SPECIAL PREDICATES

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Nonreductive physicalism is the prevailing view that while there is no substance over and above physical substance, special science (*e.g.,* biological, psychological, and sociological) properties or kinds are nonreducible to physical properties or kinds.[1] Some have forcefully argued, however, that nonreductive physicalism is fundamentally flawed since nonreductionism entails property dualism, but property dualism is inconsistent with physicalism (Kim 1992, 1998; Bickle 1998). Difficulty arises for those making this charge, though, for while such inconsistency would seem to entail the denial of nonreductionism, it is not obvious how one might go about the task of reduction. Moreover, scientific domains indeed appear autonomous. Consequently, many nonreductive physicalists consider the apparent inconsistency between property dualism and physicalism a puzzle to be solved rather than evidence of fundamental error. Exposing this inconsistency within nonreductive physicalism is thus necessary but insufficient to overthrowing the prevailing nonreductive physicalist view; one must also account for the appearance of property dualism and for the nonreducibility of special-science predicates.

In this paper, which deals with the latter of these two issues, I argue that predicates peculiar to special sciences (hereafter, 'special predicates') are not reducible in any formal way to physical predicates, not so much because property dualism is true, but because these predicates fail to pick out genuine properties.[2] To give an overview, in the first section, I discuss two ambiguities that often make distinguishing between genuine predicates (which pick out genuine properties) and non-genuine, or "mere-Cambridge," predicates (which fail to pick out genuine properties) difficult. The second section consists in an analysis of mere-Cambridge predicates themselves and ends with a general principle for identifying such predicates. Drawing from the analysis in the second section, I show in the third section that predicates which denote putative causal powers (*e.g.,* '*x* has the power to open this lock') are also mere-Cambridge. In the fourth section, I turn to the predicates of science and argue that unlike physical predicates, special predicates consist in mere-Cambridge predicates of the "causal power" variety. I conclude with reasons to believe that special predicates are advantageous despite their failing to denote genuine properties. I should mention that I assume causation is physical and that, since my concerns are broadly scientific, modality here should be understood in terms of nomological necessity and possibility.

1. The Problem with Predicates

Consider, on the one hand, that there are many ways an object *x* can be. For example, *x* might be five feet four inches tall, or *x* might be five feet six inches tall. There are, of course, different determinate predicates to denote these different ways of being:

(1) *x* is five feet four inches tall

(2) *x* is five feet six inches tall

Call predicates of this type 'internal determinate predicates'.[3]

On the other hand, however, there are several ways an object can be a way. For one thing, an object can be a particular way *in virtue of* being a more primary way. An object *x* can be a certain way with regard to, say, height as opposed to being a way with regard to shape,

(3) *x* has height

(4) *x* has shape

Call predicates such as these 'internal determin*able* predicates'.

For another thing, returning to determinate predicates, while some denote internal properties, others denote putative external properties. For example, an object *x* can be a particular way relative to another object,

(5) *x* is taller than Theaetetus

Or an object can be a way in virtue of another object's being a way,

(6) *x* is such that Theaetetus is five feet four inches tall

The predicate (6) might be true of, say, Socrates (or of all objects in the universe of discourse, for that matter) at a certain time, t_1. Call predicates such as (5) and (6) 'external determinate predicates'.

The problem with predicates begins with there being (at least!) three distinct types of predicates, all of which share one, lowly form:

(7) *x* is [or has] *F*

Call this a concern about 'formal ambiguity'.

A second concern is about truth-conditional ambiguity. As is well known, commonsense (which I assume is correct) claims that for all sentences *P*, *P* is true iff *P* corresponds in the right way to the world.[4] So, declarative sentences regardless of predicate type, have their truth conditions *in the world*. The problem with predicates arises from a conjunction of formal and truth-conditional ambiguities: singleness of predicate form and singleness of truth-conditions, regardless of predicate type, conspire with our intuitions, I fear, to make some predicates appear genuine when they are not.[5]

2. Mere-Cambridge-ness

Properties, the putative referents of predicates, have long been divided into types, and not too long ago Peter Geach (1969) distinguished between properties that give rise to genuine change and those that do not. According to the so-called Cambridge criterion of change,

(8) An object *x* has undergone a change...just in case for some predicate *F* and times t_1 and t_2, it is true (false) that *x* is *F* at t_1, but false (true) that *x* is *F* at t_2.[6]

Geach has pointed out, however, that this criterion is too weak, for it allows that something in Socrates has changed in virtue of his being outgrown by Theaetetus, although surely no genuine change in Socrates has occurred (Geach 1969). "Properties" denoted by such predicates as

(9) *y* is being outgrown by Theaetetus

have been dubbed 'mere-Cambridge' properties, and many have concluded (rightly, I believe) that mere-Cambridge properties are themselves non-genuine.

In "Mere Cambridge Properties," Robert Francescotti attempts to determine just where the line between genuine and mere-Cambridge properties falls. After considering several possibilities, Francescotti temporarily concludes that a property *F* of an object *x* is genuine iff it is internal to *x*. He defines an internal property thus (Francescotti, 1999):

(10) *F* is an internal property of an item $x =^{df} x$ has *F*, and *F* is not the sort of property *x* has in virtue of having a relationship to an object *y*, where *x* is distinct from *y*.

Then, Francescotti posits this definition of 'mere-Cambridge property' (Francescotti, 1999):

(11) *F* is a mere-Cambridge property of an item $x =^{df} x$ has *F*, and *F* is not an internal property of *x*.

Some non-wholly-internal properties such as that denoted by the following, however, appear genuine,

(12) x is growing taller than Socrates

So, Francescotti expends much energy redefining 'mere-Cambridge property' to exclude these.

Francescotti's attempt at redefinition focuses on determining what might confer genuineness upon (13), which undoubtedly denotes a genuine property of x,

(13) x is growing taller

and (12), but not upon (9) which seems clearly mere-Cambridge. He eventually concludes with this definition of 'mere-Cambridge property',

(14) F is a [mere-Cambridge] property of an item $x =^{df} x$ has F, and for any properties G_1, ..., and G_n, such that x's having F consists in x's having G_1,..., and G_n, neither G_1,..., nor G_n is an internal property of x.

So, considering (9), on the one hand, "being outgrown by Theaetetus is [mere-Cambridge] since [Socrates's] having this property is not to be identified, *even in part*, with the having of any internal properties" (Francescotti, 1999; italics mine). Turning to (12), on the other hand, "outgrowing Socrates is a genuine property of Theaetetus because Theaetetus has this property by virtue of (i) growing and (ii) become taller than Socrates." While (ii) is external to Theaetetus, (i) is internal to him, and (i)'s being internal to Theaetetus is sufficient to make (12) denote a genuine property of Theaetetus (Francescotti, 1999). Therefore, on Francescotti's view, (12) and (13) denote a genuine property, while (9) does not.

Evaluating Francescotti's argument is done best, I believe, by first attempting to ascertain exactly which of (9)'s aspects both *(a)* has to do with y's being outgrown by Theaetetus while having nothing to do with y itself, and *(b)* is not possessed by (12). The only thing that meets this criterion seems to be the failure of occurrent ontological change's coinciding with y's entering into a new relation (shorter-than).[7] Of course, in one sense entering into a new relation *always* coincides with occurrent ontological change. So, what is needed is the change's occurring in a particular place. This might seem strange at first, but if predicates rather than properties are considered mere-Cambridge (after all, attributing non-genuineness to a property has all the markings of attributing non-existence to an object, which seems odd indeed), then the "right place" for occurrent change seems determined by where the variable occurs in the predicate. Indeed, (9)'s variable fails to "match up" with occurrent ontological change, while no such failure occurs in (12). So, on what Francescotti's view seems to amount to, it is this matching-up failure that makes (9) mere-Cambridge.

Now, the failure of (9)'s variable to match up with the locus of occurrent change certainly makes (9) distinct from (12) and (13), but is matching (12)'s variable to the locus of occurrent change sufficient to make (12) genuine, as Francescotti claims? I am dubious. For, it is not at all clear to me why matching up with a locus of occurrent change is any better than matching up with a locus of invariance or a locus of potential change. Furthermore, consider that Socrates could begin growing at a certain point (say, just when x reaches Socrates's height) thereby making (12) true of x at one point and false of x at another without x undergoing any new change. Therefore, I see no reason to think that a predicate whose variable matches up with the locus of occurrent change has any better claim to genuineness than a predicate whose variable does not. As I shall show, a more plausible and parsimonious explanation of the division between genuineness and mere-Cambridge-ness, as it were, is made available by removing the requirement that the variable must match up with a locus of occurrent ontological change. The consequence is that, while (13) remains unharmed, (9) and (12) live and die by the same sword. I argue that both should be regarded as mere-Cambridge.

Crucial to the analysis offered here are these two claims: *(a)* properties and objects are fundamentally different with regard to change, and *(b)* while names denote objects, genuine predicates denote properties. First, properties and objects are fundamentally different, for unlike the latter, the former are, in an important sense, immutable. If a particle *p* were to have no charge at one time but later gained a positive charge, *p* would have suffered change, but the property denoted by '*x* has a positive charge' would not have changed.[8] Second, and consequently, genuine predicates "possess" only one axis of change, *viz.,* truth-value (*t*-value). For this reason, a change in a predicate's *t*-value usually indicates a change in the predicate's extensional object rather than in that which is denoted by the predicate. A mutable thing "named" in a predicate, however, has the potential to change the predicate's *t*-value despite the predicate's extensional objects' failing to change. Therefore, it is including in a predicate the name of something mutable that makes that predicate mere-Cambridge. So, (9) is mere-Cambridge not so much because it denotes actual change taking place in Theaetetus rather than in *y*, but because Theaetetus could cease growing at a particular point (perhaps when he reaches *y*'s height) thereby making (9) no longer true of *y* despite *y*'s failure to undergo any new change.

This account of mere-Cambridge-ness is more plausible because it does not base the genuineness of a predicate upon whether or not change is occurring. Granted, where change occurs will affect which property is instantiated and thus which predicate is true in a particular instance, but whether or not change is occurring surely does not affect which predicates pick out genuine properties. Properties are immutable; and since objects (material or conceptual[9]) are mutable, their names cannot appear in predicates that denote genuine properties. On the account offered here, then, a predicate is mere-Cambridge if it simply contains the name of an object, whether or not the object is changing.

Two things are worth noting here. First, (9) is true in virtue of *both* Theaetetus changing in height *and* the extensional objects' respective heights falling within a certain range. It seems, then, that (9) *consists in* a two-place relational predicate in which the name of the second relatum, *viz.,* 'Theaetetus', is in some sense "fixed." Thus, a general principle: mere-Cambridge-ness is *indicated* when the number of loci of possible change (Lδs) necessary to make the predicate true of an object exceeds the number of variables in the predicate;[10] mere-Cambridge-ness *occurs* in predicates that consist partially in the name of an Lδ; and a mere-Cambridge "property" is an illusion stemming from a conceptual cluster of genuine predicates and conceptual objects.

Notice, second, that claiming (9) is non-genuine is not the same as claiming (9) is vacuous or that sentences in which (9) appears have no *t*-value: surely a majority of people will agree on when (9) is true and when it is false of *y*, and they will arrive at their agreement *by observing the world*. This is instructive, for it shows that a predicate can be of the form '*x* is [or has] *F*', even be true of an object, and yet fail to denote a genuine property. So, despite initial intuitions, perhaps, form and the possibility of truth-conditions do *not* distinguish genuine from mere-Cambridge predicates.

So, when Francescotti's account leads one to pick out mere-Cambridge predicates correctly, it does so for the wrong reasons. The location of occurrent change does not make a predicate mere-Cambridge, although it often indicates a predicate's being mere-Cambridge. Rather, an Lδ's name's appearing in a predicate makes the predicate mere-Cambridge. Next, I will discuss mere-Cambridge predicates consisting in causal predicates.

3. The Corrupting Influence of 'Power'

Drawing from Robert Boyle (1666), consider the claim that a key *k* has the power *R* to unlock a lock *l* in virtue of *k*'s having certain physical properties.[11] What does having this putative power amount to? This much seems true: first, that,

(15) *k* has the power *R* to unlock any member of a set $\mathscr{L}$ of locks, where, $\mathscr{L} =^{df} \{l \mid S_2 l \,\&\, D_2 l \,\&\, Z_2 l \,\&\, ...\}$

where S_2x is '*x* has [such and such] shape', D_2x is '*x* is rigid to [such and such] degree', Z_2x is '*x* has [such and such] size' and so on; and, second, that the lock in question is a member of the set defined in (15). Particularly instructive is that *k* has *R* in virtue of *k*'s having a certain shape S_1x, a particular degree of rigidity D_1x, a certain size Z_1x and so on. Therefore, *k*'s having *R* can be expressed thus:

(16) $Rk \leftrightarrow (S_1k \,\&\, D_1k \,\&\, Z_1k \, ...)$

Furthermore,

(17) $Rk \leftrightarrow \forall l \in \mathscr{L}\, Ukl$

where '*Ukl*' is interpreted as *k* unlocks *l*, and therefore,

(18) $(S_1k \,\&\, D_1k \,\&\, Z_1k \, ...) \leftrightarrow \forall l \in \mathscr{L}\, Ukl$

Some have taken the material equivalence in (18) to mean that causal relations between objects are metaphysically necessary.[12] As to whether or not such relations are necessary, I am unsure, but it seems an extravagant claim. I believe, however, one can avoid many necessity claims regarding material objects (of which so little seems necessary) by simply taking (18) to be a law of kinematic geometry: for all objects *x*, if *x* has a certain set $\mathscr{F}$ of attributes, then *x* stands in a (potential) causal relation *Rxy* to any object *y* which has a set $\mathscr{G}$ of attributes. Thus, when speaking of a particular key *k*, the set of properties possessed by *k* simply determines which causal relations *k* can enter into. In short, then, the material equivalence in (18) should be taken simply to show that possessing powers is ontologically identical to having a set of properties, as John Locke (1690) suggests.[13]

Consider, now, the predicates (hereafter 'power-predicates') by which putative powers are attributed to objects. Suppose first that the following predicate,

(19) *x* has the power *R* to unlock *l*

is true of a key *k*. Second, recall from above that a predicate in which the number of Lδs necessary to make it true of an object exceeds the number of variables in the predicate is mere-Cambridge. A brief glance at (19) shows it to meet this criterion. Power-predicates, I therefore submit, are in fact mere-Cambridge predicates whose constituent relational predicate is causal.

That the constituent predicate is causal is important. For, unlike (12), the relational predicate contained in (19) denotes a *physical* relation such that a physical change (say, a change in position) in *x* can *bring about* a physical change in *l* (*l* becomes unlocked). Physical interaction between causal relata makes the genuineness of power-predicates an even more convincing illusion. That (19) is mere-Cambridge can, however, be easily seen: an alteration in *l* (say, smashing it with a hammer) can make (19) true of *x* at one time and false of *x* at another (*x* can no longer unlock *l*) without any ontological change in *x*. Therefore, for the same reasons that predicates like (9) and (12) are mere-Cambridge, power-predicates are mere-Cambridge.

By revealing power-predicates to be mere-Cambridge predicates constructed from causal relations, we can "reduce" power-predicates to the names of objects and genuine binary causal predicates which are true of a (perhaps ordered) pair of objects in virtue of their possessing certain physical properties. Claiming that power predicates are genuine, however, is to attribute genuineness to a mere-Cambridge predicate on the order of (12).

So, to summarize what has been argued thus far, many predicates possess the form '*x* is [or has] *F*', might even be true of an object, and yet fail to denote a genuine property; call such predicates as these, 'mere-Cambridge predicates'. Now, mere-Cambridge-ness occurs when a predicate consists in the name of a locus of possible change (Lδ). Therefore, if the number of Lδs necessary to make a predicate true is greater than the number of variables in the predicate, the predicate is mere-Cambridge. This (sufficient) criterion of mere-Cambridge-ness holds even for predicates that denote causal relations, thus showing that power-predicates are mere-Cambridge. In the next section, I shall show that special predicates, too, consist partially in mere-Cambridge predicates built up from causal relations.

4. Mere-Cambridge Kinds

From here on, I will assume a much more austere ontology than what I have thus far: only particles, waves, fields of force, and their respective properties are assumed to exist. As to whether or not there are physical kinds, special kinds, special properties, or even macro-level square pegs, I shall assume for the time being agnosticism. Regarding kinds specifically, there are two accounts of kind-hood that are particularly compelling and from which, I believe, a coherent picture of kind-hood emerges. According to Jerry Fodor (1974), kinds are the sorts of things whose names appear in universally quantified law-statements. Since laws do not consist in disjunctions, Fodor argues, there can be no disjunctive kinds. Kim (1992) takes kinds just to be projectible properties and then argues that disjunctive properties cannot be kinds for they are not projectible. It is their failing to be projectible that prevents "disjunctive kinds" from appearing in laws. I shall for the time being assume Kim's picture of kinds (should kinds exist).

The argument I put forward in the present section is roughly this: If the number of Lδs necessary to make a predicate true exceeds the number of variables in the predicate, then that predicate is mere-Cambridge. Since special predicates consist in relational predicates (often thought to be causal) despite their typically being unary (*e.g., x* is a tiger), the number of Lδs necessary to make a special predicate true indeed exceeds the number of variables in the special predicate. Therefore, special predicates are mere-Cambridge. Now, I do not mean to argue that there are no kinds at all; in fact, I believe there are kinds at the physical level. So, I will need to show that physical kinds and special kinds (should they exist) are distinct in a fundamental way, and I will argue that this distinction is based on the role of causation in kind-predication. In order to illuminate causation's role, I discuss first the relationship between causation and predicating physical properties; then, I consider the relation between causation and physical kind-predicates; and finally, I take up special predicates, showing first the distinction between special and physical predicates and second that the distinctive element in special predicates just is what makes them mere-Cambridge. I begin at the physical level.

4.1. Properties, Partitions, and Predicates

David Hume (1748) points out that from a given effect, one cannot deduce its cause; but, as D. M. Armstrong (1978) notes, a property must have causal efficacy if it is to be known. How, then, do we become aware of properties? I submit that properties in particular instances are revealed via inference from changes in dependent variables (DVs) *vis-à-vis* changes in independent variables (IVs). Such inferences occur not only in the laboratory but also in everyday life: our brains are wired to infer the nature of the property in a particular instance based upon a series of causal interactions with that property. As we change, say, our vantage point (the IV), we experience a change in the property's effects (the DV). Moreover, we often receive multiple streams of empirical data simultaneously. Together, these data streams largely remove the likelihood of confounding variables, thereby allowing for a well-founded and quite precise description of the property in question. Often the nature of objects in the laboratory, however, do not allow for simultaneous streams of input. Therefore, since confounding variables are more likely to lurk in the laboratory, controls are put in place. Whether in everyday life or in a controlled setting, however, the nature of the property in a particular instance is inferred based on causal interactions as revealed by IV manipulation and DV measurement.

Now, consider, on the one hand, that while the inference to a particular property based on observing a single effect has little justification, observing a correlation between changes in an effect and changes in the context often provides considerable inferential justification. Moreover, if one can manipulate the context (the IV), measure her IV manipulation, measure the DV changes, *and* see that there is a statistically significant correlation between the IV and DV changes, she becomes quite justified in making her inference to the causal property involved. On the other hand, confounding variables undermine inferential justification to a particular property because *(a)* such variables (by definition) alter observed DV changes beyond changes resulting from IV manipulation alone, and *(b)* DV changes *vis-à-vis* IV changes are largely what our causal inferences are based on. That IV-DV measurement and manipulation can increase inferential justification and that insidious variables can confound it show that inferential justification to a particular property *assumes properties to behave distinctively across possible worlds.*

This assumption is reasonable. If two properties *F* and *G* give rise to an identical set of DV measurements across a set of tests (across nearby possible worlds, by analogy), we have no justification for inferring a distinction between *F* and *G*. If, for example, after running a series of tests on a particle p_1, the DV measurements indicate that p_1 has a negative charge, and then particle p_2 is run through the same tests which yield the same DV measurements as for p_1, it would be odd indeed to conclude that p_2 has a positive charge. For, we (rightly) distinguish between two properties based on *differences* in observed sets of causal interactions. Similarly, if *F* and *G* give rise to different results across the same set of tests, there is no reason to believe they are in fact the same property. If p_1 repels p_2 and attracts p_3, but p_4 attracts p_2 and repels p_3, we infer (again, rightly) that p_1 and p_4 possess different properties. To paraphrase Hume, we expect like sets of IV manipulations and properties to produce like DV measurements; and this expectation is most reasonable.

To put things a slightly different way, inferring from IV-DV correlations to the property involved presupposes (correctly) that properties themselves uniquely *partition* the set of (nomologically) possible causal relations. Call this aspect unique to each property, the property's 'causal partition'. Now, although it is convenient to talk as if partitions are a property of properties, I take 'causal partition' simply to indicate that possessing a certain property places an object under the "authority" of one set of kinematic laws rather than another; the partition itself is ontologically nothing over and above the property.

As is well known, there are an infinite number of possible DV values that any one property can give rise to, and therefore two properties can be distinct in an infinite number of ways. Consequently, in the laboratory, fitting well a curve to plot points representing causal interactions becomes crucial. Now, I shall assume that curve-fitting can provide a reasonably accurate representation of the world. If my assumption is correct, a well-fitted curve is thus a graphic representation of a property's causal partition. For, each plot point represents a causal interaction in a different context (as determined by a change in the IV), and therefore a series of plot points is analogous to a representation of such causal interactions across nearby possible worlds. Now, the act itself of curve-fitting is analogous to everyday inferences to properties, for in both the laboratory and everyday life, we predicate a physical property of an object based on a "curve" inferred from a finite set of causal interactions. So, in short, the causal partition unique to each property is represented by a well-fitting curve, which in turn provides the means for property predication (see Fig. 1).

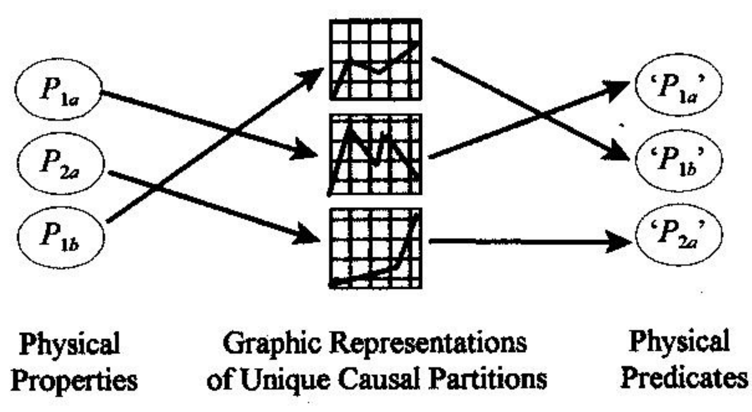

Fig. 1. Physical Curve-fitting. Together, the one-to-one correspondence between physical properties and graphically represented causal partitions (which result from curve-fitting) and the one-to-one correspondence between represented causal partitions and physical kind-predicates allow for physical kind-predication based solely on physical properties.

Importantly, then, despite causation's being a relation, curve-fitting based on a set of observed causal interactions can guide one toward genuine unary property predication.

4.2. Physical Kinds

Of course, though, physical properties come in sets. But at the lowest level, a set of properties is nothing over and above a conjunction of its constituents. Therefore, if physical properties are the lowest, then each set of physical properties will also have a unique set of causal partitions. For example, by fitting curves to several series of DV measurements, it might be determined that a particle *p* has a rest mass of 9.10956×10^{-31} kg, a charge of -1.602×10^{-19} C, and spin 1/2. A conjunctive predicate might be used to pick out this property set,

(20) *x* has a rest mass of 9.10956×10^{-31} kg, a charge of -1.602×10^{-19} C, and spin 1/2

Since the set of properties predicated in (20) is nothing over and above the individual physical properties that make it up, this conjunction has a unique set of causal partitions. Further, if the set of physical properties denoted by (20) is discovered to be a regular feature of the universe, the predicate might be replaced with something a bit more manageable:

(21) *x* is an electron

If physical kind membership is predicated on a set of observed causal interactions, such predication is based on a set of causal partitions, which is materially equivalent to the set of physical properties the object possesses. Therefore, an object's possessing membership in a particular physical kind, say, electron-hood, need not be based on causal relations, *per se*; rather, it can be based on the object's possessing a certain set of physical properties, which are simply *revealed* through a set of causal interactions. I shall therefore qualify my agreement with Kim's assessment of kinds: while kinds are indeed projectible, they are not themselves properties; rather, they consist in *sets* of projectible properties. So, if physical kind-predicates are simply other labels for conjunctive sets of physical properties, then the number of Lδs necessary to make physical kind-predicates true of an object is the same number of Lδs necessary to make its constituent physical predicates true: one, the object itself.

4.3. Special Predication and the Grouping Problem

Now, turning to the properties and predicates peculiar to the special sciences, suppose (somewhat artificially) that there are two distinct higher-level properties, S_1 and S_2, and that each of these is materially equivalent (*i.e.,* their respective predicates can be connected with '$\leftrightarrow$') to a disjunction of three physical properties each:

(22) $S_1 \leftrightarrow (P_{1a} \vee P_{1b} \vee P_{1c})$

(23) $S_2 \leftrightarrow (P_{2a} \vee P_{2b} \vee P_{2c})$

Consider for the moment only the right hand side of these biconditionals. The properties P_{1a}, P_{1b}, and P_{1c}, for example, are *dis*joined because they are *distinct* physical properties. In fact, the disjunction, $P_{1a} \vee P_{1b} \vee P_{1c}$, is non-projectible just *because* each disjunct is a distinct property (Kim, 1992). So, (22) and (23) both consist partially in disjunctions of distinct physical properties. Moreover, what *informs* the observer that these are distinct physical properties is each property's unique causal partition, which is revealed through distinctive IV-DV correlations.

A question that desperately needs an answer, however, I believe, is this: in virtue of what do the predicates, 'P_{1a}', 'P_{1b}', and 'P_{1c}' get placed in one disjunctive statement while 'P_{2a}', 'P_{2b}', and 'P_{2c}' get placed in another such that never the twain shall meet? Surely, this grouping occurs along axes of homogeneity, but herein lies difficulty. If homogeneity exists in the world, then it seems that our recognition of it must stem from one of only two places: either from the observed causal partitions themselves or from the observed supervening higher-level property.

Taking the first, as just noted causal partitions observed through sets of causal interactions seem sufficient to *distinguish* between physical properties, but they do not seem sufficient to reveal *similarities* between physical properties. As discussed above, if a set of IV manipulations is run on two different instances, and each run produces a different set of DV measurements, then (assuming no confounding variables) there is little justification for claiming that the two sets of DV measurements arise from the same property. Indeed, observing distinct sets of causal interactions provides the very means by which two properties are distinguished. So, since distinct causal partitions can only reveal that two properties are distinct, whatever groups P_{1a}, P_{1b}, and P_{1c} to the exclusion of P_{2a} must be something other than causal partitions.

Second, perhaps the higher-level property itself determines which physical predicates get subsumed under it. Here, however, a different problem arises. Conventional wisdom avers that special science properties are nonreducible to lower-level properties as indicated by their being multiply realizable. But if special-science properties are multiply realizable, then they are more liberal than physical properties with regard to which causal partitions count as instances of them. Consequently, a multitude of well-fit curves can indicate an instance of a single special-science property. But if one cannot know of properties except in virtue of their causal efficacy, and causation is a physical relation the realization of which is determined only by physical properties, then causation will guide one only to physical properties. In short, curves fit to representations of causal relations are simply too fine-grained to represent special science properties (see Fig. 2).

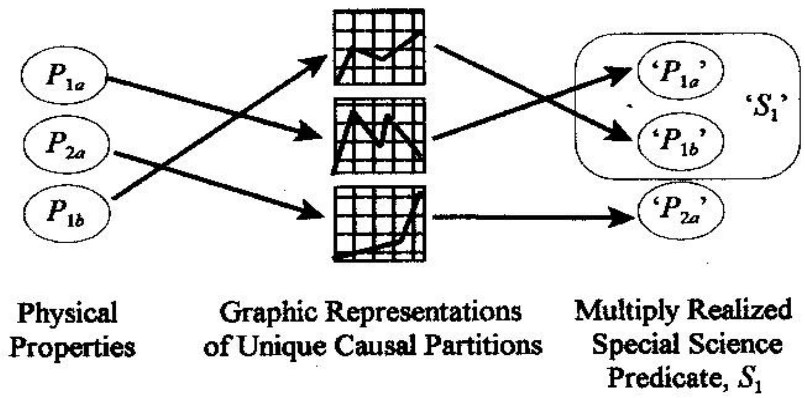

Fig. 2. Special Curve-fitting. The onto relation between represented causal partitions and special predicates shows that curve-fitting based on observed sets of causal interactions is too fine-grained to yield special predicates.

Now, there is little doubt that causation in some way guides special predication. But that which groups physical predicates under one special predicate rather than another must be located somewhere other than the set of causal relations itself. Consider that in a particular instance of special predication, one will often say that *x* is *S* (where *S* is a special predicate) because things of *S*-kind cause things of *T*-kind, and *x* just caused a thing of *T*-kind. Since perceived causal interactions are insufficient for special predication, *x* must be labeled with '*S*' in virtue of *T*. It is therefore a bit of a misnomer to say that special predicates are causally defined; rather, they are defined in terms of a second causal relatum. (Notice that this definitional relatum [*T*] had better be a member of a special kind itself, otherwise we run into the same grouping problem mentioned in the last paragraph.[14]) The inclusion of a second relatum in a unary special predicate makes the predicate itself non-genuine. It is therefore instructive that special predicates denote things that cause *things* of *T*-kind. Indeed, they do cause such things, and those things just are the insidious Lδ of mere-Cambridge-ness.

5. The Predicate Advantage

I submit that special science predicates are nonreducible *not* because scientific domains are autonomous, but because, despite appearances, they do not pick out genuine properties. Formal and truth-conditional ambiguities, and perhaps the infelicitous intuition that a predicate has *t*-value only if it is genuine, make distinguishing between genuine and non-genuine, or mere-Cambridge, predicates difficult. An analysis of mere-Cambridge predicates reveals that mere-Cambridge-ness, as it were, occurs when the number of loci of possible change (Lδs; roughly, material or conceptual objects) necessary to make a predicate true exceeds the number of variables in the predicate. Moreover, this criterion of sufficiency holds for predicates built up from causal relations. Therefore, unlike physical predicates whose application may be only guided by observed causal interactions, special predicates are guided by causal interactions *and* are defined in terms of their causal relata. Consequently, also unlike physical predicates, the number of Lδs required to make a special predicate true exceeds the number of variables in a typical special predicate. This discrepancy reveals that special predicates are in fact mere-Cambridge.

Now, a predicate's being mere-Cambridge does not entail its being useless. For, a predicate's usefulness really depends on the world's being a certain way, but not necessarily the way the predicate seems to indicate. Consider that since mere-Cambridge predicates are relational predicates in which the name of one relatum is fixed, such predicates can in fact be quite useful so long as the relatum whose name is fixed is relatively stable. For, by fixing the name of the more stable relatum, calculating a developing relation becomes much more manageable. Multi-variable mathematical statements are analogous: holding one variable constant makes easier the calculation of the other variables' values. By switching between which relatum is fixed, an organism can quickly make calculations as circumstances develop. Since the most advantageously significant relations are causal, power-predicates will be among the most useful predicates available despite the unlikelihood that possessing a power is anything over and above possessing a certain set of properties. Special sciences, therefore, might be predictively successful not so much because special predicates accurately depict the ontology of the world, but because they describe the world in ways that have proven advantageous to surviving organisms.

ENDNOTES

1. David Chalmers, Richard Swinburne, and others maintain one form of substance dualism or another as against physicalist monism (hereafter, simply 'physicalism'). While these positions are interesting, I shall assume throughout this paper that physicalism as a scientific thesis is true.

2. The argument presented here is concerned only with the predicates themselves and thus will not bear upon the ontological status of non-physical scientific properties (although I am dubious of their existence).

3. By 'internal' I mean something like the property's being exemplified in the same spacetime region as the object of which the property is predicated.

4. I trust the reader's intuition as to what the right way is.

5. The word 'genuine' in 'genuine predicate' is *not* being used synonymously with 'real' or 'actual'. The set of genuine predicates is a proper subset of the set of real predicates, for 'genuine' merely implies an ontological claim: genuine predicates (*e.g.,* '*x* is negatively charged) are real predicates that pick out genuine properties.

6. Adapted from Francescotti's version for consistency (Francescotti 1999).

7. First, none of the taller/shorter-than relations themselves can be the required aspect. For, while these relations certainly have to do with *y*'s being outgrown by Theaetetus, *y* itself can be, say, shorter than Theaetetus only in virtue of *y*'s height, which of course has quite a bit to do with *y*. Second, Theaetetus's growing cannot alone be the elusive aspect, since growing has to do only with Theaetetus, as indicated by his possibly growing whether or not he outgrows any particular object.

8. I take it that while '*x* is growing' denotes mutation, *x*'s growing is an immutable property, as indicated by '*x* is growing' having only two *t*-values; either growing is "instantiated" or it is not.

9. Conceptual objects are mentally conceived objects to which the features of object-hood (*e.g.,* mutability) are attributed, rather than the features of property-hood (*e.g.,* immutability). Santa Claus is a conceptual object. He can conceivably turn red with anger or green with envy, but '*x* is red with anger' can only be either true or false of Santa.

Some (if not all) conceptual objects are arrived at via abstracting away from properties possessed by material objects. Nonetheless, the conceptual entity arrived at has the conceptual attributes of a material object (mutability, say), rather than those of a property.

10. Two things should be mentioned here. First, I use 'Lδ' for simplicity, but 'set of Lδ in the extension of a bound variable' will work too, in which case that a predicate is mere-Cambridge is indicated when the number of Lδ sets necessary to make the predicate true exceeds the number of variables in the predicate.

Second, the number of Lδs exceeding the number of variables in the predicate is merely a sufficient indicator of mere-Cambridge-ness. Consider the following (for which I thank Rob Rupert):

(a) *x* is Tom's favorite property

If properties are immutable and thus cannot be Lδs, then only one Lδ is necessary to make (a) true of *x*: Tom, who must be in a particular frame of mind. That (a) is mere-Cambridge, however, is shown by the possibility of Tom's changing his mind, for Tom's mind changing would make (a) true of the immutable *x* at one time and false of it at another. So, it is (a)'s consisting partially in the name of an Lδ that makes (a) mere-Cambridge.

11. I have modified Boyle's example slightly for the sake of perspicuity.

12. See, for example, Sydney Shoemaker (1980), who argues that properties can be reduced to causal powers by means of such a material conditional.

13. This holds for conceptual objects, too, except perhaps in cases where the object is conceived to have powers other than those found in nature.

14. The claim that physical properties are grouped under a special predicate *S* in virtue of a relation to a special predicate *T* does not solve the grouping problem; it merely pushes it back a step. The question becomes, in virtue of what are physical properties grouped under a *T*-causing predicate?

The short answer is, I believe, that such grouping is adaptive cognitive behavior. Bornstein (1987) and Shepard (1994) have shown that certain types of abstracting and conceptual clustering begin prior to consciousness, and Shepard (1994) argues that much of preconscious conceptual clustering is selectively advantageous. I argued in my master's thesis that grouping physical properties under various special predicates results from these natural cognitive processes.

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