. Hence, unless NNLs are impossible, (ii) is false. In other words, the possibility of S1 does not by itself entail the falsity of ET; instead, the possibility of S1 entails either that ET is false or that NNLs are possible. If NNLs are possible and S1 obtains, then there is an NNL of the form, '$\Box$ (if glass a is ϕ when knocked hard, then a breaks)', where ϕ is the IC or ICs in virtue of which a and d. In this case there would be no corresponding NNL of the form, '$\Box$ (if glass b is ϕ when knocked hard, then b breaks)'.

In order to refute ET, Mackie would have to prove both that (i) S1 is possible, and (ii) NNLs are impossible. But (i) and (ii) cannot both be true. If S1 is possible, then it is possible that there is a law of

nature L which subsumes a but not b, and which states a nomically sufficient condition for a's having d. Of what form will L be? Since we have stipulated that a's having some non-intrinsic property or properties is neither nomically necessary nor sufficient for a's having d, L will state a nomically sufficient condition for a's having d in terms of a's having some IC or ICs. But a and b have all the same ICs. Therefore, L cannot be a general law, since if it were, it would also subsume b. Hence, L must be an NNL which involves a and not b.

These considerations show that whatever plausibility there is in saying that S1 is possible derives from the plausibility of the assertion that NNLs are possible. Since the possibility of S1 entails the possibility of NNLs, and since the possibility of S1 is incompatible with ET only if NNLs are impossible, Mackie is mistaken in thinking that the possibility of S1 is incompatible with ET.

It might be argued that Mackie's case against ET can be improved by adding the following assumption to S1: no matter how a's structural/compositional properties were altered--so long as a still existed--a would retain d. This added assumption implies that a does not have d in virtue of any of its purely qualitative ICs.

If at time t_2, a possesses d and a does not possess d in virtue of having some purely qualitative IC or ICs, then a possesses d in virtue of having some non-qualitative IC or ICs, for example, the property of being identical with a, or the property of being that object,[11] or in virtue of having some conjunction of qualitative and non-qualitative ICs. Hence, the assumption that a does not have d in virtue of having any purely qualitative ICs is inconsistent with Mackie's prior assumption that a and b are alike in all their ICs. To describe a consistent state of affairs this new example (S2) must require only that a and b are alike in all their purely qualitative ICs. In this case, the possibility of S2 does not entail the falsity of ET. If S2 is possible, then it is possible that there are non-qualitative ICs. And if S2 were to obtain, then (ignoring the more complicated case where a has d in virtue of having a conjunction of qualitative and non-qualitative ICs) (i) a would possess d in virtue of having some non-qualitative IC, for example the property of being identical with a, and (ii) there would be an NNL of the form, '$\Box$ (y) (if y is identical with a and is knocked hard, then y breaks)'. (Notice that while a sentence of this form is universally quantified, nevertheless it expresses a non-general law because it makes ineliminable reference to a particular.) This law, together with the statement that a has the

property of being identical with a and b does not, explains a's having d and b's not having d.

A second kind of objection to ET has also been raised by Mackie, and is based on the possibility of action at a (temporal) distance (Mackie, p. 131).[12] Mackie claims that the following state of affairs (S3) is possible: there are two objects a and b which are alike in all their ICs; when a is struck hard it breaks, but when b is struck hard it doesn't break; the difference in how a and b react to being struck hard is caused by their different methods of manufacture, and not by any occurrent events or conditions. Mackie thinks that if S3 obtains, then a and b have different dispositions but all the same ICs. From this he concludes that if S3 obtains, then there are dispositions which are not had in virtue of any ICs, and that ET is false.[13]

As I have shown for S1, if NNLs are possible, then one can grant that a and b have all the same ICs and different dispositions and still maintain that whatever dispositions a and b have they have in virtue of possessing certain ICs. But this reply is not needed here, for Mackie is mistaken if he thinks that S3 implies that a and b have different dispositions. They have all the same dispositions, including the disposition d to break-when-struck-hard-if-manufactured-by-method-m, where method m is a's method of manufacture. In other words, the method of manufacture m is a relevant circumstance of the manifestation of d. The feature of S3 which implies action at a distance is that a past circumstance continues to be a causally relevant circumstance of the manifestation of d. This way of understanding S3 implies that object b does not break when struck hard because the circumstance of being struck hard is not sufficient to manifest its disposition d. One of the necessary conditions of the manifestation of d is missing, namely, having been manufactured by method m. Since this circumstance is no longer possible, it is not possible for b to manifest d. This is peculiar, but the peculiarity is inherited from the assumption of action at a temporal distance.[14]

Hence, S3 does not describe a possible state of affairs in which an object has a disposition but does not have it in virtue of possessing certain ICs. In other words, the possibility of S3 is consistent with the truth of ET.

It might be objected at this point that my interpretation of S3 begs the question against Mackie. Of course, I think that my interpretation is the more intuitive, but obviously Mackie does not share my intuition.

In a situation like this, when philosophers have different intuitions concerning conceptual claims, the proper procedure to follow in attempting to resolve the dispute is to appeal to some criterion or principle. I shall argue in Section III below that ET is clearly true for a large class of standard cases. In addition, as the preceding discussion has shown, S3 admits of an interpretation consistent with ET. In these circumstances, if there are no other reasons for preferring Mackie's interpretation of S3, then the fact that my interpretation of S3 enables us to formulate a uniform theory of dispositions while Mackie's does not puts the onus on Mackie to provide an unequivocal counterexample to ET based on the possibility of action at a distance. S3 is not such a counterexample.

A third kind of objection to ET is based on the possibility of there being basic physical objects. Before discussing this objection it will be helpful to elucidate the notions of a non-basic physical object and a basic physical object. Non-basic physical objects are such that it is physically possible to break them into proper parts. The ICs of such objects that are relevant to their having dispositions are usually internal states. These internal states are structural/compositional properties, the molecular, atomic, or subatomic make-ups of these objects. Basic physical objects are such that it is not physically possible to break them into proper parts.[15] They have no structural/compositional properties; therefore, if any entity of this sort has a disposition in virtue of having a certain IC, then this IC cannot be a structural/compositional property.

William Alston's view is representative of the objection to ET based on the possibility of there being basic physical objects:

> . . . we cannot claim that a dispositonal attribution entails the existence of a basis; it is not necessary that every disposition have a basis. In particular, if there are atomic substances with no internal structure (and this would seem to be at least logically possible), they will undoubtedly have dispositions, for they will undoubtedly react in characteristic ways to certain conditions. But since they lack any internal structure, there can be no question of various features of their structure serving as the basis for various dispositions. Their dispositions will be ultimate properties. (Alston, p. 143)

To cite another example, while D. M. Armstrong maintains that necessarily, if a non-basic physical object has a disposition d, then it is in some state which is the basis of d, he does not insist on extending this claim to basic physical objects. He is willing to say that in the case where we have a basic physical object, " . . . we might reach ultimate potentialities of the disposed thing, potentialities which do not depend upon non-dispositional properties" (Armstrong, pp. 13-14).

Alston and Armstrong confuse two roles which an IC, ϕ, may play. First, ϕ may play a role in a theory which explains why it is a law of nature that an individual x ψ's when ϕ in C. Second, ϕ may play a role in the explanation of x's having a disposition d in ψ-in-C.

In its former guise, ϕ is the structural/compositional property of x which explains by characterizing a causal mechanism, why x ψ's when ϕ in C. For example, the molecular structure of salt, in the context of the atomic theory of matter, characterizes a causal mechanism whose workings explain why it is a law of nature that salt dissolves in water.

In its later guise, ϕ is the IC of x in virtue of which x has d. In this case, there is a law of nature which asserts that $\Box$(if x is ϕ in C, then x ψ's), or a law of nature which asserts that $\Box$(y) (if y is ϕ in C, then y ψ's). This, together with the proposition that x is ϕ, explains why x has d in the sense that it entails that x has d.

An IC of an object can play the latter role without playing the former, but not vice-versa. Hence, though it is true that the ICs of a basic physical object could not play the former role vis-a-vis the dispositions of that object, they could and would play the latter role vis-a-vis those dispositions. Since this is all that ET requires of the ICs of a basic physical object--namely, that for every disposition d of a basic physical object x there is some one or more ICs of x in virtue of which it has d--the possibility of there being basic physical objects is consistent with the truth of ET.

We have noted that if there were basic physical objects then the ICs in virtue of which they had their dispositions would not be structural/compositional properties. What sort of properties would they be? If all laws of nature were either general or DNLs, then the ICs in question would be sortal or natural kind properties, e.g., being a basic physical object, being a field of potential, being a photon. On the other hand, if there were NNLs involving basic individuals,

then the ICs in virtue of which those individuals possessed their dispositions would be either the above sort of properties or else non-qualitative ICs, e.g., the property of being identical with a, or the property of being that individual.

III

We have considered several objections to ET. I have shown that even if we concede the possibility of the states of affairs upon which these objections are based, their possibility is compatible with the truth of ET. Since there are no good objections to ET, there is no logical bar to our accepting it. Hence, we will be warranted in accepting ET if we can show that there are good reasons for making ET a part of our theory of dispositions. These reasons are as follows.

There is a broad class of dispositional attributions where ET clearly fits the facts. Consider a standard situation, i.e., a situation where an object x has a disposition d to ψ-in-C, and where it is physically possible for x to be in C and not have d. As we have seen, x's having d entails that there is a law of nature which subsumes x. Since, by hypothesis, it is physically possible for x to be in C and fail to ψ, this law does not assert simply that □(if x is in C, then x ψ's), or that □(y) (if y is in C, they y ψ's). Rather, x's having d entails that (εφ)[(x is φ) & (□ (if x is φ in C, then x ψ's) v (y) (if y is φ in C, then y ψ's))], where φ is an IC. In other words, in standard cases of the sort described, x's having d entails that x has an IC in virute of which it has d, and ET is true at least for those cases.

Therefore, any consistent theory of dispositions which implies that dispositional attributions entail laws, i.e., any nomological theory of dispositions, implies a version of ET which pertains at least to this standard class of cases. While some of the critics of ET concede the plausibility of a version of ET which has limited scope, they object to extending this limited version to include certain non-standard cases, namely, the cases we have examined above (Mackie, p. 133). Since we must accept a limited version of ET in any case, an adequate nomological theory of dispositions can provide a uniform analysis of dispositional attributions only if it entails ET. Because of this, and because none of the objections to ET succeed, our acceptance of ET is warranted, and it is reasonale to conclude that ET is part of the analysis of dispositional attributions.[16]

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NOTES

[1]J. L. Mackie, Truth, Probability, and Paradox (Oxford: Clarendon Press, 1972), Chapter 4.

[2]See W. Alston, "Dispositions and Occurrences," Canadian Journal of Philosophy I (1971), pp. 125-54, and D. M. Armstrong, Belief, Truth and Knowledge (Cambridge: Cambridge University Press, 1975).

[3]D. Bohm, Causality and Chance in Modern Physics (Princeton: Van Nostrand, 1957).

[4]Whenever I use one of these letters schematically, I follow this convention for its replacement. For example, if 'x' is used schematically, then it is to be replaced with a proper name denoting an individual 'ψ' with a predicate, and so forth.

[5]More specifically, it is a necessary truth that if an object x has a disposition d, then there is a nomically sufficient condition for x's having d.

[6]Whenever I employ a law-schema such as this, I intend that the reader understand it to be implicitly temporally quantified. For example, this schema should be read as "it is physically necessary that (y) (t) (if at t, y, is ϕ in C, then at Δt y ψ's)", where t is suitably later than t.

[7]This is demonstrated by D. Follesdal "Quantification into Causal Contexts" in Linsky (ed.), Reference and Modality (London: Oxford University Press, 1977), pp. 52-62.

[8]If a law of nature involves an individual x, then it also subsumes x. Suppose that there ia a law L which asserts that (if x is ϕ in C, then x ψ's). Then L involves x. But L is logically equivalent to $\Box(y)$ (if y is ϕ & $y = x$, then y ψ's), which subsumes x.

[9]Hence, ET logically implies that if an object x has a disposition d, then x's having some IC or ICs is a nomically sufficient condition for x's having d.

[10]As we shall see, Mackie bases a second objection to ET on the alleged possibility that an objects's having a conjunction of relational properties and ICs provides a nomically sufficient condition for its possessing a disposition, while its possessing those ICs alone does not. This objection will be dealt with later.

[11]If the property of being identical with a were a property of a, then it would be what some philosophers have called an individual essence of a. For a thorough defense and explication of individual essences see R. M. Chisholm Person and Object (London: G. Allen & Unwin, 1976) and A. Plantinga, The Nature of Necessity (Oxford: Clarendon Press, 1974. It might be objected that non-qualitative ICs such as individual essences are peculiar and unintuitive. Perhaps they are, but no more so than the state of affairs which S2 describes. Furthermore, ET does not imply that there are individual essences. If one is willing to deny the possibility of a state of affairs in which an object has a disposition which it does not have in virtue of having any purely qualitative IC or ICs, then it is open to him to accept ET and deny the possibility of non-qualitative ICs.

[12]A. D. Smith agrees with Mackie that the possibility of action at a distance proves the falsity of ET, "Dispositional Properties," Mind 86 (1977), pp. 439-45.

[13]Apparently, Mackie thinks that if S3 were to obtain then object a would have a disposition in virtue of having a relational, i.e., a non-intrinsic, property, or in virtue of having a conjunction of relational and intrinsic properties. I show that this interpretation of S3 is unwarranted.

[14]The strategy I have employed for handling S3 is capable of dealing with any kind of action at a distance. In every such case a relational property of an individual will be a condition of the manifestation of a disposition of that individual.

[15]I do not mean to commit myself to the existence of basic physical objects. Rather, I am interested in determining what we should say, if basic objects were to exist, about the relation of their dispositions to their ICs.

[16]I wish to thank J. L. Mackie, Gary Rosenkrantz, Terrance McConnell, and the referees of Auslegung for their comments on earlier drafts of this paper.