CAN I KILL MY YOUNGER SELF?
TIME TRAVEL AND THE RETRO-SUICIDE PARADOX

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Abstract. If (backward) time travel is possible, presumably so is my shooting my younger self (YS); then apparently I can kill him—I can commit *retro-suicide*. But to kill him would be to change the past, so how can I kill him? The standard solution to this paradox understands ability as *compossibility* with the relevant facts and points to an equivocation about which facts are relevant: my killing YS is compossible with his proximity but not with his survival, so I can kill him if facts like his survival are irrelevant but I cannot if they are relevant. I identify a lacuna in this solution, namely its reliance without argument on the hidden assumption that my killing YS is *possible*: if it is impossible, it is not compossible with anything. Even if one charitably modifies the solution by dropping its talk of compossibility but keeping its idea that ability varies with the relevant facts, the solution fails to address a harder paradox: I cannot kill YS (not because I cannot change the past, but) because (a) resurrection is impossible and thus so is my killing YS, and (b) impossibility entails inability *no matter* what facts are relevant. I propose a conditional resolution of the harder paradox: if in some world YS coexists with me without being an earlier stage of mine, then my killing YS may be possible even if resurrection is not. I conclude that, if origin essentialism is false, I *can* kill YS.

1. Introduction.[1]

If you believe that time travel is a frivolous topic, good for science fiction but not for rigorous scientific or philosophical investigation, think again. The physical possibility of time machines has recently become the subject of an active debate in leading physics journals like *Physical Review* and *Classical and Quantum Gravity*. The lion's share of attention in this debate has been devoted to time travel by means of "traversable wormholes". A *wormhole* is roughly analogous to a tunnel: it is a shortcut connecting two otherwise distant spacetime regions. A *traversable* wormhole is suitable for travel by humans (Morris & Thorne 1988); e.g., I enter one of the two "mouths" (spherical entrances) of the wormhole in Boston, I travel through the "tunnel" for two minutes (as measured by my watch), and I emerge from the second wormhole mouth in Detroit. Now recall the twin paradox from special relativity: the twin who goes on a space trip and returns ages less than the twin who stays on Earth. Similarly, if one takes the Boston mouth on a space trip and returns it to Boston, then time inside the mouth will run behind Boston time (Morris, Thorne, & Yurtsever 1988). Here is how to use this effect for time travel. I enter the Boston mouth at noon, Boston time. Inside the mouth it's earlier, say 8am. I traverse the wormhole in two minutes and I emerge from the Detroit mouth at 8:02am. Then I catch a 9am flight to Boston and I arrive at 11am, in time to watch my younger self enter the Boston mouth.[2]

[1] This section presents the issues in a simplified and slightly imprecise way. Rigor is introduced in later sections.

[2] Cf. Davies 1995: 246, 2002: 89-91; Forward 1992; Friedman 1988; Gott 2001: 118-24; Nahin 1993: 344-5, 1999: 506-7; Novikov 1998: 246-9; Pickover 1998: 198-200; Redmount 1990: 58-9; Thorne 1994: 500-4. On other kinds of

Not every physicist is convinced. Some physicists even adhere to Stephen Hawking's (1992) "chronology protection conjecture", which says that the laws of physics prevent the construction of time machines.[3] They may or may not be right, but more relevant to my concerns is the motivation of some of them for appealing to the conjecture in the first place, namely the worry that allowing time travel would open up "Pandora's box" (Visser 1993: 557-8) and let loose a bundle of paradoxes. Two kinds of such paradoxes are particularly popular. (1) *Bootstrap* paradoxes involve causal or information loops. Suppose, in the example of the last paragraph, that after arriving in Boston at 11am I go and persuade my younger self to enter the Boston mouth at noon, and I do so only because I (correctly) remember that my younger self entered the mouth only because he was persuaded to do so by his older self (me!). Then the younger self enters the mouth because the older self tells him to, and the older self tells him to because (he remembers that) the younger self entered the mouth: a causal loop. Moreover, suppose the younger self learns the secret location of the mouth from the older self, who learns it (by remembering it) from the younger self: an information loop.[4] (2) *Consistency* paradoxes involve roughly the possibility of generating an inconsistency. Suppose that, after arriving in Boston at 11am, I meet my younger self and I point a loaded gun at him. It seems then that I can kill him; to put it more dramatically, I can commit "retro-suicide". But wait: I cannot kill him, because to kill him would be to change the past. This is a sketch of what I call the "retro-suicide paradox" (RSP; details in §2). In this paper I deal exclusively with such consistency paradoxes.[5]

John Earman (1995a: 281, 1995b: 170) finds puzzling the amount of attention lavished on consistency paradoxes: time travel is compatible with general relativity, so how could the paradoxes show it to be physically impossible? I have three reactions. First, even if time travel is compatible with *classical* general relativity (and semiclassical quantum gravity), it's still questionable whether it is physically possible because it's questionable whether it will be compatible with a full theory of quantum gravity (Simon 1994: 33). Second, noting the putative fact that time travel is physically possible does not resolve the paradoxes and thus need not trivialize them; as an analogy, noting that

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general relativistic spacetimes which allow time travel see, e.g.: Gödel 1949a, 1949b (cf. Malament 1985a, 1985b, 1987; Stein 1970; Yourgrau 1999); Tipler 1974; Gott 1991, 2001: 92-118. Earman (1995a: 277-80, 1995b: 167-9) and Nahin (1993, 1999) give reviews of the physics literature.

[3] On the (ongoing) debate about the conjecture see, e.g.: Cassidy & Hawking 1998; Earman 1995a: 304-9, 1995b: 188-93, 1995c; Earman & Smeenk unpublished; Hawking 2001: chap. 5; Li 1999; Nahin 1993, 1999; Visser 1995: 263-74.

[4] On bootstrap paradoxes see: Airaksinen 1980: 116-7; Al-Khalili 1999: 180-4; Callender & Edney 2001: 70-5; Davies 2002: 102-5; Deutsch 1991: 3204, 1997: 314-7; Deutsch & Lockwood 1994a: 71; Dummett 1986: 155-7; Dwyer 1978: 26; Edwards 1995: 23; Fulmer 1980: 154-5, 1983: 33-4; Gott 2001: 20-4; Hanley 1997: 218-23, unpublished; Heinlein 1941: 119-20, 145, 147; Horwich 1995; Levin 1980; Lewis 1976: 146; MacBeath 1982: 418-9, 427-8; Nahin 1993: 205-14, 1999: 304-19; Ney 2000: 318; Richmond 2001: 310-1; Riggs 1997: 58-64; Smith 1997: 371; Visser 1995: 213; Woodward 1995.

[5] Further kinds of popular paradoxes include: (1) Williams's (1951: 463) claim that it's contradictory to say, e.g., that (cf. Wells 1895: 70) five minutes from now a time traveler may be a hundred years from now (Dowe 2000: 446-8; Grey 1999: 58; Holt 1981; Horwich 1975: 433, 1987: 114; Lewis 1976: 146-7; Matthews 1984: 84-5; Meiland 1974: 153-4; Mellor 1998: 126; Nahin 1993: 174-5, 1999: 256-9; Smart 1963: 239-40; Smith 1998: 156-7); (2) biological paradoxes, with time travelers being their own fathers or mothers (Dowe & Evans unpublished; Godfrey-Smith 1980: 72; Gott 2001: 24-5; Grey 1999: 67-8; Hanley unpublished; Harrison 1980: 67; Heinlein 1959; MacBeath 1982: 427-8, 430 n. 22; Nahin 1993: 214-7, 1999: 319-23; Richmond 2001: 309-10); (3) the "cumulative audience paradox", which asks why we don't observe an accumulation of tourists from the future at historically significant events (a related question is why we observe no visitors from the future at all: Al-Khalili 1999: 191-2; Barrow 1998: 202-3; Davies 1995: 250-1, 2002: 93-4; Deutsch & Lockwood 1994a: 74; Edwards 1995: 22; Fulmer 1980: 155-6; Gott 2001: 109-10; Grey 1999: 56; Hawking 1992: 610; Nahin 1993: 43-7, 189-90, 1999: 66-72, 279-80; Pickover 1998: 81; Richmond 2001: 307, 316-7; Smith 1997: 364, 1998: 158).

the reality of motion is unquestionable does not resolve or trivialize Zeno's paradoxes (cf. Chambers 1999: 301). Indeed, and this is my third point, right after disparaging the paradoxes Earman himself goes on to derive from them the interesting-looking moral that, in spacetimes which allow time travel, local data are subject to unfamiliar "consistency constraints" which may have the status of physical laws. So in this paper I assume that the consistency paradoxes are worthy of serious scrutiny.

The standard solution to RSP and to related paradoxes, due to David Lewis,[6] understands ability as *compossibility* with the relevant facts and explains RSP away as due to an equivocation about which facts are relevant. As an analogy, my speaking Finnish is compossible with the anatomy of my larynx but not with my lack of training, so in one sense I can speak Finnish but in another I cannot. Similarly, my killing my younger self is compossible with his proximity but not with his survival, so in one sense I can kill him but in another I cannot. It is reasonable to use 'can' in either sense, but one must choose; what one must not do is waver, say in the same breath both that I can and that I cannot (Lewis 1976: 150-1; details in §2).

In this paper I undertake four major tasks. (1) I identify a lacuna in the standard solution, namely its reliance without argument on the *hidden assumption* that retro-suicide is *possible*: if it is impossible, it is not compossible with anything, and the standard solution fails because it supplies no sense in which I *can* commit retro-suicide (details in §2). (2) I argue that this lacuna is important. Two versions of RSP can be distinguished: an easier version according to which I cannot commit retro-suicide because I cannot change the past, and a harder version according to which I cannot commit retro-suicide because (a) resurrection is impossible and thus so is retro-suicide and (b) impossibility entails inability. Given that the harder version rests on the *negation* of the hidden assumption, by relying without argument on this assumption the standard solution just *fails to address* the harder version and thus misses the thrust of RSP (details in §3). (3) I resolve the easier version by distinguishing two senses of 'changing the past': an inability to change the past in a first sense does not entail an inability to commit retro-suicide, and an inability to change the past in a second sense does not follow from the claim that necessarily the past is already actualized (details in §3.3.2). (4) I propose a conditional resolution of the harder version. Is retro-suicide possible? In other words, is there a possible world in which I kill my younger self (or, if you will, my counterpart kills his)? These interrogative sentences are ambiguous (cf. Smith 1997: 379). Let 'my younger self' be a *non*rigid designator, and let 'YS' *rigidly* (Kripke 1980: 77-8)—or, if you will, *quasi-rigidly* (Lewis 1986a: 256)—denote my younger self. If resurrection is impossible, then so is my killing my younger self. But my killing *YS* may still be possible: it depends on whether there is a possible world in which *YS coexists with me without being my younger self*. I argue that, *if* origin essentialism is false, then such a world exists, so that retro-suicide (understood from now on as my killing *YS*) may be possible even if resurrection is not (details in §4). This conditional resolution of the harder version does not exonerate the standard solution: even if the hidden assumption turns out to be true, its truth is controversial and cannot be just taken for granted. Contrary to the standard solution, which in a sense trivializes RSP by reducing it to an equivocation, my proposal takes RSP seriously by arguing that it hinges on the puzzling metaphysical issue of origin essentialism.

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[6] For (at least tentative or partial) endorsements of Lewis's (1976) solution see: Brown 1992: 435-6; Dowe 2000: 448-51; Hanley 1997: 209-10, unpublished; MacBeath 1982: 411, 1983: 34; Richmond 2001: 310, 314, 317; Sider 1997: 143. Not everyone agrees with Lewis's solution (e.g.: Grey 1999: 66-7; Smith 1985: 60), but even some of those who disagree admit that the solution is considered "standard" (Vihvelin 1996: 315, 329 n. 1; cf. Riggs 1997: 51).

In §2 I formulate RSP and the standard solution and I argue that this solution relies on the hidden assumption. In §3 I argue that this assumption is important and I resolve the easier version of RSP. In §4 I propose my conditional resolution of the harder version. In §5 I attack an argument, due to Vihvelin (1996), for the claim that I cannot kill YS. I conclude in §6.

2. The retro-suicide paradox (RSP), the standard solution, and the hidden assumption.

Call (rigidly) 'YS' an earlier temporal *stage* of mine and consider an atom-for-atom duplicate of YS: the duplicate and YS have indistinguishable bodies but are temporal stages of different persons, whereas I and YS are different temporal stages of the same person. (Three-dimensionalists may be unhappy with my talk of stages, but as I explain in §4 I don't see how to formulate a paradox in terms of persons rather than stages. See also Sider 2001: 101-9.) Take any situation in which I *can* kill the duplicate: it is within my power to kill him, I have both the ability and the opportunity[7] to do so. For example: he is asleep, I am pointing a loaded gun at him, there is no one around to help him, and so on. (I am *assuming* I can kill the duplicate: I am not saying that the features I list in the example *guarantee* I can kill him. Nor am I saying that I *know* I can kill him: maybe I can but I believe I cannot.) Suppose further that I *don't* kill the duplicate; e.g., I shoot but I miss him. Now modify the situation by replacing the duplicate with YS (YS is asleep etc. and I don't kill him).[8] Since in the previous situation I could kill the duplicate, it seems that in the new situation I can kill YS. But in the new situation by definition I don't kill YS, so apparently I cannot kill him: to kill him would be to change the past. It seems then that P1 entails both C1 and its negation and is thus (metaphysically, hence also) physically[9] impossible:

(P1) My situation is identical to one in which I can (but I don't) kill a duplicate of YS, except that in my situation YS is in the place of the duplicate.

(C1) In my situation I can kill YS (i.e., in my situation I can commit retro-suicide).

But if the physical possibility of P1 follows from the physical possibility of time travel,[10] then time travel is also physically impossible. This is RSP.[11]

Let 'GF' denote rigidly a temporal stage of my paternal grandfather at a time "earlier" (see MacBeath 1982: 411) than my father's conception. Replacing in RSP YS with GF results in the "grandfather paradox" (GFP), a consistency paradox analogous to RSP. Both RSP and GFP focus on what I can or cannot do and thus may be called *ability* paradoxes. By focusing instead on the

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[7] If you are a novice and I am an expert in chess but you refuse to play with me, then in one sense of 'can' I can defeat you but in another I cannot (cf. Austin 1956: 229-30; Cross 1986: 54-7; Hasker 1989: 134-5); I am interested in the latter sense, so I require opportunity in addition to ability (cf. Kenny 1976: 219; Mann 1991: 620; Vihvelin 1996: 318; contrast Goldman 1970: 199). For the sake of simplicity I will in general omit mention of opportunity.

[8] I don't really need to assume that such a modified situation is possible: as it will be seen in a moment, RSP assumes instead that such a situation is physically possible *if* time travel is.

[9] I call a proposition *physically possible* when it is true in a physically possible world; i.e., in a metaphysically possible world in which the actual laws of physics are true. In §4 (see footnote 39 and corresponding text) I give a reason why I formulate RSP in terms of *physical* rather than *metaphysical* or *logical* (im)possibility.

[10] E.g., if time travel by means of a traversable wormhole is physically possible, then under certain assumptions (concerning, e.g., my spatiotemporal location with respect to the wormhole mouths) it is also physically possible that I go back in time and point a loaded gun at YS.

[11] More formally, letting P0 be the claim that time travel is physically possible, and taking a *paradox* to be an apparently sound argument with an apparently unacceptable conclusion (cf. Sainsbury 1995: 1), RSP is the valid argument whose three apparently true premises are: (1) P0 entails that P1 is physically possible; (2) P1 entails C1; (3) P1 entails ¬C1. The conclusion, namely ¬P0, can be considered unacceptable because time travel is compatible with general relativity. (Denying P0 is a live option, however: as I said in §1, it is questionable whether time travel will be compatible with a full theory of quantum gravity.)

question of what will prevent me from killing if I (repeatedly) try, one gets what may be called *exertion* paradoxes. An ability paradox purports to derive an impossibility from the assumption that time travel is possible; an exertion paradox, by contrast, purports to derive a strange or improbable but not impossible consequence, namely that (roughly) something will always come up to prevent me from killing no matter how often or how hard I try. In this paper I deal only with ability paradoxes.[12]

The standard solution to the ability paradoxes—proposed by David Lewis in response to GFP but easily modified to fit RSP—understands ability in a given situation as compossibility with the relevant features of the situation and claims that " 'can' is equivocal":

> To say that something can happen means that its happening is compossible with certain facts. *Which* facts? That is determined, but sometimes not determined well enough, by context. … What I can do, relative to one set of facts, I cannot do, relative to another, more inclusive, set. Whenever the context leaves it open which facts are to count as relevant, it is possible to equivocate about whether I can [do something] (Lewis 1976: 150, 1986b: 77).[13]

In other words, according to the standard solution, C1 is ambiguous between (e.g.) C2 and C3:

> (C2) The relevant features of my situation—namely that YS is asleep etc.—are compossible with my killing YS.

> (C3) The relevant features of my situation—namely that YS is asleep etc. *and* that I don't kill YS (and that YS is an earlier stage of mine)—are compossible with my killing YS.[14]

So P1 does not entail a logical impossibility, the conjunction of C1 with its negation; P1 entails rather a logical possibility, the conjunction of C2 with the negation of C3, and the paradox is resolved. Is it, though? Not if C2 (hence C2∧¬C3) is physically impossible, because then so is P1 (on the assumption that P1 entails C2) and the paradox is restored. But the physical possibility of C2 presupposes that of the proposition that I kill YS: if this proposition is physically impossible, then it is not physically compossible with anything.[15] It won't do to reply that this proposition may still be *logically* or *metaphysically* compossible with the relevant features of the situation in C2. These kinds of compossibility are not enough for ability: my killing someone is logically and metaphysically compossible with her being surrounded by bullet-proof glass, but normally in such a situation I cannot kill her. In sum, the standard solution relies without argument on the *hidden assumption* that the proposition that I kill YS is physically possible.

3. The importance of the hidden assumption.

How damaging to the standard solution is its reliance without argument on the hidden assumption? Proponents of the solution might see no damage: they might contend that the assumption (1) is ob-

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[12] Cf., however, §5. On exertion paradoxes see: Bennett unpublished; Earman 1995a: 282-4, 1995b: 171-2; Horwich 1987: chap. 7; Meiland 1974: 173 n. 15; Nahin 1993: 193-201, 1999: 285-94; Price 1996: 278 n. 7; Riggs 1997; Sider unpublished; Smith 1997, 1998: 157-8.

[13] Agreeing with Kratzer (1977: 337-43), in a later piece Lewis regards 'can' as univocal but contextual, "unambiguous but relative" (1979b: 246). For the sake of simplicity I will continue to speak of an alleged equivocation, but for my purposes only the alleged relativity matters.

[14] To circumvent the objection that there is no such *fact* as my killing YS, take compossibility to be a relation between *propositions*; here, between the proposition that I kill YS and some other proposition.

[15] This lack of physical compossibility amounts to the *falsity* of C2, so strictly speaking it is the *truth* of C2 which relies on the hidden assumption that my killing YS is physically possible; the physical *possibility* of C2 relies on the *strict* hidden assumption that my killing YS is physically *possibly* possible. The latter assumption entails the former if the accessibility relation between physically possible worlds is transitive (cf. Loux 1979: 23-4), but it is not (Salmon 1989: 8-9). For the sake of simplicity I will not talk again about the strict hidden assumption, but mutatis mutandis my reasoning would go through if I did. (I would then modify P2, P4, and P5—see §3.2 and §4—by replacing 'impossible' with '*necessarily* impossible'. P5 follows from the modified P5, so if P5 is false then so is the modified P5.)

viously true and thus needs no argument, (2) can be dispensed with by charitably modifying the solution, or (3) must be true if a paradox is to arise at all. In the next three subsections I argue that all three contentions fail; it turns out that by relying without argument on the hidden assumption the standard solution misses the thrust of RSP.

3.1. Is the hidden assumption obvious?

Look at this helpless boy, lying asleep within the range of my loaded gun! *Of course* it's physically possible that I kill this boy; what's physically impossible is the *conjunction* of the propositions that I kill this boy and that this boy is an earlier stage of mine—or so a proponent of the standard solution might claim. In reply I grant that one can refer to YS by pointing to him and uttering "this boy" (and thus without mentioning that he is an earlier stage of mine) but I deny that the physical possibility of the proposition that I kill this boy is obvious. The physical possibility of this proposition amounts to the existence of a physically possible world in which I *do* kill this boy. But in any such world this boy *is* YS (given that 'this boy' and 'YS' are rigid designators), so what happens after I kill him—does he rise from the dead and grow up to become me? If resurrection is physically impossible, then apparently so is my killing YS. In §4 we will see that the story is more complicated (maybe in some world YS—and thus this boy—is not an earlier stage of mine); my present point is only that the physical possibility of my killing YS cannot be just taken for granted, so the current contention on behalf of the standard solution (namely that the hidden assumption is obvious) fails.

My reply to the contention that the hidden assumption is obvious hinged on the *rigidity* of the designator 'this boy'; what if I refer to YS by using instead the *non*rigid designator 'the boy in front of me'? Then I grant that the physical possibility of the *new* proposition that I kill the boy in front of me is obvious: in some physically possible world the boy in front of me is (say) a duplicate of YS rather than YS, I kill the duplicate, and he does not rise from the dead. But the physical possibility of this new proposition need not entail the hidden assumption, so it need not follow that *the hidden assumption* is obvious. A proponent of the standard solution might argue that (charitably understood) the solution relies on the physical possibility of the new proposition *rather than* on the hidden assumption, because C2 (and C3) should be modified by substituting 'the boy in front of me' for 'YS'.[16] In reply I grant that C2 should be thus modified *if* P1 and C1 *also* are; so I grant that in response to a *variant* of RSP (which corresponds to the *modified* P1 and C1) the standard solution does not rely on the hidden assumption (but relies instead on the trivial assumption that the proposition that I kill the boy in front of me is physically possible). But the fact remains that *in response to RSP* the standard solution does rely on the hidden assumption. Similar remarks apply to GFP. Even if resurrection is physically impossible and my father is born in 1933, the physical possibility of my killing GF in 1930 might seem obvious (suppose for the sake of argument that there is a physically possible world in which my father is born in 1929); so *in response to GFP* the standard solution relies on an arguably trivial assumption rather than on the hidden assumption. But although Lewis (1976) proposed the standard solution in response to GFP rather than RSP and is thus in a

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[16] The point would be that it is uncharitable to formulate the standard solution in terms of C2: the use of the rigid designator 'YS' in C2 smuggles in the facts that the boy in front of me is an earlier stage of mine and that I don't kill him, facts which are irrelevant to the sense in which I can kill him. I have three replies. (1) In §4 I argue that maybe YS is not *necessarily* an earlier stage of mine; if so, then the use of 'YS' in C2 need not smuggle in any irrelevant facts. (2) Lewis (1976) talks about "Tim's killing Grandfather" (rather than "his grandfather"), so apparently he uses 'Grandfather' as a name and thus as what he calls a 'quasi-rigid' designator (1986a: 6, 256). (3) My argument does not hinge on Lewis exegesis: in the text I go on to grant that Lewis's solution avoids my current critique with respect to *his* (but not *my*) ability paradox.

sense immune to the criticism that his solution relies without argument on the hidden assumption, it would be a Pyrrhic victory for a proponent of the solution to conclude that it works against GFP (or the modified RSP) but fails against RSP. I am not saying that a single approach should resolve all ability paradoxes: it turns out, surprisingly, that GFP and RSP are subtly different, and so are various variants of RSP. I am rather saying that, if it is conceded that the standard solution fails against RSP, then it is conceded that RSP requires some other solution. (In §6 I criticize the standard solution even in response to GFP.)

3.2. Is the hidden assumption dispensable?

One might try to get rid of the hidden assumption by charitably modifying the standard solution. The claim that ability in a given situation amounts to compossibility with the relevant features of the situation *grounds* in the standard solution the claim that ability can vary with the relevant features, but one can reject the former claim and still accept the latter. In other words, one can drop all talk of compossibility but still claim that C1 is ambiguous, now between (e.g.) C4 and C5:

> (C4) Relative to the relevant features of my situation—namely that YS is asleep etc.—I can kill YS.
>
> (C5) Relative to the relevant features of my situation—namely that YS is asleep etc. *and* that I don't kill YS (and that YS is an earlier stage of mine)—I can kill YS.

According to the modified standard solution, P1 entails C4∧¬C5 rather than C2∧¬C3. Even if my killing YS is physically impossible and is thus not physically compossible with anything, it need not follow that C4 (or C4∧¬C5) is physically impossible: C4 (unlike C2) is not a compossibility claim. So it seems that the modified standard solution dispenses with the hidden assumption. Does it, though? Not if *physical impossibility entails inability*, because then the physical impossibility of my killing YS does entail that of C4 (thus of C4∧¬C5) and the paradox is restored. More rigorously, even if the modified standard solution does not rely on the hidden assumption that P2 is false, it still relies on the *modified hidden assumption* that P2∧P3 is false:

> (P2) It is physically impossible that I kill YS. [P2 is the negation of the hidden assumption.]
>
> (P3) Necessarily, if it is physically impossible that I kill YS, then in my situation I cannot kill YS.

P3 is impervious to equivocation: according to P3, *no matter* what the relevant features of my situation are, relative to these features I cannot kill YS if it is physically impossible that I kill him.[17] So P3 suggests a general reason why solutions to RSP that appeal to an equivocation about relevance fail if the hidden assumption is false: even if *normally* whether I can make a proposition true depends on what counts as relevant, in the *special* case in which the proposition is physically impossible I just cannot make it true—regardless of what counts as relevant.

Proponents of the (modified) standard solution might wish to contest P3. But how could they do so convincingly? The original standard solution *presupposes* P3: it can be seen that an understanding of ability as physical compossibility entails P3.[18] Moreover, and more important, it seems that *any*

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[17] Lewis might reply that, not only is it possible to equivocate about whether I can do something, "[i]t is likewise possible to equivocate about whether it is possible for me to [do something]" (1976: 150). But such a reply would not sit well on Lewis's own use of compossibility: to say that two propositions are compossible is to say that their conjunction is possible, so if 'possible' is equivocal then so is 'compossible'. More importantly, however, it seems that there *is* a fact of the matter about whether in some physically possible world I kill YS, so P3 can escape equivocation.

[18] The claim that, necessarily, if I can kill YS then my killing YS is physically compossible with the relevant features of my situation entails the claim (P3) that, necessarily, if I can kill YS then my killing YS is physically possible.

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reasonable understanding of ability must satisfy P3: we common mortals cannot bring about physically impossible states of affairs—even if God, saints, or magicians can, because they can perform miracles.[19] One might object that my inability to perform miracles does not entail P3: even if my killing YS is *physically impossible*, it doesn't follow that it's a *miracle*. The idea is that my killing YS may be physically impossible by virtue of *entailing* (rather than *being*) a miracle, namely the miracle that YS is resurrected (maybe by someone else, who *can* perform miracles). But then, I reply, P3 follows from my inability to perform actions which *are or entail* miracles—to use a label, my inability to *guarantee* miracles. One might respond that, if the world is deterministic but I have free will, then I *can* guarantee miracles: I can (e.g.) whistle although the laws of physics together with the current state S of the world entail that I won't. I reply that this need not count as "guaranteeing" because my whistling need not *entail* a miracle: even if in every world *with state S* in which I whistle a miracle occurs, maybe in some world with state *different* from S I whistle but no miracle occurs. (From the claim that my whistling is physically *not compossible* with the current state of the world it need not follow that my whistling is physically *impossible*; cf. van Inwagen 1993: 188.) Let me emphasize, however, that I am not committed to the claim that I cannot guarantee miracles or to the *truth* of P3. My point is rather that P3 is *plausible*, so we have good reason to believe that even the above charitable modification of the standard solution relies without argument on the hidden assumption. In any case the modified standard solution relies without argument on the *modified* hidden assumption that P2∧P3 is false.[20]

3.3. Is the hidden assumption innocuous?

If retro-suicide is physically impossible, then *of course* we common mortals cannot commit retro-suicide. But in such a case not much of a paradox is left: the proper reaction to RSP is simply that, contrary to initial appearances, I cannot kill YS. If so, then the standard solution cannot be faulted for relying on the hidden assumption: the assumption must be true if a paradox is to arise at all, and is in this sense innocuous—or so one might reason on behalf of the standard solution. I reply that this reasoning gets things backwards: in fact the paradox becomes *harder* when the hidden assumption is false than when it is true. More precisely, in §3.3.1-§3.3.3 I argue that: (1) two versions of RSP can be distinguished, one which doesn't and one which does presuppose that the modified hidden assumption is false; (2) the former version is relatively easy; (3) the latter version is hard. If so, then the hidden assumption is not innocuous: by relying without argument on this assumption the standard solution fails to address the harder version and thus misses the thrust of RSP.

3.3.1. The wide and the narrow RSP.

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[19] Assuming that "[a] miracle is a violation of the [actual] laws of nature" (Hume 1748: 114; contrast Clarke 1999; cf. Lewis 1979a: 44-5). If God, saints, and magicians can perform miracles, then my objection to the modified standard solution does not work for a *variant* of RSP formulated with respect to these kinds of beings; nevertheless, my objection works against the solution *in response to RSP*. "Necessarily" in P3 is understood *physically*: arguably it is physically but not metaphysically impossible for me to be (e.g.) a saint, able to perform miracles.

[20] Another attempt to get rid of the hidden assumption starts with the claim that my killing YS is not a miracle; to use a label, it is *locally (physically) possible*—even if it is ("globally") physically impossible. (See Brown (1992: 440), Earman (1995a: 286, 1995b: 174), and Kutach (2002: 2-3) for distinctions similar to the one between local and global physical possibility.) If C2 and C3 are modified by replacing compossibility with local compossibility, the resulting modification of the standard solution (call it the *local standard solution*) relies not on the hidden assumption but rather on the (trivial) *local hidden assumption* that my killing YS is *locally* possible. (An alternative idea is that C1 is ambiguous not between local-C2 and local-C3, but rather between C2 and local-C2.) I reply that if physical impossibility entails inability and ability amounts to local compossibility, then the physical impossibility of my killing YS entails that of local-C2; so even the local standard solution relies without argument on the modified hidden assumption that P2∧P3 is false.

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The two versions of RSP that I want to distinguish correspond to two ways of grounding the claim that I cannot kill YS: in the *wide* RSP this claim is grounded on the assumption that YS was not killed (so that to kill him would be to change the past), whereas in the *narrow* RSP the claim is grounded on the assumption that P2∧P3 is true (it is physically impossible that I kill YS, and this physical impossibility entails my inability to kill him).[21] These two grounds for claiming that I cannot kill YS are not clearly distinguished in the literature, but the distinction is of interest: the wide ground is inadequate and something like the narrow ground is required to account for our reactions to RSP. Here is why. (1) The wide ground is inadequate because, if it were (sound and) the whole story, then my inability to kill YS would be on a par with my inability to do *anything* inconsistent with the actual past; e.g., with my inability to kill Hitler (to kill him would also be to change the past, given that he was not killed by me). But we are not inclined to treat these cases equally: it seems that there is something *especially* problematic when my target is YS rather than anyone else (cf. Brown 1992: 436; Vihvelin 1996: 328-9). (It seems likewise essential to assume in GFP that the time of the contemplated murder *precedes* my father's conception, but this assumption would be inessential if the wide ground were the whole story.) (2) To see why something like the narrow ground is required, modify my formulation of RSP (see beginning of §2) by dropping the assumption that I don't kill the duplicate of YS; in other words, leave unspecified whether I kill the duplicate or not. When we consider the new situation in which YS replaces the duplicate, it seems we cannot drop the assumption that I don't kill YS: although this assumption is no longer explicitly specified, it pops up again as a consequence of the assumption that YS is an earlier stage of mine. So it seems that we take the proposition that I don't kill YS to be *necessary*, just as (P2 and thus) the narrow ground claims.[22] (We attach no similar necessity to the proposition that I don't kill Hitler.) I conclude that our *reactions* to RSP are not adequately captured by the wide ground; something like the narrow ground is (also) required. Now our reactions may well be misguided (I gave no *argument* against the claim that my inability to kill YS is on a par with my inability to kill Hitler), and in any case some people (e.g., Horwich 1987: 119) do not share the above reactions, so let me emphasize that this conclusion is intended primarily to motivate the distinction between the wide and the narrow RSP but is inessential to my argument; more important is the contention, which I will now defend, that the wide ground is not a sound ground for claiming that I cannot kill YS.

3.3.2. Debunking the wide RSP.

Suppose that it's now (a moment in) 2000 and that in my situation (referred to in P1) I first point a gun to YS at a moment *t* in 1975. Here is why, according to the wide ground, P1 (strictly speaking: P1∧W3) entails the negation of C1:

        (W1) I don't kill YS (shortly after *t*). [From P1.]

Thus: (W2) To kill YS would be to change the past.

        (W3) I can't change the past.

Thus: (W4) I can't kill YS. [From W2 and W3.]

W4 is ambiguous between W4a and W4b:

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[21] My formulation of RSP in footnote 11 corresponds to the *wide* RSP (provided that the inference in (3) is filled in as in §3.3.2). The *narrow* RSP replaces (3) with: (3′) P2∧P3. This entails that C1 is physically impossible and in conjunction with (2) entails that so is P1. (Actually the narrow RSP does not just assume P2 but derives it from P4∧P5: see §4.)

[22] It's not clear, however, that we take this necessity to be *physical* or that P3 is required; this is why I say that *something like* the narrow ground is required.

(W4a) At *t* (in 1975) I can't kill YS.

(W4b) Now (in 2000) I can't kill YS.

Since in my situation it's at *t* rather than now that I am pointing a gun at YS, the claim that (C1) in my situation I can kill YS corresponds to the negation of W4a rather than W4b—so let me focus for the moment on W4a. If to kill YS shortly after *t* would be to change the past *of 2000*, it would be to change the *future* of *t*. Even if at *t* I cannot change the past of *t*, why can't I at *t* change the future of *t* and thus the part of the past of 2000 that lies in the future of *t*? In other words, W3 is also ambiguous:

(W3a) At *t* I can't change the past of *t*.

(W3b) At *t* I can't change the past of 2000.

If W3 is understood as W3a, then the above argument from W1-W3 to W4a is invalid because the "past" in W2 is the past of 2000 (if it were the past of *t*, then W2 would not follow from W1). And if W3 is understood as W3b, then the argument is unsound because W3b entails the false claim W5 and is thus false:

(W5) At *t* I can't change the part of the future of *t* that lies in the past of 2000.

One might object, however, that W5 is true because, as Lewis claims, one can no more change the future than one can change the past (1976: 150, 1979a: 37-8; cf. Smart 1958: 76, 1981: 149). Now I grant that there *is* a sense of 'changing the future' (similarly for the past) in which, for any moment τ, at τ I cannot change the future of τ: at τ I cannot bring about a (logically impossible) state of affairs in which an event both does and does not occur at some moment after (or before) τ.[23] But in *this* sense of 'changing the future' to kill YS shortly after *t* would *not* be to change the future of *t* (or the past of 2000); to kill YS would be instead to change the future of *t* in the *different* sense of actualizing a nonactual future of *t* (cf. Mavrodes 1984: 143).[24] (As an analogy, assuming I won't raise my arm, to raise my arm would not be to bring about a state of affairs in which I both do and don't raise my arm; it would be instead to actualize a nonactual future—or a nonactual past of, e.g., 3000.[25]) In this *second* sense of 'changing the future' I *can* at *t* change the future of *t* (because, e.g., I can raise my arm even though I won't).[26] So W2, W3b, and W5 are also ambiguous. On the former understanding of 'changing the future' (similarly for the past) W3b and W5 are true but W2 is false; on the latter understanding (which I adopt from now on) W2 is true but W3b and W5 are false. In either case the argument from W1-W3b to W4a is unsound.

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[23] It may be logically possible that (e.g.) I both raise my arm at some moment and not raise my arm at the "corresponding" moment in a different temporal dimension (cf. Meiland 1974) or in a different parallel universe (cf. Abbruzzese 2001; Airaksinen 1980: 118-21; Al-Khalili 1999: 185-91; Barksdale 1998: chap. 5; Beeman 1994; Blumenthal 1988: 17-8; Davies & Cole 1997: 321-2; Davies & Brown 1986: chap. 6; Deutsch 1991: 3206-7, 1997: chap. 12; Deutsch & Lockwood 1994a: 72-3, 1994b; Dowe unpublished; Edwards 1995: 18-20; Hanley 1997: 210-1; Hewett 1994; Lewis 1976: 152; Mellor 1998: 127; Nahin 1993: 201-5, 1999: 294-303; Ney 2000: 320 n. 3; Pickover 1998: 81-6; Richmond 2001: 315-7); but in such cases there need be no paradox because I am *avoiding* (Smith 1997: 365-6) rather than *changing* the future or the past.

[24] There *are* such nonactual futures because resurrection is *meta*physically possible: "There is a possible world at which … the time traveler shoots and kills her baby self; the baby … is resurrected from the dead; the baby grows up to become the time traveler who journeys back to the past where she shoots and kills her baby self" (Vihvelin 1996: 317).

[25] Lewis might claim that this is "not an actual change: not a difference between two successive actualities" (1976: 150; cf. 1979a: 38). See Vranas unpublished for a response.

[26] Hard determinists might object: it is physically impossible that I can but I don't φ. I reply that then the wide RSP needs no resolution because it does not even get off the ground: there is no physically possible situation in which I can but I don't kill a duplicate of YS, so P0 (footnote 11) does not entail that P1 is physically possible. (Hard determinism cannot similarly avoid the *narrow* RSP: the parenthetical clause "but I don't [kill the duplicate]" was included in P1 to make P1 entail W1, but it seems that a modification of P1 without this clause (a) must be physically possible if P0 is true and (b) entails C1. This is one reason why the narrow RSP is harder than the wide.)

So far I have been talking about the *chronological* past (or future) of *t*, which contains the events that occur before (or after) *t*. I argued that to kill YS shortly after *t* would be to change the chronological *future* (not the past) of *t*, and that at *t* I *can* change the chronological future (even if not the past) of *t*. One might respond, however, that to kill YS shortly after *t* would also be to change the *causal* past of *t*, which contains the events that (ultimately) bring about the state of the world at *t*. One might then argue that I can't kill YS shortly after *t* because (W3a′) at *t* I can't change the causal past of *t*.[27] In reply I contest W3a′. Suppose that shortly after *t* YS eats a bar of chocolate, *C*. This event is in the causal past of *t*: the chocolate provides YS with nutrients which contribute to his growing up and becoming the time traveler who points a gun to YS at *t*. It seems clear, however, that at *t* I can substitute for *C* a qualitatively identical chocolate bar *C′*, so that YS eats *C′* rather than *C* shortly after *t*; so at *t* I *can* change the causal past of *t*, actualize a nonactual causal past (which differs *qualitatively* from the actual one: the latter contains no substitution). In response one might argue that such a substitution would make no difference to the state of the world at *t*. Not so (one might continue) if I were to kill YS shortly after *t*: then YS would not grow up, I would not point a gun to him at *t*, and I would not kill him shortly after *t*. Note that this objection makes no appeal to an inability to change the (chronological or causal) past: the objection is rather that if I were to kill YS then I would not kill him, so that a contradiction would be true. Such an objection, however, has already been satisfactorily addressed by David Lewis:

> If you make *any* counterfactual supposition and hold all else fixed you get a contradiction. The thing to do is rather to make the counterfactual supposition and hold all else as close to fixed as you consistently can. … It is hard to say what is the least revision …, but certainly the contradictory story in which the killing both does and doesn't occur is not the least revision. Hence it is false … that if [I had killed YS] then contradictions would have been true (Lewis 1976: 152).

I revert now to talking exclusively about *chronological* past and future, and I turn to W4b. One might grant that *at t* I can kill YS but deny that *now* (in 2000) I can do so; as an analogy, one might grant that *in 1865* I can (though I don't) prevent Lincoln's assassination (assuming I am in Washington as a time traveler) but deny that *now* I can prevent it. But why exactly would this be a problem? What I can do at a given moment I cannot always do at a later moment: in the morning I can keep my evening appointment but in the afternoon I cannot—I missed the noon plane (cf. Stocker 1971: 311 n.12; Goldman 1970: 204). If it's at *t* rather than now that I am pointing a gun at YS, what is the problem with saying that at *t* I can kill him but now I cannot? The problem, one might answer, stems from the validity of the inference from "now I can go back to *t*" and "at *t* I can kill YS" to "now I can kill YS" (contrast Brown 1988: 20; Horty 2001: 24). Equivalently (one might continue), from "at *t* I can kill YS but now I cannot" it follows that now I cannot go back to *t*. But then P1, understood as presupposing that I *do* go back to *t* and thus that I *can* go back, entails a contradiction—or so the objection goes.

I reply that the reasoning of the objection could be turned on its head. The objection grants that at *t* I can kill YS, and assumes the validity of the inference from "now I can go back to *t*" and "at *t* I can kill YS" to "now I can kill YS". The objection further assumes that now I cannot kill YS and infers

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[27] My distinction between chronological and causal past (or future) is similar to Lewis's distinction between "external" and "personal" time (1976: 146-7, 149; cf. Brown 1992: 435 n. 11; Edwards 1995: 17; Fulmer 1980: 152, 1983: 32; Gallois 1994: 65; Godfrey-Smith 1980: 72; Gilmore 1997: 17-9; Grey 1999: 62-3; Hanley 1997: 199; Holt 1981: 7-9; Keller & Nelson 2001: 339-40; MacBeath 1982: 404-6, 409-10; Ney 2000: 314; Richmond 2001: 305; cf. also Chapman 1982: 45; Harrison 1971: 10). If to kill *Hitler* shortly after 1920 would not be to change the causal past of 1920, then the current version of the wide RSP does distinguish my putative inability to kill YS from my putative inability to kill Hitler.

that now I cannot go back to *t*; but why not contrapositively assume that now I *can* go back to *t* and infer that now I *can* kill YS after all, contrary to what the objection assumes? To avoid being question-begging, the objection needs to be supplemented with an *argument* for the claim that now I cannot kill YS (although at *t* I can). Here is such an argument. Even if at any moment τ I can change the future of τ, I cannot change the past of τ: necessarily, at τ the future of τ is not yet actualized but the past of τ already is (cf. Hasker 1989: 123; Freddoso 1982: 55-6), so at τ it's *too late* for me to change the past of τ (to actualize a nonactual past). In reply I ask: granted that necessarily the past is already actualized, how does it follow that now I cannot actualize a nonactual past? If I were to actualize a nonactual past, "[i]t's not that … the [past] would change retrospectively. Rather, it would never have been what it actually is, and would always have been something different" (Lewis 1994: 482-3). So the claim that, e.g., now I can (go back to 1865 and) prevent Lincoln's assassination is compatible with the claim that necessarily the past is already actualized, namely that necessarily every past event has already occurred:[28] Lincoln's assassination has already occurred in the actual world, in which I don't prevent it, and has already been prevented (by the time I start my journey back to 1865) in every possible world in which I prevent it. These considerations do not establish that now I *can* actualize a nonactual past, but I take it they show that the claim that I *cannot* fails to follow from the premise that necessarily the past is already actualized—and showing this suffices for refuting the objection.

Let me summarize my treatment of the wide RSP. I distinguished two senses of 'changing the past'. It is widely recognized that an inability to change the past in the *first* sense (e.g., to both visit and not visit *t*) fails to jeopardize the (physical) possibility of time travel.[29] My contribution was to argue that an inability to change the past in the *second* sense (i.e., to actualize a nonactual past) (1) does not follow from the premise that necessarily the past is already actualized, and (2) does not entail that *at t* I cannot kill YS.[30] Of course for all I argued it may still be false (e.g., if the *narrow* ground is sound) that now or at *t* I can kill YS; my current point is only that the falsity of these claims is not established by the wide ground, so the wide RSP is resolved.

3.3.3. The recalcitrance of the narrow RSP.

The narrow RSP pits against each other two compelling lines of reasoning: I can kill YS because (P1) in a similar situation I can kill an atom-for-atom duplicate of his, but I cannot kill YS because (P2) it

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[28] I take it that an event is actualized when it *occurs*. Alternatively, one might say that an event is actualized when it is *caused* (or when its cause occurs). But if time travel is possible and thus so is backward causation, then it is possible that some past events have not yet been caused, and thus that the past has not yet been (fully) actualized in the alternative sense. So the claim that necessarily the past is already (fully) actualized in the alternative sense presupposes the impossibility of time travel and would thus be question-begging in the context of an objection to the possibility of time travel.

[29] More than ten authors have pointed out that if one were to go back in time one would not change the past in the first sense: there would not be a "first time around" at which some event occurred and a "second time around" at which the event did not occur (see Dwyer 1975: 344-5; Fulmer 1980: 151, 1983: 33; MacBeath 1982: 410-1; Mavrodes 1984: 143; and all authors in footnote 30).

[30] In the terminology of Vranas unpublished, *replacing* the past (i.e., changing it in the second sense) should be distinguished not only from *transforming* it (i.e., changing it in the first sense) but also from *affecting* it (i.e., having a causal effect on it). If time travel occurs, then time travelers (1) neither can nor do transform the past, (2) both can and do affect the past (the latter merely by arriving there), and (3) do not but maybe can replace the past (e.g., they do not but maybe they can visit times they have never visited). Not all of these distinctions are made clear by those who talk of *influencing* (Gilmore 1997: 34; Horwich 1975: 435-6, 1987: 116), *participating in* (Blumenthal 1988: 18-9), or even *affecting* (Brier 1973: 361, 1974: 27-8; Cook 1982: 51; Dwyer 1977: 384-5; Hanley 1997: 205-6; Nahin 1993: 183-93, 1999: 269-85; Smith 1997: 366, 1998: 156) the past (or the future).

is physically impossible that I kill him and (P3) this physical impossibility entails my inability to kill him. Unless one gives up the physical possibility of time travel, to resolve the paradox it is necessary to debunk at least one of the two lines of reasoning. To debunk one of the lines it is not enough to show that the *other* line is sound: this would at most establish but would not *explain* the unsoundness of the line to be debunked. So it won't do to say that, if P2∧P3 is true, "not much of a paradox is left: the proper reaction to RSP is simply that, contrary to initial appearances, I cannot kill YS" (see beginning of §3.3; cf. Malament 1985b: 98). This is unsatisfactory because the question remains: what difference between the situation in which I face YS and the situation in which I face a duplicate of YS explains why I cannot kill YS although I can kill the duplicate? I don't see what such a difference could be: the two situations are by definition indistinguishable in terms of local physical features, and the line of reasoning under attack relies implicitly on the claim that ability *supervenes* on such features.[31] This supervenience claim might be false, but its falsity is neither explained nor even established by producing an apparently sound argument for P2∧P3: one might symmetrically reason that such an argument must be flawed because the supervenience claim is true (cf. Chambers 1999: 299). Given the plausibility of the supervenience claim, it seems unpromising to try and debunk the former line of reasoning;[32] but trying to debunk the latter line seems also unpromising, because apparently P2 follows from the (arguably analytic[33]) physical impossibility of resurrection (§3.1) and P3 must be satisfied by any reasonable understanding of ability (§3.2). It seems thus that we have reached an impasse. I will soon suggest a way out, but the appearance of an impasse indicates that the narrow RSP is hard to solve—in fact *harder* than the wide RSP. If so, then the hidden assumption is not innocuous: by relying without argument on this assumption the standard solution fails to address the harder of these two versions of RSP.[34]

I conclude that the hidden assumption is neither obvious (§3.1) nor dispensable (§3.2) nor innocuous (§3.3); the reliance *without argument* of the standard solution on this assumption is a serious flaw in the solution *even if* the assumption turns out to be true.

4. A conditional resolution of the narrow RSP.

The narrow RSP relies on the claim that (P2) my killing YS is physically impossible. I said in §3.1 that if resurrection is physically impossible then *apparently* so is my killing YS. I also said, however, that the story is more complicated; here is why. The physical impossibility of resurrection entails that there is no physically possible world in which I kill a person-stage who *in that world* is

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[31] Somewhat less roughly, the claim is: for any situations S_1 and S_2 that have the same local physical features and any person-stage P, P can bring about in S_2 whatever local configuration of matter P can bring about in S_1. For similar claims see Deutsch and Lockwood's "autonomy principle" (1994a: 71) and especially its reformulations by Sider (1997: 142-3) and Chambers (1999: 298; cf. 300). If the supervenience claim is true, it is not a *relevant* difference between two situations that YS is an earlier stage of mine whereas the duplicate of YS is not. One might object that duplicates need not have the same abilities: "Suzy's duplicate can see Suzy's face without looking at a mirror, but Suzy cannot" (Vihvelin 1996: 330 n. 4; cf. 322, 327). I reply that we don't have *two* situations here: to a situation in which Suzy's duplicate is facing Suzy, no situation corresponds in which Suzy is facing Suzy (as opposed to facing Baby Suzy).

[32] Cf. Lewis: "Tim is as much able to kill Grandfather as anyone ever is to kill anyone" (1976: 149; cf. Mellor 1998: 128; Nerlich 1981: 234, 1994: 240; Sider 1997: 143).

[33] It seems natural to understand the (arguably analytic) claim that death is permanent and irreversible as the claim that it is physically impossible to live again after one's death, to be resurrected (cf. Feldman 1992: 64; contrast 66-71). But isn't it physically—even if at present not technologically—possible to revive the brain dead? If it is, then the *criterion* of brain death does not capture the *concept* of death (cf. Fischer 1993: 4).

[34] Some people might disagree with my assessment of the narrow RSP as *harder* than the wide (though cf. footnotes 26 and 38), but even an assessment of the narrow RSP as *nontrivial* suffices to conclude that the hidden assumption is not innocuous.

an earlier stage of mine; but there may still be a physically possible world in which I kill YS, a person-stage who *in the actual world* is an earlier stage of mine. As an analogy, the impossibility of killing someone before she dies entails that there is no possible world in which I kill in 1990 someone who *in that world* dies in 2010; but there is still a possible world in which I kill in 1990 someone who *in the actual world* dies in 2010. The point is simply that someone who actually dies in 2010 could have died in 1990; is it similarly the case that YS, who is actually an earlier stage of mine, could have failed to be an earlier stage of mine? If it is, then my killing YS may be physically possible even if resurrection is not, and the narrow RSP is resolved. More rigorously, P4 alone need not entail P2; the narrow RSP relies on the valid argument from P4 *and P5* to P2, which is unsound if P5 is false:

>(P4) It is physically impossible that resurrection occurs.
>(P5) It is physically impossible that I coexist with YS without being a later stage of YS.

Thus: (P2) It is physically impossible that I kill YS.[35]

Why believe P5? It might be thought (cf. Vihvelin 1996: 324) that P5 follows from a thesis of "origin essentialism" (OE): if a person-stage is a *descendant* of (i.e., originates from or has an earlier stage who originates from) a given sperm and egg, then it is (metaphysically) impossible that this person-stage exists without being a descendant of the given sperm and egg. Given that I and YS are descendants of the same sperm s and egg e, OE entails that I and YS could not have coexisted without being descendants of s and e. P5 need not follow, however: maybe I and YS could have been (post-fission) stages of different identical twins. Call 'Peter' the *person* whose *stages* I and YS actually are. There are physically possible worlds in which YS is a descendant of s and e but is a (post-fission) stage of a person P_1 who (a) dies in 1975, (b) lives a life very different from Peter's actual life, and (c) has an identical twin P_2 whose life is (qualitatively) almost exactly like Peter's actual life. One might point out that from (c) it doesn't follow that in such worlds I am a stage of P_2: "[a] possible world isn't a distant country that we are … viewing through a telescope" (Kripke 1980: 44). True: in such worlds I *need not* be a stage of P_2. But why *can't* I be? Proponents of P5 are committed to the claim (which goes beyond OE) that in *no* such world am I a stage of P_2, although in all such worlds P_2 has a stage who is almost exactly like me and who is a descendant of s and e.[36] To the extent that this commitment is implausible, P5 is itself implausible.

In response one might grant that OE need not entail P5, but might propose a variant of the narrow RSP which does not rely on P5: can I destroy s and e, the sperm and egg whose descendant I am? OE does entail the corresponding variant of P5, namely the claim that it is physically impossible that I coexist with s and e without being a descendant of s and e. In reply I could note that several philosophers reject OE and replace it with a different thesis of origin essentialism.[37] Ultimately,

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[35] By 'coexist' I mean 'exist together', not necessarily at the same *time*. P4∧P5 entails P2 because, in any possible world in which I am a later stage of YS and I kill him, resurrection occurs (so P5∧¬P2 entails ¬P4).

[36] If in such a world I am a stage of P_2, why is YS a stage of P_1? Precisely because possible worlds "are *stipulated*, not *discovered* by powerful telescopes" (Kripke 1980: 44): I am considering only worlds in which YS is a stage of P_1.

[37] Forbes, for example, argues that "what is important to the identity of the organism is the identity of the matter from which it originates, together with the configuration of that matter" (1986: 8), not the identity of the organism's precursor organisms: a zygote z formed by fusion of s and e could have been synthesized, nucleotide by nucleotide, by scientists using "exactly the actual matter of z in exactly its actual z-configuration" (1986: 7; cf. Hawthorne & Gendler 2000: 286; Price 1982: 35; Robertson 1998: 731; Vahid 1994: 65). Note that Kripke's (1980: 110-5) "necessity of origin" thesis, namely that a person who originates from a given sperm and egg could not have originated from a *totally different* sperm and egg, is compatible with the claim that the person could have originated from *no* sperm and egg. So Kripke is not clearly committed to OE and need not disagree with Forbes (see Robertson 1998: 732 n. 5).

however, this reply might not help me. Suppose that *some* entity is an *essential ancestor* of mine; i.e., it is (metaphysically, hence also) physically impossible that I exist (or, more weakly, that I co-exist with it) without being a descendant or a later stage of it. Then it is also physically impossible that I destroy it by means of a physically irreversible process (e.g., that I *annihilate* it: I transform its matter into energy by means of a process whose reversal is physically impossible). But then the narrow RSP need not be so narrow after all: it can be adapted to whatever forms of origin essentialism turn out to be true and to whatever destruction processes turn out to be physically irreversible.[38] This generic formulation of the narrow RSP in terms of origin essentialism and physical irreversibility I take to be of considerable interest. The formulation is in terms of *physical* impossibility because arguably no process is *metaphysically* or *logically* irreversible.[39]

For the sake of argument let me assume that all forms of origin essentialism are false. (This assumption is arguably less controversial than one might at first think: it refers to origin essentialism about *stages*, not *persons*.) Defending this assumption goes beyond the scope of this paper, so I am proposing instead a *conditional* resolution of the narrow RSP: *if* the assumption is true, then the reasoning which concludes that I cannot irreversibly destroy a supposedly essential ancestor of mine is blocked (because then nothing *is* an *essential* ancestor of mine). In the remainder of this section I defend this conditional resolution against three objections. For concreteness from now on I revert to talk of killing YS, but my remarks apply mutatis mutandis to talk of irreversibly destroying a supposedly essential ancestor of mine.

(1) If all forms of origin essentialism are false, then there are physically possible worlds in which YS dies in 1975 and coexists with me without being an earlier stage of mine (e.g., we have different parents). One might argue, however, that the physical possibility of my killing YS does not follow: the claim that in some of these physically possible worlds YS dies in 1975 *because I kill him* presupposes the physical possibility of time travel or at least of backward causation (given that I am a person-*stage* existing in 2000) and is thus controversial. This argument assumes that I could not have existed in 1975 "directly", without going there as a time traveler from 2000. But arguably I could: my parents could have procreated 25 years earlier than they in fact did. In any case, to resolve the narrow RSP I don't need to show that my killing YS is physically possible: it suffices instead to debunk the line of reasoning to the effect that it's *im*possible, and this line is debunked if it is shown to rely on a false premise (origin essentialism). In response one might insist that I do need to show my killing YS to be physically possible: if it is not, and physical impossibility entails inability, then I cannot kill YS after all. So my conditional resolution relies without argument on the hidden assumption that my killing YS is physically possible, just as the standard solution did—or so the objection goes. I reply that the real problem with the standard solution was its failure to address the plausible argument from the physical impossibility of resurrection to the falsity of the hidden assumption. My approach does address this argument (by showing that it relies on the—questionable—premise of origin essentialism), and no other argument against the hidden assumption is on the horizon.

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[38] It can also be adapted to forms of origin essentialism that allow for slight variation in origin (Hawthorne & Gendler 2000: 286). The flexibility of the narrow RSP is another reason why it is harder than the wide.

[39] I find thus questionable Thom's (1975: 212) assumption that resurrection is *logically* impossible (cf. Hanley 1997: 205). The above remarks suggest an answer to Savitt's (1999: 488) question: "the grandfather paradox isn't a *physical* consideration", so how could it show that time travel is just physically impossible? (Physical irreversibility is irrelevant to the *wide* RSP.)

(2) Can my talk of person-stages be replaced with talk of persons?[40] Arguably not. If in a world *w* I coexist with YS without being a later stage of YS, then in *w* I and YS are not stages of the same person (assuming I am not an earlier stage of YS either). So if Peter (the person whose stages I and YS actually are) exists at all in *w*, he does not have both me and YS as stages. It follows that, even if in *w* I kill YS, Peter does not thereby kill Peter (cf. Vihvelin 1996: 325). One might argue that this result is worrisome because it shows that my approach fails against a variant of the narrow RSP formulated in terms of persons rather than stages. I don't see, however, how such a formulation would go. I guess not in terms of whether Peter can kill Peter: he can, by committing ordinary suicide. Is the relevant question whether Peter can kill Peter *and yet go on living* (cf. Smith 1997: 380)? No: if Peter is born in 1965, lives through 2000, and goes back to 1975, in 1975 he can commit ordinary suicide and yet go on living (he lives from 1975 to 2000).[41] It seems that the relevant question is instead whether *Peter-the-adult* can kill *Peter-the-boy*. But if 'Peter-the-adult' and 'Peter-the-boy' denote *persons*, then they denote the *same* person (Peter), so we are back to the uninteresting question of whether Peter can kill Peter. And if 'Peter-the-adult' and 'Peter-the-boy' denote *stages*, then we are back to the question of whether I can kill YS, so we don't have a *new* variant of RSP after all.[42]

(3) If I kill YS in a world in which he is not an earlier stage of mine, isn't it a misnomer to say that I commit "retro-suicide"? One might be interested instead in *real* retro-suicide, which I commit in a world exactly if in that world I kill a person-stage who in *that* world is an earlier stage of mine. If resurrection is physically impossible, then so is real retro-suicide. So if in addition physical impossibility entails inability, then I cannot commit real retro-suicide. It follows that my conditional resolution fails against a variant of the narrow RSP in which 'an earlier stage of mine' replaces 'YS'—or so the objection goes. I reply that there are (at least) two ways to understand the claim that I can commit real retro-suicide (I can kill an earlier stage of mine):

    (C6) For some person-stage *S* who is an earlier stage of mine, I *can* kill *S*.

    (C7) I can make the following proposition true: for some person-stage *S* who is an earlier stage of mine, I *kill S*.

(The existence of *this* ambiguity might help explain the popularity of the standard solution but by no means vindicates that solution.) The reasoning of the objection establishes at most that, given P3 and P4, C7 is physically impossible. But this is no problem for the physical possibility of time travel, which need not entail that of C7. (To see this, note that C7 is true only if I can make it the case that some person-stage is an earlier stage of mine.) On the other hand, if I can kill YS, then C6

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[40] I understand person-stages more or less as Lewis (1983: 76-7) does, but I am talking about temporally extended person-*segments*, not about (almost) instantaneous person-*slices* (cf. Brink 1997: 112-3). So I see no problem with my talk of "killing" a person-stage. The temporal boundaries between successive person-stages may be vague and arbitrary, but I see this as creating no problem for my reasoning.

[41] Is the relevant question whether Peter in 2000 can cause Peter's death in 1975? No: if Peter in 1974 travels *forward* to 2000, sends a bomb through a wormhole back to 1975, travels back to 1974, and is killed by the bomb in 1975, then Peter in 2000 causes Peter's death in 1975 but no retro-suicide occurs (it's a *younger* stage who causes the death of an older one).

[42] There is a general reason why in time-travel contexts talk of stages is preferable to talk of persons. If in 1975 I meet YS, is Peter a boy or an adult in 1975? It seems that he is both, so that talk of persons forces us to give up statements like "no person is both a boy and an adult at the same time". This may just show that such statements are not conceptual truths after all (MacBeath 1982: 411-3; cf. Grice & Strawson 1956: 204-5), but the fact remains that in time-travel contexts talk of stages is less confusing. (Cf. also Parsons 2000: 88-90; Sider 2001: 102.)

is true (just take *S* to be YS), and then there is a straightforward sense in which I can (though I don't) commit *real* retro-suicide: I can kill YS, who *is* an earlier stage of mine.[43]

5. Vihvelin's argument for the claim that I cannot kill YS.

In the last two sections I argued that neither the wide nor—if origin essentialism is false—the narrow ground is a sound ground for claiming that I cannot kill YS. Vihvelin (1996), however, proposes a third ground, namely the following valid argument:

(P6) Necessarily, if it is the case that if I (repeatedly) tried to kill YS I would fail, then in my situation I cannot kill YS.

(P7) If I (repeatedly) tried to kill YS, I would fail.

Thus: (C0) In my situation I cannot kill YS.

P6 is an instance of the claim that (P6*) *counterfactual failure entails inability*: according to Vihvelin, "everyone should agree that if someone would fail to do something, no matter how hard or how many times she tried, then she cannot do it" (1996: 318).[44] P6*, however, is false: in some cases the very act of trying would make one self-conscious and thus would make one fail. Suppose that if I tried to win a singing contest I would become so nervous and I would sing so poorly that I would fail; but suppose further that if I sang without trying to win I would sing so well that I would win. Then it seems clear that I *can* win the contest.[45] In response Vihvelin might grant that P6* is false but insist that P6 is true: she might restrict P6* to cases in which it is not the very act of trying that would make one fail, and might claim that such cases include attempted retro-suicide. In reply consider another example. Suppose I am an expert dart player and I have the ability to score a bull's-eye; but suppose further that, if I tried now to hit the target, I would slip on a banana peel so that I would fail. Still, it seems that I *can* hit the target.[46] Vihvelin might respond that, if it is indeed the case that I *would*—not just that I *might*—slip on the banana peel, then it is *determined* that I would not hit the target (contrast Lewis 1986b: 63-5), so I cannot hit it. In reply let me grant for the sake of argument that I cannot hit the target if it is determined that I will not hit it. Still, it need not be determined that I will not hit the target when it is determined that I would fail *if I tried* to hit it: maybe it is *also* determined that I would hit it if I did *not* try. (For example: if I threw a dart without aiming, I would position my legs so that I would not slip on the banana peel, and I would hit the target.) The general point, which was already illustrated by the singing contest example, is this: the claim that I would fail if I tried to do something is compatible with the claim that (thanks to my

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[43] One might object that is proper to say I can commit any kind of *suicide* by killing YS only if I can end my own life by killing YS. In reply note first that I *can* end my own life by killing YS if I can kill YS by means of (e.g.) an explosion which would also kill me. Moreover, and more important, no substantive point in this paper hinges on my use of the label 'retro-suicide'; those who are worried by the label can just replace it with 'my killing YS' or similar expressions throughout.

[44] Cf. Brown 1992: 434; Kenny 1975: 129, 1976: 229. P6* entails (but need not be entailed by) the claim that (P3*) physical impossibility entails inability: necessarily, if it is physically impossible that I do something, then I would fail if I (repeatedly) tried to do it (but not vice versa: I would fail if I tried to beat Kasparov at chess, but it is physically possible that I beat him). By contraposition, P6* affirms a necessary condition for ability, namely that trying *might* lead to success (on the standard understanding of "might" as "not-would-not": Lewis 1973a: 21-4, 1973b: 8-9, 1986b: 63-4). This is weaker than the discredited condition that trying *would* lead to success (cf. Austin 1956: 218; Kane 1996: 53-4; Lewis 1976: 150; contrast Cross 1986: 58-61).

[45] Another kind of case in which arguably I can do something although I would fail if I tried to do it involves *finkish* abilities: abilities that I would lose if I tried to exercise them (cf. Lewis 1997; Martin 1994).

[46] Vihvelin might respond that I have the ability but not the *opportunity* (cf. footnote 7). But I don't see why I lack the opportunity: the banana peel does not *prevent* me from exercising my ability, it just so *happens* that I would fail to notice it.

ability) I would—or at least I might—do it if I did *not* try and thus does not entail that I cannot do it. So it seems that even the restriction of P6* is false.[47]

In response Vihvelin might ask what would happen if I tried *again* to hit the target. Suppose I would bump into a piece of furniture so that I would again fail. It's true that after a string of such failures I might begin to suspect that I cannot hit the target after all: some "hidden force" is thwarting my attempts. Suppose, however, that no such hidden force exists: my repeated failures would be just due to a string of coincidences (cf. Bennett unpublished; Sider unpublished). Then it remains true that I *can* hit the target. Vihvelin might object that attempted retro-suicide is significantly different: there is a "deep reason" why my attempts to kill YS would all fail. But if the deep reason is that YS is an earlier stage of mine so that it's impossible for me to kill him, then we are back to the narrow RSP. More generally, the objection implicitly grants that P6 is false: if an appeal to a deep reason is needed, then the *mere* claim that I would repeatedly fail if I tried to kill YS does not entail that I cannot kill him.

Consider now P7. In support of P7 Vihvelin argues that all possible worlds in which I try to kill YS and I succeed are less close to α (the actual world) than some possible world in which I try to kill YS and I fail. Vihvelin's argument relies on the claim that worlds in which I try (e.g., in 1975) to kill YS and I succeed either include miracles or have a past (of 1975) different from that of α. For example, they are worlds in which YS is resurrected, or in which I am not a later stage of YS and either I "miraculously come into existence out of thin air" (1996: 326) or I am a later stage of some other boy with DNA that matches the DNA of YS. Vihvelin, however, does not consider worlds which have the *same* past as α and in which I am a later stage of a boy with DNA that does *not* match the DNA of YS. (Such worlds are possible if all forms of origin essentialism is false.) For example: in 1975 I pull the trigger, YS dies, and I am a later stage of a baby born in 1976. (I enter the time machine in 2011, at the age of 35, whereas in α I enter it in 2000, again at the age of 35.) Vihvelin might respond that all such worlds have a future (of 1975) much more different from that of α than does some world w in which in 1975 I pull the trigger, I miss, YS survives, and I am a later stage of YS. I reply that it need not follow that the former worlds are less close to α than w. To see this, suppose that if Nixon in 1974 had pushed a certain button there would have been a nuclear holocaust. Then, on standard analyses of counterfactuals (Lewis 1973a, 1973b),[48] some world in which Nixon pushes the button and there is a nuclear holocaust is closer to α than every world in which Nixon pushes the button but it malfunctions and there is no nuclear holocaust—despite the fact that every world of the former kind has a future much more different from that of α than does some world of the latter kind. So a difference between two worlds in degree of future similarity to α need not entail a corresponding difference in degree of closeness to α.

In response Vihvelin might argue that, although we can accept that if Nixon had pushed the button there would have been a nuclear holocaust, we cannot accept that "if that adult stage had pulled the trigger, then that adult stage and this [boy] stage would have been stages of different persons" (1996: 326). I reply that I need only a *might*—not a *would*—counterfactual for P7 to be false. Resis-

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[47] Vihvelin might agree but might modify her argument by adding an extra premise: (P8) it is not the case that, if I did not try to kill YS, I might kill him. I reply that a modification of what I say about P7 (see below in the text) applies to P8.

[48] Some people (e.g., Fine 1975: 452) have argued that examples like that of the nuclear holocaust refute standard analyses of counterfactuals (see also Tooley 2002 and Noordhof 2003), but Vihvelin (1996: 319) explicitly endorses and uses such an analysis.

tance to accepting such a "might" counterfactual may be due to understanding it as "back-tracking" (Lewis 1979a: 34); such resistance should dissolve if it is accepted that some worlds in which I am not a later stage of YS have the *same* past as α. So Vihvelin has failed to adequately support P7. I conclude that Vihvelin's argument for the claim that I cannot kill YS is unsound: P6 is false and arguably so is P7.

6. Concluding comments.

(1) Gratuitous complexity? One might argue that this paper is needlessly complicated: why entangle considerations of origin essentialism with a paradox that is in itself hard enough to think straight about? In reply I grant that such metaphysical considerations are not directly relevant to the *wide* RSP, which may well be hard enough to think straight about. But a key lesson of this paper is that superficially similar ability paradoxes are subtly different: I argued that the *narrow* RSP does hinge on such metaphysical issues, and that it is even harder than the wide RSP. If we want to resolve *all* ability paradoxes, not just the easier ones, then we may need to tackle the metaphysical issues.

(2) Mechanical paradoxes. Why focus on *ability* paradoxes? Other consistency paradoxes can be formulated without referring to (human) agents at all, and thus without introducing considerations of ability. For an example of such a *mechanical* paradox, imagine a billiard table with two holes which are the mouths of a wormhole time machine. Suppose that a billiard ball which is carrying a bomb enters the first hole and emerges from the second at an earlier time, poised to collide with its younger self and thus detonate the bomb and blow up the younger self before it enters the first hole.[49] I take one (kind of) consistency paradox here to consist partly of an argument for the physical impossibility of the collision between LS (the later stage of the ball) and ES (the earlier stage). How would such an argument go? If one argues that the collision would change the past, then my solution to the wide RSP applies: the collision would not change the past, it would rather actualize a nonactual past (e.g., one in which the fragments of ES are miraculously reassembled). And if one argues that the collision is physically impossible because so is (e.g.) the reassembly of fragments, then my approach to the narrow RSP applies: the collision occurs without reassembly in a physically possible world in which ES is not an earlier stage of LS. So it turns out that the metaphysical intricacies of the narrow RSP are not due to considerations of ability: the intricacies crop up even in some mechanical paradoxes. It also turns out that the tools I developed in response to ability paradoxes are useful for some mechanical paradoxes as well. This is not to deny that mechanical paradoxes might pose new and interesting problems, but such problems are beyond the scope of this paper.

(3) The verdict on the standard solution. Lewis (1976) proposed the standard solution in response to a version of GFP analogous to the *wide* RSP: he formulated GFP in terms of an inability to change the past. I argued that the wide RSP trades on a couple of ambiguities, none of which is about relevance. I also argued that the narrow RSP, which the standard solution just fails to address, can be (conditionally) resolved without any talk of relevance. It follows that the appeal of the standard solution to an equivocation about relevance is superfluous (as a response both to RSP and to

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[49] Novikov 1992: 1991-2. Cf. Arntzenius & Maudlin 2000; Earman 1995a: 297-303, 1995b: 183-8; Echeverria, Klinkhammer, & Thorne 1991; Lossev & Novikov 1992; Nahin 1993: 345-6, 1999: 510-1; Novikov 1998: 254-63; Thorne 1994: 508-16. On other mechanical paradoxes see: Clarke 1977: 102-4; Craig 1988: 144-50; Earman 1972: 231-3; Fitzgerald 1974: 534-6; Gilmore 1997: 42-5; Hanley unpublished; Horwich 1975: 438-42; Kutach 2002; Maudlin 1990; Moravec 1991; Ray 1991: 167-8; Riggs 1997: 60-3; Smith 1997: 387-8; Wheeler & Feynman 1949: 427-8.

GFP). But then why has this solution come to be considered "standard"? Maybe because it seems to explain our vacillation between saying that I can and that I cannot kill YS: the fact that I don't kill him seems to pop in and out of our mind. This explanation is superficial, however. I may believe that, *regardless* of what counts as relevant, I cannot kill YS because it is physically impossible that I kill him; and I may *still* vacillate because, given that in a similar situation I can kill a duplicate of YS, it seems that I *can* kill YS after all. In any case if our primary interest is not in *explaining* people's vacillation but is rather in *resolving* RSP, then the standard solution loses even its superficial appeal.

(4) So, can I kill YS? I examined three grounds for claiming that I cannot kill YS (namely the wide ground, the narrow ground, and Vihvelin's argument), and I found them all wanting. It doesn't *follow* that I can kill YS: maybe there are other, better grounds why I cannot. (For example, hard determinism might be true.) Nevertheless, if in a situation like mine I can kill a duplicate of YS, and if my arguments against the above three obstacles to concluding that I can kill YS are sound, it seems reasonable to reach the tentative conclusion that, if origin essentialism is false, I *can* kill YS.

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