On structural universals

Bojan Borstner

It is not a necessary truth that there are complex properties, but it is an undeniable fact. It is another undeniable fact that there are properties which appear to us to be simple. (Armstrong 1978, II,67)

I

This paper is just a part of a greater project – A Realistic Ontology. So, we need some preliminary remarks for the present purpose.[1]

(i) The world contains a number of individuals.[2] The number of them is an empirical question that can be decided a posteriori (if it can be decided at all) in the process of scientific inquiry.

(ii) Properties and relations are fundamental constituents of the world. What properties and relations there are cannot be determinated a priori, but a posteriori, empirically, on the basis of total science.

(iii) Properties and relations are conceived of as universals. They are not the meanings of predicates and no simple relation between predicats and universals can be assumed.

(iv) Individuals, properties and relations are constituents of states of affairs.[3] We don't use a part-whole relation between individuals, properties, relations and states of affairs because the mereological sum of 'a+F' is not automatically the state of affairs 'a is F'.[4]

II

Simple and complex properties

We accept the Armstrongean position that in the world there are complex and simple properties.[5] Complex properties[6] have constituents that themselves are

1. I have presented some parts of that project in Borstner 1989a, 1989b.
2. Individuals are first – order particulars. With a particular I have in the mind so-called 'thick conception' of particulars – a particular is a thing taken along with all its properties. When I use a particular in relation to a state of affairs, I mean a particular in 'thin conception' – a thing taken in abstraction from all its properties (and relations).
3. The very idea of states of affairs is taken from Wittgenstein's Tractatus, where he used facts for what we here have states of affair. (see: Skyrms 1981, Armstrong 1989a)
4. The mere existence of an individual (a) and a property does not ensure that a is F. But in the mereology if a and F exist, then also exists their mereological sum.
5. This position is hardly attacked by R. Grossmann (Grossmann 1983, 147): »There is no complex properties, only complex facts.« He assumed the situation where some individual thing <u>A</u> is both green and round – so there are individual thing <u>A</u>, property green and states of affairs (facts as said Grossmann), there are three states of affairs: <u>A</u> is green; <u>A</u> is property round, but no property being both green and round. Or, if we speak in language of

properties. The question that arises here is: are constituent properties simple or not? Both answers are possible:

- complex properties have constituents that are not ultimate – complexity without simple constituents
- complex properties have constituents that are ultimate – simple properties that are finite or infinite in number[7] – complexity may be finite or infinite

A structure; structural properties

We can get an impulse for the further investigation in the area of properties from the distiction between simple and complex properties. At first (as Armstrong does), the old distinction between homoeomerous and anomoeomerous properties[8] will be introduced. As an example, we can take the ball that is used for basketball. This (particular) ball is orange (is a certain shade of orange O), has a mass of 700g, is made of special mixture of synthetic materials. 'Is a certain shade of orange –' and 'is made of special mixture of synthetic materials' are candidates for homoeomerous properties but 'has a mass of 700g' is evidentally a candidate for an anomoeorous property because

round; A is green and A is round. All aditional properties, states of affairs are ontological superstitions which lead to the distorted picture of the world. As Grossmann said we can introduce a new word 'gruond' for 'property' 'being green and round' – we have now a conjunctive property. But, why do we need it? Grossmann tried to show that Armstrongean argument for conjunctive properties as constituents of ontology of the world is invalid and incoherent with Armstrong's thesis that what properties there are can be determinated only on the basis of total science. If Armstrongean takes GR (property 'ground) as a conjunctive property (G+R), then the sign + represents a nexus that connects properties in such a way that the result is a property GR. On the ground of »the eleatic principle« that there exist only such entities which posses causal power a scientist can make a causal test. If the result shows that there are three properties this is not only an argument for a conjuctive property (G+R) but also for the hypothesis that GR, G and R are all simple properties. Something being GR (or something has GR) means that it has (is) both G and R – there is equivalence but not identity. »... I do not see how science could ever establish anything stronger than the equivalence statement. (Precisely the same considerations are applicable... to the claim that science may some day prove that mental properties are really physical properties.)« (op. cit., 152) What has Grossmann said is valid only for the instantiation of conjunctive properties (universals) – if the property is complex, then its constituents instantiate the very same particular as the complex property does. But it does not hold for the structural properties (universals) as shall we see later.

6. But complex properties are not identified with D. Lewis' properties, which are simply classes: »To have the property is to belong to the class« (Lewis 1987, 244). Compare Borstner 1989a for an argument against Lewis.
7. »First, the infinitely complex property might be a complex of simple constituents, but simples of which there are an infinite number. Second, the infinitely complex properties might dissolve ad infinitum into constituents that themselves lacked simple constituents, either a finite or an infinite in number.« (Armstrong 1978, II, 67)
8. »A property is homoeomerous if and only if for all particulars, x, which have that property, then for all parts y of x, y also has that property. If a property is not homoeomerous, then it is anomoeomerous.« (Armstrong 1978, II, 68) This distinction is necessary for the theory of quantities which are universals. (Swoyer 1987, Bigelow and Pargetter 1988b)

parts of the ball do not have this determinate property (but have the property 'has a mass' – determinable[9]). However, this distinction is not so self-evident as we usually think it is – if we analysed the certain part that has a shade of orange (or a carbon atom) on the microscopic level, we would see that these properties are not homoeomerous but anomoerous. But, even in the situation where properties are not genuinely homoeomerous, we speak of them as examples of homoeomerous properties.

The next step we must take is to explain 'structure':

(a) a structure is not identical with the class of all of its parts;[10]
(b) a structure consists of nonrelational and relational parts;
(c) a structure is identical with other structure if and only if they have the same nonrelational parts; they have the same relations; the same parts stand in the same relations to each other (Grossmann 1983, 242).

9. Take as an example: 'Having a mass of 700 g' and 'having a mass of 1kg' These properties have something in common but at the same time they are different. In platonic interpretation: both things with different masses have something in common – a property which they shared is called determinable; the two distinct properties not shared by two things are called determinates. This theory was proposed by W.E. Johnson (Johnson 1921, chapter 11). The determinable is: 'having a mass' (or just 'mass'); the determinants are 'having a mass of 700 g' and 'having a mass of 1 kg' (or 'having this (that) such of mass'). The distinction between determinable and determinate can help us in the explanation of what is in common and what is different in objects. Both determinate and determinable are properties of individuals. This means that the object that has a mass (determinable) is the very same object which has a mass of 700 g (determinate). This exposition is somehow questionable if we really take in account Eleatic principle: Only those things which are causally active are real. What is, then, the causal difference between determinable and determinate? If we interprete causation as a relation between first order preperties (as Armstrong does) – »necessitation« – then determinate and determinable must enter into necessitation relation with other properties. Properties enter into causal relation with other properties – they are causally active and not particulars (individuals). However, particulars are then excluded from the realm of existing objects what is highly implausible. We must weaken the Eleatic principle so that the state of affairs (a particular is just a special sort of state of affairs) is constituent of causal relations and at the same time properties, which are constituents of state of affairs, enter into necessitation relation. So, the causal relation holds between state of affairs and the necessitation relation holds between properties (the necessity relation holds between F and G if the state of affairs consisting in X's having F cause the state of affairs consisting in X's having G). If we accept this weak position, then determinables are second – order properties. In our initial case there are two things with different masses (700 g and 1 kg). As first, we analyse just the second thing with the mass of 1kg. The parts of those things also have a mass and the question is: does the instantiation of mass 1 kg necessitate the instantiation of all masses less than 1kg but no greater mass? The answer is possible only in the field of structural properties.

10. »Imagine three squares, A, B, and C, arranged in a line from left to right in the order mentioned. These squares form a certain spatial structure... of the three squares and the relation being to the left of between them. Next, imagine the same squares arranged again from left to right, but this time in the different order... C, B, and A. This structure is not identical with the first one. Yet it consists of precisely the same nonrelational and relational parts.« (Grossmann 1983, 242)

What is, then, a structural property?[11] A structural property is a special kind of anomoeomerus property, which means that a property F is structural if proper parts of particulars having F have some property G (or more properties H, I, J,...) not identical with F, and this state of affairs is constitutive of G. Some properties entail others, and sometimes it is necessary that when F is instantiated, also instantiated is another property, G.[12]

III

Properties and universals

As we have stated before, properties are fundamental constituents of reality. But, this could be heard from different sides. There are at least three positions that exclude one another. First is G. Bergmann's thesis that properties are perfect particulars; second is K. Campbell's Trope theory; third is Armstrong's theory of properties as universals.

Bergmann has defended a thesis (Bergmann 1967) that several spots have exactly the same colour property – but this not mean that he accepts the universals. For him, properties are exactly the same in the sense that carries no ontological commitment[13] and the ontological ground for this 'exactly the same' is not a single thing but two things, one in each spot. These two things are perfect particulars that are the simple things of the ontology. He is against platonic universals, which are separable from things, but not against any universals. He holds the Principle of Exemplification but does not infer from the true premise (there are no separable universals) the nominalistic conclusion that there are none of them.[14]

11. A structural property can be relational and it is relational if it includes relations between its parts.

12. Structural properties are not simply identical with anomoemerous properties. Armstrong divides anomoeomerous properties in: –emergent properties which could be complex or simple; – structural properties, which must be complex (Armstrong 1978, II, 70) Emergent properties that characterized no proper parts of the particular are evidentially anomoeomerous but are also distinct from any property structure possessed by the particulat having emergent property. It is hard to rule out such a property from a consistent realistic theory of properties (universals) a priori, but we have good scientific and methodological grounds for the claim that emergent properties do not exist.

13. »'Literally the same' I use only in ontological discourse such that 'to be literally the same', 'to be one and not two'...« (Bergmann 1967, 85).

14. Bergmann makes a distinction between 'same' and 'identical'. 'Identity' is for him 'identity through time and change'. That means that we can use 'identity' in the contex of substance. 'Substances' ground the identity of objects. (Bergmann 1967, 112) This distinction is like Bishop Butler's characterisation of the 'loose and popular' sense of the world 'same', which is at the heart of Armstrong's argumentation against trope theory. As Butler thought: we say the same human body (the body which is changed over time) but we do not really mean it. It is only a loose and popular identity. But even in this loose and popular case of identity, the things for which it is said to be the same must be the members of the same class – 'same class' is taken in the strict sense. (see Armstrong 1990)

K. Campbell defends on more occasions (Campbell 1976, 1981, 1988) what is from D. Williams' analysis (Williams 1953, 1966, 1983) known as trope theory. For Campbell, tropes are abstract particulars,[15] and abstract particulars are for him basic particulars that are simple[16], fundamental and independent.[17] Real tropes are qualities-of-a-formed-volume and the distinction we can make between say, size, shape and colour are distinctions in thought to which correspond no distictions in reality. (Campbell 1981, 486). A problem that arises from so articulated a theory of tropes is a problem of tropes' individuation. Their individuation does not come from place (as is usual for particulars); it is ultimate and unanalysable.[18] The second problem is resemblance. No one would deny that particulars resemble one another. In Campbell's terminology, the colours as abstract particulars all resemble one another, but how can he define what is exactly the same? Exact similarity is symmetrical and transitive – the relation of exact similarity is an equivalence relation. Campbell could explain this with the postulation of equivalence classes – tropes that are in the relation of exact similarity are members of a class of exact similar tropes. But, for trope theorists this does not mean that tropes that are exactly similar are identical – the trope theory denies identity of tropes that are exactly similar.[19]

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15. He uses the opposition particular/universal and concrete/abstract. A particular is for him an entity that is exhausted in one embodiment (occasion). Abstract he does not take in the ontological sense – existing outside of space and time – but only as the characterisation of an entity that is usually found in the presence of other tropes and which is not multiply exemplifiable. Campbell describes a universal somehow incorrectly as an entity that can have multiple location in the same space at the same time – much better is characterisation that universals are entities capable of multiple exemplification (instantiation).
16. The problem of simplicity of tropes is connected with the problem of extension. Extension involves parts and parts exlude simplicity, but, at the same time, a trope is a-quality-at-a-place. So, we have the contradiction: if a trop is extended, then it is not simple, and if it is simple then it is an unextended entity whose location is that of an unextended mathematical point (Newton).
17. Concrete particulars are bundles of basic particulars (abstract particulars) – tropes. They are dependent, only tropes can exist on their own.
18. Campbell's position is very like Hume's distiction in A Treatise of Human Nature. Hume uses the distinction of reason to explicate the distiction between the colour and form of an impression of a globe of white marble. If this is so, then the resemblances are not grounded in a real entity but in a habit of the mind in perceiving the trope.
19. If we take in account Armstrong's example of two electrons with the very same charge, then according to trope theory strictly the tropes involved are not identical. For trope theorist is exactly resemblance between tropes 'primitive' and he needs the Axioms of Resemblance (specially because necessity which is involved in symmetry and transitivity is fundamental necessity that cannot be explained further). »Explanation is a virtue in metaphysics, as elsewhere. I submit that this startingly easy deduction, indeed reduction, of the property of resemblance from the entirely uncontroversial properties of identity, is a major advantage of the Universal theory. It enables one to see the intuitive force behind the old, inconclusive criticism brought against Resemblance Nominalism that resemblance is resemblance in identical respects.« (Armstrong 1990, 17)

IV

Structural universals

That some universals entail others is undeniable fact. How can entailment be explained? We'll begin with P. Forrest's thesis that complex properties must in some way be composed of simpler properties and relations.[20]

Take 'being carbon monoxide' (CO) as a complex property with the constituents: 'being an oxygen atom', 'being a carbon atom' and 'being bonded'. But, we can have also other complex properties that have these constituents: 'carbon dioxide'(CO_2 O-C-O) which is stable and unstable (C-O-O). The carbon monoxide molecule instantiates universal C-O (C,O,B) and carbon monoxide is intrinsically related to three universals C, O and B. So, necessary, what instantiates carbon monoxide must have three parts (constituents):

– part c – carbon atom – which instantiates universal C
– part o – oxygen atom – which instantiates universal O
– c-o pair, which instantiats universal B

If we make the same analysis for carbon methane, CH_4, we get:

– three universals (C,H,B)
– five spatial parts, c, h_1, h_2, h_3, h_4, which instantiate three universals.

But, a molecule of carbon methane instantiates universal M and five spatial parts instantiate universals C,H,B. There is a problem, because the universal H is instantiated 4 times, universal C just 1 time and universal B also 4 times, so that there are only C-H pairs and never H-H pairs. How could we explain this differentiation in the entailment relation? D. Lewis (1986a, 1986b) has claimed that all theories about structural universals are either Mereology or Magic.

A. Mereology

We take the previous example – CH_4:

- The structural universal methane M is an individual that is the mereological composite of its constituent universals. M is then nothing more than the mereological sum of hydrogen, carbon, and bonding. These are proper parts of methene;
- if M is instantiated, then H also is instantiated – if a molecule instantiates methane, it has a part that instantiates hydrogen;
- hydrogen is instantiated four times – there are four distinct things which instantiate hydrogen;
- if the part – whole relation obeys Goodman's calculus of individuals, then in the case of mereological substraction of hydrogen from methane what

20. The complex properties in Forrest's sense are structural properties in our (Armstrongean) theory.

remains no longer contains hydrogen because a part cannot occur in a whole several times over.

However, if methane contains hydrogen (universal) as a part, then it contains it just once. The mere existence of a single part cannot explain the entailed four-fold instantiation of that part.[21]

But, let us see a proposal which was made by J. Bigelow (1986):

There are two universals, A and B. A is a part of B; yet (B-A) need not be a universal.[22] If A is a (natural) part of B, then it means that A (universal) is a natural part of four natural parts of B (universal). So, we get a specific structure:

$$\text{hydrogen} < \text{part}_1 < \text{part}_2 < \text{part}_3 < \text{part}_4 < \text{methane}$$

On the other side is the problem with carbon. It occurs in methane in a different way. There are no such intermediate natural parts of methane, each of which is a natural part. Carbon is itself just a natural part of methane.

The structural universal methane M has the characteristics:

- a bonded pair of H and C forms a natural unit of molecule;
- in an individual methane molecule, the carbon atom is a part of four natural units, whereas each hydrogen atom is a part of only one natural unit.

A carbon atom is so a part of four natural units, but C (universal) is a part of just one natural part.

A hydrogen atom is a part of just one natural unit, but H (universal) is a part of four natural parts.

The most questionable aspect of this explanation are the four natural parts that intermediate between hydrogen and methane. Lewis could say that they are »amphibias«, and it could be true, but this is not a conclusive argument against them.

B. Magic

For Lewis, »Magic« is used only in a situation where it is said that the structural property (M) is a simple unstructured property of an individual, and has no parts at all. But, how could it be explained that there is a necessary connection between methane (M – universal) being instantiated and carbon (C) being instantiated if M and C are two universals that are unstructured and wholly distinct. This art of explanation tells us only that there is an entailment (M entails C and H) but nothing more – entailment is just there – something primitive.

21. A plausible strategy against Lewis is: universals are not proper parts of a whole because a part is always a part of particular – is something particulary, is a particular – for instance a cat Tibless consists of a body Tib and a tail Tail so that Tib + Tail = Tibless; but Tibless could loose its tail – so there could be Tib = Tibless and Tail.

If we do not accept Lewis' explanation, then there is another way: There is a nonmereological composition (complex, structure) so that it is possible to have two different things that are made of exactly the same parts (relational parts are included).[23] But, what is with a relation of entailment? We know that: necessarily, methane and being carbone are in essential relation – entailment.

$$\Box(M > C)$$

M is a relational property of an object (of molecule methane) that relates an object to various properties (C,H,B). So M is second order relational property of molecule – the property of having:

- a part that has the property of being carbon;
- a part that has the property of being hydrogen;
- a second different part, which has the property of being hydrogen;
- a third different part, which has the property of being hydrogen;
- a fourth different part, which has the property of being hydrogen;
- the relational property of being bonded to another part.

The properties C, H, and B are constitutive properties of M[24] – standing in these relations is an essential characteristic of methane. M is related to C so that M cannot exist if it is not related to C. There is the ratio of 4:1 of hydrogen atoms to carbon atoms in methane because the property of »being hydrogen and being part of this methane molecule« stands in the proportion of 4:1 to »being carbon and being part of this methane molecule«.

Proportions are internal relations – essential for things. We can specify proportions if we use the old W. Johnson's (1921) distiction between determinables and determinates. Two objects (two balls having different masses) have distinct properties – first has a mass of 1 kg, second has a mass of 2 kg – determinates – but at the same time they share a property »having a mass« – determinable.[25] There are three ontological ingredients (see Bigelow and Pargeter, 1988):

22. A is convex, B is convex; A is a part of B; (B-A) need not be convex. But, if, for instance, A ia a region, B is a region, A is a part of B, then there is such a thing – a residue (B-A) which remains after A is substracted from B.

23. a and b particulars; R is a nonsymmetrical relation; aRb = state of affairs$_1$; bRa = state of affairs$_2$. SOA$_1$ is not identical with SOA$_2$, but they have the very same non-relational parts, the very same relations, but it is not the case that the same parts stand in the same relation to each other.

24. These properties are not constitutive in the mereological sense, because if this was true then we should come into trouble as we have stated before.

25. These two balls have the property »having a mass« in common – this property is supervenient on the different specific masses: if an object has a determinate, this entails that it has the corresponding determinable. But, vice verse does not hold – possesion of that determinable does not entail the possesion of one of determinates falling under its scope (possesion of mass does entail possesion of either this specific mass or that specific mass,.. – a thing cannot just have a mass without having a particular specific mass).

(i) individuals;
(ii) determinate relationships between individuals;
(iii) relations of proportion between those determinate relationships.

Two balls – a, b – are individuals (level (i)); their properties – »having a mass of 1 kg« and »having a mass of 2 kg« (ii) – may be classified because they stand in the proportion to one another (1:2) (iii).[26]

Universals can share properties and relations, and if universals are in relation to each other, then proportions are such relations – internal relations of proportions are universals of level (iii).

We use this result for the methane case:

$\Box\,(M > C)$

If (>) is the essential relation then

$\Box$ for any F and G, if (F) > (G)

any instance of F has a part which is an instance of G.

Because M and C stand in (>) relation, here is an entailment between something being methane and that thing containing a part that is carbon.

V

What do we have from our analysis? We see that there is a special pattern of entailment that is explainable on the ground of primitive relations between universals. However, this is not enough. We need some further explanation of what these relations are. It is a kind of white magic, as Lewis said, because structural universals are not made out of simpler universals in a straightforward sense. But, as we stated before, structural universals are explainable with the help of relational properties – proportions or higher-order universals.

26. Level (iii) proportions are universals – they can be multiply instantiated so that one and the same relation of proportion may hold between several distinct pairs of level (ii) properties and relations. Several distinct pairs of mass properties may stand in the same level (iii) proportion (1:2) but the same is with the distinct pairs of volume properties ($V_1 = 1m^3$; $V_2 = 2m^3$). When we say b is »twice the mass of« a and b is »twice the volume of«, these two relations are at the same time both the same and yet also different. They are different because one is a mass property standing in the proportion to other mass relations, while the other is a volume property (is not a mass property) and stands in the proportions to volume properties (not to mass properties). But, they have something in commmon. There is a proportion between the mass property of a and the mass property of b and this very same proportion holds also between the volume property of a and the volume property of b. They have the proportion (1:2) (level (iiii)) in common.

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