What Happens When the Zygote Divides?
On the Metaphysics of Monozygotic Twinning

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Jeremy W. Skrzypek
Ohio Dominican University

Abstract. *It is often argued that certain metaphysical complications surrounding the phenomenon of monozygotic twinning force us to conclude that, prior to the point at which twinning is no longer possible, the zygote or early embryo cannot be considered an individual human organism. In this essay, I argue, on the contrary, that there are in fact several ways of making sense of monozygotic twinning which uphold the humanity of the original zygote, but also that there is no easy answer to what happens when the human zygote twins. All of the options available carry with them one or more surprising, alarming, or otherwise counterintuitive implications. All things considered, I conclude that the "budding option", according to which the original human organism present before twinning carries on as one of the resulting embryos but not the other, is the most plausible explanation of what happens when a human zygote twins.*

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I. INTRODUCTION

Monozygotic twinning is the process by which identical twins come to be. Identical twins, unlike fraternal twins, can trace their history back to a single fertilized ovum or zygote. On those rare occasions when a human zygote successfully "splits", "divides", "separates", or "twins" early on in its development, the result is a pair of identical twin human embryos.

Monozygotic twinning is a metaphysically puzzling phenomenon. When a human zygote "twins", the result is two living human embryos. And if individual human organisms begin to exist at or shortly after fertilization, then the zygote or early embryo that twins is an individual human organism. But if the zygote or early embryo that twins is an individual human organism, what happens to that organism when it twins? Does its life end and is the result two new human organisms? Does it carry on as one of the resulting embryos but not the other? Does it carry on as both? Or were both of the later embryos somehow there all along? The purpose of this essay is to

provide an overview of the metaphysics of monozygotic twinning and to argue in favor of the second interpretation of those just mentioned, according to which the original human organism present before twinning carries on as one of the resulting embryos but not the other.

In the next section, I begin by providing a brief overview of some of the basic embryological details necessary for understanding the phenomenon of monozygotic twinning. I then run through the main metaphysical options available for explaining what happens when a human zygote twins. Here I identify four main options and at least twelve possible variants of those options, some of which are standard in the literature, others of which are a bit more "metaphysically exotic". After that I present the main considerations that can be offered for and against each of the metaphysical options for explaining what happens when a human zygote twins. I conclude that, with all of these considerations in view, the "budding option", according to which the original human organism present before twinning carries on as one of the resulting embryos but not the other, turns out to be the most plausible explanation of what happens when a human zygote twins.

There are two upshots to my investigation. First, it reveals that there are several workable options available to those looking to uphold the humanity of the zygote or early embryo. And so, contrary to what many authors have argued, the phenomenon of monozygotic twinning gives us no good reason to think that a zygote or early embryo is not an individual human organism until after the period during which twinning can occur. However, the second upshot of my investigation is that there really is no easy answer to what happens when a human zygote twins. Every one of the available options carries with it one or more surprising, alarming, or otherwise counterintuitive implications. What I think this shows us is that even at the end of the day monozygotic twinning remains a puzzling phenomenon, reflection upon which may force us to

alter or surrender one or more of the beliefs or assumptions that we hold about human persistence, material composition, spatial location, or the ways in which human life develops at its earliest stages.

II. SOME BASIC EMBRYOLOGICAL DETAILS

When a single human sperm and a single human egg or oocyte successfully fuse during fertilization, the result is a single-celled human zygote.[1] That zygote then undergoes a series of mitotic divisions, giving rise first to a two-celled human embryo, then a four-celled human embryo, then an eight-celled human embryo, and so on, as it travels down the fallopian tube to the uterus. At around six to nine days after fertilization, the embryo, now composed of as many as seventy to one hundred cells, begins the process of implantation, during which it embeds itself in the uterine wall. At around fourteen to sixteen days after fertilization, the implanted embryo undergoes a process known as gastrulation, during which the "primitive streak", a new central axis and the embryonic precursor to the spinal cord and brain, is formed.

During these early stages of embryonic development, monozygotic twinning can sometimes occur. Monozygotic twinning occurs when a single zygote or early embryo successfully splits, divides, separates, or twins, producing two smaller living human embryos. The two smaller living human embryos produced by monozygotic twinning are genetically identical, though there may be epigenetic or other physiological differences between the two.[2] Monozygotic twinning is rare, but can occur as early as day two, during or shortly after the transition from the single-cell zygote to the two-cell early embryo, and at least as late as day nine

[1] Sources that I have found useful in preparing this section of the paper include: Ford (1988); Smith and Brogaard (2003); Shoemaker (2005); Lee and George (2006); Koch (2006); and Condic (2020). Interested readers are encouraged to consult the sources cited in these works.
[2] See Howsepian (2008, 144); Condic and Condic (2018, 91); and Condic (2020, 59) for evidence of this.

or ten.[3] It is believed that monozygotic twinning can no longer occur once the process of gastrulation has begun at day fourteen to sixteen. The causes of monozygotic twinning are still not completely understood. Though we now know that monozygotic twinning can be triggered by external or environmental influences, it is still unclear whether certain zygotes are "internally programmed" to twin from the start.

Though my focus here will be on monozygotic twinning, monozygotic tripling or quadrupling can and does also occur, and in two ways. First, the process of monozygotic twinning can repeat in one or both of the embryos produced by an earlier twinning. Second, a single human embryo at the four or eight-celled stage can also split or divide into three or more living embryos at the same time (though it seems that this is much more rare). Early on in development, the opposite of monozygotic twinning, dizygotic fusion or embryonic absorption, can also occur: two human zygotes or embryos can "fuse" together to form one single human embryo, or a single human zygote can be "absorbed" by another twin in utero. In this essay, though, I will focus on those cases in which a single zygote or early embryo splits, divides, separates, or twins.[4] With these basic embryological details in mind, let us then move on to explore the metaphysical options available to us in explaining what happens when a zygote twins.

III. EXPLORING THE LOGICAL SPACE

What should we say happens, metaphysically speaking, when a human zygote twins? Let *A* refer to the pre-twinning human zygote and *B* and *C* refer to each of the embryos that are present after twinning has occurred. What is the relationship between A, B, and C? Logically, it

[3] See Condic (2020, 41-48) for a helpful overview of the various ways in which monozygotic twinning can occur, the stages of development at which each of these types of twinning can occur, and the frequency with which these different types of twinning occur.

[4] The phenomena of dizygotic fusion and embryonic absorption also raise some very interesting metaphysical puzzles at the early stages of human life, but, unfortunately, I do not have the space here to give those particular issues the attention they deserve. Interested readers are encouraged to check out Hershenov and Doroski (2018).

appears that we have four main options: A is identical to neither B nor C, A is identical to B but not C, A is identical to C but not B, or A is identical to both B and C.

According to the first main option, A is identical to neither B nor C. On this view, what happens when a human zygote twins is that A dies or otherwise ceases to exist, giving rise to two new entities, B and C, neither of which is identical to A. And there are two ways in which this option can be fleshed out. According to the first, none of A, B, or C is an individual human organism. B and C may later become individual human organisms, but there is no individual human organism present prior to gastrulation, the point after which twinning is no longer possible. On this view, A does cease to exist when it splits, divides, separates, or twins, but since A is not an individual human organism, this is of little consequence. Because it holds that there is no individual human organism present prior to the point at which twinning is no longer possible, this is known as the delayed hominization option.[5] Alternatively, we could say that A, B, and C are all individual human organisms, but that A dies upon twinning, and in its place are now two new living human organisms, B and C. This is the fission option.[6]

According to the second and third main options, A is identical to B or C, but not both. On these views, A is indeed an individual human organism, and A survives monozygotic twinning as

[5] Proponents of this position include: Joseph Donceel (Donceel, 1970, 98-99); Norman Ford (Ford, 1988), William Wallace (Wallace, 1994); Anthony Kenny (Kenny, 2008); Peter van Inwagen (van Inwagen, 1990, 152-154); Eric Olson (Olson, 1997, 89-93); Lynne Rudder Baker (Baker, 2005, 26-28); Barry Smith and Berit Brogaard (Smith and Brogaard, 2003; Brogaard, 2002/2003, 45-48); Jeff McMahan (McMahan, 2002, 25-29; McMahan, 2007, 177-181); Ingmar Persson (Persson, 2003, 510-513); David DeGrazia (DeGrazia, 2005, 246-254; DeGrazia, 2006, 51-53); Bonnie Steinbock (Steinbock, 2008, 269-270); Helga Kuhse and Peter Singer (Kuhse and Singer, 2002, 190-192); and Mark Brown (Brown, 2007; Brown, 2019; Brown, 2021). All of these authors are in agreement that the zygote or early embryo that twins is something less than an individual human organism, but they are divided (!) over what precisely that something is. Some authors hold that the zygote or early embryo is indeed human and alive, but still not an individual human organism. Others authors hold that the zygote or early embryo is human and a biological individual but not a living human organism. Finally, some authors hold that the zygote or early embryo is not even one thing at all, just a loose collection of pre-embryonic materials which have yet to compose anything larger than themselves.

[6] Proponents of this position include David Oderberg (Oderberg, 1997; Oderberg, 2000, 16-19; Oderberg, 2008), Germain Grisez (Grisez, 1970, 25), Christopher Tollefsen (Tollefsen, 2006), and Kevin Flannery (Flannery, 2003, 277). There is also room here for a sort of in-between view, according to which B and C are individual human organisms even though A is not. But, as we have seen, B and C can, in some cases, also twin, and so it is not clear what the motivation would be for this in-between view.

either B or C. But what happens when A "twins" is that part of A buds or branches off to form a new individual human organism. This is the budding option.[7]

The delayed hominization, fission, and budding options are the three most common approaches to understanding monozygotic twinning. But there are also several more "metaphysically exotic" options available, all of which can be understood as ways of making sense of the fourth main option mentioned above: that A is identical to both B and C. Most of the time this fourth main option is dismissed outright, and, as we'll see, there are some good reasons to think that every way of making sense of this option is ultimately unfeasible. But let's put it on the table and see how far we can go with it.

The first two ways of making sense of the proposal that A is identical to both B and C are built on non-standard modes of spatial location. First, we might say that upon twinning A becomes a scattered object.[8] To say that an object is scattered is to say that the object is spread out across disconnected regions of space, that is to say, part of the object is located at one region and some other part of the object is located at some other region. What makes the object scattered is that the regions within which its parts reside are spatially disconnected: they are separate and have no points of contact with one another. In this case, what we would have here is a scattered human organism. Where what appears to be two human organisms, there are actually

[7] Proponents of this position include Benedict Ashley and Albert Moraczewski (Ashley and Moraczewski, 2001, 194-198), Jason Eberl (Eberl, 2006, 38-39, 82; Eberl, 2009, 325-326; Eberl, 2020, 159-161), Samuel and Maureen Condic (Condic and Condic, 2018, 95-100; Condic, 2020, 53-56), Helen Watt (Watt, 2016, 18), Stephen Napier (Napier, 2008, 257; Napier, 2010, 790-791), Patrick Lee and Robert George (Lee and George, 2006; Lee and George, 2009, 123), Robert George and Christopher Tollefsen (George and Tollefsen, 2008, 228-230). There is also room here for a delayed hominization variant of the budding option, according to which one and only one of B or C is identical to A, though none of the three is an individual human organism.

[8] For some helpful discussions of what a scattered object would be and whether there really are such things, see Cartwright (1975), Hershenov (2002), and Biro (2017).

two scattered parts or halves of a single human organism (each of which, importantly, may possess different properties or attributes). This is the scattered object option.[9]

The second way of making sense of the claim that A is identical to both B and C is to say that upon twinning A becomes bi-located or multi-located.[10] To say that an object is bi-located or multi-located is to say that the object is exactly located at two or more regions of space. To say that an object is exactly located at some region is to say that there are no parts of the object which do not coincide with the region and there are no parts of the region which do not include some part of the object. To say that an object is exactly located at multiple regions, then, is to say that there are no parts of the object which do not coincide with each region and there are no parts of each region which do not include some part of the object. Another way to describe a multi-located object is as being wholly present at multiple regions of space at the same time. Importantly, for a multi-located object, it is not the case that part of the object is located at one region and some other part is located at the other region. That would make it a scattered object. Rather, all of the parts of the object are located at one region and all of those same parts of the object are also located at the other region (which, importantly, is compatible with those parts, and the whole that they compose, possessing different properties or attributes at different regions). In this case, what we would have here is a multi-located human organism. Where what appears to be two human organisms, there is actually just one human organism exactly located at two disconnected regions of space. This is the multi-location option.[11]

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[9] While I have found no author who explicitly argues for this position (and perhaps for good reason!), this seems to be how most authors are interpreting the claim that A is identical to both B and C when they argue against it.

[10] For a helpful discussion of what a multi-located object would be and whether there really are such things, see Gilmore (2018)

[11] While I know of no author who has argued for this position in the case of monozygotic twinning, Barry Dainton defends a multi-locational account of similar fission cases in Dainton (2011, 364-408). The possibility of multi-location might also provide an explanation for the phenomenon of quantum entanglement, in which the state or spin of one particle appears to be determinative of the spin or state of another seemingly distinct particle at some discontinuous region of space. I thank an anonymous referee for this suggestion.

The third way of making sense of the proposal that A is identical to both B and C is to say that A is identical to both B and C, but that B and C are not identical to each other. Here one would have to either deny that numerical identity is a transitive relation or hold that the relation that A bears to B and C is a kind of identity relation short of numerical identity, an identity relation which is not bound by transitivity. This is the intransitivity option.[12] I explore one way of making sense of this option later on when I discuss views that require alternative conceptions of human persistence.

In addition to the three ways of making sense of the fourth main option just mentioned, there are several other possibilities, all of which share a commitment to the following claim: that neither B nor C begin to exist upon A's twinning, but, rather, that B and C were there all along. I can think of six ways of making sense of this proposal.

The first way of making room for both B and C "in" A from the beginning is to say that prior to twinning, B and C co-existed as completely overlapping material objects.[13] To say that two material objects overlap is to say that they share at least one part. So if B and C overlap, some part of B is also a part of C. To say that two material objects completely overlap is to say that they share all of their parts. So if B and C completely overlap, then all of the parts of B are also parts of C. There is no part of either B or C which is not also a part of the other. In this case, what we would have here are two completely overlapping human organisms who share all of their parts up until the point at which they separate at twinning. This is the complete overlap option.[14]

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[12] Proponents of this position include Alan Holland (Holland, 1990) and Jan Deckers (Deckers, 2007).

[13] For some helpful discussions of what exactly it would mean for two objects to completely overlap and whether this is even possible, see Oderberg (1996) and Hershenov (2003).

[14] The authors who come closest to advocating this position are David Hershenov and Rose Koch/Koch-Hershenov (Koch, 2006; Koch-Hershenov, 2006; Hershenov and Koch-Hershenov, 2006). Hershenov and Koch/Koch-Hershenov propose that there are two completely overlapping human organisms present "in" A prior to A's twinning, but they also hold that each possesses its own distinct rational soul. And so Hershenov and

The second way of making room for both B and C "in" A from the beginning is to say that prior to twinning, B and C co-existed as completely interpenetrating material objects.[15] To say that two material objects interpenetrate is to say that they are both at least partly located at some region of space but do not share any parts at that region. To say that two material objects completely interpenetrate is to say that the two objects are exactly located at the same region of space but do not share any parts. In this case, what we would have here are two completely interpenetrating human organisms who occupy the very same spatial region without sharing any of their parts up until the point at which they separate at twinning. This is the complete interpenetration option.[16]

The third way of making room for both B and C "in" A from the beginning is to say that prior to twinning B and C possessed the very same body but possessed numerically distinct souls. In this case what we would have here are two immaterial souls "occupying" the same human body up until the point at which they separate at twinning. If human persons turn out to be immaterial souls, then we could say that there are two human persons who occupy the very same human body. Or if human persons turn out to be soul-body compounds, then we could say that prior to twinning there are two human persons who completely overlap in terms of their material parts but who nonetheless possess distinct immaterial souls. This is the double-ensoulment option.[17]

A fourth way of making room for both B and C "in" A from the beginning is to say that prior to twinning B and C exist "in" A not as overlapping material objects nor as interpenetrating

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Koch/Koch-Hershenov's position turns out to fall somewhere between what I'm calling the complete overlap option and what I'm calling the double-ensoulment option.

[15] For a helpful overview of what it would mean for two objects to completely interpenetrate and whether this is even possible, see Gilmore (2018)

[16] To my knowledge, no author has yet defended this particular option.

[17] As I said, Hershenov and Koch/Koch-Hershenov come very close to advocating for this position. While on their proposal, the two souls enform the very same matter, the result is actually two completely overlapping human bodies.

material objects, but as adjoining material objects. To say that two material objects are adjoining is to say that each possess its own material parts, and each occupies its own region of space, but that the regions of space that both occupy are contiguous. And there are two ways in which this option can be fleshed out. First, we could say that B and C are adjoining human organisms. In such case, the human zygote or early embryo would not itself be a human organism but a pair of adjoining organisms. Alternatively, we could say that B and C are adjoining parts of a single human organism which later become complete human organisms in their own right. In such case, the human zygote or early embryo is indeed a human organism, and B and C are distinct parts of that organism. In either case, what we would have here are two adjoining human persons in the original zygote, each composed of a different portion of the parts of that zygote, up until the point at which they separate at twinning. This is the adjoining objects option.[18]

The final two ways of making room for both B and C "in" A from the beginning are built on non-standard conceptions of human persistence.[19] The first is to say that prior to twinning B and C co-exist at A as partially overlapping perduring material objects. To say that a material object perdures is to say that the object is spread out across time and persists through time by possessing different temporal parts at different times. To say that two material objects overlap on this model is to say that the two objects share at least one temporal part. And to say that two objects partially overlap is to say that the two objects share at least one but not all of their temporal parts. In this case, what we would have here are two four-dimensional human organisms who overlap in the sense of sharing temporal parts up until the point at which they

[18] To my knowledge, no author has yet explicitly defended this particular option, though I think it may be what many authors have in mind when they speak of both B and C being present "in" A from the beginning.

[19] For a helpful overview of contemporary theories of persistence, including detailed discussions of endurantist, perdurantist, and exdurantist theories, see Costa (2020).

separate at twinning. This is the perdurance option.[20] (There is also space here for a perdurantist partial interpenetration account, according to which to the two perduring objects possess distinct interpenetrating temporal parts up until the point of twinning, but it is not exactly clear to me whether this offers any advantages over the standard, perdurantist partial overlap account.)

The second persistence-based strategy for making room for both B and C in A is to say that B and C co-exist in A as partially co-related exduring material objects. To say that a material object exdures is to say that the object exists at just a single instant but that it can also be said to persist through time by virtue of possessing different temporal counterparts at different times, that is, by bearing a certain degree of causal continuity with other relevantly similar instantaneous objects. To say that two material objects are co-related on this model is to say that they share some temporal counterpart. And to say that two objects are partially co-related is to say that they share at least one but not all of their temporal counterparts. In this case, what we would have here are two exduring human organisms who share a series of temporal counterparts up until the point at which the causally continuous series of instantaneous stages splits into two discrete series at twinning. On this view, both B and C are related to A in such a way that we can say that they both share their identity with A in the way just described. But because neither is strictly numerically identical with A, they need not be strictly numerically identical with one another. The relation that each of B and C bear to A is not a relation that either bears to one another. This is the exdurance option.[21]

IV. CONSIDERATIONS FOR AND AGAINST EACH OF THE AFOREMENTIONED OPTIONS

[20] Benjamin Curtis advocates this position in Curtis (2012). This view is discussed, but not endorsed, by David Shoemaker (Shoemaker, 2005), John Burgess (Burgess, 2010), David Efird and Stephen Holland (Efird and Holland, 2019), and David Hershenov and Rose Hershenov (Hershenov and Hershenov, 2020).

[21] David Efird and Stephen Holland advocate for this position in their (2019). For reasons outlined below, I think that Holland and Deckers, who appear willing to pursue the intransitivity option, may also end up being committed to this sort of view in the end.

There are, then, four main options for explaining what happens, metaphysically speaking, when a human zygote twins, and at least twelve possible variants of those options, some of which are standard in the literature, others of which are admittedly a bit more "metaphysically exotic". Here are the main options and each of the variants of those options that have been discussed thus far (where *A* refers to the pre-twinning human zygote and *B* and *C* refer to each of the embryos that are present after twinning has occurred):[22]

<table>
<tr><th>Main Options</th><th colspan="2">Specific Variants</th></tr>
<tr><td rowspan="2">A is identical to neither B nor C</td><td colspan="2">1. Delayed Hominization: Upon twinning, A ceases to exist, giving rise to both B and C. However, none of A, B, or C is an individual human organism.</td></tr>
<tr><td colspan="2">2. Fission: Upon twinning, A, an individual human organism, ceases to exist, giving rise to two new individual human organisms, B and C.</td></tr>
<tr><td>A is identical to B but not C

OR

A is identical to C but not B</td><td colspan="2">3. Budding: Upon twinning, A survives as either B or C, but also gives rise to a new individual, the other of B or C.</td></tr>
<tr><td rowspan="6">A is identical to both B and C</td><td rowspan="3">B and C began to exist upon A's twinning</td><td>4. Scattered Object: Upon twinning, A comes to be spread out across disconnected regions of space, such that part of A is B and part of A is C.</td></tr>
<tr><td>5. Multi-Location: Upon twinning, A comes to be wholly present at two disconnected regions of space, such that A is wholly present at B and wholly present at C.</td></tr>
<tr><td>6. Intransitivity: Upon twinning, A is identical to B and C, but B and C are not identical to one another.</td></tr>
<tr><td rowspan="3">B and C existed prior to A's twinning</td><td>7. Complete Overlap: Prior to A's twinning, B and C shared all and only the same parts.</td></tr>
<tr><td>8. Complete Interpenetration: Prior to A's twinning, B and C occupied the same region of space, but shared no parts.</td></tr>
<tr><td>9. Double-Ensoulment: Prior to A's twinning, the souls of B and C were numerically distinct, but occupied the same human body.</td></tr>
</table>

[22] Thanks to an anonymous referee for suggesting that I add a chart like this to help keep track of the various options and variants.

		10. **Adjoining Objects:** Prior to *A*'s twinning, *B* and *C* possessed their own material parts, each within its own region of space, but those regions were contiguous.
		11. **Perdurance:** Prior to *A*'s twinning (but not after), *B* and *C* share all (and only) the same temporal parts.
		12. **Exdurance:** Prior to *A*'s twinning (but not after), *B* and *C* shared all (and only) the same temporal counterparts.

Having carefully laid out our options, let's now take a look at the major considerations that can be offered for and against each of these views. As we'll see, some of these considerations are logical, others empirical, and some practical. By weighing all of these considerations, we can better determine which of our options is the most plausible overall.

Delayed Hominization

First let's take a look at the delayed hominization option. What are the main considerations in favor of this view? In other words, why would someone think that the best account of monozygotic twinning is one that denies that the human zygote or early human embryo is an individual human organism? There are three sorts of arguments that are often presented in favor of this position. First, it is sometimes said that the very fact that A can split into B and C is reason enough to think that A cannot be an individual human organism (Ford, 1988, 120, 135-136); (DeGrazia, 2005, 246-249); (DeGrazia, 2006, 51-52); (Baker, 2005, 26-27); (Kenny, 2008, 7-8); (Steinbock, 2008, 269-270). Alternatively, it is commonly argued that the fact that A can split into B and C is indicative of the presence or absence of certain other features which make it the case that A cannot be considered an individual human organism (Ford, 1988, 137-163); (Olson, 1997, 90-91); (DeGrazia, 2005, 249-254); (DeGrazia, 2006, 51-53); (Smith and Brogaard, 2003, 59-63); (Brown, 2019, 1038-1039); (Brown, 2021, 675-676). So, for example, perhaps the reason why A can be split into B and C is because, at that early stage, the parts of A lack the requisite integration, coordination, or specialization for A to count

as an individual human organism.[23] Finally, others have argued that the fact that every other option for explaining what happens when the zygote twins is either untenable or deeply implausible makes it more reasonable to conclude that A is not an individual human organism at all (McMahan, 2002, 25-29); (McMahan, 2007, 177-178); (Brown, 2007, 609); (Kuhse and Singer, 2002, 190-192).

To the first argument, it has been pointed out by several authors (even by some who ultimately deny the humanity of the zygote), that just because something can be split into two of the same kind, that does not mean that it is not presently an individual of its kind (Oderberg, 2000, 17-19); (Oderberg, 2008, 268-269); (McMahan, 2007, 177); (Lee and George, 2009, 123-124); (Lu, 2013, 105-108); (Brogaard, 2002/2003, 46); (Guenin, 2006, 478-480); (Rankin, 2013, 47-50). Other creatures can be split into two of the same kind despite clearly being individuals of their kind prior to the split (amoebae, flatworms, starfish, and most species of plants, for example). Arguably, there are even some scenarios (some hypothetical, some actual) in which it seems that a single human organism could be split into two separate human beings.[24] And so the fact that A can split into B and C is no reason to think that it is not already an individual human organism.

To the second, it has been argued by several authors that, on the contrary, there are several features present in the zygote before twinning is no longer possible that indicate that it is

[23] So, for example, Olson argues that "those cells adhere together only loosely, and their growth and other activities are not coordinated in the way that the activities of an organism's cells are coordinated…Each functions independently of the others, metabolizing and dividing at its own rate" (Olson, 1997, 90).

[24] In terms of hypothetical scenarios, I am thinking of those described by Richard Swinburne, in which the whole brain of a living human organism is split in two and both halves are successfully transplanted into two separate, brainless human bodies (see, for example, Swinburne (2019, 53-55)), D. Alan Shewmon, in which the whole brain of a living human organism is transplanted to another brainless body while the living human body left behind is kept on life support (see, for example, Shewmon (1985, 43-47) and Shewmon (2001, 474)), and Christian Munthe, in which it is hypothesized that there could be a species of rational animals which naturally multiply by a kind of fission, like amoebae (see Munthe (2001, 387-388)). In terms of actual scenarios, I am thinking of those rare cases in which monozygotic twinning occurs later in utero (see Koch (2006, 359-363)) for more on these sorts of cases) and the possibility of adult human cloning.

an individual living organism (Tollefsen, 2006, 256-259); (Lee and George, 2006); (Lee and George, 2009, 124-130); (Liao, 2010, 64-67); (Damschen, Gomez-Lobo, and Schonecker, 2006, 169-172); (Condic and Condic, 2018, 110-112); (Condic, 2020, 7-11); (Blackshaw and Rodger, 2020, 551-552). So, for example, it is argued that there is evidence of a remarkable degree of internal coordination, communication, and job specialization among the parts very early on.[25] And if we have do indeed have good evidence to believe that the zygote is an individual living organism, then it would seem most plausible to conclude that it is an individual living *human* organism, given its genetic identity and its developmental trajectory.[26]

Whether the third argument is conclusive remains to be seen. Let's, then, move on to consider whether all of the other options are indeed untenable or so implausible as to think that they cannot possibly be correct.

Fission

The main considerations in favor of the fission option are as follows. First, a proponent of this view could make use of the observations cited above for thinking that A is indeed an individual human organism prior to twinning. Second, a proponent of this view could argue that

[25] So, for example, Liao argues that "there is scientific evidence that shows that when the sperm penetrates the egg, the point at which the penetration takes place seems to determine which part of the zygote will develop into the embryoblast and which part into the trophoblast. This suggests that there is some kind of exchange of information and coordination within the single-cell zygote, the multiple-cell zygote, and subsequently within the morula and the blastocyst… There is ample scientific evidence that the daughter entities of an embryo do communicate with one another to coordinate further development. For example, if one of the cells in the embryo were removed, the other cells would coordinate to replace the cell so that further development would continue. Also, studies have shown that the various totipotent cells also coordinate with one another at very early stages. In particular, after the single zygote divides into two cells, one of these cells will divide first, giving rise to three cells, while the other one will 'wait.' After some time, the other cell will divide, making it four cells, and then eight cells, etc. This suggests that there is coordination among the cells even at such an early stage… If all of this is right, there are reasons to be skeptical of the idea that there is not sufficient coordination among the cells prior to twinning such that a distinct individual could not possibly have already existed" (Liao, 2010, 64-66). Now, whether these and other such considerations do ultimately show that the zygote is a living human organism is not something that I can hope to settle here. I mean only to point out that there are a number of empirical considerations that might serve to undermine this sort of argument in favor of the delayed hominization option. Interested readers are encouraged to consult the sources cited above.

[26] Indeed, if A is an individual living organism, but not an individual living human organism, one might wonder: to what species does A belong, then? Cat? Bear? Mushroom? Better, then, for the proponent of the delayed hominization option to insist that A is no kind of individual living organism at all.

A must be said to die upon twinning, given that there are no other plausible options. For it would be absurd to say that A is identical to both B and C, and it would be arbitrary to identify B or C with A and not the other since, in symmetrical cases, they are qualitatively identical, they are exactly alike in every way. There would simply be no fact about either twin that could make it the case that one of them is the original and the other a new human organism. And so the only remaining option is to say that A dies upon twinning.

Later on, we will consider whether it is indeed absurd to say that A is identical to both B and C and whether it would indeed be arbitrary to identify B or C with A and not the other, but let's begin by calling into question the assumption here that the "only" remaining option, the fission option, is itself free of difficulty.

The problem with saying that A dies upon twinning is that B and C both seem to have everything that it takes to be identical to A. Each is biologically continuous with A: the life processes of each maintain a kind of causal continuity with the life processes present in A. Indeed, if not for the other, it seems that B or C would clearly be identical to A. So how could the presence of the other make it the case that the one is not identical to A? In the words of Derek Parfit, "how could a double success be a failure?" (Parfit, 1984, 256).

The argument just presented is one that is often presented by proponents of the delayed hominization option in support of their position. Saying that A is an individual human organism but that it is identical to neither B nor C is just as implausible as saying that it is both or one but not the other. And so, it is argued, we ought to conclude that it is more reasonable to suppose that A is not an individual human organism at all. But any such argument ought to strike those familiar with the philosophical literature on personal identity as unpersuasive. Structurally analogous branching or duplication scenarios, such as Parfit's famous branchline and double

transplant cases (Parfit, 1984, Ch. 10 and Ch. 12, respectively), plague psychological theories of the human person as well, and while they are indeed puzzling for those sorts of theories, when faced with the difficulties that these cases present, no one in the literature draws the conclusion there must not have been any individual human person there before the split.[27] And so while I do think that this is an important challenge for a proponent of the fission option, I do not believe that it lends support to the delayed hominization view.

In response to this challenge, proponents of the fission option would have to argue that the process of twinning is so disruptive to that organism's life processes that it necessarily brings about the death of that organism, and that, as a result, there is not the same degree of biological continuity between B and A or C and A as there would be between B and A or C and A were twinning not to occur and the other embryo never to arise. Whether there is enough empirical support for this interpretation, though, is unclear.

Let's, then, consider some of the more serious concerns for the fission option. According to the fission option, A dies upon twinning. And so for every pair of identical human twins, there was some earlier human organism who had to die to give them life. And this can be seen to give rise to several other difficulties. First, if the fission option were correct, it would mean that A died without leaving a corpse behind, or that A somehow ceased to exist without dying (Ford, 1988, 120); (Kuhse and Singer, 2002, 190); (Burgess, 2010, 64, 67); (Guenin, 2006, 481).[28] Second, it might mean that we ought to mourn the death of a woman's earlier child whenever we

[27] See also Oderberg (1997, 176-177) and Munthe (2001, 387). As Brown rightly points out, one conclusion that we can reasonably draw from reflecting on cases like Parfit's is that the sort of psychological continuity taken by some proponents of psychological theories of the human person to be determinative of our identity is actually not sufficient for our numerical identity over time (Brown, 2007, 614-615). And so at most what the case of monozygotic twinning force us to conclude is that the sort of biological continuity taken by some proponents of biological theories of the human person to be determinative of our identity is not sufficient for our numerical identity over time. But even that only follows if there is indeed a sufficient and equal degree of biological continuity between A and both B and C.

[28] Koch calls this the problem of "Fissioning Out of Existence" (Koch, 2006, 356, 363, 365).

hear the news that she is pregnant with identical twins (McMahan, 2002, 26); (McMahan, 2007, 178); (Burgess, 2010, 64, 67-68); (Hershenov and Hershenov, 2020, 373); (Brown, 2007, 613); (Ramsay, 2011, 199).[29] Third, monozygotic twinning is rare but not exceedingly so. And so to say that in every case of monozygotic twinning a child dies would seem to introduce a rather difficult instance of the problem of evil, at least for those proponents of the fission option who are also theists and who regard the loss of any innocent human life as tragic: why would God allow so many innocent children to die in that way? Why would He create these human beings just to have them die a few days later (Shoemaker, 2005, 63); (Rankin, 2013, 53-54)?

To the first of these objections, it can be said that there are plenty of ways of dying which do not produce a corpse. Human organisms can die by combustion, explosion, vaporization, atomization, or by being consumed by, by being subsumed into, or by fusing with, another organism. Death by fission is only one of the uncommon but interesting ways a human organism can die without leaving a corpse.[30]

To the second of these objections, some authors have argued that, if we regard the loss of any innocent human life as tragic, then it is not at all implausible to suggest that it would be appropriate to mourn the deaths of those human organisms who die as a result of monozygotic twinning. Though these human organisms did not live long enough for us to invest in their wellbeing or to share any emotional bonds with them, their deaths could still be seen as tragic nonetheless, perhaps at least as tragic as the death of an innocent stranger. And so if the fission option were correct, then it could be perfectly appropriate to mourn the death of the woman's

[29] Koch calls this the "Tragedy of the Multiples" (Koch, 2006, 356-357, 363, 365).
[30] This point is also appreciated by Oderberg (Oderberg, 2000, 19) and Hershenov and Koch-Hershenov (Hershenov and Koch-Hershenov, 2006, 245).

earlier child whenever we hear the news that she is pregnant with identical twins (assuming that we regard the loss of any innocent human life as tragic).[31]

To the third objection, a proponent of the fission option could point out that we already know that early miscarriages are quite common and that, as a result, many innocent human beings die in utero every day. And so the death of the zygote or early embryo in a case of monozygotic twinning is not a unique difficulty for the theist trying to reconcile her beliefs with the problem of evil. In whatever way one answers the more general problem of miscarriage, it seems that the same solution can be extended to the case of the innocents who perish upon twinning.[32]

One final implication of the fission option worth mentioning is that, according to this view, human organisms B and C first begin to exist, not at fertilization, but at the moment of twinning. It will follow from this view, then, that not all human organisms begin to exist at fertilization. Now, this is still compatible with the claim that every successful fertilization produces an individual human organism. But it will also follow that all identical twins are a bit younger than any other children born on the same day. And that is a curious result.[33]

Budding

Unlike the delayed hominization option, the budding option is committed to there being an individual human organism prior to twinning. And unlike the fission option, the budding option maintains that the original human zygote survives twinning as one of the twin human embryos that result. The budding option is, then, compatible with the claim that every successful act of fertilization produces an individual human organism. Like the fission option, however, this

[31] See, for example, Oderberg (1997, 270-271) and (2000, 19).
[32] A similar reply to this objection is also given by Hershenov and Koch-Hershenov in their (2006, 244).
[33] Koch/Koch-Hershenov calls this the problem of "Varying Origins" (Koch, 2006, 356, 363, 365; Koch-Hershenov, 2006, 155).

view is also committed to the claim that at least some individual human organisms begin to exist not at fertilization but at the moment of twinning. In this case, only one of the twins begins to exist at fertilization; the other begins to exist at the moment of twinning. An interesting consequence of this view, then, is that, for every set of identical twins, one of the twins is actually older than the other by at least a few days. This is similar to the curious result of the fission option that all identical twins are at least a few days younger than any other children born on that day.

It is sometimes argued that the budding option is untenable because it would be entirely arbitrary to identify B or C with A and not the other since, in symmetrical cases, they are qualitatively identical, they are exactly alike in every way. It isn't just that we may never be in a position to determine which of B or C is A. It is that there would be no fact about either twin that could make it the case that one of them is the original and the other a new human organism.[34] But there are several ways of responding to this objection. First, if we already have some reason to think that human persons have souls, then there would be a further fact that could explain why either B or C is identical to A but not the other. One of the twins would possess A's soul and, in such case, the other would not. And whichever does not cannot be identical to A. We might never be able to know which of the twins possesses A's soul, or even if that soul survived at all, but there would still be a fact in the world that could make one of them identical to A and the other not.[35] A proponent of the budding option could also reply to this objection by espousing an anti-criterialist account of human persistence, according to which there are no informative criteria of identity over time. In such case, the lack of any further fact that could make B or C

[34] We should, of course, be open to the possibility that while the two appear to be exactly alike in every way, it could turn out upon further investigation or future discovery that there are indeed intrinsic differences between the two. What we are considering here is a scenario in which there is simply no difference between B and C, no fact in the world, that could make it the case that one is identical to A but not the other.

[35] This is a point also appreciated by Eberl (2006, 131, 2009, 333; 2020, 159), Condic and Condic (Condic and Condic, 2018, 104-105; Condic, 2020, 54-55), and Howsepian (2008, 145-146).

identical to A but not the other is of no concern, since there is never any additional fact that makes a person identical over time beyond the bare fact that she remains identical to herself. Alternatively, a proponent of the budding option could reply to this objection by positing some further fact other than the presence or absence of an immaterial soul. Perhaps each individual substance possesses its own distinctive qualitative property that makes it what it is, an haecceity or "this-ness". And perhaps the haecceity or this-ness of the early zygote carries on in one of the twins, but not the other.[36]

One clear advantage of the budding option is that it successfully avoids all of the concerns that arise for the fission option due to the fission option's commitment to the death of the earlier organism. On the budding option, no human organism dies when twinning occurs. The original zygote survives and carries on as one of the resulting embryos. There is no need for a corpse, there is no need to mourn, and there is no additional problem of evil brought on by monozygotic twinning.

There is, however, one notable implication of the budding option that some may find troubling. Recall that, according to the budding option, what happens when a zygote twins is that during one of the early cell divisions, one or more of the cells of that embryo separates from the rest to form a brand new human organism of its own while the original zygote self-repairs and carries on along its developmental trajectory. One surprising implication of this model for understanding monozygotic twinning is that the process of monozygotic twinning turns out to be a kind of asexual human reproduction (Ford, 1988, 121, 136); (Wallace, 1994, 188). When a

[36] These last two options are proposed, but not endorsed, by Howsepian in his (2008, 145-146) and Eberl in his (2020, 159). One might wonder, though, whether these replies simply push the problem back a step. Isn't it still entirely arbitrary which of B or C gets A's soul or haecceity? What sort of explanation could there be as to why A jumps to B rather than the C, or vice versa, since B and C are qualitatively identical to one another? Here's how I think the proponent of the budding option ought to reply: The objection misunderstands what is being proposed in the budding option. The claim isn't that A's soul or haecceity "jumps" from A to B or C. The claim is that B or C *just is* A. A's soul or haecceity doesn't need to "jump" to B or C. It simply has to remain in the same body in which it has been present all along as that body gives rise to another of its kind.

human zygote twins, a new human organism is produced not by means of the fusion of complementary genetic materials provided by its parents, but by means of the duplication or cloning of a single human organism's genetic material. Indeed, on this understanding of monozygotic twinning, identical twins are genetically identical precisely because one is a clone of the other. Perhaps even more troubling, what also follows from this is that the two identical "twins" that result from monozygotic twinning are not actually twins at all: the elder "twin" turns out to be the progenitor or parent of the younger, and the younger turns out to be its offspring, that is to say, its son or daughter (Ford, 1988, 136). This is a surprising result, to say the least, given that human beings are typically taken to be exclusively sexually-reproducing organisms.[37]

One way to try to avoid this potentially troubling conclusion is to stipulate that parenthood is not simply a matter of material contribution. Rather, what is required for parenthood is that the new life be brought into the world by means of an intentional act (and here "intentional" is meant to include both conscious and natural intentionality). A parent is one who intentionally acts so as to create new life. And because the early zygote does not intentionally bring about the existence of its twin, either consciously or naturally, it does not count as the parent of that organism. Only the mother and father who intentionally performed the action that gave rise to the initial zygote can claim to be the parent of both.[38]

But intentional accounts of parenthood are implausible, and for two reasons. These accounts would seem to have the result that a woman who conceives a child as a result of rape fails to be the mother of that child, and that the scientist in the lab who produces a human zygote by means of in vitro fertilization is the one and only parent of that child.[39] More plausible would

[37] To be clear, it wouldn't be surprising that certain organisms reproduce asexually, given that the vast majority of biological species on earth reproduce in that way, and it wouldn't be surprising that certain organisms can reproduce in both ways, since there are other species that do this (such as starfish, sea anemones, and certain species of plants). It would be surprising that human organisms turn out to be capable of this rare feat.
[38] See, for example, Oderberg (2000, 19); Condic and Condic (2018, 98-100); (Condic, 2020, 56-58).
[39] As Condic and Condic themselves admit (see Condic and Condic (2018, 98-100)).

be a gestational account of parenthood, according to which she is the mother in whose womb the child is formed. On this account, both of the twins would count as the children of the mother who gives birth to them. But even on this gestational account, we may still wonder: who would count as the father of the younger twin? The gestational account also faces the problem of surrogacy: are those surrogates who carry children who are genetically not their own still the mothers of those children?

Better, then, to maintain a genetic account of parenthood and accept the surprising conclusion that the elder twin is in fact the parent of the younger. That in every case of identical twins, one of those twins is the parent of the other is a rather startling result, to be sure. We do not normally regard an elder twin as in any way the parent of the other. And it would seem wrong or inappropriate to treat him or her as if he or she were. But these observations do nothing to undermine the fact that the elder twin really is the parent of the other. For even if one of the twins were the parent of the other, for reasons outlined above, we may have no way of telling which one is which. And even if we could determine which twin is the parent of which, it might still, for various reasons, be impractical and imprudent to treat him or her as such. I submit that a proponent of the budding approach can hold both that the elder twin is truly the parent of the younger and also that, due to our inability to determine which is which, and due to the proximity of their ages, it would be impractical or imprudent to treat either of the twins as the parent of the other. The result would, in some ways, be similar to what occurs in the not uncommon scenario in which a person's uncle is much younger than his niece or nephew. In such case, we regard it as true that the boy, no matter how young, is in fact the person's uncle, but because of the proximity of their ages we absolve the young man of his avuncular duties. In the case of monozygotic twinning, while the elder twin may in fact be the parent of the younger, we may never be able to

know which one is the older twin. And even if we could, it would still be right and fitting to absolve that twin of his or her parental duties and relegate those duties to the closest and most capable kin: his or her own parents. And so the underlying fact that one of the twins really is the parent of the other would make no practical difference, as surprising or alarming as that underlying truth may be.[40]

One last thing that can be said about the problem of parentage is this: even if it is a problem for the budding option, it is just as much a problem for the fission option. For on the fission option, both of the twins are the offspring of the earlier parent zygote who died. And so neither is actually the child of the woman who gives birth to them. Each twin is at best the grandchild of the woman who gives birth to them.[41] And so in whatever way proponents of the fission option hope to resolve the problem of parentage, it seems that proponents of the budding option can make use of the very same strategy. In the meantime, a proponent of the budding option can at least say that one of the twins to whom the woman gives birth is in fact her child, that is, her genetic offspring – something that proponents of the fission option cannot.

Scattered Objects and Multi-location

Contrary to popular belief, neither the scattered object option nor the multi-location option is logically incoherent. It is often suggested that A simply cannot be identical to both B and C because B and C may possess contrary or contradictory properties, and no single thing can possess contrary or contradictory properties at the same time. But I think that this argument misses its mark. It is only impossible for a single thing to possess contrary or contradictory properties if it possesses those properties at the same time, in the same place, and in the same

[40] Eberl offers a similar reply to this worry in his (2006, 131) and (2009, 332).

[41] As Grisez, a proponent of the fission option, appears to admit: "Which one of the two new animals is to be identified with the original individual that was divided? In a case of this sort, perhaps neither. It has been suggested that we should think of identical twins as grandchildren of their putative parents, the individual that divided being the true offspring, and the identical twins children of that offspring by atypical reproduction" (Grisez, 1970, 25).

way. And for both the scattered object option and the multi-location option, while it is true that one single human organism may come to possess contrary or contradictory properties at the same time, he or she would not possess them in the same place and in the same way. On the scattered object option, one human organism may possess one of the contraries or contradictories in one of his or her parts and the other contrary or contradictory in another part, without contradiction, just like I can possess the properties of hot and cold or hot and not-hot by virtue of one of my parts being hot and another being cold. Similarly, for the multi-location option, one human organism may possess one of the contraries or contradictories at one region and the other contrary or contradictory at another region, without contradiction, just like I can possess the property of being hot over here (pointing to one of the regions that my parts occupy) and the property of being cold or not-hot over there (pointing to another region that my parts occupy) (Johnston, 1989, 382).

There are also several examples in the literature of both possible and actual scattered and multi-located objects. Examples of scattered objects include things like bikinis, disassembled bicycles, watches, and guns, sports teams, the state of Hawaii, and the Church.[42] Examples of multi-located objects include things like universal properties, enduring material objects, backwards time-travellers, souls, angels, and God.[43] Roman Catholics may also be theologically committed to the actual existence of at least two sorts of multi-located material objects: bi-located saints and the body of Christ in the Eucharist (Pruss, 2011).

Neither the scattered object option nor the multi-location option is, then, logically incoherent or ad hoc. And, indeed, both of these options have some clear advantages. On both views, all human beings begin to exist at fertilization, and no human being dies when the zygote

[42] See, for example, the articles cited in footnote 8 above.
[43] For discussion, see Gilmore (2018).

or early embryo twins. There are no worries here about some human beings coming into existence later than, and so being younger, than others born on the same day. And there are no worries about one of the twins being the parent of the other or both being the children of the original human organism that died upon twinning.

The scattered object and multi-location options, then, should not be dismissed because they are incoherent or ad hoc or insufficiently motivated. We'll have to find better reasons than that to count them out. Thankfully, there are at least two compelling reasons to reject the scattered object and multi-location options. The first good reason to reject both of these accounts is that it is unclear by what measure or by what criteria two spatially disconnected "parts" or "iterations" of the same object could count as parts or iterations of the very same object. Typically, we use spatial contiguity or functional integration to establish that two otherwise separate entities are in fact just one. But here we appear to have neither spatial contiguity nor functional integration between the parts or iterations of the whole. There would appear to be no biological or psychological continuity of any kind between the two halves or iterations. One of them could be fatally wounded and it seems the other would be just fine. It is not clear at all how two disconnected "parts" or "iterations" of a single organism could maintain enough causal continuity to be said to participate in the very same biological life. Or one could have a vivid memory of her first-grade graduation and the other could have no recollection of that event. In such case, there would certainly seem to be two separate conscious subjects.

The second good reason to reject the scattered object and multi-location options is that even if proponents of these views could successfully respond to the other concerns raised above, at the end the day the view still strikes most of us as deeply counterintuitive. If true, it would require us to think about and to treat identical twins very differently than we currently do. For

example, if one of the parts or iterations of the whole commits a murder, would we have to throw "both" of them in jail? If one of the parts or iterations of the whole gets married, would he or she need to purchase two rings? If a doctor were to ask for the person's weight, would we add up the weights of the parts or iterations or would we average the two? And so on.[44] There appears to be no shortage of similarly perplexing questions that proliferate upon acceptance of either of these views. Paired with the earlier concern about having no clear principle of unity or unification, I think that these practical concerns give us compelling reasons to look for more plausible options.

Intransitivity

The intransitivity option captures the inclination that many of us have to think of B and C as both once having been A, despite clearly not being identical to each other now. But in order to say that both B and C were once identical to A and also that B and C are, right now, not identical to each other, it seems that we are going to have to give up on any claim to B or C's being strictly numerical to A. For what we mean by strict numerical identity is the strongest possible sameness relation, one that is reflexive, symmetric, and transitive. And so at best a proponent of this option can say that B and C bear some intimate relation to A that approximates, but falls short of, strict numerical identity. Now, it should perhaps be noted that proponents of this approach would not be the first to speak of a kind of identity that is less than strict numerical identity.[45] As we've

[44] Shoemaker raises a similar worry in his (2005, 63). Here proponents of the scattered object and multi-location options could reply that these sorts of concerns reveal only that we would have compelling practical or prudential reasons to treat B and C as separate human organisms, even in the case that they are in fact just one scattered or multi-located organism. Notice that this is similar to the response that I offered above to the problem of parentage for the budding option. There it was argued that we may have compelling practical or prudential reasons not to treat one of the twins as the parent of the other, even in the case that it turns out to be true. And so if this sort of move is available to a proponent of the budding option, then it should also be available to proponents of the scattered object and multi-location options. To this I say: granted. But these are not the only concerns raised for the scattered object and multi-location options. Proponents of the scattered object or multi-location options would still need to contend with the earlier concerns about lacking a clear principle of unity or unification. And so I think that the budding option may still come out ahead.

[45] In addition to the exdurantist strategy mentioned here, I am also thinking of Michael Rea's and Jeffrey Brower's relation of "numerical sameness without identity" (see, for example, (Rea, 1998) and (Brower, 2010)), Lynne Rudder Baker's relation of "constitution" (see, for example, (Baker, 2000)), and Peter Geach's relation of "relative identity" (see, for example, (Geach, 1967)).

seen, exdurantists speak of all persisting objects as being identical over time in this less than strictly numerical sense. And, indeed, Trinitarian Christians are required to make a similar move to explain how the Persons of the Holy Trinity can all be identical to God without being strictly numerically identical to each other (Pawl, 2020). The major cost of going this route is that it would seem to require that we join exdurantists in abandoning the notion of strict numerical identity for persisting objects altogether. And so in order to say that B and C are, in some sense, identical, but not *strictly numerically* identical, to A, may require that we also say that B and C are not strictly numerically identical to any entity before or after the moment of twinning. It may require that no object is ever strictly numerically identical to any entity that precedes or follows it in time. And that would be a rather steep cost for maintaining the humanity of the human zygote or early embryo. It may be the case that the human zygote or early embryo is indeed an individual human organism, but on this view it wouldn't be strictly numerically identical to any individual human organism alive tomorrow.

Varieties of Co-location

Each of the six "co-location" options introduced earlier share certain common dialectical advantages in this debate: on each of these views, all human beings begin to exist at fertilization and no human being dies when the zygote or early embryo twins. There are no worries here about some human beings coming into existence later, and so being younger, than others born on the same day. There are no worries about one of the twins being the parent of the other or both being the children of the original human organism that died upon twinning. And there is no need to try to reconcile the appearance of two seemingly distinct identical twin organisms with the deeper metaphysical reality that they are merely one.

There are also several examples in the literature of purportedly completely overlapping or completely interpenetrating objects. Examples of completely overlapping objects include the much-discussed puzzle of the statue and the clay, the puzzle of Dion and Theon, and other similar cases.[46] Examples of completely interpenetrating objects include universals, tropes, shadows, beams of light, and subatomic particles.[47] Christians may also be theologically committed to the actual occurrence of at least two instances of complete interpenetration: the infant Christ passing through Mary's womb, and the glorified Christ passing through the locked door.[48] Finally, certain cases of conjoined twins may serve as actual examples of cases in which two human souls may reside either in the very same or in two partially overlapping bodies (Koch, 2006).

The first three co-location options, then, like the earlier scattered object and multi-location options, should not be dismissed because they are incoherent or ad hoc or insufficiently motivated. Nevertheless, all three do face some serious difficulties. If we accept that two objects of the very same kind can share all of their parts, or that two objects of the very same kind can occupy the very same region of space, or that two souls of the very same kind can occupy the very same body, then the question immediately arises as to what makes these two entities two rather than one. Typically, we would say that what makes two objects of the same kind two objects and not one is that they are composed of different parts or occupy different

[46] See, for example, Wasserman (2018). Further examples are discussed in Oderberg (1996) and Hershenov (2003). Hershenov and Koch-Hershenov make use of some of these examples in defending their co-location account of monozygotic twinning in their (2006).
[47] For discussion, see Gilmore (2018).
[48] See, for example, Aquinas (2009, q. 4, a. 3). Koch-Hershenov cites this passage in support of her complete overlap account (Koch-Hershenov, 2006, 159), but I think that what Aquinas is considering here is actually complete interpenetration. To fill in more of the details of these two theological cases, the infant Christ is said by some Christian theologians to have "passed through" Mary's womb because it is held that this is the only way that the perfect physical integrity of Mary's body could have been preserved throughout the process (and perhaps the only way that she could have been kept entirely free from the pangs of childbirth). The glorified Christ is said by some Christian theologians to have "passed through" the locked door of the upper room where the disciples were because it is held that this is the only way Christ's physical body could have entered that space (the relevant passage here is John 20: 19-20).

regions. But if it is neither the parts nor the location of a material object or soul that distinguishes it from others of its kind, then it is hard to see what could be making that particular object or soul distinct from the others with which it shares its parts or location. Whereas the scattered object and multi-location accounts have trouble unifying or uniting the parts or iterations of the whole present after twinning, the complete overlap, complete interpenetration, and double-ensoulment options have trouble distinguishing or individuating the two objects or souls present before twinning. The problem here is both metaphysical and epistemological. It is not clear what fact in the world could be making the purportedly two objects or souls distinct from one another once they are said to share their parts and their locations, and it is unclear by what means we could ever determine how many such entities we have in front of us. Once we are willing to grant the possibility that there can be completely overlapping or completely interpenetrating human organisms or human beings, it seems hard to say how we can ever be sure that in the case of adult human organisms where there appears to be just one organism there is not two or more lurking in its vicinity. And the same goes with souls. Once we are willing to grant the possibility that two human souls can occupy the same human body or the same portion of matter, it seems hard to say how we can ever be sure that in my body right now there is just one soul. And if the number of human persons is determined by the number of human souls, then it seems that I can never be sure that seated in my chair at this present moment is just one human person.[49]

The adjoining object option would seem to do much better on this score. The adjoining objects option appears to gain all of the benefits of the three co-location accounts just mentioned without having to accept any non-standard account of material constitution or spatial location.

[49] Those sympathetic to a Thomistic hylomorphic account of human persons may have additional reasons to be wary of the complete overlap and double-ensoulment options. Both would seem to conflict with Aquinas's views on individuation (according to which material substances are individuated by the dimensions of their matter) and his unicity doctrine (according to which in any one body or any single portion of matter there can be one and only one substantial form). Koch-Hershenov responds to the first of these concerns in her (2006, 158-159). Eberl presses similar concerns in his critique of Koch-Hershenov's view (see (Eberl, 2007, 286-287)).

The biggest problem with the adjoining objects option is not that it is metaphysically implausible but that it is empirically suspect. The same observations regarding the integration, cooperation, and job specialization of the parts of the early zygote that support the conclusion that there is an individual human organism present before twinning also support the conclusion that there is just one individual human organism there. Indeed, as far as we know, an early zygote that is destined to twin can be qualitatively identical to one that never does. And surely there is only one human organism present in those cases. If a proponent of this view were to insist that there really are two adjoining human organisms present "in" the early zygote before twinning or two adjoining human persons "in" the single human organism that is the early zygote, it would seem entirely arbitrary where we draw the line between the two. There would seem to be no principled way of drawing the boundaries between the bodies of the two persons.

The two remaining options share the benefits of the four co-location accounts just mentioned. But unlike the complete overlap or the complete interpenetration option, neither of these is committed to the possibility of completely overlapping or completely interpenetrating objects or souls. Recall that, on the perdurance option, prior to twinning, B and C co-exist at A as partially overlapping perduring material objects. In other words, B and C are two four-dimensional human organisms who overlap in the sense of sharing temporal parts up until the point at which they separate at twinning. B and C, then, do not share all of their parts, nor do they occupy the very same region of space-time. They only partially overlap at their earliest stages. Like the complete overlap, complete interpenetration, and double-ensoulment accounts, the perdurance account is committed to the claim that prior to twinning there are two co-location human organisms present. And so, right away, the perdurance account inherits the epistemological difficulties faced by similarly committed views. If there can be multiple

perduring human organisms overlapping at the same place and at the same time, then it is hard to see how we could ever determine just how many human organisms there are in front of us at any time. Even worse, many perdurantists also espouse a kind of four-dimensional mereological universalism, according to which every possible set of temporal parts composes a different perduring, four-dimensional object. In that case, prior to twinning, not only will B and C be present in A, but so will every other perduring four-dimensional object that has any temporal parts present at those early stages.[50] Now, it is not clear to me that a proponent of the perdurance option is required to take on this additional commitment of the view (and, indeed, I think they should probably not). But even if they do shed this common commitment of the view, the epistemological and practical concerns introduced by granting the possibility of co-located human organisms remain.

The main problem with the exdurance option is the problem I outlined above in discussing the intransitivity option: it demands that we abandon the notion of strict numerical identity for persisting objects altogether. Recall that, on the exdurance option, B and C co-exist in A as partially co-related exduring material objects. In other words, B and C are two exduring human organisms who share a series of temporal counterparts up until the point at which the causally continuous series of instantaneous stages splits into two discrete series at twinning. While it is true that, on this view, both B and C are related to A in such a way that we can say that they both, in some sense, share their identity with A, neither is strictly numerically identical with A. And so while it may be true that the human zygote or early embryo is indeed an

[50] See, for example, Lewis (1999) and Hudson (2001, Ch. 1). It should be noted that Lewis accepts the result that on his view there are multiple partially overlapping four-dimensional persons sitting in your chair right now, and so the phenomenon of monozygotic twinning would not present any new challenges for the sort of view that he adopts. But it is true that the perdurantist option for explaining what happens in a case of monozygotic twinning would inherit these same concerns and extend them further by introducing a new case in which they may be said to arise. See Curtis (2012) and Efird and Holland (2019) for discussions of the relevance of this point to the case of monozygotic twinning.

individual human organism, it wouldn't be strictly numerically identical to B or C or any individual human organism alive tomorrow. And that would seem to be a rather steep cost for maintaining the humanity of the human zygote or early embryo.

As a way of concluding this section, let me raise just one more concern that I think may arise for any version of the co-location view. Each of the six co-location accounts just mentioned holds that both B and C were present "in" A from the beginning and only became separate from one another at the moment of twinning. But what if A hadn't twinned? Would both B and C have continued to exist "in" A for the rest of "A's" life? Would one of B or C have been absorbed into the other with the result that only one of them survives past gastrulation? Or would both B and C have fused together to give rise to some new individual human organism, D? Each of these options seems problematic. The first seems problematic because then the metaphysical and epistemological concerns just raised would arise not only at the very early stages of human development, but for the entirely of "A's" life. Where there would appear to be a single human organism, there could actually be two, and none of us would have any way of knowing. The second and third seem problematic because then proponents of the co-location view would be committed to the death of one or both of the twins that are present in those cases in which twinning would have occurred but is somehow prevented. Consequently, proponents of the co-location view would thereby inherit the same sorts of difficulties that proponents of the fission option face as a result of their similar commitment.[51]

It seems to me that there are only three possible ways around this worry. First, a proponent of the co-location view could argue that in those cases in which B and C are present "in" A from the beginning, twinning is certain to occur. But this is implausible. Even if

[51] Objections similar to this one have also been raised by Brogaard (2002/2003, 47-48) and Shoemaker (2005, 64-65).

monozygotic twinning were set up to occur from the start, it certainly seems possible that something could go wrong or something else get in the way and twinning never occur. Second, a proponent of the co-location view could argue that in those cases in which B and C are present "in" A from the beginning, they are there precisely because they will later twin. But this would commit its proponent to an inadmissible kind of backwards causation. Third, a proponent could argue that in those cases in which B and C are present "in" A from the beginning, it is God that places B and C "in" A and He does this with perfect foreknowledge that twinning will in fact occur (Munthe, 2001, 384). To the last proposal, I see no reason why this could not work in principle, though it does carry quite a bit of extra baggage. It would mean that there are no religiously-neutral grounds by which one can adequately defend the claim that the zygote or early embryo is an individual human organism. It would mean that we are required to establish the existence of God and give an account of His perfect foreknowledge of future contingents before we could establish that human life begins at fertilization.

V. CONCLUSION

It is often argued that certain metaphysical complications surrounding the phenomenon of monozygotic twinning force us to conclude that, prior to the point at which twinning is no longer possible, there is not yet any individual human organism there. One of the conclusions that I hope to have demonstrated in this essay is that any such argument fails. The metaphysical complications surrounding the phenomenon of monozygotic twinning no more compel us to deny the humanity of the original zygote than the metaphysical complications surrounding brain bi-section or teletransportation compel us to deny the humanity of adult human organisms. As I have argued above, there are in fact several ways of making sense of monozygotic twinning which uphold the humanity of the original zygote. The other conclusion that I have demonstrated

in this essay is that there is no easy answer to what happens when the human zygote twins. All of the options available carry with them one or more surprising, alarming, or otherwise counterintuitive implications. Advocates of the fission option are burdened with having to accept that for every set of identical twins that ever lived, some other human being had to die to give them life. Advocates of the budding option are burdened with having to accept that for every set of identical twins that we know, one of them is actually the (genetic) parent of the other. And advocates of all of the other options are burdened with having to take on some non-standard theory of material composition, spatial location, or human persistence and inherit all of the counterintuitive implications that come with it.

To my mind, the budding option is the most plausible of those on offer. It successfully avoids all of the concerns that arise for the fission view due to the latter's commitment to the death of the earlier organism. And it does so without having to take on any of the theoretical costs of the other views. In order to accept the budding view, it may require that we also accept some kind of further fact view of the human person, perhaps one committed to the existence of souls or haecceities. But that seems like a rather small cost to pay, since there may already be good reasons to think that that sort of view might be right.[52]

In the end, though, I have my doubts. Perhaps what the metaphysical complications surrounding the phenomenon of monozygotic twinning show us is that there is no one single way of explaining what happens when the zygote twins. Perhaps there are several different ways in which monozygotic twinning can and does occur. Perhaps in truly symmetrical cases, or those in which twinning occurs earlier on in development, the fission option accurately describes what is happening there, and perhaps in asymmetrical cases, or those in which twinning occurs later on in development, the budding option has it right. Perhaps we will need to wait for further

[52] See, for example, Swinburne's Alex/Sandra argument from his (2019, 53-55).

empirical evidence to know whether either or both of these views is in fact correct. In the meantime, as long as either one of these two views turns out to be right, the most important conclusion goes through either way: there is nothing about monozygotic twinning that forces us to conclude that a human zygote still capable of twinning is not an individual human organism. Or, to put it another way, there may or may not be good reasons to think that a zygote or early embryo is not an individual human being, but the phenomenon of monozygotic twinning is not one.[53]

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