Distributional Properties.

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Abstract

This paper discusses a distinctive kind of property that I call "distributional" properties, which include, for example, the property of *being polka-dotted* (a colour-distributional property) and the property of *being hot at one end and cold at the other* (a heat-distributional property). I argue that distributional properties exist in whatever sense other properties exist, that they do not simply reduce to the non-distributional properties of points, and that they are implicated in the correct analysis of change.

1 Introduction

Distributional properties are perfectly simple and straightforward. Let me give some examples. *Being polka-dotted* is an example of a colour-distributional property — the property a surface has when it has the right kind of colour distribution. *Being hot at one end and cold at the other* is an example of a heat-distributional property. *Having a uniform density of 1 kg/m^3 throughout* is an example of a density-distributional property.

It's hard for me to say more about what a distributional property is without begging the question against some of the arguments I'm about to discuss. Intuitively, though, a distributional property is like a way of painting, or filling in, a spatially extended object with some property such as colour, or heat, or density. Properties that can be filled in (like colours, temperatures, or densities themselves) I call "qualities" (one might alternatively call them "distributable properties"). The qualities and the distributional properties are prima facie distinct: it's one thing to have a redness distribution (to be red in some places, one might say), another to just plain be red.

I think that distributional properties have been unfairly neglected by metaphysicians. What I am going to do in this paper is to try to remedy that by pointing out two doctrines about distributional properties that are worthy of debate: the view that distributional properties reduce to non-distributional properties (which I'll discuss in section 2), and the view that distributional properties are part of the correct analysis of change (section 3).

In the remainder of this section, I'll describe some features of distributional properties that are not at all remarkable. In most respects, distributional properties are just like every other property.

Are there any? You already believe in distributional properties to whatever extent you believe in properties at all. To be more accurate, I should say, "... you believe in abundant properties at all." Abundant properties are ways things might be. "Abundant property" is a technical term, and it's part of the meaning of that term that there's such a property for every way something might be (unless it can be proved otherwise — for example, by Russell's paradox). If something might be either a raven or a writing desk, then there is the abundant property of *being either a raven or a writing desk* (if there are abundant properties at all). If something might be slithy, then there is the abundant property of *being slithy* (if there are abundant properties at all).

So, it's rather trivial that there are distributional properties (if there are abundant properties at all). Some things are polka-dotted, hot at one end, and so on. Therefore some things might be polka-dotted, hot at one end, and so on. Therefore, there are properties of *being polka-dotted*, *being hot at one end*, and so on. We don't have such convenient names as "*being polka-dotted*" for most of the distributional properties. But that is true of abundant properties generally.

Some people believe that abundant properties are functions from possible worlds to sets of trans-world individuals. If you think that, then that's what distributional properties are too. Some people believe that abundant properties are sets of world-bound possible individuals. If you think that, then that's what distributional properties are too. Some people believe that abundant properties are other things. If you think that, then that's what distributional properties are too.

Some people (and here it gets a little tricky) believe that there are no abundant properties at all. These people are nominalists (at least with regard to abundant properties). I am tempted by this position myself. I have two things to say here: 1) If you're a nominalist, distributional properties are not any worse off than any other abundant property (for the reasons given above, if there are abundant properties, then there are distributional properties). 2) If you're a nominalist, you have a way of understanding what people mean when they go around saying things like "mass is intrinsic, weight is not", "*being humble* is a virtue", and "red is more like orange than like green", in a way that doesn't commit you to there being properties (of mass, humility, redness, etc.) Whatever that way is, apply it to me when I talk about distributional properties. What I am saying about them is intended to be interpreted in a nominalistically acceptable way if at all possible.

Naturalness and intrinsicality. Like other abundant properties, some distributional properties are more natural than others. Natural properties are the grounds of objective resemblance, and of causal powers. Or at least that's what some people believe. (Lewis 1983, pp. 14–19) If you think that, and you think that *being green* is more natural than *being grue*, then you may think also that *being uniformly green all over* is more natural than *being uniformly grue all over*.

Some distributional properties are intrinsic, and others are extrinsic. Whatever your favourite account of intrinsicality is, you could apply it in the case of distributional properties, I hope. If you don't have a favourite account (it would go beyond the scope of this paper to offer one here) you can be guided by the thought that all heat-distributional properties are intrinsic iff heat is intrinsic, and similarly for other distributional properties and their corresponding qualities. (Can

this be more than a guide? Perhaps there are distributional properties with no corresponding qualities — shapes, for example).

Distributional properties have an additional feature that's a bit like naturalness. Some distributional properties make for uniformity in their instances. For short I will say that such properties are *uniform*. For example, the colour distribution of the flag of Libya is more uniform than the colour distribution of the Union Jack. I discuss this feature of distributional properties further in section 3.

Determinates and determinables. Like other abundant properties, distributional properties admit of determinates and determinables. To give an example of this, as it applies to non-distributional properties, *being coloured* is a determinable, and *being red* is one of its determinates. This is not a distinction between two kinds of property — *being red* has its own determinables (*being scarlet*, *being vermilion*, and so on), and even these have further determinables which we have no names for — but a relationship between pairs of properties. We may say that *being red* is a determinate of *being coloured*, or perhaps that *being scarlet* is more determinate than *being red*. Perhaps there are perfectly determinate properties that are not themselves determinables to any further properties (a fully specified wavelength reflectance profile might be a perfectly determinate colour property).

The same is true of distributional properties. *Having a colour distribution* is a determinable, and *being polka dotted* is one of its determinates, as is *being uniformly red all over*. These both have further determinates of their own: respectively, *having red polka dots on a white background*, *being uniformly scarlet all over*. And so on.

I'm tempted to say that shape properties are a kind of degenerate case of distributional properties. At least, something couldn't have the exact colour distribution of my tablecloth without being the very same shape as my tablecloth. But shapes are not colour or heat or mass distributions — they're what you get when you abstract away from whether a distributional property is a colour or heat or mass distribution.

2 Anti-reductionism

What I've just been saying about distributional properties should, I hope, be uncontroversial. Here is a more controversial claim:

Anti-reductionism. Distributional properties are not, in general, equivalent to any non-distributional properties.

By "equivalent" here, I mean necessarily co-extensional. I remain neutral on whether equivalence, in this sense, is sufficient for property identity. It is certainly necessary for property identity, so anti-reductionism deserves its name. I should also point out here that anti-reductionism does *not* mean that distributional properties are not equivalent to any property describable in the language of physical science. It's just that they are only equivalent to distributional properties

describable in the language of physical science. (For example, colour distributions might be equivalent to wavelength reflectance profile distributions.)

When people (call them "reductionists") deny anti-reductionism, they have in mind that, if a cloth, say, is polka-dotted red on white, then it has some parts which are just red simpliciter, and other parts which are just white simpliciter. When, and only when, things like that are spatially arranged in the right way, you get something polka-dotted red on white. *Being red* and *being white* are non-distributional colour properties, and of course the spatial relations are not distributional properties. So, *being polka-dotted red on white* would be equivalent to a property that fully spells out exactly what the "right way" of spatial arrangement of red and white things is; and this is just a matter of (non-distributional) spatial relations, and (non-distributional) colour properties. The property would be of the form *being an x such that there are there some ys, and the ys are part of x, and the ys are of the right sorts of colour, and the ys are spatially related in the right sorts of ways*. Such a property is not a distributional property — it's a kind of logical combination of non-distributional properties.[1] The same sort of story will work for any other distributional property.

I have no really important quarrel with the example here, but there are some respects in which it could do with tidying up.

- First, what are the red parts of the cloth that the reductionist is appealing to? Suppose that they are the dots — circular, maximal, red pieces of cloth that are parts of the whole polka-dotted cloth. On any real polka-dotted cloth, the dots would be dyed slightly unevenly, so that they themselves have a non-uniform colour distribution. This cannot be the non-distributional colour property the reductionist meant to appeal to. That is, the proposed reduction doesn't *immediately* work for non-idealised examples. (Though there are ways of getting around this point, which I will consider in a moment).

- Second, the proposed reduction doesn't work for idealised examples either. It doesn't really make any difference if the dots are uniformly coloured, for a uniform distributional property is still a distributional property.

- So, third, the parts the reductionist had in mind cannot be the dots. This is the right way of getting around the first point: What we need to do to get to the non-distributional way of describing what it is to be polka-dotted is go all the way down to parts of the cloth that are so small they couldn't have distributional properties — to unextended "mathematical" points.[2]

[1] More specifically, it's a structural property, in roughly the sense of Armstrong (1997, pp. 32–38). (I am using the term "structural property", rather than "structural universal", here to abstract away from the specific proposal that Armstrong has about the structure of the properties themselves.) My argument against reductionism is an argument to the conclusion that distributional properties are not the same things as structural properties.

[2] A fourth tidying up point is that both I and my presumed opponent are engaging in the fiction that unextended points might have a colour. It would be possible to reconstruct all the arguments in this section using some better-behaved "primary" property such as charge, but then the arguments would be harder to understand.

So, what the tidied up example must say is that when, and only when, red and white point-sized objects are spatially arranged in the right way, you get something polka-dotted red on white. Therefore, *being polka-dotted red on white* is equivalent to a non-distributional property specifying the arrangement of such points, and the same sort of story will work for any other distributional property.

But, when the reductionist story is put this way, I hope you see that it ought to be at least contentious. For it is at least contentious that polka-dotted table cloths consist of unextended points. Surely more so that, necessarily, everything that has a distributional property — everything extended — must consist of unextended points. It's a fair enough metaphysical speculation that, as it happens, the world is made of points. But necessarily?

That, in a nutshell, is why I believe that distributional properties are not equivalent to non-distributional properties. It seems to me that the nature of extended things could go lots of ways. They could be made of points; they could be made of pointless, infinitely divisible gunk; they could be made of partless, extended matter. These are weak claims of metaphysical possibility — the onus is on the person who thinks they are false to give evidence to that effect. In the absence of such evidence, we should accept these possibilities, and that, therefore, reductionism about distributional properties is false.

2.1 A reductionist reply

A reductionist might complain about the way I tidied up the example of the polka-dotted cloth. They might complain at the first tidying move: by what right did I assume that, if a dot is not uniform in colour, then it is not red simpliciter? Perhaps being non-uniformly red is just a way of being red? I don't object to this at all, but it sounds to me as if it is another way of saying that *being red* is the property of *having a reddish colour distribution* (or something like that). On this view, all colour properties are distributional properties, so reductionism is false — there are no non-distributional properties for distributional properties to be equivalent to.

With more justification, they might complain at the second tidying move. Perhaps *being red* is *being uniformly red*. So, I was wrong to say that the latter is just as much a distributional property as *being polka-dotted*.

We face a choice of terminology here. I've made up the term "distributional property", and given you some advice how to use it. Now I stipulate: uniform distributional properties are distributional properties. However, that stipulation doesn't answer the objector. Rephrased in the chosen terminology, the objection is this: I haven't done anything to show that non-uniform distributional properties aren't equivalent to any logical combinations of non-distributional properties and uniform distributional properties taken together. This is as interesting an equivalence claim as the one I've refuted, and is perhaps what reductionists really had in mind all along.

I agree with this. But the new equivalence claim is false for the same reasons as the old one (though the examples which show this are more artificial). It again requires that extended objects are necessarily made up of points. I'll show this in two steps.

First, suppose that there was a polka-dotted cloth made out of some fantastic matter that was extended without having spatial proper parts. Elsewhere I have called this type of matter "entended" — by contrast with "pertended" matter, which extends by having different parts in different places.[3] (Parsons 2000, p. 404) Such a cloth would have a non-uniform colour-distributional property without having any proper parts to have uniform distributional properties. The new equivalence claim is committed at least to the impossibility of this scenario.

I think it's bad enough that the reductionist must regard entended matter as impossible, but not everyone will be struck that way by this particular impossibility claim. We could have an argument about this now, but let's shelve our differences (if any) and suppose for the space of a paragraph that, as the reductionist would have it, entended matter is indeed impossible.

This is the second step. I will now show that the reductionist must believe that matter is necessarily made out of unextended points. Suppose that there was a cloth made out of matter that did not contain any points, and did not contain any entended matter either, as (for this paragraph) that's impossible. Each part of this cloth must be extended (otherwise that part would be a point), and every extended part must be divisible (otherwise that part would be entended). So every part of the cloth is divisible — it is made of gunk: infinitely divisible pointless matter. Now, suppose that this cloth has the following (garish) non-uniform colour distribution. The left side of the cloth is red, the right side is blue, and in between there is a fully continuous spectrum. At the top of the cloth, the colours are pale, while at the bottom they are saturated. Because the cloth varies continuously in colour in all directions, every extended part of the cloth contains a subtle gradient between two colours. But that means every part of the cloth, because it has no extensionless parts. So no part of the cloth has a uniform colour distribution. So the non-uniform colour distribution of the whole cloth is not equivalent to some property that specifies the spatial arrangement of uniformly coloured parts of the cloth. So the reductionist can't believe that cloths like that could exist — the only way for matter to be extended and capable of having non-uniform distributional properties is for it to be made of unextended points.

So, whether the reductionist claims that distributional properties reduce to non-distributional properties, or to uniform distributional properties, they are committed to matter's being made of points as a matter of necessity.

3 Change

So far I have been discussing spatial distributional properties, that are, as it were, distributed across space. But this is not the only kind. One can conceive of distributional properties that are distributed across anything that is relevantly like space. The most obvious example is time.

If you think that time is a dimension, like space, then you can think of objects having temporal distributional properties. Suppose a poker begins its life hot, cools down over time, and ends

[3] By analogy with the contrast between enduring objects, which persist without having temporal parts, and perduring objects which persist by having a distinct temporal part located at each time at which the perduring object exists.

its life cold. Such a poker has a temporal heat-distributional property which we might call "*beginning hot and ending cold*". Suppose another poker begins and ends its life at the same times as the first, but stays hot throughout. The second poker has a different temporal heat-distributional property, *beginning hot and ending hot*.

There is an interesting difference between the two distributional properties of the two pokers: the former is non-uniform, and the latter is uniform. I propose that an object *changes* iff it has a non-uniform temporal distributional property. More specifically, an object changes in a respect ϕ (where ϕ might be "heat", or "mass", or "believing in the Hegelian Dialectic") iff it has a non-uniform temporal ϕ-distribution.[4]

You might have three immediate worries about this account of change. First, you might be worried whether time is enough like space for there to be temporal distributional properties. Fair enough: I think time is enough like space for that, but this is another argument for another paper.

Second, You might worry about the distinction between uniform and non-uniform distributional properties. I've been using it freely, but I haven't said much about what makes a distributional property uniform or non-uniform.

I think it's a good thing that I don't say much because there are lots of interesting theories of uniformity that you might plug in according to taste. Uniformity of distributional properties is rather like naturalness of any abundant property. Like naturalness, uniformity can't be just read off from the name of a property. *Beginning grue and ending bleen* might be a uniform distributional property for all that its name sounds like the name of a non-uniform one. You might, like Lewis (1983, pp. 14–19), think that there's just a brute metaphysical difference between properties that are natural and those that are not. Similarly, you might think that there's a brute difference between properties that are uniform and those that are not. Or you might think, like Barry Taylor (1993), that natural properties are those which play a distinctive role in our thinking, and similarly that what it is for a property to be uniform is for it to play some such role. Or you might go all response dependent, and think that uniform properties are those that provoke us to go around saying "That's a uniform property!"

Third, you might be worried that this kind of analysis eliminates change. Lewis, for example, has complained that the distributional properties approach to change "trade[s] in the changing temporary intrinsic properties for the permanent intrinsic property of having such and such a history of change." (Lewis 2003, p. 36)

I am not totally sure what Lewis means. Clearly, he thinks I have violated some desideratum for the analysis of change: but what could this be? Could the desideratum be that the analysis of change must not reduce change into merely atemporal relations between objects and their properties? Surely not: that would refute Lewis's own account just as much as mine. For on Lewis's

[4]This analysis of change has some advantages over more standard analyses, which I discuss in more detail in my (2000) To briefly summarise them: 1) If I am right about the non-reduction of distributional properties in general, then it doesn't require that objects have strange and surprising fine structure (temporal parts, for example) in order to change. 2) There's no funny business with the distinction between intrinsic and extrinsic properties, as appears to be needed by some other accounts that have the first advantage. 3) There's no funny business with instantiation, as is needed by "adverbial" accounts of change.

account, intrinsic change is a matter of an object's having two qualitatively different temporal parts, where the relationship between an object and its temporal parts is an atemporal one. This trades in, if you like, changing temporary intrinsic properties for the permanent intrinsic property of having such-and-such temporal parts.[5]

Could the desideratum be that the analysis of intrinsic change must proceed via an account of temporary predication? This seems to be something Lewis can do which I cannot. He can analyse intrinsic change in two steps: the first step would say "*x* changes intrinsically iff *x* has an intrinsic property temporarily", and then the second step would say "*x* has the property ϕ temporarily iff *x* has a temporal proper part which has the property ϕ".

Suppose that we accept this desideratum. Notice that on Lewis's view, having a property temporarily is not a way of having that property. For example, something which is temporarily hot is not hot simpliciter — rather, it is something with a hot part. I can have that kind of temporary predication too. Here is my analysis of temporary predication: "*x* has the property ϕ temporarily iff *x* changes with respect to ϕ". And my analysis of change completes the story: "an object changes in a respect ϕ iff it has a non-uniform temporal ϕ-distribution". So I can agree with the first step of Lewis's analysis, it's just that I think the analysis proceeds in the opposite direction.

4 Conclusion

What I hope to do with this paper is, at least, convince you that there are interesting debates to be had here. At most, I might convince you to agree with me on everything I've said, but that's surely too much to hope for.

Of the things I've said, some are more controversial than others, and I think it's worth pointing out the points where we might part company. The following claims which I've made in this paper are ranked in order of increasing strength:

1. There are distributional properties in whatever sense there are properties at all.
2. To change is to have a non-uniform temporal distributional property.
3. Distributional properties are not equivalent to logical combinations of non-distributional properties.
4. Entended matter is possible.

I hope that no reader of this paper is in doubt about 1. Being committed to 1 does not commit you to 2 or 3 (in particular, it's a mistake to characterise 3 as a debate about whether there

[5]Though some people have taken this desideratum seriously — for example, McTaggart, in his criticism of Russell (McTaggart 1927, s. 315) — it would go beyond the scope of this paper to address them here. I claim only that my account of change is no worse than any broadly eternalist account.

are distributional properties). 2 and 3 are mutually independent, and I think are independently attractive. 3 is connected with 4, but I might be able to argue for 3 even if 4 is false (provided gunk is possible).

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References

Armstrong, D. M. (1997). *A World of States of Affairs*. Cambridge: Cambridge University Press.

Lewis, D. (1983). New work for a theory of universals. In *Papers in Metaphysics and Epistemology*, pp. 8–55. Cambridge: Cambridge University Press.

Lewis, D. (2003). Things qua truthmakers. In H. Lillehammer and G. Rodriguez-Pereyra (Eds.), *Real Metaphysics: Essays in honour of D. H. Mellor*, pp. 25–38. Routledge.

McTaggart, J. M. E. (1927). *The Nature of Existence*, Volume 2. Cambridge: Cambridge University Press.

Parsons, J. (2000). Must a four-dimensionalist believe in temporal parts? *Monist 83*(3), 399–418.

Taylor, B. (1993). Natural properties in metaphysics. *Mind 102*, 81–100.