

Fusion

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‘Fusion’ is a philosophical term of art, with a variety of uses. First, it is often a synonym for ‘sum’. In this sense, *a* is a fusion of *b*, *c* and *d* iff *b*, *c* and *d* are parts of *a*, and every part of *a* shares a part with *b*, *c* or *d*. So a cat is a fusion of the cells which compose it, and the same cat is a fusion of the molecules which compose it. Relatedly, ‘fusion’ can refer to the occurrence of such composition: philosophers disagree about whether fusion is widespread, about whether it can be a vague matter, and so on.

There is a second main use of ‘fusion’, according to which fusions are sums which inherit their temporal and modal identity conditions from their parts. In this sense, if *a* is now the fusion of *b*, *c* and *d*, then it is the fusion of *b*, *c* and *d* whenever it exists, and at every world in which it exists. Thus if *a* exists at a time (or world), then so do all of *b*, *c* and *d*. In addition, it is usually presupposed that the mere existence of *b*, *c* and *d* at a time (or world) suffices for the existence of *a* at that time (or world), no matter how scattered they are.

These two senses of ‘fusion’ are not always clearly distinguished, but the difference between them is important. Anything which is a fusion in the second sense is also a fusion in the first sense: a sum with distinctive identity conditions is nonetheless a sum. But not everything which is a fusion in the first sense is also a fusion in the second sense: everyday complex objects are fusions in the first, but apparently not the second sense. It is not clear whether anything is a fusion in the second sense; if there

are such things, presumably some of them coincide temporarily or contingently with ordinary objects. The phrase ‘mere fusion’ (or ‘mere sum’) may be used to mark this second sense of ‘fusion’. Unlike an ordinary object, a mere fusion satisfies no sortal, whence the idea that its identity conditions must be inherited from its parts. Moreover mere fusions obey the principles of classical extensional mereology (for discussion, see Simons 1987).

A third, more expansive sense of ‘fusion’ is due to Leśniewski. In this sense, a fusion of *bs* is a sum of at least some *bs*. For example, consider all the people currently alive. In Leśniewski’s sense, there are many fusions of these people, including the sum of the Welsh, the sum of the Europeans, and the sum of the left-handers. As Peter Simons explains, “if there is any sum [of *bs*], there is exactly one, whereas if there is more than one *b*, there is more than one fusion of *bs*, of which the sum is the largest”. (1987, 65)

This third, Leśniewskian sense of ‘fusion’ is not now widely recognised, and it is controversial whether the second sense has any application. So the remainder of this article will focus upon fusions in the first sense of the term. Two main questions arise.

First question: is fusion unrestricted? That is, does every plurality of objects have at least one fusion? Classical extensional mereology includes a principle of unrestricted fusion, sometimes called the ‘fusion axiom’, or even just ‘Fusion’ (Simons 1987 section 3.2.3, Casati and Varzi 1999 chapter 3). But this commits us to a vast array of unfamiliar scattered objects and ‘arbitrary sums’ (van Inwagen 1990, Markosian 1998

and forthcoming). Fans of unrestricted composition argue that restrictions upon which pluralities have fusions are inevitably either vague or arbitrary; in addition, they reconcile their position with common sense by conceding that we do not usually quantify over arbitrary sums (Lewis 1986 pp. 211-213, and Sider 2001 section 4.9.1). Debate about unrestricted fusion usually focuses on pluralities of material objects, or pluralities of material objects which exist in the same world, or at the same time. But we may also wonder whether fusion extends across ontological categories, combining abstract and concrete objects, or universals and particulars, or events and continuants.

Second question: is fusion unique? That is, does a given plurality of objects have at most one fusion, or could there be two different objects wholly composed of the same parts? Classical extensional mereology is committed to the uniqueness of fusion; indeed, the term 'extensional' alludes to this very feature (Simons 1987 section 3.2.4, Casati and Varzi 1999 p. 40ff). Moreover, uniqueness complements the attractive idea that the properties of a whole are determined by those of its parts. However, it looks as if the very same plurality can have different fusions at different times, and in different possible worlds. Perhaps the molecules which currently compose you once composed Julius Caesar; perhaps they *could* have composed Jarvis Cocker right now.

Fans of unique composition have two options. First, they may argue that you do not literally share parts with either Caesar or Cocker: Caesar is composed of earlier temporal parts of the molecules whose later parts compose you now, whilst a possible Cocker is composed of counterparts of your molecules (Lewis 1986, chapter 4).

Second, they may instead retreat to the claim that a given plurality of objects has at most one fusion at a given time and world. But there are apparent counterexamples

even to this restricted uniqueness principle. The statue and its constituent lump of clay appear to be made of the same parts at the same time, and in the same world. Yet apparently they are distinct objects, with different modal, historical and perhaps aesthetic properties. Fans of unique composition must somehow explain away these differences (for discussion see Baker 2000, Bennett 2004, Fine 2003, Olson 1996 and Wasserman 2002).

Both main questions about fusion are ontological questions, questions about what exists. Those who disagree about whether fusion is unrestricted disagree about how many distinct complex objects exist, as do those who disagree about whether fusion is unique. Such disagreements remind us that classical extensional mereology is not an innocuous formalism: it is a theory which has conditional but substantive consequences about what there is.

Further Readings

Simons, P., 1987, *Parts: A Study in Ontology*, Oxford: Clarendon Press. Sets out the principles of classical extensional mereology, then rejects some of them.

Sider, T., 2001, *Four-Dimensionalism*, Oxford: Oxford University Press. Section 4.9.1 advocates unrestricted composition; section 5.3 advocates uniqueness.

Van Inwagen, P., 1990, *Material Beings*, Ithaca, NY: Cornell University Press. Argues for a very stringent restriction on composition.

Baker, L. R., 2000, *Persons and Bodies: A Constitution View*, Cambridge: Cambridge University Press. Argues against uniqueness.

Short Bibliography

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