The Paradox of Increase

Eric T. Olson

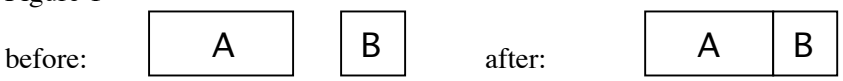
1.

It seems evident that things sometimes get bigger by acquiring new parts. But there is an ancient argument purporting to show that this is impossible: the paradox of increase or growing argument.[i]

Here is a sketch of the paradox. Suppose we have an object, A, and we want to make it bigger by adding a part, B. That is, we want to bring it about that A first lacks and then has B as a part. Imagine, then, that we conjoin B to A in some appropriate way. Never mind what A and B are, or what this conjoining amounts to: let A be anything that can gain a part if anything can gain a part, and let B be the sort of thing that can become a part of A, and suppose we do whatever it would take to make B come to be a part of A if this is possible at all. Have we thereby made B a part of A?

It seems not. We seem only to have brought it about that B is attached to A, like this:

Figure 1



We have rearranged A's surroundings by giving it a new neighbor, but we haven't given it a new part. If B has come to be a part of anything, it is the thing made up of A and B after our conjoining. But that thing didn't gain any new parts either. It didn't exist at all when we started: our conjoining B to A brought it into existence. Or if it did exist at the outset, it already had B as a part then and we merely changed it from a disconnected or "scattered" object (like an archipelago) to a connected one.

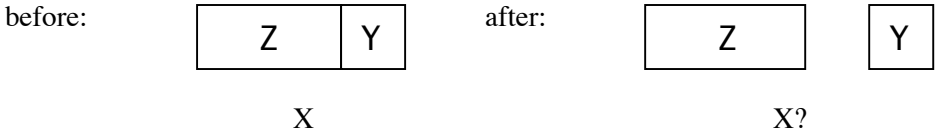
So we have failed to give A a new part. And since this reasoning makes no assumptions about the nature of A or B or the manner in which we conjoined them, it seems to follow that nothing could ever increase in size by gaining a new part. The very idea of growth by addition of parts is incoherent.

Now I believe that some things can grow by acquiring parts; but it takes a good deal of controversial metaphysics to show how they can. The paradox of increase really is a paradox: its conclusion is more or less incredible, yet we cannot resist it without accepting something that looks nearly as bad. I begin by discussing some of the paradox's implications (§§2-5). I then state it in a more careful way that makes its premises explicit (§6). The remainder of the paper asks what it would take to solve it (§§7-12).

2.

If the paradox of increase prevents anything from growing by gaining parts, a similar argument—running the paradox of increase in reverse--is likely to rule out a thing's shrinking by losing parts. Suppose we want to make an object X—anything at all--smaller by removing a part, Y. That is, we want to bring it about that X first has and then lacks Y as a part. Imagine, then, that we detach Y from X in some appropriate way: let us do whatever would bring it about that Y ceases to be a part of X if X can ever lose a part and carry on without it. Have we thereby made it the case that X no longer has Y as a part? Have we made X smaller? It seems not. X starts out made up of Y and something else--"the rest of X", which I shall call Z--like this:

Figure 2



Afterwards Y is no longer attached to Z. But what has happened to X? It doesn't seem to exist any longer; or if it does still exist, it still has Y as a part, and we have merely changed it from a connected object to a scattered one. Either way, it doesn't get any smaller by losing a part. And of course Y and Z don't lose any parts either. It seems that nothing we can do would ever make anything smaller than it was before by virtue of having lost a part.

This is the amputation paradox or shrinking argument.[ii] Like the growing argument, it assumes nothing about the nature of X or Y or the manner in which Y is detached. So it threatens to show that nothing could ever lose a part: the very idea of shrinking by losing parts is incoherent.

These arguments purport to rule out a thing's growing by gaining a part or shrinking by losing one. If they are sound, it is hard to see how anything could exchange an old part for a new one without shrinking or growing either. So they suggest the general conclusion that nothing can have different parts at different times: it is absolutely impossible for anything to have a certain part at one time and exist without having that thing as a part at another time. Nothing can change any of its parts. If a thing has such and such parts, this must be a permanent and unchangeable feature of it. Call this the doctrine of mereological constancy:

Necessarily, if x is a part of y at some time, then x is a part of y at every time when y exists.

Let us not confuse mereological constancy with the better-known doctrine of mereological essentialism, that things have their parts essentially. We might state it like this:

If x is a part of y at some time, then necessarily x is a part of y at every time when y exists.

Mereological essentialism entails mereological constancy but not vice versa. Suppose P is now a part of me. Mereological essentialism says that it is necessary that I have P as a part at every time when I exist. That of course rules out my having P as a part at one time and lacking it at another time. But the impossibility of my having P as a part at one time and lacking it at another would not rule out my existing without ever having P as a part. It might be possible for me to have had different parts all along, even I cannot change my parts. My having a certain part might be an unchangeable but contingent feature of me. Having a certain part might be like having a certain birthplace. I can't change my birthplace: it couldn't be the case that my birthplace was Aberdeen during my first twenty years and Karachi afterwards. But I could have had a different birthplace from the start: I might have been born in Karachi.

That said, those who hold mereological constancy are likely to hold mereological essentialism as well. It is easy enough to construct modal versions of the growing and shrinking arguments: just replace the words 'before' and 'after' in the diagrams with 'actual' and 'possible'. We might think that X could have been smaller at some time by lacking a part, Y. But if we try to imagine X without Y as a part, we only get a scenario in which Z--the rest of X--is not attached to Y. X itself doesn't exist in this possible situation; or if it does, it still has Y as a part and is merely a scattered object instead of a connected one. So we haven't imagined anything as being smaller than it actually is. The very idea that a thing might have lacked a part that it actually has (or have had a part that it actually lacks) is incoherent. Or at least this seems to be so if growing and shrinking are impossible.

We will revisit the modal argument in §11. Let us return now to mereological constancy.

3.

What would it mean if mereological constancy were true? Its consequences appear to be shattering. Change a spoke on your bicycle and the result is a numerically different bike from the one you began with. For that matter, you get a new bike whenever so much as a single atom falls off. Given the rate at which bicycles shed atoms, this would mean that you can't ride the same bicycle twice.

We may not lose sleep over the identity of bicycles. Some things, though, mean more to us. Consider your mother. She is made up at least partly of atoms: many atoms are parts of her. (Or maybe she is made up of perceptions--mental states and events--as Hume suggested. It makes no

difference for our purposes. Suppose she is made of atoms.) Owing to metabolic turnover, those atoms are constantly coming and going. If mereological constancy is true, the being we now call "your mother" is not the being we called your mother a moment ago, or the being who will answer to that description a moment hence. The being we now call your mother cannot be the being we called your mother a moment ago because she has parts now that were not parts, a moment ago, of the being we called your mother then. Thus, according to mereological constancy what appears to be a persisting human being is in reality a series of numerically different beings, succeeding one another at a rate of trillions per second.

What happens to your mother, then, when her metabolic processes assimilate or expel an atom? Mereological constancy does not answer this question. Or rather it gives only a partial answer, namely that she doesn't gain or lose any parts. But it doesn't tell us, for instance, whether she continues to exist. That is because it doesn't tell us whether the atoms she sheds thereby cease to be parts of her. Nor, for that matter, does it tell us whether the atoms she assimilates were parts of her before she assimilated them as well as afterwards.

Suppose your mother's atoms don't remain parts of her when they are expelled, and likewise that no atom is a part of her before her metabolism assimilates it. Then according to mereological constancy your mother--or the being we now call your mother--exists for only as long as all her current atoms remain caught up in her metabolism: not long at all. As soon as she sheds an atom, she perishes and is instantly replaced by someone else: a being very like the woman who existed a moment earlier—so much like her that no one could ever tell the difference--but numerically different because she has different parts.

What if your mother's atoms do remain parts of her when her metabolism expels them, and were already parts of her before she took them in? In that case she presumably continues to exist for as long as her atoms exist, no matter how those atoms come to be arranged. (If your mother's atoms remain parts of her even when they are scattered to the four winds, it is hard to see what could cause them to cease to be parts of her, short of annihilating them.) So the being we now call your mother survives the expulsion of an atom, and merely changes thereby from a connected object to a scattered one. She begins to disperse. In a few years' time, when all her current atoms have been expelled, she will be scattered thinly across the biosphere. She was similarly scattered in the past. She has existed for billions of years. She has spent most of her career as a nondescript and highly rarefied cloud of interstellar dust. Much later she became confined to the earth, and at one point she coalesced into human form--but not for long, for she will begin almost instantly to disperse once more. She will then immediately be replaced by a numerically different maternal being, just as she is according to the first story (where she perishes when she expels an atom). The difference is that on the second story the beings that successively bear your mother's name exist before and after they take on human form, whereas on the first story they exist only for the brief moment when they are human.

Either way, nothing persists as a human being for more than a moment. You can't shake hands with the same person twice. The same goes for all ordinary objects. They come and go in a flash. Ours is a Heraclitean world of constant flux, where nothing persists, save perhaps tiny particles and "masses of matter" which never change their parts.

This seems incredible. A great many of our beliefs imply that people and bicycles not only persist but remain people or bicycles for many years. I believe, for instance, that I was once smaller than I am now, and that I have a mother, and that I am married. For that matter, I believe that I am the person who began writing this sentence a moment ago. None of these things could be true if I existed as a human being for only a moment.

Nor are beliefs like these mere intellectual speculations. They are some of our deepest convictions. Important practical attitudes and social institutions depend on them. Take moral responsibility: you can be responsible for an action only if you did it (or you at least had some hand in its doing). If we don't persist as human agents, then no one is ever responsible for anything, for by the time any action is done those who did it no longer exist, or at any rate are no longer the sort of beings that can be responsible for anything. Or promising: why keep a promise when both the promiser and the promisee have long since passed away? Or prudence: why save for my retirement if I am never going to retire, and the old men who benefit will all be someone else? Come to that, why do anything? Nothing I do is ever going to benefit me. The only possible reason for acting would

seem to be the altruistic wish to benefit future generations.

4.

The doctrine of mereological constancy looks hard to live with. Most of us will reject it out of hand, and assume that the reasoning leading to it is therefore mistaken. We will see the paradox of increase in the way that we see Zeno's paradoxes: we know that things can change their parts, just as we know that things can move; the only question is how. But not all philosophers find mereological constancy troubling. Some argue that it is not as bad as it seems. We know how good philosophers can be at making seemingly absurd claims appear respectable. Let us see how they might defend mereological constancy.

Some philosophers say that despite appearances none of the things we say and do when engaged in the ordinary business of life assert or imply or presuppose that anything persists through time. Everything we ordinarily say and do is therefore entirely compatible with mereological constancy. That doctrine may conflict with things we say in philosophy seminars, but it doesn't conflict with the ordinary beliefs that really matter. Call this the revisionary proposal.[iii] (It is an interesting fact that no one ever responds to Zeno's paradoxes in this way. No one says, "Yes, motion is impossible, but that's nothing to worry about. Despite appearances, none of the things we say and do when engaged in the ordinary business of life assert or imply or presuppose that anything moves.")

How could the things we say and do in ordinary life be compatible with mereological constancy? Suppose we say,

> Judy was a schoolteacher in 1980 and is now retired.

This appears to assert that some one thing is both a schoolteacher in 1980 and retired now, which according to the doctrine of mereological constancy is false, given that no retiree now has all and only the parts that any schoolteacher had in 1980. But maybe it doesn't really assert this. Maybe it doesn't assert that anything persists at all. Perhaps when we say such things we are only speaking as if something persisted because that is a convenient way to talk. (You can imagine how inconvenient it would be if we had to call every new momentary object by a different name.) Maybe we are only doing what Hume called "feigning a continu'd being" (1978: 208).

How could this be? Well, consider this sentence:

> The Prime Minister was a woman in 1980 and is now a man.

We wouldn't ordinarily use this to assert that some one thing is both a woman in 1980 and a man now. If we are using the language of identity over time when we say this, we are using it loosely: all we mean is that a woman who existed in 1980 and a man who exists now relate to one another in some way other than identity--that they both hold the office of Prime Minister, to be precise, one in 1980 and one now. According to the revisionary proposal, in saying that Judy was a teacher in 1980 and is now retired, we are likewise saying only that a teacher of 1980 and a retiree who exists now relate to one another in some way other than identity.

This other relation might be something physical: some sort of spatio-temporal continuity, perhaps. Or it might be a kind of psychological continuity. Or maybe something else. The nature of this other relation, according to the revisionary proposal, is one of the subjects of the philosophy of personal identity. (The revisionary proposal suggests that what we call personal identity is not about the numerical identity of people at all, for the numerical identity of people is no different from the numerical identity of other composite objects, which given mereological constancy is a dull and dreary affair.) So the revisionary proposal has it that our claim about Judy is equivalent to something like this:

> Judy is retired, and she is psychologically continuous with someone who was a schoolteacher in 1980,

which looks compatible with mereological constancy.

Of course, even if this right, it is only one example of an ordinary claim that appears to conflict with mereological constancy. It also seems to be true that there are people I have met twice. It won't be as easy to give an account of what this claim means that is compatible with mereological constancy as it is for the retired-schoolteacher case. But revisionists are resourceful people.

What about the practical attitudes and social institutions that seem to require people to persist through time--responsibility, promising, and so on? The revisionary proposal says that they are not based on numerical identity at all, but on some other relation. It might be some sort of psychological continuity: perhaps you are now responsible for the past actions of anyone who is then psychologically continuous with you as you are now, even if that person is not you but someone else. If anyone psychologically continuous with you once made a promise to someone, perhaps you are obliged to keep that promise to anyone who is now psychologically continuous with the promisee. Perhaps we couldn't care less what happens to ourselves tomorrow, or even whether we shall exist tomorrow at all; we care only about those who will be psychologically continuous with us tomorrow. Maybe your desire to live to see your great-grandchildren is in no way frustrated by the fact by the time your great-grandchildren exist you will no longer be in a position to see or be aware of anything. According to the revisionary proposal it makes no practical difference at all if mereological constancy is true and we are all momentary beings.

5.

A second way of trying to make the doctrine of mereological constancy more attractive is to say that whatever dire implications it may have for composite objects, we ourselves are immune to them because we are not composite. We have no proper parts (no parts other than ourselves). We are mereologically simple. Thus, although material things may be fleeting, we still persist as we always thought. Call this the reactionary proposal.[iv]

We could even use the paradox of increase to argue against materialism--the view that we are material things. The paradox implies that we could only be things that don't change their parts, since nothing can change its parts. But what material things that don't change their parts could we be? We might be momentary beings that exist only as long as their atoms remain in human form. Or we might be long-lived beings that are human for only a moment and spend most of their careers as rarefied clouds. Or maybe each of us might be a tiny physical particle (a view that Chisholm (1989) once defended). But despite what the revisionists may say, we cannot take these claims seriously. No sensible view about our nature is compatible with materialism. And if we are not material (even partly material), then we are immaterial. To put it another way: If we were anything other than immaterial things, we should have different parts at different times, which according to the paradox is impossible; so we are immaterial. The only account of our nature that is compatible with our having the careers we think we have is that we are immaterial.

I like this better than any of the traditional arguments against materialism. If there is a weakness in the inference from mereological constancy to our being immaterial, it is this. Consider those material things that, according to mereological constancy, take on human form for a moment before either passing away or gradually dispersing. Each of those beings has, for a moment at least, a working human brain and nervous system (perhaps longer than a moment if the atoms a thing sheds remain parts of it). It is surrounded by a community of thinkers and speakers. It has the same evolutionary history as we have. That sounds like it ought to suffice for these beings to have mental properties. They ought to be conscious and intelligent, just as we are, for as long as they remain in human form. The material object that is now human and sitting in your chair ought to be a subject of your current thoughts and sensations: it ought to think what you now think and feel what you now feel.

But if there are material beings thinking our thoughts, even if each one thinks for only a moment, there are unlikely to be immaterial beings thinking our thoughts as well. No one ever supposed that for each human person there is, at any moment, both an entirely material thing and an entirely immaterial thing, each bearing all the mental properties that the person has then. And if there is no immaterial thing thinking your thoughts, you cannot be an immaterial thing. (Surely we are not unthinking immaterial things.)

Those who say that you and I are immaterial will want to deny that any material things think our

thoughts. But the argument from mereological constancy, by itself anyway, gives no grounds for such a denial. The fact that material things have careers very different from the ones we thought they have doesn't obviously rule out their being able to think while they are human. The argument implies that we are either immaterial things or material things with alien careers; but it doesn't say why we must choose the first alternative over the second. For that we should need a reason to suppose that the material things we should be if we are material things at all would lack the mental properties that we have.

Is there such a reason? It might seem impossible for a thing to think for only a billionth of a second. That just isn't long enough. (At any rate it isn't long enough for anything human to think given the laws of nature. Fast-paced beings for whom a second felt like a century feels to us might be able to think for a billionth of a second; but that is irrelevant to our situation.) Since no material thing would have more than a billionth of a second to think, given mereological constancy, it would follow that no material thing could think.

If this is true, the argument from mereological contancy to our being immaterial is on strong ground. As you might expect, however, it is disputed. Some say that even if no isolated being that existed for only a billionth of a second could think, a being can think for any length of time—even for an instant—if it has the right causal antecedents (Sider 2001: 197f.). What something does for a moment might count as thinking in part because of what other beings do at earlier (and perhaps later) times, in something like the way that a tiny splotch of paint represents a window in part because of its position relative to other splotches of paint. What it is right to say here seems to me to be anyone's guess.[v]

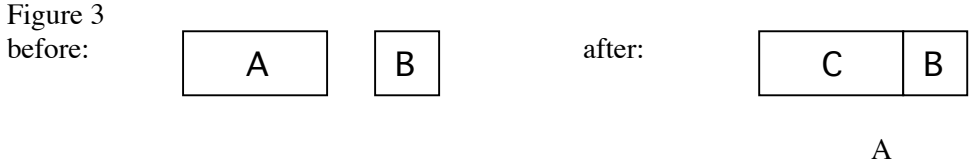
6.

But do we really have to choose between the revisionary and reactionary proposals--between Heraclitus and Descartes? Must we accept that nothing can have different parts at different times?

The argument for this, or more precisely for the claim that nothing can grow by gaining a part, was that if we try to give A a new part, B, we shall only succeed in attaching something to A and changing its surroundings. Let us set out this reasoning in more detail. (I leave it as an exercise for the reader to do the same for the amputation paradox.)

Suppose for the sake of argument that conjoining B to A in some appropriate way does make it a part of A: A lacks B as a part before we attach it, and has it as a part afterwards. Suppose, that is, that A and B don't come to make up some new thing, as Figure 1 invites us to think, but rather that A comes to be made up of B and something else. Of course, that something else appears to be A: it is made of the same matter as A was a moment earlier (supposing that A is a material thing), and that matter is arranged in the same way. It differs from A as it was before only in its surroundings.[vi] The fact that the thing B ends up attached to appears to be A is what supports the claim that B never becomes a part of A. But let us see if we can resist this conclusion. To avoid assuming the point at issue, call the thing that looks like A and ends up attached to B, C. Suppose, then, that when we coinjoin B to A we make it a part of A, so that A comes to be made up of B and C, like this:

Figure 3



Is this picture coherent? Well, let us ask where C came from. Where was it before we attached B? Presumably it existed then: conjoining B to A didn't bring C into being. If conjoining two objects adds anything to the furniture of the earth, it ought to be something made up of those two objects. We don't expect it to create a new object that is just like one of the original objects was before the attachment. We can make this more vivid by imagining the process in reverse: suppose A is made up of C and B and we want to make it smaller by removing B as a part. If attaching B to A brings C into being, then detaching B again ought to destroy C. But surely we can't destroy an object merely by detaching from it a thing that was never a part of it.

Suppose, then, that C existed before B was attached. Now C was the same size as A was then: attaching B didn't make C any larger or smaller. A and C must have occupied exactly the same place before B was attached: Figure 3 ought to show A and C superimposed on the left-hand side. But their relationship then was more intimate than mere co-location: as we have noted, they were made of the same matter then (if they are material things). A's gaining a part could hardly require it, before it got the new part, to share its location with something made of different matter. More generally, A and C share all their proper parts then. Or at least there are things that compose A, and also compose C before B is attached--where some things, the xs, compose something y if and only if each of the xs is a part of y, no two of the xs share a part, and every part of y shares a part with one or more of the xs. Let us abbreviate the claim that there are things that compose A and also compose C by saying that A and C coincide mereologically.

But can two different things coincide mereologically? Can two material things be made of the same matter at the same time? Can the same parts make up two different wholes at once? Do your own atoms, for instance, now make up two different beings, you and something else—a sort of immanent doppelgänger of you? It seems not. If that is right, then A and C really were the same thing before we attached B, just as it appeared.

But now our story has fallen apart. C didn't acquire B as a part: that was the whole point of introducing C. But if C is really just A, and C didn't acquire B as a part, then A didn't acquire B as a part either, contradicting our original assumption. The supposition that A gains a part has therefore been reduced to absurdity.

What assumptions did we make in this reasoning? Well, we began by supposing, for reductio, that B comes to be a part of A:

1. A acquires B as a part.

In that case, we reasoned, A comes to be composed of B and a third thing, "the rest of A apart from B", which we called C:

2. When A acquires B as a part, A comes to be composed of B and C.

This is an important premise. Now it follows from 2 and the definition of 'compose' that B doesn't come to be a part of C when we attach it:

3. C does not acquire B as a part.

Next we assumed that making B a part of A doesn't bring C into being; rather, C exists before we attach B to it:

4. C exists before B is attached.

This is another crucial premise. Now it is part of the story that C doesn't get any bigger or smaller when we attach B: it has the same boundaries, before B is attached, as A has then. What's more, there are things that compose A and also compose C then:

5. C coincides mereologically with A before B is attached.

This follows from 2, 3, and 4, given that C doesn't move, grow, or shrink when B is attached. Our next premise was that

6. No two things can coincide mereologically at the same time.

And 5 and 6 imply that

7. C = A.

But if C is A, and C doesn't acquire B as a part (3), then neither does A:

8. A does not acquire B as a part,

contrary to our original assumption, 1. Supposing that A gets bigger by gaining a part has led to a contradiction.

There is no easy way of resisting this argument. As far as I can see, we can avoid its conclusion only by taking on one of five serious metaphysical commitments. Each of these commitments strikes me as highly implausible. In any case they are all very interesting and completely different from one another. The paradox of increase is a sort of metaphysical crossroads, offering a number of paths, each leading off into its own peculiar landscape. Which of the paths one finds attractive or repugnant reveals a good deal about one's cast of mind.

In the remainder of this essay I will sketch these five proposals for solving the paradox. Since each is a large topic in itself, I shall have to be brief.

7.

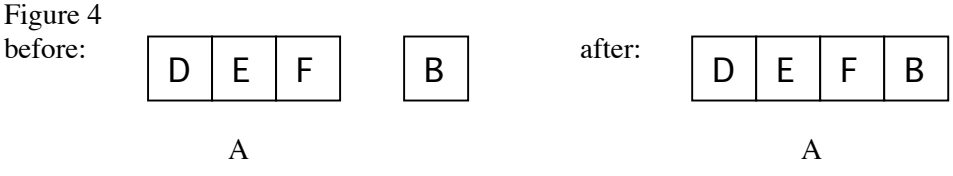
One way of resisting the argument is to challenge its logic.[vii] Someone might say that C and A are one thing before we attach B and two things afterwards. What started out as a thing and itself have come to be a thing and another thing. Identity is time-relative: things might be identical at one time and distinct at another, just as you and I might be neighbors at one time and not neighbors at another time. So all that follows from 5 and 6 is that C is identical with A before B is attached, not that C is identical with A simpliciter. If C is not A after B is attached, then the fact that C doesn't gain B as a part does not imply that A doesn't gain B as a part, and the argument fails. We might call this proposed solution the way of funny logic—though it is no mere logical hypothesis, but has important metaphysical implications for the nature of identity.

Beguiling though the way of funny logic may appear, it is hard to take seriously. Suppose that C and A are one thing now but two things tomorrow. The suggestion is that tomorrow B will be a part of A and not a part of C. A is about to grow. C isn't. That means that A now has a property that C now lacks, namely being such that it will have B as a part tomorrow. At any rate there is something now true of A that is not now true of C. But C and A are supposed to be the very same thing now. How can a thing now have a property that that very thing now lacks? How can a thing be about to grow when that very thing is not about to grow? (Funny logicians have an answer to this question. But to my mind their answer does little to blunt the force of the objection.)

8.

If the growing argument is logically impeccable, those who reject its conclusion will have to deny one of its premises. The first substantial premise is 2, that if A acquires B as a part, it comes to be composed of B and "the rest of A", C. This assumption makes trouble because C appears to be identical with A; and since C doesn't acquire B as a part, it follows that A doesn't either. So we might solve the paradox by denying that there is ever such a thing as C. Of course, there has to be something in the box labelled 'C' in Figure 3. B is never A's only part; there is another part of A that B ends up attached to. But there is no one such thing as "all of A apart from B". There is no nothing whose boundary the box represents. There are only a lot of smaller things--D, E, and F, say--each of which partly fills that space. We can illustrate this by re-drawing the picture so:

Figure 4



A starts out composed of D, E, and F, and when it gains B as a part it comes to be composed of D, E, F, and B. But D, E, and F don't themselves compose anything after B is attached: there is nothing that has D, E, and F as parts then, and every part of which then shares a part with D, E, or F. The view is not merely that D, E, and F don't then compose anything interesting, or don't compose a "genuine object" or the like. The claim has to be that they don't then make up anything at all. Suppose that D, E, F, and G each have a mass of 1kg. Then there is nothing on the right-hand side of the diagram that has a mass of 3kg and does not overlap B.

Call this the way of sparse ontology.[viii] It contradicts the widely held view that composition is universal: that any things whatever always compose something bigger. Not everyone finds universal composition attractive—it implies the existence of all sorts of things that most of us would rather do without, such as a thing composed of your left ear, the biggest fish in the sea, and the color blue. In fact it implies that almost all objects are mere ontological junk. But the way of sparse ontology implies that there are fewer things than almost anyone would have thought.

If it is to provide a general solution to the paradox of increase, the way of sparse ontology must imply that nothing ever has a proper part that it once coincided with. This is surprising. Suppose we make a house bigger by adding an extension, in a way that doesn't disturb any of the house's original parts. (Think of a house made of Lego bricks.) Most of us probably thought that after the building work there remains such a thing as "the original part of the house", made up of those bricks that composed the house before the building work began. The way of sparse ontology denies this: it says that if it was possible for the house to get bigger in this way, that is because there is no such thing, afterwards, as the original part of the house. The bricks that compose the house beforehand cease to compose anything the moment the house begins to grow. (Sparse ontologists may want to say that there are no houses either: though there may be bricks "arranged domestically", they never compose anything. But to deny that any objects ever compose anything capable of growing would be to accept the doctrine of mereological constancy. So the way of sparse ontology implies that some things grow, and they grow only because there is nothing, after their growth, composed of their original parts.)

The corresponding solution to the amputation paradox is to deny that anything ever has a proper part that it could be pared down to. Assuming that you could survive the loss of your left hand, this implies that there is now no such thing as your left-hand complement--"all of you but your left hand". Maybe no one cares about left-hand complements. But the way of sparse ontology implies that there is no such thing as your head either—assuming that it is possible for you to survive, at least briefly, being pared down to a head. Our nursery-school ontology of parts of the body is shot through with error.

Of course, sparse ontologists can argue that despite appearances their view is compatible with everything we say and do in the ordinary business of life (van Inwagen 1990: 98-114): when we say that someone has a large head, for instance, we are not implying that the existence of a head, but at most the existence of things—atoms, say—"arranged capitally". Still, it isn't very nice.

9.

A third way of resisting the argument is to accept that C exists after B is attached, but deny that it exists beforehand (step 4). We could say, rather, that attaching B to A brings C into being. If C doesn't exist before B is attached, then there is no reason to suppose that C is A, thus blocking the argument. The general principle behind this thinking is that whenever any object gains a part, a new thing, composed of the object's original parts, is thereby created. Because it implies that things come into being and pass away in a surprising way, we might call this the way of funny persistence conditions[ix].

This is not a nice solution to the paradox either, however. Suppose we have a house made entirely of red Lego bricks, and we make it bigger by adding an extension made entirely of blue bricks. The way of funny persistence conditions implies that when the original red house expands by acquiring blue parts, a new red house, composed of the original house's original bricks, immediately comes into being to take its place. Or perhaps we shouldn't call the new object a house: maybe no proper part of a house can be a house itself. In any case, the building work creates a new material object very like a house. Now when we lay bricks, we may expect to create a new object made up of those bricks. But laying only blue bricks is a strange way of creating an object made up entirely of

red bricks.

If we apply the way of funny persistence conditions to the amputation paradox, we get the claim that whenever anything loses a part, the complement of that part--the thing composed of all the object's parts save those that overlap the lost part--ceases to exist. So there is now such a thing as your head, but cutting away the rest of you would necessarily destroy it (supposing you survive the adventure, anyway): the head you would be in this badly maimed condition would not be the head you once had. No undetached head could ever come to be a live, detached head. In general, it is possible to destroy an object merely by moving things that were never parts of it.

To be fair, there are important considerations in support of the way of funny persistence conditions--as there are for the way of sparse ontology. But we must press on.

10.

The next important claim we made in stating the paradox was 6, that no two things can coincide mereologically at the same time. Given that A and C coincide mereologically before we attached B, it follows from this claim that they are identical. But many philosophers say that different things can coincide mereologically at once. Why can't C exist before B is attached without being identical with A? In that case A would begin by coinciding mereologically with C and end up with C and B as parts. The corresponding solution to the amputation paradox would say that when an object shrinks by losing a part, it comes to coincide mereologically with the complement of that part--the largest part of the object that didn't share a part, before the loss, with the lost part. Call this the way of coincidence (Wiggins 1968, Thomson 1983, Baker 2000: ch. 2).

Some will find this a neat solution to the paradox: simply drop the dogmatic assumption that no two things can be in the same place and made of the same matter at once. Others will be uneasy. There is something at least a little bit odd in saying that what enables a thing to gain parts is the fact that it coincides with something that can't gain parts.

In any case, the way of coincidence raises a pointed question (Burke 1992, Olson 2001): If A gets bigger, why doesn't C get bigger too? If conjoining B to A makes it a part of A, why doesn't conjoining it in the same way to C make it a part of C? It is no accident, according to the way of coincidence, that A acquires B as a part and C doesn't: if we conjoined B a thousand times, it would come to be a part of A each time and would never become a part of C. A, but not C, has the capacity to grow by gaining B as a part. Presumably C cannot gain any parts at all. This is surprising. Aren't A and C exactly alike before the attachment? They have the same parts then, arranged in the same way. They are physically identical. They have the same surroundings. They may even have the same past history. There appears to be no difference between A and C that could account for their differing capacities to acquire parts.

We might try to explain it in terms of a difference in kind: A can acquire new parts because it is an organism or a person or a thing of some other "mereologically inconstant" kind; C cannot change its parts because it is a "mass of matter" or a "mereological sum" or the like. But this is little help. Suppose we ask what it is about A that makes it an organism rather than a mass of matter, and what it is about C that makes it a mass of matter and not an organism. Ordinarily we expect there to be physical differences between organisms and non-organisms. We think we can tell whether something is an organism by examining it. But there is no such difference between A and C. (They will of course have different histories. But they needn't: an organism newly created ex nihilo would surely be able to grow if anything can.) It looks as if what makes A an organism rather than a mass of matter is nothing more than the sort of thing it can survive: it is an organism because, in addition to having all the right physical properties (which C shares), it can also gain new parts. C is not an organism merely because it cannot gain parts. But if we say that A is able to gain parts because it is an organism, we cannot also say that it is an organism because it can gain parts.

Coincidentalists will apparently have to say that there is no explanation of why A but not C can gain parts. Nothing makes them able or unable to gain parts. They just are. A's capacity and C's incapacity to gain new parts are basic properties of them: we cannot explain their having these properties in terms of their having any other properties, in the way that we can explain why an object is fragile in terms of the way its particles are bonded together. And surely things have to have some basic properties: not all properties can be such that a thing's having them is explainable in terms its

having some other properties. Still, this proposal conflicts with our expectation that physically identical material objects tend to behave identically in physically identical situations.

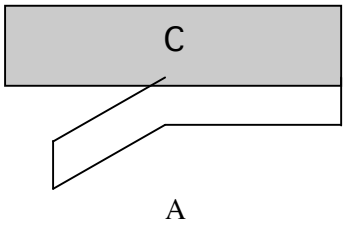
Most coincidentalists will want to say that coinciding objects differ in other ways too, besides the capacity to change their parts. They will want to say, for instance, that you and I are conscious and intelligent, whereas the masses of matter (or whatever) coinciding with us that make it possible for us to gain parts are not conscious or intelligent. Otherwise there would be two conscious, intelligent beings thinking your thoughts, and it is hard to see how you could ever know which one you are--the conscious human being that can gain parts or the conscious mass of matter that can't. (If it seems obvious that you are the human being, it ought to seem equally obvious to the mass of matter that it is a human being, even though it isn't. How do you know that you're not making this mistake?) Coincidentalists will be no better able to explain why these things differ mentally from us than they can explain why they differ from us in their ability to gain parts. Most of us probably thought that our mental abilities are explained by our physical structure. (Perhaps our surroundings are also relevant.) But if, as the coincidentalists say, there are beings with the same physical structure and surroundings as we have but no mental properties (or mental properties very different from ours), this cannot be the case. At any rate a thing's having the right structure and surroundings will not by itself explain why it has mental properties. Coincidentalists may have to say that things' mental properties are basic in the same way as their capacity to gain parts is—not an appealing thought.[x]

11.

Here is one final proposal. A, B, and C are extended in time, much as a sausage is extended in space. And they are composed of temporal parts. A temporal part of something is a part of it that takes up "all of that object" that is located between two times, a bit like a section of a sausage. (An uncut section, that is. Imagine a butcher eyeing up a sausage and contemplating which of the infinitely many sections to cut away from the rest of it.) We commonly speak of events as having temporal parts: the first half of a football game would be a temporal part of the game. The idea is that all things capable of changing their parts have temporal parts.

How does this solve the paradox? Suppose, to make things simple, that A's acquiring B is the only change of parts in its career and that B comes to an end when A does. Then A is composed of C and the temporal part of B located after it is attached, or more precisely the largest such part. The best way to illustrate this is to replace our "before" and "after" pictures with a spacetime diagram, where the vertical axis represents space and the horizontal axis time:

Figure 5



[The entire horizontal portion of the figure should be shaded.] Here A is the shaded object. Because the later temporal parts of A but not the earlier ones include temporal parts of B, A gains B as a part.

Call this the way of temporal parts (Heller 1984, Sider 2001: ch. 5). Most of those who accept it hold the more general view that all persisting things are made up of temporal parts, sometimes called "four-dimensionalism" because it implies that persisting things are extended in one dimension of time as well as the three dimensions of space.

The way of temporal parts is hard to compare with the alternatives because it holds that things have their parts without temporal qualification. Up to now we have spoken of the parts a thing has at some time, much as we speak of how tall something is at some time. But according to the way of temporal parts things have their parts timelessly. Thus, A is timelessly composed of C and the largest post-attachment temporal part of B. Saying that A has certain parts, on this view, is like saying that 4 is less than 7: it isn't the case at some time, or for that matter at every time; it is the case without any temporal qualification at all. A thing may have parts that are located at different times, just as it may

have parts located in different places, but they are parts of it simpliciter. So it is perhaps a bit misleading to say that things change their parts: the truth of the matter is simply that A's later temporal parts overlap B and its earlier temporal parts don't.

Like the way of coincidence, the way of temporal parts rejects 6, the claim that no two things can coincide mereologically at a time. But because four-dimensionalists take parthood to be timeless, they understand 6 differently from coincidentalists. On their view, for things to coincide at a time is simply for them to share those of their temporal parts that are located then. So as they see it, A coincides with C before B is attached only in something like the way in which two roads might coincide for part of their length.

Four-dimensionalists accept the atemporal analog of 6: that no two things can coincide mereologically simpliciter. A differs mereologically from C, on their view, in that A but not C has the later temporal parts of B as parts. This gives the way of temporal parts an advantage over the way of coincidence: it is not committed to the mysterious view that things can differ qualitatively--in their kind, their capacity to gain parts, and their mental capacities, for instance--without differing in their internal structure or surroundings.

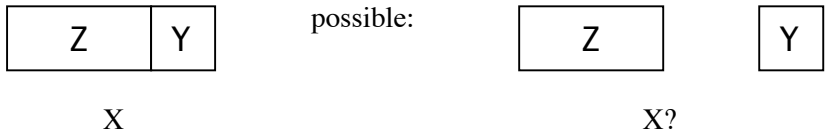
Four-dimensionalism is a powerful metaphysical theory, offering answers to a wide range of difficult questions. It is also highly controversial. It is to metaphysics rather as act utilitarianism is to ethics. Here are just two controversial implications of the way of temporal parts.

First, if it is to offer a general solution to the paradox, all things capable of changing their parts must be made up of temporal parts. More strongly, they must be made up of arbitrary temporal parts: for every moment or stretch of time in a thing's career, there must be a temporal part of that thing located exactly then. If persisting things had temporal parts corresponding to only some stretches of their careers, nothing would guarantee that there is any such thing as the temporal part of B that extends from its attachment to C until its demise, throwing the way of temporal parts into doubt.

So the way of temporal parts implies that every ordinary object is accompanied by an infinite number of beings just like it only shorter-lived. There are as many temporal segments of you located now as there are stretches of your career that include the present moment. During the time it takes you to read this sentence, an infinite number of these beings come into existence, and an infinite number of them pass away. The world is fantastically crowded with objects: just the opposite of the sparse ontology of §8. As if this weren't bad enough already, it raises the problem of how you can know which of these beings you are. You may think you have existed for many years, and that many more years lie in store for you. But your temporal part that extends from midnight last night until midnight tonight would appear to think in the same way as you do. (It would be mysterious if it didn't.) And it presumably has the same reason to believe that it is going to enjoy a long future as you have to believe that you are. Yet its belief is sadly mistaken. How do you know that you're not making this mistake? Your belief that you will still exist tomorrow looks entirely unwarranted.[xi]

Second, recall the modal paradox from §2. We all think that at least some objects might have been smaller by lacking some of the parts they actually have: your house, for instance, might have had a brick missing. But if we try to imagine an object, X, without one of its parts, Y, we seem to get only a possible situation in which the complement of Y, Z, is not attached to Y:

Figure 6



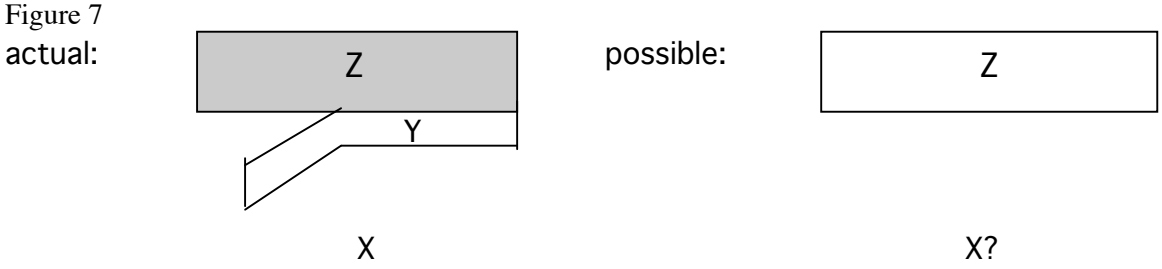
X itself either doesn't exist at all in this possible situation, or it exists and has the very parts it actually has and is merely a scattered object instead of a connected one. How can it be possible, then, for a thing to exist with different parts from the ones it actually has?

The other ways of solving the paradox of increase all suggest ways of solving the modal paradox as well. The way of funny logic suggests that X and Z, though actually distinct, are identical in the merely possible situation: what are in fact a thing and another thing might have been a thing and itself. Friends of sparse ontology will say that there is actually no such thing as Z, but only a lot of

smaller things that jointly fill that space. The way of funny persistence conditions suggests that Z doesn't exist in the merely possible situation. Friends of coincidence can say that X simply coincides mereologically with Z on the right-hand side. Each of these proposals would enable X to exist in a possible situation where it lacks Y as a part.

What about the way of temporal parts? It gives an account of how a house can lose a brick, but it suggests no account of how the house might have had a brick missing all along. In fact it seems to imply that a house could not have existed with a brick missing.[xii] If Y were not a part of X, and neither were any replacement for Y, then X could exist only by coinciding mereologically with Z:

Figure 7



[Here too the entire horizontal bit of the left-hand figure should be shaded.] But four-dimensionalism denies that any two things can coincide mereologically. So it looks as if X could not possibly exist without having Y as a part. More generally, nothing could exist without having all the parts it actually has. Similar reasoning--swapping 'actual' and 'possible' in the diagram--suggests that nothing could have had parts it doesn't actually have either. The way of temporal parts appears to imply mereological essentialism.

Now I said in §2 that mereological essentialism entails mereological constancy: if everything has its parts essentially, then nothing can have different parts at different times. How can I now say that the way of temporal parts makes mereological essentialism true and mereological constancy false? Well, what I said in §2 is true if mereological essentialism and mereological constancy are stated as they are there, in terms of things' having parts at times. But as we noted earlier, on the way of temporal parts things have their parts timelessly speaking: for x to be a part of y at a time t is for the temporal part of x located at t to be (timelessly) a part of the temporal part of y located at t (Sider 2001: 57; see also Olson forthcoming). Applying this to the time-relative doctrine of mereological constancy of §2, we get timeless mereological constancy:

> Necessarily, if a temporal part of x located at t is a part of the temporal part of y located at t, then every temporal part of y has a temporal part of x as a part.

The timeless version of mereological essentialism that four-dimensionalism seems to imply is this:

> If x is a part of y, then it is not possible for y to exist without having x as a part.

And timeless mereological essentialism does not entail timeless mereological constancy: even if a house could not have had different parts from those it in fact has, some of its temporal parts may still include temporal parts of a certain brick while others don't.

But a solution to the paradox of increase that lands us with mereological essentialism is hardly a solution at all. Suppose you had eaten less this morning than you actually did--even just a few atoms less. In that case the human being bearing your name would have different parts from you. According to mereological essentialism, it would therefore be someone else: you wouldn't exist in that situation at all. Or if you did, you wouldn't be a human being, but rather a scattered object composed of the very atoms—or rather temporal parts of atoms--that in fact compose you. So mereological essentialism implies that it is impossible for you to have eaten less than you actually did this morning and been a human being. But isn't it obvious that this is possible?

Some four-dimensionalists try to avoid this consequence by endorsing modal counterpart theory. The story is too complex to summarize here.[xiii] It is, in any case, highly contentious.

12.

We have considered five accounts of how things might acquire new parts despite appearances to the contrary. None is very nice. At any rate they all have some pretty surprising consequences. We may even doubt whether any is better than the disease it is meant to cure: mereological constancy might not look so bad once we have seen the alternatives.

Someone might try combining some of these proposed solutions. Maybe things don't all gain and lose parts in the same way: perhaps the way of sparse ontology is right for organisms and the way of funny persistence conditions is right for artefacts, say; or perhaps it is the other way round. Or one might say that only some composite objects can change their parts, while mereological constancy is true for others. This sort of "mixed" solution might seem only to add the counterintuitive consequences of one "pure" solution to those of another, rather like explaining some unlikely events by appeal to extra-terrestrial meddling and others by appeal to magic. But some of the pure solutions may look more attractive if we take them to apply only in certain cases rather than across the board: for instance, it may be easier to believe that organisms have no proper parts that they can survive being pared down to than it is to believe this about houses.

Mixed accounts are in danger of being unprincipled. While it may be easy enough to say that the way of sparse ontology is right for organisms and the way of funny persistence conditions is right for artefacts, it will be harder to explain why this should be so. Why should organisms have fewer parts than houses have? One would like to think that there was a satisfying answer to such questions. And maybe there is; but it isn't easy to see. Developing a mixed solution would be a large and difficult project.

I am not aware of any other solution to the paradox. I suppose it would be rash to assume that there is none. But no other solution is likely to be any nicer than these.[xiv]

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Notes

[i]An elegant modern statement of the paradox (and the inspiration for this paper) is Chisholm 1976: 157f. The ancient sources are obscure. The introduction to Rea 1997 (as well as the rest of the volume) is a useful guide to these regions.

[ii]The most important discussion of the amputation paradox is probably van Inwagen 1981. See also Heller 1984.

[iii]Defenses of this claim include Sider 1996, 2001: 188-208, and Hawley 2001: chh. 2-3 (see also Chisholm 1976: 97-104). The claim that our practical attitudes are not based on identity over time is most famously defended by Parfit (1984: ch. 12).

[iv]The doctrine of mereological constancy was popular among 18th-century advocates of the reactionary proposal: see for instance Leibniz 1982: 238 and the snippets by Butler and Reid in Perry 1975. See also Chisholm 1976: ch. 3 and Zimmerman 2003. A variant of the reactionary proposal is the Aristotelian view that living organisms have no proper parts: they can grow or shrink by assimilating or expelling matter, but neither particles nor internal organs nor hands or feet are parts of them. This view is difficult to reconcile with the fact that matter is made up of particles, however.

[v]Shoemaker 1999 gives an ingenious argument that would rule out any material thing's thinking if mereological constancy were true. I suspect that his argument is incompatible with our being immaterial, though he disagrees: see Olson 2002a, Shoemaker 2004.

[vi] This is a fib. It probably isn't true that anything ever gains a part without changing internally at least a little bit. It certainly isn't true if a thing comes to be a part of an object by coming to interact causally with that object in some way—by becoming physically bonded to it, say, or by getting caught up in its metabolic processes. Because the relevance of this point to the paradox and its proposed

solutions is unclear to me, I will ignore it, though not without some unease.

[vii]See e.g. Myro 1986 (who attributes the view to Grice), and Gallois 1990 or 1998. Sider 2001: 165-76 is a helpful critical discussion.

[viii]Van Inwagen 1981, Lowe 2002: 75f. The classic defense of the sparse ontology of material objects is van Inwagen 1990a; see also Merricks 2001. For what it's worth, this is my own favorite solution to the paradox. I argue for this sort of view in a different way in Olson 1995.

[ix] Burke 1994, 1996; Hoffman and Rosenkrantz 1997: 163; Rea 2000. It seems to have been the view of Chrysippus as well: see Burke 1994: 129f.

[x] The only serious attempt I know of to explain why things coinciding with us cannot think is Shoemaker 1999. See note 5 for further references.

[xi]Olson 2002b discusses a possible solution to this problem. It would also solve the coincidentalist's problem of how you can know you are not the mass that now constitutes you.

[xii]A similar argument is given in van Inwagen 1990b.

[xiii]For the basics of counterpart theory see Lewis 1971, 1986: 248-263. The world still awaits a good critique of counterpart theory.

[xiv]For perceptive comments on earlier versions of this paper I am grateful to audiences at London, Leeds, Nottingham, Oxford, and Sheffield, and to Bryan Frances, Briggs Wright, and especially David Hershenov.