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## A NOTE ON ANALYSING SUBSTANCEHOOD

David Denby

I propose an analysis of the notion of a substance. I define two ‘quasi-logical’ independence relations, and state the analysis in terms of the distribution of these relations among substances and properties generally. This analysis treats the categories of substance and property as mutually dependent. To show that it (probably) states a sufficient condition for substance, I argue that it is in a certain kind of equilibrium. This illustrates a promising general approach to analysing fundamental metaphysical notions.

I will use ‘substance’ to refer to ordinary individuals, contingent things like atoms, chairs, galaxies, people, plants, Cartesian egos, perhaps gods, and so on.<sup>1</sup> One question about substances is: can they be reduced, say to bundles of properties? Another is: are some more ontologically fundamental than others? Is the whole universe, for instance, more fundamental than its parts? A third is: what substances are there? Is there, for any arbitrary collection of substances, a substance that is their sum? Are there really macroscopic as well as microscopic substances? Artefacts as well as living things? In this note, I ignore these questions, though I will assume that at least the ordinary individuals mentioned above qualify as substances. I will attempt instead to answer a fourth question: how should substancehood be analysed, i.e., what conditions must a thing satisfy to qualify as a substance rather than a member of some other ontological category, e.g., the category of properties?

Many philosophers regard the capacity for independent existence as central to the notion of a substance.<sup>2</sup> So why not take it as definitive? Why not say that *x* is a *substance* iff *x* is capable of existing independently? One problem is that independence is a relation. So we need to ask: what are

<sup>1</sup>Sometimes ‘substance’ has been used instead to mean that which is ontologically basic, a priority in nature. Both senses have roots in Aristotle’s *Metaphysics* Z.8. Maybe the same things qualify as substances either way; maybe ordinary individuals are ontologically basic. But maybe not. If, for instance, the whole universe is more basic than its parts, then there are many substances in our official sense, many individuals, but just one in this second sense, the whole cosmos. Perhaps ‘individual’ would have been a less misleading term here, especially given the focus in this paper on the contrast with properties. But it is not a perfect choice either since it could be taken to comprehend spacetime points and other entities that do not belong in the same ontological category as atoms, chairs, etc. And ‘substance’ is the more usual term for individual things even when ontological priority is not at issue, see, e.g., Hoffman and Rosenkrantz [1994; 1997]. ‘Substance’ is also sometimes used as a mass-noun rather than a count-noun. That too is a different use from the use in this paper.

<sup>2</sup>Including, among contemporary philosophers, D. M. Armstrong [1978: 115]: ‘a particular is a substance, logically capable of independent existence. It could exist although nothing else existed’; and Hoffman and Rosenkrantz, who have proposed an analysis of substancehood in which the capacity of substances for mutually independent existence plays a central role [1994; 1997]. Of course, Descartes [1985: I.51], Spinoza [1985: Pt I def. 3], and others also focused on this feature of ‘substances’, but their concern was with substances *qua* that which is ontologically basic rather than *qua* individual things.

substances capable of existing independently *of*? Not properties or relations; no substance could lack all properties or relations.<sup>3</sup> Not space or time; physical objects at least seem to be essentially spatiotemporal. And not sets or propositions; no substance could exist without certain sets and propositions also existing—their singletons, the propositions asserting their existence, etc. Rather, what substances are capable of existing independently of are other *substances*. But, thus understood, the suggested analysis is circular.

Another central feature of substancehood is the capacity to instantiate properties without being a property.<sup>4</sup> This suggests: *x* is a *substance* iff *x* instantiates properties but is not instantiated by anything.<sup>5</sup> But instantiation and propertyhood are metaphysical notions that are neither clearer nor more fundamental than substancehood itself. So such an analysis could offer only limited insight.

In this note, I propose a Ramsey-Lewis style analysis of substancehood that treats the categories of substance and property as mutually dependent [Lewis 1970]. Such an analysis has several advantages: it can exploit the mutual independence of substances without circularity; it can be formulated in precise quasi-logical terms, avoiding metaphysical primitives; and it can illuminate the relation between the two central features of substancehood. However, Ramsey-Lewis style analyses have a drawback: in general there is no guarantee that they pin down their targets uniquely, that they state sufficient conditions. So I will argue that any division of entities that satisfies the analysis of substancehood I propose must be in a certain kind of equilibrium. While not a guarantee, this is at least strong evidence that there is only one such division, i.e., that satisfying this analysis is indeed sufficient for being a substance.

I have two main aims. First, to illustrate this idea of supplementing Ramsey-Lewis style analyses with a proof of equilibrium. Such analyses are much more attractive if we have a way to argue for their sufficiency. Second, to define a quasi-logical notion of substancehood. This reveals its structure, at least in part, and it reveals a way to grasp substancehood and other basic ontological categories without a prior grasp on any metaphysical notions.

These aims are best served by minimizing other complications. So I will not attempt to evaluate other extant accounts of substancehood.<sup>6</sup> Nor will I

<sup>3</sup>In this paper, I use 'property' in the sparse sense according to which properties correspond to natural similarities or patterns among things (regardless of how we speak or think), rather than in the abundant sense according to which there is a property corresponding to every possible monadic predicate. Clearly, nothing at all could lack properties in the abundant sense, but perhaps spacetime points lack properties in the sparse sense.

<sup>4</sup>Possibly we should also include the capacity to stand in relations. But, for simplicity, I am ignoring relations throughout this paper.

<sup>5</sup>Aristotle, for instance, mentions this in several places, e.g., *Metaphysics* Δ.7 (1017b14) and *Categories* 2a11.

<sup>6</sup>However, I should say a word or two about the important work of Hoffman and Rosenkrantz [1994; 1997]. Like me, they see the mutual independence of substances as the key to analysing substancehood. But they proceed differently and have different aims. They start by presupposing a division of entities into basic ontological categories—intuitively, the substances, properties, events, times, collections, etc.—and attempt to formulate a criterion to single out the category of substances. My analysis is both less and more ambitious than this: less, because I attempt to distinguish substances only from properties and ignore the other categories; more, because I do not presuppose an initial division of entities into (two) basic categories—my analysis aims to generate the categories, not just to identify which one is which. And unlike me, they aim neither to discuss equilibria in Ramsey-Lewis definitions nor quasi-logical analyses of substancehood.

attempt to justify several controversial assumptions that I will make about properties and substances (though they are all familiar and widely-shared). And I will make two simplifications: I will pretend that everything is either a substance or a property, ignoring other fundamental kinds of thing—relations, spacetime points, sets, numbers, events, propositions, etc.; and I will pretend that nothing has any proper parts (though I will sketch an approach to dropping this second simplification in Section III).<sup>7</sup> Evaluating other accounts, justifying the assumptions, or refining away the simplifications would mean becoming embroiled in ancient metaphysical controversies, which would shift our focus away from the basic ideas behind the analysis of substancehood and the overall approach to analysis it exemplifies.<sup>8</sup> The cost of not doing so, however, is that we must think of the proposal as merely a first step towards an analysis rather than the final word (with no guarantee that further steps are possible).

### I. Substances, Properties, and Independence

My proposal relies on intuitions about the distribution of two relations among properties and substances: weak independence and strong independence. These are relations that entities of any category can bear to classes of entities from any category. An entity  $x$  is *weakly independent* of a class  $A$  iff for any member of  $A$ ,  $y$  (distinct from  $x$ ), there is a possible world where  $x$  exists but  $y$  doesn't; and  $x$  is *strongly independent* of  $A$  iff there is a possible world where  $x$  exists but no (distinct) member of  $A$  exists. Strong independence entails weak independence, but not vice versa. Intuitively, my shoe could be any colour, though it has to be some colour or other. So (assuming for simplicity that a colour property exists iff it is instantiated) my shoe is weakly but not strongly independent of the class of colours. Similarly, the whole world seems to be weakly but not strongly independent of the class of possible spatiotemporal structures: it must have some such structure or other, but there is no particular structure it must have.

How are these relations distributed among substances and properties generally? Start with the substances. As already noted, a substance seems to be capable of existing even in the absence of all distinct substances.<sup>9</sup> An electron, a Cartesian ego, a person, a god, a galaxy, the whole cosmos: each of these substances could still exist even if every distinct substance were suddenly to go out of existence. So it seems that every substance is strongly

<sup>7</sup>Though I frame my discussion of this pretend ontology in terms of sets, relations, times, etc.!

<sup>8</sup>Notice that the mere fact that my proposal is framed in quasi-logical terms does not mean that it has managed to avoid metaphysical controversies, that it is somehow metaphysically neutral. For it is proposed as an analysis of *substancehood* and it is framed so as to incorporate features of the substance role. But quite what these features are is controversial. Insofar as the proposal includes controversial features, or leaves them out, it takes metaphysically controversial stands, regardless of the terms in which it is framed.

<sup>9</sup>No substance can exist in the absence of any necessarily existent substances, and of course there is a long tradition of taking God to be a necessarily existent substance. Recall, however, that we're using 'substance' to refer only to contingent entities. Gods qualify only if they're contingent.

independent of the class of all substances.<sup>10</sup> More generally, it seems that existential constraints on substances cannot come from other substances at all: if a substance is strongly independent of some class of entities, it remains so regardless of how many substances we add to that class. Formally: if a substance *x* is strongly independent of some class *A*, then for any class of substances, *B*, *x* is also strongly independent of the union of *A* and *B*. (This principle entails, as a special case, that every substance is strongly independent of the class of all substances, that any substance could be the only one: just let *A* be the null set—of which every individual is trivially strongly independent—and let *B* be the class of all substances.)

However, one might object that some substances are essentially complex: they couldn't exist without other substances to be their (proper) parts. No such substance could be the only substance. Agreed; but remember that we are simplifying for now and pretending that nothing is complex.

One might also object that some substances have their causal origins essentially. Perhaps a person's existence requires the prior existence of her parents, or an artwork's existence requires the prior existence of a particular artist. Again no such substance could be the only one. Perhaps; though to debate it would take us too far afield and obscure our aims. So let me make do with two remarks. First, even if there is sense in which I couldn't have existed without my parents, surely there is also a sense in which I could—couldn't God have created me directly?—and it is worth exploring this second sense of 'substance'. Second, it seems that this sort of essentialism can be accommodated anyway simply by replacing 'possible world' with 'possible world *and time*' in the definitions of 'weak' and 'strong independence'. For even if there are no worlds where I exist but my parents don't, for instance, there are surely *times* at various worlds at which I exist but they don't.<sup>11</sup>

Next, consider properties. In contrast to substances, properties constitute a 'system'; there is a network of entailments among them. In particular, it seems that for any property to exist, some other property must also exist; there couldn't be just one property. That is, it seems that no property is strongly independent of the class of properties. This is difficult to justify generally, but, at least if we assume a venerable principle about properties, viz., that a property exists iff it is instantiated, it seems true in at least three central cases. First, it seems true of determinate properties (specific shades of colour, specific masses, specific charges, etc.), for no determinate could exist without the corresponding determinable also existing. Nothing could be (some specific shade of) red, for instance, and not be coloured; hence if redness exists, so does being-coloured. Second, it seems true of determinable properties, for no determinable could exist without at least one of its determinates also existing.

<sup>10</sup>I don't claim that this is universally accepted; it contradicts certain kinds of Leibnizian holism, for instance. But it seems to me to have very strong intuitive appeal (even when it is clear we are talking about substance qua individual things rather than substances qua priorities in nature), certainly strong enough for its consequences to be worth exploring.

<sup>11</sup>Hoffman and Rosenkrantz [1994: 50 ff.] deal with these cases in a similar way.

But what if there could be simultaneous causation (and some substances have their simultaneous causes essentially)? Then we could replace 'possible world' with 'possible world and time *and place*' in the definitions of 'weak' and 'strong independence'. What if there could be causation that is not just simultaneous but even spatially co-located (and some substances have such causes essentially)? In that case, I doubt that the substances are genuinely distinct, but it is such an *outré* possibility that to discuss it would take us too far afield.

Nothing could be coloured without instantiating some specific shade of colour; hence if being-coloured exists, so does some specific shade. Finally, it seems true of 'compound' properties.<sup>12</sup> Nothing could be both red and square, for instance, unless it is red and it is square, in which case redness and squareness exist. Moreover, there are no clear-cut counterexamples. Could there really be a world of simple (extensionless) particles instantiating just, say, unit mass? What about the kind to which the particles belong? Their determinables? Their causal roles? Of course, none of this is conclusive. One could deny, for instance, that determinables, kinds, causal roles, etc., qualify as properties (in the sparse sense) or that determinates and their determinables are distinct. However, it would again take us too far afield to debate the matter. Let us just observe that the denial of the possibility of a single property is sufficiently widely shared for its consequences to be worth exploring.<sup>13</sup>

Consider next the relations between individual substances on the one hand, and the class of properties on the other. Intuitively, an individual substance must have some properties; it cannot be featureless. To fail to have any properties is to fail to be genuinely similar to any possible thing. Surely, that's just inconceivable in a substance. So it seems that each substance fails to be strongly independent of the class of properties: if a substance exists, so must some property. Do substances also fail to be weakly independent of the class of properties? There are many possible positions: perhaps every substance has essential properties; perhaps just some substances do; perhaps none do; perhaps it's all context-dependent. Let us stay neutral. Let us assume only that each substance fails to be strongly independent of the class of properties, leaving open whether or not all or some of them fail to be weakly independent also.

Finally, consider the relations between individual properties on the one hand, and the class of substances on the other. Intuitively, to be a property (in the sparse sense) is to be 'general' and 'repeatable'.<sup>14</sup> What this means, at least in part, is that no property requires the existence of any particular substance or substances. The existence of redness, for instance, does not require the existence of any particular red substance—any one would do. More generally, for any particular finite set of substances, redness could exist even in the absence of every member of that set; it requires at most only one substance, any one, that is red.<sup>15</sup> So it seems that every property is

<sup>12</sup>I ignore properties that are negative, disjunctive, conditional, etc., because the only compound properties with any claim to corresponding to natural similarities are conjunctive properties.

<sup>13</sup>It is shared, e.g., by Hoffman and Rosenkrantz [1994: 53–5].

<sup>14</sup>Though not in the abundant sense. For among the properties in the abundant sense are 'haecceities', properties for which some specific individual is the only possible instantiator, and these are necessarily unrepeatable. However, haecceities do not qualify in properties in the sparse sense because they correspond to no similarity or pattern in nature.

In calling properties general or repeatable, I talk as if properties are universals. This is merely for convenience. The (natural) class nominalist, the trope-theorist and others endorse exactly parallel doctrines. The intuition being expressed is independent of the particular theoretical setting and it is a simple matter to recast all the above remarks accordingly. My use of 'property' corresponds, for instance, to 'natural class of tropes' as used by certain trope theorists, e.g., G. F. Stout [1921], and where I say that properties are repeatable, these trope theorists would say something to the effect that every trope belongs to some natural class of tropes containing many members.

<sup>15</sup>Intuitions are less clear or reliable in infinite cases. Is it also true that for any particular infinite set of substances, redness could exist even in the absence of every member of that set? Probably, but not so obviously. And I will not assume it in what follows.

strongly independent of every finite subset of the class of substances. (Notice that this entails that every property is weakly independent of the class of substances. For if a property is strongly independent of every finite subset of a class, in particular it is strongly independent of each member's singleton, for the singleton of any member of the class is one of that class's finite subsets. And clearly if something is strongly independent of the singleton of each member of a class, it is weakly independent of the class itself.)

Are properties also strongly independent of the class of substances? I think not. Of course, both answers are backed by venerable traditions, but this time we must choose; to stay neutral would provide too little to sustain an analysis. And I find the denial more plausible. To suppose that a property could exist in the absence of all substances—if indeed there could be no substances at all—seems to me to lose one's grip on a central feature of our notion of a property: that properties are somehow secondary or abstracted entities.<sup>16</sup> Again, there is not space to justify this fully, but again it is sufficiently widely-held for its consequences to be worth exploring [Armstrong 1978: esp. chap. 7].

In short, there are certain basic, albeit controversial, intuitions: any substance could be the only one; no substance could be featureless; no property could be the only one; properties are general; properties are abstractions. And these intuitions suggest a certain pattern of distribution of strong and weak independence among substances and properties generally.

## II. A Holistic Analysis of Substancehood

We know that this pattern cannot be exploited in a traditional analysis of substancehood on pain of circularity. But it can be exploited in a Ramsey-Lewis-style holistic analysis, as follows.

First, say that a pair of classes  $\langle S, P \rangle$  is *eligible* iff

- (SS) If any member of S is strongly independent of any class A, then it is also strongly independent of the union of A and any subset of S, (in particular, it is strongly independent of S itself);
- (SP) every member of S fails to be strongly independent of P;
- (PP) every member of P fails to be strongly independent of P; and
- (PS) every member of P: (a) is strongly independent of every finite subset of S (and so is weakly independent of S itself); but (b) fails to be strongly independent of S.

<sup>16</sup>I don't think this must mean that a property exists only if it itself is instantiated (despite assuming this for simplicity above). For perhaps uninstantiated determinates belonging to determinables some of whose other determinates are instantiated, e.g., actually uninstantiated masses and lengths, exist even if they are not instantiated. After all, we have no problem referring to them (cf. Hume's missing shade of blue). Even then, strong independence seems false: surely no property could exist in the absence of all substances.

Next, say that such a pair is *maximal* iff everything is a member of S or P. Finally, the analysis: x is a *substance* iff x is a member of the first member of a maximal eligible pair.<sup>17</sup>

This analysis, or rather this first step towards an analysis (recall our simplifying assumptions), has several attractive features.

First, it is ‘quasi-logical’: all its primitives are drawn from logic, mereology, or set-theory, or are simple modal notions. In particular, it makes no explicit or implicit use of ‘substance’ or any other metaphysical primitives such as ‘property’ or ‘instantiates’. So it is not circular and its analysans notions are clearer and more fundamental than substancehood. It thereby suggests a general route to grasp the most basic ontological categories, indeed entire ontological schemes, viz., holistically via a quasi-logical Ramsey-Lewis-style definition.

Second, it (almost) captures the two characteristic features of substancehood we started with. Indeed, they are inextricably blended in the analysis. (SS) guarantees that any substance could be the only substance, while (PP) guarantees that no property could be the only property. This is a plausible way to understand the first feature, the characteristic capacity of substances for independent existence. And (SS) and (PSb) guarantee that no substance is a property, while (SP) guarantees that substances can exist only if properties also exist. This nearly captures the second feature, that substances instantiate properties without being properties. (It falls short only in failing to guarantee that substances *instantiate* properties; ‘instantiation’ of course is being avoided. But it does guarantee instead that they cannot exist without them, which comes pretty close, especially when combined with the implication of (SS) that any substance could be the only one.)

Third, and connectedly, it guarantees that substances are suited to their conceptual role. Our experience, thought, and speech is of a world that is patterned, one that contains distinct things that are similar in various ways. To play their role of ‘pattern-nodes’ substances must be characterizable independently of one another, and instantiators of properties/similarities. Notice then that the analysis guarantees the mutual independence of substances (by (SS)) and a conceptual link between the existence of substances and the existence of properties (by (SP)).

None of this means that this analysis is the only or even the best way to understand substancehood. Perhaps it needs no further clarification, quasi-logical or otherwise. Nor does it tell us whether substances also have various other characteristics sometimes ascribed to them—being active; persisting; surviving change, etc.—which it is plausibly the job of conceptual analysis, of one form or another, to decide. However, the analysis does reveal some of the internal and external structure of substancehood. And it is genuinely

<sup>17</sup>The analysis treats substancehood and propertyhood as mutually dependent notions. So why is it to be an analysis of substancehood only rather than of both notion? Because the analysis yields a natural criterion of identity for substances—x is the same substance as y iff each fails to be strongly independent of the other’s singleton, i.e., x could not exist without y or vice versa—but it yields no criterion of identity for properties.

surprising both how little structure is required to pin down the distinction between substances and properties and that this structure can be captured in purely quasi-logical terms.

### III. An Extension: Proper Parts of Substances

Until now, I have been pretending that nothing is complex. In this section, I sketch a way partially to drop this simplification and allow for complex substances, those with other substances as proper parts. I do not discuss complex properties (if such there be) because their mereology is too controversial and complicated to broach here.

First, some terminology: say that a class of entities is an *atomization* of a thing iff none of the members of the class overlap, and collectively they compose the thing (the thing is their sum). Roughly, an atomization of a thing is the result of decomposing it into non-overlapping parts. Three points about atomizations are relevant to what follows. First, complex substances typically have many atomizations; think of all the ways to divide a cake into slices. In particular, reality as a whole presumably has many atomizations.<sup>18</sup> Second, because the members of an atomization do not overlap, no atomization can contain both a substance and any of its proper parts. But third, whenever something is complex, there are some atomizations that contain it and others that contain its parts—it is a single slice on some divisions of the cake, but several slices on others.

Now, recall the problem that prompted our simplification: if there are any essentially complex substances, then (SS), which entails that each substance could be the only one, is false. Pretending that nothing has proper parts was a way of bracketing this threat to (SS). But notice that the threat can also be avoided by restricting the ‘input’ to the analysis, i.e., the universe of discourse of its quantifiers, to an atomization of reality as a whole. For then the collection of substances that the analysis yields as output is guaranteed not to contain any substance and its parts. And presumably (SS) would be true of such a collection of substances; any one of them could be the only one *of them*, even if some are really essentially complex. Of course, such a collection now fails to contain every substance; the fact that it fails to contain any parts or sums of its members is enough to show that. But there are many atomizations of reality, many possible inputs, yielding many different collections of substances as outputs (of each of which (SS) is true). By taking the union of all such collections we can be sure that every substance—including all sums and parts—is included without jeopardising (SS). This suggests the following extension to the analysis. Say that *x* is a *substance* iff there is *some* atomization of the whole of reality *A* such that the

<sup>18</sup>One could accept some (essentially) complex substances but deny that there is such a thing as reality as whole. This seems to be a consequence of Peter van Inwagen’s view as articulated and defended [1990]. Again, it would take us too far afield to discuss this (and the discussion could be adapted to deal with it without much difficulty anyway).

analysis categorizes  $x$  as a substance when  $A$  is taken as the input to the analysis; i.e., iff  $x$  belongs to the first member of a maximal eligible pair when  $A$  constitutes the universe of discourse for the analysis's quantifiers.

In short, there is a way to drop the simplification that nothing has parts while sidestepping the threat to (SS) posed by essentially complex substances: restrict the input to the analysis to atomizations, and count as a substance anything the analysis classifies as such on any such input.

#### IV. Uniqueness and Equilibrium

An analysis is adequate only if it pins down its target uniquely; it must state a sufficient condition. In our case, that means that there had better be only one maximal eligible pair. In this section, I provide some evidence of this uniqueness, though this evidence is not conclusive.

Let us say, for any natural number  $n$ , that a maximal eligible pair is in *n-equilibrium* iff its classification of any  $n$  entities is uniquely determined given the classification of the others; that is, iff there is no way to reclassify any  $n$  entities without destroying the pair's eligibility. Now, suppose maximal eligible pairs are in 1-equilibrium. That does not mean that there could not be two of them, but it does mean that there could not be two of them differing only in how they classify a single entity—some evidence of uniqueness. And if they are in  $n$ -equilibrium for all  $n$ , then there could not be two of them differing only in how they classify a finite number of entities; they would have to differ in their classifications of infinitely many entities. That is more evidence of uniqueness—not a proof, but sufficient I think to shift the onus onto the opposition.

In the remainder of this section, I argue by induction that maximal eligible pairs are indeed in  $n$ -equilibrium for all  $n$ .

##### *Base Case: Maximal Eligible Pairs are in 1-Equilibrium*

Consider any entity  $x$  and any maximal eligible pair  $\langle S, P \rangle$ . To show that  $\langle S, P \rangle$  is in 1-equilibrium, it suffices to show that  $x$ 's relations to  $S$  and  $P$  uniquely determine its classification (in either  $S$  or  $P$ ).<sup>19</sup>

Now, either  $x$  is strongly independent of  $S$  or it isn't. If it is, then it cannot be in  $P$  on pain of violating (PSb); so, by maximality, it must be in  $S$ . If it isn't, then it cannot be in  $S$  on pain of violating (SS); so, by maximality, it must be in  $P$ . Either way then  $x$ 's classification is uniquely determined. So  $\langle S, P \rangle$  is in 1-equilibrium.

<sup>19</sup>Recall that we are ignoring the possibility that  $S$  or  $P$  contain entities which are parts of  $x$  or of which  $x$  is a part.

*Inductive Step: If Maximal Eligible Pairs are in (n - 1)-Equilibrium, then they are in n-Equilibrium*

Consider any  $n$  entities  $x_1, \dots, x_n$ , and any maximal eligible pair  $\langle S, P \rangle$ . Let  $S^-$  be the set,  $S - \{x_1, \dots, x_n\}$ ; and let  $P^-$  be the set,  $P - \{x_1, \dots, x_n\}$ . Roughly,  $S^-$  and  $P^-$  are what's left of  $S$  and  $P$  respectively after  $x_1, \dots, x_n$  have been 'removed'. To complete the induction, we must show that the relations of each of  $x_1, \dots, x_n$  to  $S^-$ ,  $P^-$ , and  $\{x_1, \dots, x_n\}$  uniquely determines its classification, assuming that  $\langle S, P \rangle$  is in  $(n - 1)$ -equilibrium. And for the sake of the proof let us introduce the following definition: a set  $A$  is a *P-verification set* for  $x = \text{df.}$  (1)  $x$  is strongly independent of  $A$ ; but (2)  $x$  is not strongly independent of  $S^- \cup A$ . This definition is framed to guarantee that if any entity has a  $P$ -verification set, it cannot be in  $S$  on pain of violating (SS), and so must be in  $P$ , by maximality. In effect, the existence of a  $P$ -verification set for  $x$  guarantees that  $x$  is in  $P$ .

Now, let  $x$  be any arbitrary entity from among  $x_1, \dots, x_n$ . I argue first that if some subset of  $\{x_1, \dots, x_n\}$  is a  $P$ -verification set for  $x$ ,  $x$  must indeed be in  $P$ . Then I argue that if none is,  $x$  must be in  $S$ . Finally, I appeal to the induction hypothesis to guarantee the classification of the rest of  $\{x_1, \dots, x_n\}$ . This shows that regardless of whether some subset of  $\{x_1, \dots, x_n\}$  is a  $P$ -verification set for  $x$ , the classification of each of  $x_1, \dots, x_n$  is uniquely determined, which completes the proof.

Suppose first that some subset of  $\{x_1, \dots, x_n\}$ ,  $A$ , is a  $P$ -verification set for  $x$ . Then, by part (1) of the definition of 'P-verification set',  $x$  is strongly independent of  $A$ . But then  $x$  cannot be in  $S$ . For if it were, by (SS) and the obvious fact that  $S^-$  is a subset of  $S$ ,  $x$  would also be strongly independent of  $S^- \cup A$ , violating part (2) of the definition of 'P-verification set'. So, by maximality,  $x$  must be in  $P$ .

Suppose next that no subset of  $\{x_1, \dots, x_n\}$  is a  $P$ -verification set for  $x$ . Then  $x$  cannot be in  $P$  because if it were, then, for any classification of the rest of  $\{x_1, \dots, x_n\}$ , the set  $S \cap \{x_1, \dots, x_n\}$ —call it ' $A$ '—would be a subset of  $\{x_1, \dots, x_n\}$  that is a  $P$ -verification set for  $x$ . To see this, notice three facts about  $A$ . (i) It is obviously a subset of both  $S$  and  $\{x_1, \dots, x_n\}$ . (ii) It is finite. For it is a subset of the finite set  $\{x_1, \dots, x_n\}$ . (iii)  $S^- \cup A = S$ . For  $S^- = S - \{x_1, \dots, x_n\}$ ,  $A = S \cap \{x_1, \dots, x_n\}$ , and clearly  $[S - \{x_1, \dots, x_n\}] \cup [S \cap \{x_1, \dots, x_n\}] = S$ . Now, suppose for reductio that  $x$  is indeed a member of  $P$ . Then, (PSa) guarantees that it is strongly independent of each finite subset of  $S$ . And since, by (i) and (ii),  $A$  is one of them,  $x$  is strongly independent of  $A$ . Thus,  $A$  satisfies part (1) of the definition of 'P-verification set' for  $x$ . Moreover, since, by (iii),  $S^- \cup A = S$ , by (PSb),  $x$  fails to be strongly independent of  $S^- \cup A$ . Thus,  $A$  also satisfies part (2) of the definition. Hence it qualifies as a  $P$ -verification set for  $x$ . But since, by (i),  $A$  is a subset of  $\{x_1, \dots, x_n\}$ , that contradicts our original assumption that no subset of  $\{x_1, \dots, x_n\}$  is a  $P$ -verification set for  $x$ . So  $x$  cannot be in  $P$  after all. Thus, by maximality, it must be in  $S$ .

So the classification of  $x$  is determined either way—when some subset of  $\{x_1, \dots, x_n\}$  is a  $P$ -verification set for  $x$ , and when none is. That leaves just the other  $n - 1$  entities in  $\{x_1, \dots, x_n\} - \{x\}$  still to be classified.

But if maximal eligible pairs are in  $(n - 1)$ -equilibrium, we already know that their classification is also uniquely determined. This shows that if  $\langle S, P \rangle$  is in  $(n - 1)$ -equilibrium, the relations of each of  $x_1, \dots, x_n$  to  $S^-$ ,  $P^-$ , and  $\{x_1, \dots, x_n\}$  uniquely determines its classification, completing the proof.

Notice that this proof does not appear to appeal to (PP). This may seem surprising because it is (PP) along with (SS) that provides the contrast between substances and properties: roughly, substances are strongly independent of substances; properties are not strongly independent of properties. How could any analysis succeed in pinning down the distinction between substances and properties if it doesn't incorporate this crucial contrast?

I don't think it could, but appearances are misleading. The equilibrium proof simply refers to  $S$  and  $P$ , the two classes that comprise a maximal eligible pair, in asking about the relations of entities  $x_1, \dots, x_n$  to them. But that presupposes that it has already been settled which class is which, which is  $S$  and which is  $P$ . And without (PP) this would not have been possible. So, in effect, (PP) does play a role in the proof after all, albeit an implicit one. Connectedly, (PP) and (SS) are both required to preclude the possibility of distinct 'mirror-image' maximal eligible pairs, ones that differ simply by swapping all the members of  $S$  and  $P$  over en masse. Without (PP), there is no guarantee that re-labelling 'S' as 'P' and vice versa will destroy eligibility.

The proof does not appeal to (SP) either. I suspect that the appearance of redundancy is also misleading here, caused by our simplified ontology. For (SP) seems likely to play a crucial role in distinguishing substances from spacetime points, which *are* featureless; no equivalent to (SP) holds of them.

## V. Summary and Conclusions

In this paper, I have proposed a holistic analysis of substancehood, one that treats it and propertyhood as mutually dependent. (Ignoring the simplifications) it turns out that an entity's location in the pattern of weak and strong independence relations among entities generally is (probably) all that is needed to pin down its classification as either a substance or a property. This analysis is quasi-logical and clearly reveals some of the structure of substancehood. In particular, it reveals how minimal this structure can be and still generate the categories of substance and property. It also suggests that any attempt to analyse substancehood quasi-logically in isolation from other fundamental categories is probably doomed. For a genuinely holistic distinction can be characterized only by referring to the interrelations among its categories—in this case the categories of substance and property—and no non-holistic analysis can do that without circularity.

As a holistic analysis, however, it has to face a fundamental problem: why think that it succeeds in stating a sufficient condition for

substancehood? I have argued that the pattern of independence relations involved in our analysis is in a certain kind of equilibrium: there is no way to reclassify any finite number of entities and still satisfy the analysis. This strongly suggests (though it doesn't quite prove) that only one way of dividing entities into properties and substances could satisfy the analysis, i.e. that the analysis does indeed state a sufficient condition for substancehood.

Moreover, it seems to me that this overall approach—holistic analysis plus proof of equilibrium—is a promising one for analysing recalcitrant notions generally. It seems particularly promising in cases where proposed analyses always seem to run into circularity or unilluminating primitives.<sup>20</sup>

*Tufts University*

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