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**SHARPNESS: AN INTERESTING EXCEPTION TO THE RULE
THAT DISPOSITIONAL PROPERTIES REQUIRE EXPLANATION
IN TERMS OF THEIR OWNER'S MICROSTRUCTURE¹**

ULLIN T. PLACE

Abstract

The most common form of distinctively scientific causal explanation is an explanation of the dispositional properties shared by instances of a universal or kind. Such explanations typically invoke the structural properties of the property-bearer. In the majority of cases and in all cases where a specifically scientific explanation is required, what are invoked are features of the *microstructure* of the property-bearer which are not accessible to ordinary observation at the level of common sense. An interesting exception is the case of the sharpness of a knife or needle.

Sharpness is a property and a concept with a number of unusual features. Most property-concepts are either purely dispositional, as in the case of such things as the brittleness of glass, the flexibility of rubber or the magnetic properties of an iron bar, or they are structural properties, such as the external shape and internal arrangement of an object. Sharpness, by contrast, is a property with two aspects, a purely dispositional aspect, the property-bearer's propensity to cut or pierce, and a structural aspect, the fineness and hardness of its edge or point. However, the relation between these two aspects is a causal relation between "distinct existences", not a relation of identity. The dispositional property, aptness to cut or pierce, depends on and is explained by the structural properties, the fineness and hardness of the edge or point. In this it differs from most other dispositional properties. For in this case, the structural properties on which the dispositional property depends are features of the *macrostructure* rather than the microstructure of the property-bearer. They are thus available to common observation by the man- or woman-in-the-street in a way that the microstructural properties on which most dispositional properties depend are not. Hence the absorption of both cause and its effect into a single common-sense concept.

Causal relations and the causal explanations which invoke them have two components:

- (a) a *categorical* component, some kind of contact or proximity between the causal agent and the causal patient, and
- (b) a *dispositional* component which provides the "cement" which, in the explanation, takes the form of a 'covering law' and governs the interaction between the two.

In this respect, the causal relation whereby aptness to cut or pierce is generated by the structural properties of fineness and hardness of edge or point is no exception. Of the two structural properties which stand as cause to the dispositional property as effect, one, the fineness of the edge or point, is categorical; the other,

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its hardness, is dispositional.

From a philosophical standpoint the 'sharpness' example raises two interesting questions:

- (1) In what sense does the effect, the aptness to cut or pierce, constitute a "distinct existence" from its causes, the fineness and hardness of the edge or point, as Hume's principle requires?
- (2) What light, if any, is thrown by this example on the problem of the source of the dispositional properties of an elementary particle which has no microstructure (the 'charm' of the quark)?

Two idiosyncratic theses

The issue I am going to discuss is one which arises in the light of two theses which I hold to be true, but which are somewhat idiosyncratic in the sense that I have yet to come across anyone who shares my opinion on either issue, let alone on both of them together.² Of these two, the first is the thesis that standard philosophical discussions of microreductive explanation have failed to distinguish two different varieties of such explanation: what I call *theoretical type identities*, such as water is H₂O, and cases of the *causal dependency of function on structure*, such as the causal dependency of the horse power of an internal combustion engine on the cubic capacity of its cylinders. The second thesis is a thesis about the nature of causation according to which every causal relation has two aspects, a *categorical aspect*, whereby the causal agent comes into or remains in contact with or proximity to the causal patient, and a *dispositional aspect* which supplies, as it were, the "covering law" which governs the interaction between the two. The issue I propose to discuss is one which arises when the causal dependency of function on structure is examined in the light of the thesis that all causal relations have these two aspects.

Two varieties of micro-reductive explanation

Before engaging in that discussion however, the idiosyncratic nature of the two theses demands that something more be said by way of justification for my holding them to be true. My belief that there are two different kinds of microstructural explanations goes back to a paper which I published under the title 'Is consciousness a brain process?' in the *British Journal of Psychology* in 1956. In that paper I took as my starting point three principles which I had derived partly from having, as an undergraduate, attended Ryle's lectures at Oxford in Michaelmas 1946 and Hilary 1947 which were subsequently published as *The Concept*

² This sentence was written before I became aware of the view for which Nancy Cartwright argues in her (1989), the view that the Laws of Nature formulated by scientists are but summaries of what is in common between what she calls the "capacities" (i.e., "dispositional properties" as I would say) of particular entities. This agrees very closely with the second of my two "idiosyncratic" theses.

of *Mind*, and partly from subsequent reading of the book when it appeared in 1949. The three principles were:

(1) that what we are *talking about* when we ascribe a dispositional property to an object or person is not some inner process within the individual, nor some inner state of the object's microstructure, what we are talking about is what *would have happened* in the past or *would happen* in the future, if at any time certain conditions had been or were to be fulfilled,

(2) that most of our ordinary psychological predicates, in particular the knowings, believings, wantings and intendings which figure in our common sense explanations of behaviour, are of this dispositional kind, or have a significant dispositional component,

(3) that, nevertheless, despite Ryle's attempt to sweep such cases under the carpet, there is, as I put it in the 1956 paper, "an intractable residue of concepts clustering around the notions of consciousness, experience, sensation and mental imagery where some sort of inner process story is unavoidable."

In the paper I suggest that it is a "reasonable scientific hypothesis" that this intractable residue of inner processes are in fact processes taking place within their owner's brain. In other words, I was proposing, in the case of these inner processes, what I am now calling a "theoretical type identity" with some still to be specified processes in the brain. What I did not discuss in the paper, unfortunately, was the relationship between the existence of a mental disposition and the state of the brain microstructure on which the existence of such dispositions plainly depends. That this was a bad mistake became apparent in 1968 when David Armstrong criticised both my restriction of the mind-brain identity theory to mental processes and the Rylean account of dispositions on which that restriction relies. He claimed that just as I had argued that mental processes are theoretically type identical with processes taking place within the microstructure of the brain, so mental dispositions are theoretically type identical with inner states of the brain microstructure which are, as he puts it, "apt for the bringing about of certain behaviour."

Armstrong's argument against Ryle's hypothetical analysis of dispositions is decidedly weak. He accuses Ryle of phenomenalism, when what is wrong with phenomenalism is that it treats as dispositional something, the existence of a material substance or material object, which is categorical if anything is, a mistake of which Ryle cannot possibly be accused. If anyone makes the mistake of confounding the

categorical and the dispositional, it is Armstrong, when he claims, as he does, that dispositions are identical with *categorical states* of the microstructure of the disposition's owner. Nevertheless, presumably because no alternative account of the relation of the mental dispositions to the brain microstructure was available, Armstrong has managed to persuade a whole generation of philosophers that Ryle and I are wrong, and that his (Armstrong's) theoretical identification of dispositions with categorical states of their owner's microstructure is the right answer; though many, perhaps a majority, have followed Davidson (1970/1980) in construing the identity involved as an identity of tokens, rather than types. One possible reason why philosophers have not been deterred by the weakness of Armstrong's critique of Ryle's account of dispositions from embracing his view that dispositions are categorical states of the microstructure of their owner's brain, is that Ryle's theory had already been subjected to a number of much more devastating criticisms by Peter Geach in Chapter 3 of his 1957 book *Mental Acts*, though without the advantage of offering an alternative account of the mind-brain relation

Perhaps the most telling of Geach's arguments against Ryle is the one where he claims that "a physicist would be merely impatient if someone said to him: 'Why look for, or postulate, any actual difference between a magnetized and an unmagnetized bit of iron? Why not say that if certain things are done to a bit of iron certain hypotheticals become true of it?' He would be still more impatient at being told that his enquiries were vitiated by the logical mistake of treating 'X is magnetized' as categorical, whereas it is really hypothetical or semi-hypothetical." (Geach 1957, p. 6).

Clearly, if this is what Ryle is saying to the physicist, he is mistaken. It may be that Ryle's obvious lack of interest in and sympathy for scientific enquiry would have inclined him to say something like this, but as I see it, there is nothing in his position that requires him to view the physicist's enterprise as in any way inconsistent with his own. For the issue that concerns the physicist is quite different from that with which he, as a philosopher, is concerned. The physicist is giving a causal explanation of the phenomenon whereby things of a kind display the dispositional properties they do. He is not concerned, as Ryle is, with the question of what it *means* to say of something that it has this or that dispositional property.³

³ Rom Harré whose retirement this book celebrates was the first to appreciate and argue for the significance for science of Ryle's account of

The role of the micro-reductive explanation in such cases is very different from the role of such explanations in the case of space-occupying entities such as substances and processes. Compare, for example, the microreductive explanation of water itself with that of one of its dispositional properties, its tendency to freeze at temperatures below 0°C. The relation between water and its chemical composition H₂O is that of a whole to its parts and the way those parts are arranged so as to constitute the whole. The two descriptions, the description of the whole as water and the description of the parts and their arrangement as consisting of molecules in which two hydrogen atoms are combined with one of oxygen describe one and the same kind of stuff. This is a case, not of two distinct causally related things, but two descriptions of one and the same thing. This is a case of theoretical type identity. Water's propensity to freeze at temperatures below 0°C, on the other hand, does not have a chemical composition in the way water itself does. Nor does it have any other kind of microstructure. There is no doubt a microstructural *explanation* of why water, when relatively pure, freezes at that temperature; but the microstructure in question is the microstructure of the water, not the microstructure of its disposition to freeze. The disposition is not composed of the microstructural features which explain its existence. This is not a theoretical type identity. The relation between the microstructure of the water and its disposition to freeze at 0°C is a causal relation, and as Hume has taught us, causal relations hold only between "distinct existences."

That the relation between a dispositional property and its "basis" in the microstructure of the disposition's owner is a causal relation between distinct existences can be shown by taking an example where the relation between the two is intelligible to someone with as little grasp of the basic principles of chemistry and physics as myself, the case of the horse power of an internal combustion engine and its explanation in terms of features of the engine's microstructure such as the cubic capacity of its cylinders. That the relation between an engine's horse power and the cubic capacity of its cylinders is a causal rather than a constitutive relation is shown by the fact that there is nothing self-contradictory in the supposition that two engines have the same horse power, but have cylinders with different cubic capacity or in one case (e.g., the case of a turbine or jet engine) has no cylinders at all, or in the supposition that cylinders of the same cubic capacity produce different horse powers in different engines.

dispositions and to revive the historically important doctrine of causal powers.

Two aspects of the causal relation

My second idiosyncratic thesis, the thesis that all causal relations have two aspects, a categorical aspect and a dispositional aspect comes from a paper which I published in 1987 in *Synthesis Philosophica*, the international edition of the Croatian journal *Filozofska Istrazivanja*. Since this journal does not circulate widely outside the former Yugoslavia, few people have read it. I did, however, send a copy to David Armstrong when it first appeared, and this initiated a correspondence between the two of us which eventually evolved into a full scale debate. A version of this debate in which the American philosopher, C.B.Martin, later became involved has been published in the Austrian philosophical journal *Conceptus* (Part 1 in 1991, Part 2 in 1993). It is anticipated that a revised and extended version (edited by T. Crane) will eventually be published as a book. It was in the course of revising my contribution to the debate for the purposes of the book that my attention was drawn to the sharpness example which I shall be discussing in a moment.

As in the case of the two forms of micro-reduction thesis we have just discussed, the aspects of causation thesis takes as its starting point Ryle's (1949) account of dispositions as developed in *The Concept of Mind* and is part of an attempt to show that, despite Ryle's own anti-scientific bias which has already been remarked on, his theory of dispositions is a major contribution to the theory of scientific explanation in general and causal explanation in particular. However, the aspect of Ryle's thesis that I emphasise in the 1987 paper is not so much the thesis that a disposition is a matter of what would happen, if certain conditions were to be fulfilled, rather than of what is currently happening or currently the case. What I emphasise is his reference to the "lawlike" nature of dispositional statements. This feature of dispositional statements acquires particular significance if it is combined with two other theses. One is the counterfactual theory of causal necessity, first proposed, almost as an afterthought, by Hume (1777/1902) in his last discussion of the topic in his *Enquiry concerning the Human Understanding* where he defines a cause as

"An object, followed by another, and where all the objects similar to the first are followed by objects similar to the second. Or in other words where if the first object had not been, the second had never existed." (Section VII, Part II, p. 76).

The other thesis is Nelson Goodman's (1955/1965) observation in *Fact, Fiction and Forecast* that a statement ascribing a dispositional property to an individual is all that is needed in order to "support" a causal counterfactual. Taken together, these three theses suggest that the invisible glue, the necessary connection between cause and effect which puzzled Hume, consists in a dispositional state of the causal agent such that if at any time, so long as the disposition persists, an event or state of affairs of the cause type were to occur or exist, and other causally relevant conditions were to be in place, the probability of the occurrence or existence of an event or state of affairs of the effect type would substantially increase.

This is what I am calling the dispositional aspect which must be present for any pair of juxtaposed events or states of affairs to be causally related. But equally essential to the existence of a causal relation is the categorical aspect. In most cases this categorical aspect of the causal relation consists in some kind of spatial contact or proximity between a causal agent and a causal patient whose occurrence triggers the effect where the effect is an event or whose persistence maintains the effect where the effect is a state of affairs. However, there are cases of which the example of the drop in temperature causing the water to freeze is one where, at the common sense level at least, there is no causal agent which is clearly distinguishable from the causal patient, the water. Nevertheless the two causally related events are "distinct existences", as is shown by the fact that water freezes at different temperatures depending on the surrounding air or water pressure and what is dissolved in it. Moreover, the causal relation still has its two aspects, the actual temperature of the water which is categorical and its disposition to freeze at a particular temperature as determined by the relevant conditions.

The structural basis of a disposition cannot be purely categorical

What I now want to do is to examine the consequences of combining the thesis that every causal relation has a dispositional as well as a categorical aspect with the thesis that in the typical case the microstructure of an entity stands as cause to the dispositional properties of the entity as a whole as effect. The effect of combining these two theses is to undermine the idea that the microstructural basis of a disposition is essentially and exclusively categorical. Where this idea originated from, I know not. It is an idea which is particularly associated with David Armstrong's philosophy, but it is already present in a passage which he

quotes in his (Armstrong 1968) *A Materialist Theory of the Mind* from H.H.Price's (1953) *Thinking and Experience*. According to Price,

"There is no *a priori* necessity for supposing that all dispositional properties must have a 'categorical basis'. In particular, there may be mental dispositions which are ultimate. (Price, 1953, p. 322, quoted by Armstrong, 1968, p. 86)

It will be noted that in this passage Price does not make the "categorical basis" a microstructural or even a structural feature, though that is how he has been read, by Armstrong. But given that the typical explanation of dispositional properties, such as those discussed by Ryle (1949) and Geach (1957), properties such as brittleness, flexibility and being magnetised, are of this kind, and if, as I claim, the relation between the microstructure and the dispositional property in such cases is causal, it follows that the microstructure *qua* cause must have a dispositional as well as a categorical aspect. Its categorical aspect is the spatial arrangement of the parts that compose it. The dispositional aspect consists in the dispositional properties of the parts which "glues them together." When combined with their categorical arrangement, they give the whole so formed *its* dispositional property.

The sharpness example

An interesting example, when viewed from this standpoint, is the sharpness of a knife or needle. Sharpness is a property with a number of unusual features. One such feature is that, unlike most properties which are either purely dispositional, as in the case of the brittleness of glass, the flexibility of rubber or the magnetic properties of an iron bar, or purely categorical as in the case of the shape or size of an object, the sharpness of a knife or needle has two aspects, a dispositional aspect, the propensity to pierce or cut and a categorical/structural aspect, the fineness of the edge or point.

Now one might suppose from the analysis of causation presented above that these two aspects of sharpness are the two aspects, one categorical and the other dispositional, which combine to produce an effect, in this case the effect of piercing or cutting some other object. Reflection, however, shows that this is not the case. For although the knife or needle's propensity to cut or pierce is the dispositional glue that sticks cause to effect in such a case, the categorically occurring event which triggers the effect is not the fineness of

the edge or point, it is the collision between the edge or point and the object that is thereby cut or pierced. The role of the fineness of the edge or point here is to provide an explanation, in terms of the structure of the knife or needle, of its dispositional property, the propensity to cut or pierce. But considered as a structural explanation of a dispositional property of the object as a whole, it is again an unusual case. For in contrast to the typical case, such as the brittleness of glass, the flexibility of rubber and the magnetic properties of the iron bar, it is not a feature of the microstructure which is accessible only to the special observational and experimental techniques available to the scientist. It is a macroscopic feature of the entity which is available to unambiguous determination by the man or woman in the street through straightforward visual and tactile examination. Moreover, it is presumably this availability of the structural basis of the disposition to straightforward determination at the macro level which explains why the ordinary language term 'sharp' is systematically ambiguous as between the propensity to cut or pierce on the one hand and the structural basis of that disposition in the fineness of the edge or point on the other.

But what does this example tell us about the relation between a dispositional property and its structural basis? Does the fact that the term 'sharp' as applied to a knife or needle is equivocal as between fineness of edge or point and the propensity to cut or pierce mean that this is a case of a theoretical identity between a disposition and its structural basis, and thus an exception to what I have argued is the rule that in such cases the relation is a causal relation between distinct existences? Evidently not. This is made clear when we observe that there are both fine points and edges that are not sharp, for example in the case of hairs and leaves and cases where a fine point has another effect besides producing a propensity to pierce, for example in the case of a pen or pencil where it generates the disposition to produce a fine line when applied to a surface such as paper. It turns out, moreover, that the principle we enunciated earlier whereby a causal relation requires both a categorical and a dispositional component also holds good in this case. For, as the leaf and hair examples show, it is not just fineness of edge or point that is needed to give a knife or needle its sharpness, the point or edge must also be hard and rigid; and hardness and rigidity are dispositional properties, dispositional properties of the point or edge which, when combined with the categorical property of fineness, give to the object as a whole its ability to pierce or cut.

Two things are worth noting in this connection. One is that, although the explanation of the object's disposition to pierce or cut in terms of a combination of fineness of point or edge and its hardness and rigidity is available to observation and understanding at the level of common sense, the same cannot be said of the dispositional properties of hardness and rigidity, where what is called for is the more common variety of *microstructural* explanation which only science can provide. The second point is that, just as in the case of a microstructural explanation where it is rather more obvious, so in the case where the propensity to pierce or cut is explained by a combination of fineness with hardness and rigidity of point or edge, the dispositional properties which enter into the explanation of a dispositional property of the whole are different dispositional properties from those of the *explanandum*. They are properties of parts of the whole, in this case of the edge or point, rather than, as in the dispositional property that is thereby explained, a property of the entity as a whole. Were this not so, the contention that the relation between the disposition to cut or pierce and the fineness, hardness and rigidity of the object's edge or point is a causal relation between distinct existences would be difficult to sustain.

One last and more speculative point. It has long been something of an embarrassment to those who have sought to reduce dispositional properties to a basis in the microstructure of their owner, whether the reduction is construed as constituting or simply as explaining the existence of the property, that, whether or not they have yet been discovered by science, there must be particles so small that they have no microstructure. Yet such particles must have some dispositional property, otherwise we would have no reason to postulate their existence. But in that case, what becomes of the thesis that dispositions are always in some sense reducible to their owner's microstructure? This is not quite such a difficult problem for those who believe, as I do, that the relation between the microstructure and the disposition is a causal relation between distinct existences, as it is for those who want to say that the dispositional property just *is* the relevant state of the microstructure. For on the former view we can say that the dispositional property of an entity that has no microstructure is simply a brute fact that has no sustaining cause. This is an uncomfortable, but not an untenable view to have to hold. For those who believe that the microstructure *is* the disposition, on the other hand, there seems to be no way of accommodating a microstructureless entity, short of denying that such entity could have any kind of dispositional property.

But perhaps, the sharpness example can come to our rescue here. For the analogy to work, we would have to suppose that although a microstructureless entity, such as a quark is currently taken to be, does not have parts in the sense in which an atom is made up of its constituent sub-atomic particles, it does have parts in the sense of features comparable to the edge of a knife or the point of a needle whose categorical and dispositional properties could then explain the quark's possession of its dispositional property, its so-called "charm". But that would leave us still with an unexplained and inexplicable dispositional property, the counterpart of the hardness and rigidity which combine with the fineness and rigidity to form the structure which gives the knife its propensity to cut and the needle its propensity to pierce.⁴

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⁴ For a more sophisticated treatment of this problem of what he calls the "grounding" of the dispositional properties of fundamental particles see Robert Weingard's chapter in this volume.

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