Received: 8 March 2021 | Revised: 28 May 2021 | Accepted: 28 May 2021

DOI: 10.1111/bioe.12910

ORIGINAL ARTICLE

bioethics WILEY

The fragility of origin essentialism: Where mitochondrial 'replacement' meets the non-identity problem

Tim Lewens

Department of History and Philosophy of Science, University of Cambridge, Cambridge, United Kingdom of Great Britain and Northern Ireland

Correspondence
Tim Lewens, Department of History and Philosophy of Science, University of Cambridge, Free School Lane, Cambridge CB2 3RH, UK.
Email: tml1000@cam.ac.uk

Abstract

Few discussions of the ethics of mitochondrial 'replacement' techniques have drawn significant ethical distinctions between the two approaches now legal in the U.K. However, Anthony Wrigley, Stephen Wilkinson and John Appleby have together argued that under some circumstances pronuclear transfer (PNT) may be in better ethical standing than maternal spindle transfer (MST). They base their conclusion on what they allege to be different implications of the techniques with respect to non-identity considerations, which they ground on a version of origin essentialism. I raise a series of problems for their argument, which have cautionary implications for invocations of origin essentialism that go beyond specialized debates regarding MST and PNT. I argue that (i) origin essentialism is a fragile foundation for non-identity considerations; (ii) gametic essentialism, which Wrigley et al. believe licenses their claims, is more questionable than origin essentialism; (iii) gametic essentialism does not straightforwardly justify their conclusion; and (iv) their conclusion in fact relies on an especially dubious position that we can call chromosomal origin essentialism. No good reasons have yet been supplied to distinguish PNT from MST on ethical grounds, and one should be wary of basing claims with practical impact on fragile foundations relating to origin essentialism.

KEYWORDS

chromosomal origin essentialism, gametic essentialism, maternal spindle transfer, mitochondrial replacement therapy, non-identity problem, origin essentialism, pronuclear transfer

1 | PRONUCLEAR TRANSFER AND MATERNAL SPINDLE TRANSFER

Disorders of the mitochondrial genome can give rise to diseases that are systemic and progressive, and that can result in early death.[1] The specifics of mitochondrial inheritance mean that some women—but almost never men—can pass the genes responsible for these disorders to their children. In February 2015, the U.K. became the first country to explicitly legalize two new forms of in vitro fertilization (IVF) aimed at preventing such transmission across generations. They are maternal spindle transfer (MST) and pronuclear transfer (PNT).

The general motivation for legislation was the same in the case of both technical approaches. PNT and MST offer a woman with defective mitochondrial genes the prospect of having a child who (i) shares

[1]See e.g. Gorman, G. S., Chinnery, P. F., DiMauro, S., Hirano, M., Koga, Y., McFarland, R., … Turnbull, D. M. (2016). Mitochondrial diseases. *Nature Reviews Disease Primers*, *2*, 16080; Greenfield, A. (2020). Use of mitochondrial donation. In B. Rizk & Y. Khalaf (Eds.), *Controversies in assisted reproduction*. Boca Raton, FL: CRC Press; and Greenfield, A., Braude, P., Flinter F., Lovell-Badge, R., Ogilvie, C., & Perry, A. (2017). Assisted reproductive technologies to prevent human mitochondrial disease transmission. *Nature Biotechnology*, *35*, 1059–1068.

a nuclear genetic connection with her but (ii) has a negligible, or at least very low, chance of developing a mitochondrial disorder. In broad terms, PNT and MST work in the same ways: nuclear chromosomal material derived from the woman with defective mitochondrial genes is transferred to a healthy cellular context derived from a donor.[2] These similarities between the techniques explain why most discussions of MST and PNT have not drawn significant ethical distinctions between them: the Nuffield Council on Bioethics, for example, saw no reason on ethical grounds to prefer one technology over the other; neither did the U.S. National Academies; and the HFEA's guidelines on licensing these technologies do not differentiate between them with respect to ethical considerations.[3]

PNT and MST are often referred to jointly as 'mitochondrial replacement techniques' (MRTs), or 'mitochondrial donation'. I will sometimes use these labels in this paper, but they are misleading. It is not the case that unhealthy mitochondria are extracted from a woman's egg and replaced with healthy ones; nor is it the case that the donor gives just her healthy mitochondria to the woman seeking to use these techniques.[4] Instead, the donor supplies *all* important cellular developmental structures bar the chromosomal material.

In spite of the similarities between PNT and MST, Wrigley et al. have argued that we should evaluate the two technologies differently.[5,6] The difference they assert is potentially one of considerable importance in answering some of MRTs' critics, who have denied that these techniques have any therapeutic value.[7] Wrigley et al. argue that PNT is therapeutic, in the sense that a given individual's life may go better from a medical perspective because of PNT than that same person's life would have gone, had PNT not been used. They say that MST, on the other hand, affects which person ends up existing: 'PNT … is a form of therapy based on embryo modification while MST is, instead, an instance of selective reproduction'.[8] As a consequence, they argue that 'in some circumstances, there may be a stronger obligation to utilise PNT than to use MST'.[9] This article counters Wrigley et al.'s key contention, but in so doing it makes a series of points that have more general significance, going well beyond the specialized topic of MRTs, for efforts to put non-identity considerations to work in bioethics.

In Section 2, I offer a précis of Wrigley et al.'s argument. In very rough terms, they claim that 'gametic essentialism' licenses an asymmetrical ethical evaluation of MST versus PNT. Gametic essentialism is a claim about the identity-determining role of an individual's originating gametes. It is equivalent to what Parfit calls 'The Origin View'.[10] In subsequent sections, I raise four problems for their argument. In Section 3, I point out that gametic essentialism forms a fragile foundation for the non-identity problem, and that Parfit's formulation of that problem was not meant to rely on gametic essentialism alone. I argue that Parfit's preferred foundation for the non-identity problem, the time-dependence claim, does not entail that PNT and MST have different consequences for identity. In Section 4, I explain, in agreement with Rulli, that gametic essentialism is a specific, and especially contentious, version of the more general position of origin essentialism.[11] In Section 5, I argue that gametic essentialism does not entail that PNT is identity-preserving. In Section 6, I suggest that Wrigley et al.'s desired conclusion follows from a position I call chromosomal origin essentialism, which is distinct from gametic origin essentialism. However, I also show that this position is more dubious than both gametic essentialism and generic origin essentialism. Finally, in Section 7, I show that if one became convinced that PNT was a better option to offer to couples because of its supposed therapeutic nature, then it would be possible to configure MST so that it had this feature, too. I conclude, again endorsing Rulli, with a note of caution about using origin essentialism to justify claims with practical normative impact.[12]

2 | WRIGLEY ET AL.'S ARGUMENT

Wrigley et al. are interested in exploring the consequences of a version of origin essentialism called the 'Origin View'. They acknowledge that they do not attempt to justify this position; instead, they wish to see what follows from it:

> We do not have space here to argue for the Origin View but merely note that it is widely regarded as a plausible principle and that its supposed truth underpins a great deal of the literature on the Non-Identity Problem.[13]

[2]See Newman, S. (2014, December 1). Deceptive labeling of a radical embryo construction technique. *Huffington Post*. Retrieved from https://www.huffpost.com/entry/deceptive-labeling-of-a-r_b_6213320?guccounter=1 [Accessed Dec 1, 2014]; Lewens, T. (2015). Introduction: The biological foundations of bioethics. In *The Biological Foundations of Bioethics*, (pp. 1-13), Oxford: Oxford University Press; Baylis, F. (2017). Human nuclear genome transfer (so-called mitochondrial replacement): Clearing the underbrush. *Bioethics*, *31*, 7–19; Scully, J. L. (2017). A mitochondrial story: mitochondrial replacement, identity and narrative. *Bioethics*, *31*, 37–45; Palacios-González, C. (2017). Are there moral differences between maternal spindle transfer and pronuclear transfer? *Medicine, Health Care and Philosophy*, *20*, 503–511.

[3]HFEA. (2021). Retrieved from https://www.hfea.gov.uk/treatments/embryo-testing-and-treatments-for-disease/mitochondrial-donation-treatment/. NCOB. (2012). *Novel techniques for the prevention of mitochondrial DNA disorders: An ethical review*. London, U.K.: Nuffield Council on Bioethics; National Academies of Sciences, Engineering and Medicine. (2016). *Mitochondrial replacement techniques: Ethical, social, and policy considerations*. Washington, D.C.: National Academies. For an overview of rare instances where the two technologies have attracted contrasting verdicts, see Palacios-González (2017), op. cit. note 2.

[4]Lewens, op. cit. note 2; Rulli, T. (2016). The mitochondrial replacement "therapy" myth. *Bioethics*, *31*, 368–374; Lewens, T. (2019). The division of advisory labour: The case of mitochondrial 'donation'. *European Journal for Philosophy of Science*, *9*, 10. doi:10.1007/s13194-018-0235-3.

[5]Wrigley, A., Wilkinson, S., & Appleby, J. (2015). Mitochondrial replacement: Ethics and Identity. *Bioethics*, *29*, 631–638.

[6]Wrigley et al., op. cit. note 5.

[7]See e.g. Baylis, op. cit. note 2; Scully, op. cit. note 2. For further context, see Bredenoord, A., Dondorp, W., & Pennings, G. (2011). Ethics of modifying the mitochondrial genome. *Journal of Medical Ethics*, *37*, 97–100; Appleby, J., Scott, R., & Wilkinson, S. (2017). The ethics of mitochondrial replacement. *Bioethics*, *31*, 2–6.

[8]Wrigley et al., op. cit. note 5, p. 631.

[9]Ibid.

[10]Parfit, D. (1986). *Reasons and persons*. Oxford, U.K.: Oxford University Press.

[11]Rulli, op. cit. note 4.

[12]Ibid.

[13]Wrigley et al., op. cit. note 5, p. 634.

The label 'The Origin View' comes from Parfit, who defines it thus: 'each person has this distinctive necessary property: that of having grown from the particular pair of cells from which this person in fact grew'.[14] Wrigley et al. make use of that definition, and they note that the position can also be called 'gametic essentialism'.[15] I will use the latter, more specific, term here. That is because, as I will explain in Section 4, the view that an individual must have come from both their originating gametes is just one version of the more general position of origin essentialism.

Gametic essentialism is a view about what philosophers sometimes call *numerical identity*. It is surely possible to imagine, without contradiction, that various events in Anthony Wrigley's earlier life might have been different, so that he, Anthony Wrigley, could have had a different career, a different appearance, and so forth. In other words, it is possible to contemplate various qualitative changes to an individual. Gametic essentialism, however, tells us that had the actual egg that gave rise to Anthony Wrigley been fertilized by a different sperm, then that different set of circumstances would not have resulted in Anthony Wrigley having a different genome. Rather, Anthony Wrigley would not have existed. Whichever person would have grown from those different originating gametes would not be Anthony Wrigley. Here we are dealing with questions about a numerically distinct individual.

Wrigley et al. claim that gametic essentialism justifies their assertion that while MST triggers non-identity considerations, PNT does not. To see why they make this assertion, it is necessary to understand some further details of how the two technologies work.[16]

2.1 | MST and the alteration of numerical identity

With MST, a donor provides an egg that has had the 'spindle' of nuclear chromosomes removed. Meanwhile, the spindle of chromosomes is likewise removed from the egg of the woman affected by mitochondrial disease. That second spindle is then placed into the enucleated donor egg. The donor egg (now containing the spindle from the mother who has requested the intervention, set in a healthy cellular context) is fertilized.

Wrigley et al. point out that, 'As the very process of manipulating the maternal gamete takes time, the sperm used to fertilize it (in standard cases) will be different from the sperm that would have fertilized it if the maternal gamete had not undergone manipulation'.[17] Imagine Matilda, a healthy individual whose origins involved MST. If her parents had not thought to use MST at all, and had instead conceived naturally, then there would be no gamete derived from a union of a donor egg and chromosomal material from Matilda's mother. Matilda's mother would probably not have conceived at the time that Matilda was in fact conceived, and the chances of the very same sperm as that which actually produced Matilda fertilizing an egg from Matilda's mother would have been minuscule. Hence the chances of the actual egg and sperm that produced Matilda uniting to form an embryo, in the event that Matilda's parents had not used MST, are effectively zero.

Wrigley et al.'s observation that the process of manipulation takes time suggests, however, that we are supposed to consider a different counterfactual. What would have happened if Matilda's parents had got as far as extracting the actual egg that was the origin of Matilda's chromosomal material, and then opted simply to have the egg fertilized directly, rather than risking the experimental nature of MST? There is little reason to think that the very same sperm that went on to produce the actual Matilda would also have been chosen for fertilization in our imagined counterfactual circumstance. In short, had MST not been used, then no child would have originated from a union of Matilda's actual gametes. It follows (from gametic essentialism) that Matilda would not have existed. Wrigley et al. conclude that MST is identity-affecting, in all but the most outlandish hypothetical cases.

2.2 | PNT and the preservation of numerical identity

PNT (the approach currently being pioneered at the Newcastle Fertility Centre in the U.K.) works differently. A donor egg is fertilized, and the two pronuclei are removed from the resulting embryo. An egg from the woman with mitochondrial disease is also fertilized. The two pronuclei are removed from that second embryo, and placed into the first, healthy, embryo. Wrigley et al. claim that a significant difference follows: 'With PNT … the intervention happens after fertilization, the gametes used are unaffected, and so the Non-Identity Problem does not arise'.[18]

Talk of 'the intervention' is ambiguous. All aspects of PNT, including the initial harvesting of eggs from the donor and from the woman with mitochondrial disease, are interventions. It is nonetheless clear what aspect of PNT Wrigley et al. have in mind: the transfer of nuclear material occurs after fertilization in the case of PNT, and before fertilization in the case of MST.

Why might this ground a different verdict when it comes to identity? They ask us to imagine parents who, if they do not use one of the two techniques in question, are nearly certain to conceive a child with mitochondrial disease. Let us call them Amanda and Ben. Amanda and Ben are offered PNT. If they use PNT (and if the technique works), then they will end up having a child—call her Petra—who is free from mitochondrial disease. Suppose, on the other hand, that they choose not to use PNT. Wrigley et al. believe that Petra will still be born if they make this choice, but Petra is highly likely to have mitochondrial disease. As a consequence, PNT is therapeutic. It has enabled Petra to avoid a disease that she would otherwise have suffered from. Wrigley et al.'s view seems to be that the choice of whether to use PNT is simply the choice of whether, *after* Petra

[14]Parfit, op. cit. note 10, p. 352.

[15]Wrigley et al., op. cit. note 5, p. 634.

[16]NCOB, op. cit. note 3.

[17]Wrigley et al., op. cit. note 5, p. 634.

[18]Wrigley et al., op. cit. note 5, p. 635.

originates via the fertilization of Amanda's egg with Ben's sperm, the nuclear material that will be present at the heart of Petra's cells is to end up in a healthy or an unhealthy cellular context.

3 | THE NON-IDENTITY PROBLEM DOES NOT PRESUPPOSE ORIGIN ESSENTIALISM

I now move on to critical comments. Wrigley et al. claim that 'Two elements are required for the Non-Identity Problem to be properly understood. One is the gametic essentialist requirement; the other is an understanding of harm not in the sense of "violation of rights," but in the sense of "worse off than otherwise would have been"'.[19] But Parfit's own elaboration of the non-identity problem did not presuppose gametic essentialism (the position he calls 'The Origin View'). Rather, Parfit aimed to make the foundation of the non-identity problem as uncontentious as possible.

Parfit argued that all plausible views about identity under counterfactual circumstances—gametic essentialism, as well as other reasonable views that do not make origins essential properties of individuals—would lead to what he calls the 'time-dependence claim'. This is the claim that, 'If any particular person had not been conceived within a month of the time when he was in fact conceived, he would in fact have never existed'.[20] In other words, Parfit thought the time-dependence claim more secure than each of the different, more contentious positions that he argued gave it support.

Parfit also endorsed what he called the 'no difference view': his concern for future generations did not diminish when he came to believe that many of our decisions do not affect the interests of future people.[21] He took his time-dependence claim to have significant implications for how we must understand the general nature of harm if we are to adequately capture this concern for future generations. But its implications for specific ethical judgements relating to PNT and MST are much less clear. Imagine a couple who want to use assisted reproduction to have a child free from mitochondrial disease. They are hesitating between using a donor egg with IVF, using MST, or using PNT. Whichever option they choose, their appointment will take place within the same week. If each option will be a success, the outcome of their choice does not trigger the time-dependence claim.

One might react to this by suggesting that it is the time-dependence claim itself that should be rejected. At the very least, Parfit's claim that the Origin View supports the time-dependence claim is outdated. The ability to freeze eggs and sperm makes it possible for the moment of conception to vary by periods much longer than a month, consistent with fusion of the very same gametes. However, rather than rejecting the time-dependence claim as wholly irrelevant in the context of assisted reproduction, I suggest that it is more fruitful to ask why Parfit picked a one-month time period in formulating it. It was supposed to facilitate a focus on the consequences of *both* originating gametes being different. He thereby sidestepped more contentious questions about whether, had the egg that gave rise to a particular person been fertilized by a different sperm, that person would still have existed. In the next section, we will see that the difference between the view that each originating gamete is separately necessary for an individual's existence, and the view that just the originating egg is necessary, is a salient one in the context of Wrigley et al.'s views about MST and PNT.

I mentioned that Wrigley et al. do not mean to defend gametic essentialism; they are merely interested in establishing its consequences. In some ways, then, it is irrelevant to their project to point out that gametic essentialism has foundations that are shakier than those of the problem it partly supports. Even so, Wrigley et al. suggest that gametic essentialism's consequences are worth laying out because it is 'widely regarded as a plausible principle'. Consonant with this, one might cite the example of Matthew Liao, who has also written about MST, PNT, and identity. He seems to regard gametic essentialism as compelling, telling his readers that, 'different eggs and/or sperm will create numerically distinct individuals'.[22] Rather than arguing for that claim in his paper, Liao footnotes Mackie.[23] But in that book-length treatment of the essential properties of individuals, Mackie argues *against* origin essentialism. More generally, it is not unusual in metaphysics to find sceptical treatments of origin essentialist positions.[24]

Let me summarize this section. Many philosophers take the non-identity problem seriously. That does not mean that gametic essentialism is just as widely endorsed. The non-identity problem is a pressing one on a variety of views about essential properties of individuals. Each of those specific views about essential properties is more dubious than the more general time-dependence claim that, Parfit argues, they all support.

4 | ORIGIN ESSENTIALISM DOES NOT ENTAIL GAMETIC ESSENTIALISM

Parfit hints at some circumstances where there may be no answer to questions about identity. He entertains the possibility that his mother did not conceive a child at the time that Parfit was, in fact, conceived. Instead, the very same egg was fertilized by a different sperm. Is the resulting person Derek Parfit? 'There are cases in which our identity is indeterminate. What I have just described may be such a case. If it is, my question has no answer'.[25]

[19]Wrigley et al., op. cit. note 5, p. 634.

[20]Parfit, op. cit. note 10, p. 352.

[21]Ibid: 367.

[22]Liao, M. (2017). Do mitochondrial replacement techniques affect qualitative or numerical identity? *Bioethics*, *31*, 20–26.

[23]Mackie, P. (2006). *How things might have been: Individuals, kinds and essential properties*. Oxford, U.K.: Oxford University Press.

[24]See e.g. Robertson, T. (1998) Possibilities and the arguments for origin essentialism. *Mind*, *107*, 729–750; Hawthorne, J., & Gendler, T. S. (2000). Origin essentialism: The arguments reconsidered. *Mind*, *109*, 285–298.

[25]Parfit, op. cit. note 10, p. 352.

The preceding section already noted that what Parfit calls the 'Origin View' can be more precisely described as 'gametic essentialism'. Although Parfit cites Kripke's writings on origin essentialism when introducing this view, it is important to note that a commitment to origin essentialism—the view that 'anything coming from a different origin would not be this object'—leaves open the question of exactly which aspects of an individual's origination should be thought of as necessary.[26] Indeed, Kripke himself asks, 'How could a person originating from different parents, from a totally different sperm and egg, be *this very woman*?', and he answers by rejecting such a possibility.[27] But it is one thing to say that a given individual could not have originated from 'totally different' gametes issuing from different parents, and another to say that a given individual could not have originated from the same egg being fertilized by a different sperm from the same man. As Parfit's thought experiment regarding alternative insemination shows, Parfit is simply picking the gametic essentialist position as his focal version of origin essentialism for the sake of exposition.

The following alternative view, which we might call *ovular essentialism*, is consistent with origin essentialism in general, but it is inconsistent with gametic essentialism: *a person* x *could not have originated from a different egg to that which in fact gave rise to* x; *but* x *could have existed if a different sperm had fertilized that egg*. The arguments in favour of origin essentialism leave that view in play, because those arguments are often of a general sort that make no special reference to the details of conception.[28]

Rulli is right that Wrigley et al. work with an especially contentious version of origin essentialism.[29] Their argument for an asymmetry between the techniques relies on their claim that it is only with MST that the choice of whether to go ahead with the approach makes a difference to which sperm ends up fertilizing the egg. They do not claim that a choice to use MST affects which egg is used. In other words, their argument for an asymmetry between the techniques would not work if they had used ovular essentialism as the preferred interpretation of origin essentialism.

I am not aware of anyone who has tried to argue in favour of ovular essentialism, but it is not absurd. An egg and a sperm both contain nuclear genes. But an egg, which is much larger than a sperm, contains mitochondrial genes along with other cytoplasmic structures not present in the sperm, all of which play important roles in the initial development of an individual.[30] It is not unreasonable to identify an individual, in some counterfactual circumstances, with a person who shares this majority source of initiating developmental materials (by volume, mass, genetic information, and key developmental structures). The origin essentialist might conceivably say that Anthony Wrigley's beginnings lie in the egg that gave rise to him. He could not have begun from a different egg, but his originating egg could have been fertilized by a different sperm.

5 | GAMETIC ESSENTIALISM DOES NOT WARRANT DIFFERENT APPROACHES TO PNT AND MST

In the preceding sections, I raised worries about the plausibility of origin essentialism in general, and of gametic essentialism in particular. Suppose that one is nonetheless interested to discover—as Wrigley et al. are—what consequences gametic essentialism has. In this section, I suggest that gametic essentialism does not entail a different ethical treatment of PNT compared with MST.

Wrigley et al. imagine prospective parents who are offered PNT, but they decline it. As before, we will call them Amanda and Ben. They end up having a girl, Child A, who is affected by mitochondrial disease:

> Her parents may or may not have had good reasons for declining PNT, but – whatever their reasons – it cannot be denied that their choice harmed Child A. For, had they used PNT, she would be living without rather than with a mitochondrial disorder.[31]

When we ask what would have happened if the parents had used PNT instead of turning it down, it is not clear which contrasting situations we are supposed to entertain.[32] I suggest three options. Palacios-González suggests similar alternatives, but our evaluations of them are not quite the same, as I explain in Section 6.[33] In all three cases, one can coherently accept gametic essentialism, while denying that the parents' choice harmed Child A.

5.1 | Alternative outcomes of careful planning

Imagine that the parents contact the Newcastle clinic. They are told they qualify for PNT. They are asked if they wish to make use of it. They have long discussions with health professionals. In the end, they say no. They conceive Child A naturally.

What would have happened, had they instead decided to go ahead with PNT? There is no reason to suppose that the world where they travel to Newcastle, and the world where they stay at home and conceive naturally are worlds where the very same token gametes form an embryo. If Child A asks herself, 'Would I be better off had my parents made a different choice after talking to professionals from

[26]Kripke, S. (1980). *Naming and necessity*. Boston, MA: Harvard University Press, p. 113.

[27]Ibid, emphasis original.

[28]Robertson Ishii, T., & Atkins, P. (2020). Arguments for origin essentialism. *Stanford Encyclopedia of Philosophy*. Retrieved from https://plato.stanford.edu/entries/essential-accidental/origin-essentialism.html

[29]Rulli, op. cit. note 4, p. 370.

[30]Newman, op. cit. note 2.

[31]Wrigley et al., op. cit. note 5, p. 636.

[32]Rulli, op. cit. note 4.

[33]Palacios-González (2017), op. cit. note 2; Palacios-González, C. (2021). Reproductive genome editing interventions are therapeutic, sometimes. *Bioethics* doi: 10.1111/bioe.12846.

the Newcastle clinic?', gametic essentialism tells her that she would not have existed.

Wrigley et al. write, on the basis of their claim that PNT is identity-preserving, that:

> there is a strong prima facie harm-avoidance rationale for offering PNT to prospective parents, and for those parents to accept it; one that is not present in the case of MST.[34]

If a clinic is in contact with a couple and offers them the possibility of proceeding with PNT, then the decision the couple makes is identity-affecting (given gametic essentialism) just as it is identity-affecting if the couple is offered MST. For the same reason, we would be making a mistake if, as we outlined the risks of PNT to Amanda and Ben, we said to them 'You will have the same child whether you decide to proceed with PNT or conceive naturally; hence, your decision will make your child better off if you accept PNT than if you decline it'.

5.2 | Alternative outcomes of last-minute worries

Perhaps we are not supposed to consider alternative outcomes of careful, time-consuming deliberation when we ask whether choices about PNT are identity-preserving. Imagine once again that Amanda and Ben are told that they qualify for PNT. The relevant HFEA licence is obtained for them, and they travel to Newcastle for the procedure. One of Amanda's eggs is fertilized with a sperm from Ben. The fertility team are all ready to remove the pronuclei, and place them in an enucleated embryo that they have ready. At this point, the couple are asked 'Are you sure you wish to go ahead?' They discuss the matter, and they say no. Their embryo is instead kept intact, and Child A grows from it.

Would Child A, whom we imagine has mitochondrial disease in the actual world, have existed had Amanda and Barry decided to press on with PNT as they initially planned? Wrigley et al. say yes, but one might argue in the following way: 'Gametic essentialism says that Child A only exists in worlds where a child develops from the precise gametes that actually produced Child A. Hence, if no child develops from those very gametes, Child A does not exist. If PNT had been used, then the gametes that actually produced Child A would have formed an embryo. However, that embryo would have been discarded once two specific parts of it—the pronuclei—had been removed. The child that would have arisen via PNT comes from a donated embryo (albeit one with Child A's nuclear material), which has its origins in different gametes from those that produced Child A. In summary, gametic essentialism gives us the verdict that, had PNT been used, Child A would not have existed'.

It seems unassailable to note that the child that would have existed had PNT been used originates by virtue of the fusion of gametes other than those that gave rise to Child A. Even so, one might insist that Child A's actual gametes play a suitable originating role in these counterfactual circumstances, via their provision of pronuclei. So I do not claim that the preceding argument definitely gives the right verdict for PNT's implications for identity. Rather, my point is that any inference about what gametic essentialism tells us about numerical identity seems highly uncertain. Nothing seems obvious about whether Amanda and Ben's last-minute choice is identity-preserving.

5.3 | Alternative uses of frozen embryos

Here is a third scenario, and I am grateful to John Appleby for suggesting it. Imagine Amanda and Ben deliberately froze some of their embryos before PNT was legalized, in the hope that one day they might be able to make use of that technique. They learn that they now qualify to receive PNT, and consequently they are able to spend time deliberating over whether a specific frozen embryo should have its pronuclei transferred to a donor embryo. They decide not to use PNT, and Child A grows from that very embryo. This scenario is like the first one, in that Amanda and Ben have plenty of time to deliberate over whether to make use of PNT. But it is like the second one with respect to the verdict for identity: once again, it is unclear, given gametic essentialism, whether Child A would have existed had PNT been used.

6 | CHROMOSOMAL ORIGIN ESSENTIALISM UNDERLIES WRIGLEY ET AL.'S POSITION

Wrigley et al. seem confident that PNT is identity-preserving, given their gametic essentialist assumptions. Palacios-González endorses their verdict in the context of the second and third types of scenario I outlined above, writing that 'the process of PNT itself is not identity affecting'.[35] It seems to me that these Palacios-González's and Wrigley et al.'s apparent confidence indicates that, in fact, it is not gametic essentialism that underlies their judgements about the identity-preserving character of PNT. Instead, their judgement about PNT is motivated by the view that an individual person has their originating token chromosomal material essentially.

In the cases we examined above, Child A derives from an embryo with token chromosomal material *b* (from the nucleus of a specific sperm from Ben), and token chromosomal material *a* (from the nucleus of a specific egg from Amanda). Child A also derives from all the other non-chromosomal structures within Amanda's egg. If Amanda and Ben had used PNT in the second and third scenarios above, then the resulting child would still have originated from an embryo with token chromosomal material *b* and *a*. The view that we might

[34]Wrigley et al., op. cit. note 5, p. 636.

[35]Palacios-González, op. cit. note 2, p. 507.

cumbersomely call *chromosomal origin essentialism* makes room for the verdict that Amanda and Ben's decision not to use PNT leaves Child A worse off than she would have been, had they gone ahead. Palacios-González remarks accurately that the contributors to these debates (and he includes Wrigley et al. here) have assumed that 'numerical identity follows the nuclear genome'.[36] I add here that chromosomal origin essentialism—which also allows identity to follow the nuclear genome—is not the same view as gametic origin essentialism. Chromosomes are not gametes, they are merely parts of them, and while Wrigley et al.'s verdict follows fairly uncontroversially from chromosomal origin essentialism, it is not clear whether it follows from gametic essentialism. If the two views were the same, then their roles in inference would be identical.

Origin essentialism is, as we saw in Section 3, a contentious position. Gametic essentialism is a specific, even more contentious, version of origin essentialism. Chromosomal origin essentialism is yet more controversial, because it goes beyond gametic essentialism in privileging chromosomal material in the determination of numerical identity.[37] The considerations put forward in favour of origin essentialism by the likes of Kripke are of a thoroughly general, metaphysical nature. Robertson Ishii and Atkins's overview of arguments for origin essentialism barely mentions people and gametes.[38] It focuses almost entirely on inanimate objects. Kripke, when opining that 'It seems to me that anything coming from a different origin would not be this object', was just as interested in discussing the identity of the table in front of him as he was in the origins of Queen Elizabeth.[39]

Regardless of whether one finds Kripkean arguments for origin essentialism convincing, regardless even of whether one assumes that the relevant originating process in the case of a person is the fusing of two gametes, these arguments do not speak in favour of chromosomal origin essentialism without considerable supplementation. To see this, imagine that in the actual world we fertilize an egg in vitro. Suppose the egg goes on to become a person, Ivan. Now imagine an alternative world, just like the actual one, where the very same egg is fertilized with the very same sperm. In this alternative world, the paternal pronucleus is then removed from the formed embryo, and replaced with a different paternal pronucleus containing chromosomal material from the same father. The embryo is gestated by the same woman, at the very same time as actual Ivan develops.

The metaphysical arguments that underpin the bare bones of Kripkean origin essentialism require considerable supplementation before they give us any reason to deny that this alternative person, with different paternally derived chromosomal material, is Ivan. We can say this person is Ivan, even if this world is also one where the paternal pronucleus that produces actual Ivan is placed into a second modified embryo, and that embryo develops to become a person. Two individuals are born in this world; each shares half of actual-Ivan's original chromosomal material. We should resist the quick argument that since it cannot be the case that both individuals are Ivan, we must instead conclude that neither is. For bare-bones origin essentialism gives us reasons to single out just one of these two individuals as Ivan. While one of them has actual-Ivan's paternal chromosomal material, the other has *all* of the originating materials of actual Ivan, save for the fact that this paternal chromosomal material has been removed. Only one of these two individuals gestates in the same uterine environment as actual Ivan, and comes from just the same egg, thereby sharing actual-Ivan's cytoplasmic developmental resources (including mitochondrial DNA alongside other important originating structures), and also sharing actual-Ivan's maternal chromosomal material.

In summary, chromosomal origin essentialism is an especially controversial view. To endorse it one needs reasons for thinking that nuclear DNA has some special role in the determination of identity. Those reasons cannot be found in the more general considerations that underpin origin essentialism as a position in broader metaphysics.

7 | PHILOSOPHICAL BULLISHNESS AND PHILOSOPHICAL RISK

Chromosomal origin essentialism gives different verdicts—the very verdicts Wrigley et al. aim to secure—when it comes to PNT's and MST's usual effects on identity. I have not argued in this paper that chromosomal origin essentialism is false. I have merely argued that (i) Wrigley et al.'s claim that there may be ethical reasons to offer PNT over MST does not follow from other origin essentialist positions, such as ovular essentialism, and that it most likely does not follow from gametic essentialism either; and (ii) there are plenty of reasons to withhold belief in chromosomal origin essentialism, including the simple facts that it is a more demanding version of general origin essentialism, and that no considerations have been offered specifically in its favour. Nonetheless, many readers may remain unshaken in an intuition that chromosomal origin essentialism is correct.

In Section 6, I argued that a decision to bail out of PNT just prior to pronuclear transfer is identity-preserving if one assumes chromosomal origin essentialism. There is no moment, in the usual run of things, where a decision to bail out of MST has this identity-preserving feature. If, however, the approach to MST itself is suitably contrived, then we can make MST identity-preserving.

Imagine that Amanda and Ben are told that they qualify for the use of MST. They get the relevant licences, and travel to a clinic that offers it. Imagine—and Wrigley et al. also note this possibility—that a specific sperm is extracted from Ben. It is ready to fertilize an enucleated donor egg, once the team has placed Amanda's nuclear material in that egg. Meanwhile, one of Amanda's eggs is ready for the spindle of chromosomes to be removed. At this point, Amanda and Ben decide to bail out of using MST. They use Ben's waiting token

[36]Ibid: 506.

[37]See Lewens, T. (2015). Origins, parents and non-identity. In *The biological foundations of bioethics*. Oxford, U.K.: Oxford University Press.

[38]Robertson Ishii & Atkins, op. cit. note 28.

[39]Kripke, op. cit. note 26, p. 113.

sperm to fertilize Amanda's unhealthy egg. Child B is born, and she has mitochondrial disease. She can complain—if chromosomal origin essentialism is true, and if MST works—that she would have been in better health, had Amanda and Ben gone ahead with MST.[40] Similarly, when MST is offered in such circumstances, it has a therapeutic effect. That is because a healthy person conceived via MST can say that, had their parents bailed out, their health would probably have been worse.

What is one to make of all this? Here is what we might call a philosophically bullish response:

> Wrigley et al. are right that it may be better, under some circumstances, to offer prospective parents PNT than MST, at least given how MST is standardly arranged. That is because chromosomal origin essentialism delivers the result that PNT is therapeutic. It follows that if we are to offer MST, we should offer parents our rather contrived version of it, whereby we hold a sperm from the father ready, either to fertilize the donor egg, or to fertilize the mother's original egg. Wrigley et al. suggest that there is no clinical rationale for offering MST in this way, but the fact that it enables an individual's health to be improved constitutes such a rationale. In other words, we have generated a good set of philosophical reasons to ensure that, if MST is offered, it is offered in a certain rather unusual way that allows it to be therapeutic.

A better line of argument, mindful of what we might call *philosophical risk*, goes like this. A philosophical conclusion with potential practical import should ideally be robust, in the sense that it follows from any of a variety of plausible premises. Failing that, if a conclusion with practical import follows only from one very specific set of premises, it is important to establish those premises to an adequate level of confidence. Over the course of this paper, I have tried to show that Wrigley et al.'s effort to contrast PNT and MST's ethical standing fails both tests. In Sections 3, 4 and 5, I argued that their conclusion follows only from chromosomal origin essentialism, and not from many other apparently reasonable views about the essential properties of persons. In Section 6, I argued that chromosomal origin essentialism itself is not a position that has received a strong justification, for no arguments have been offered to explain why it is the right version of origin essentialism to espouse. We should continue to act as if the ethical standings of PNT and MST are identical.

ACKNOWLEDGEMENTS

For comments on previous drafts, I am grateful to Olesya Bondarenko, Tyler Brunet, Toby Bryant, Andrew Buskell, Richard Ngo, Victor Parchment, Raphael Scholl, Philipp Spillmann, and especially John Appleby and Andy Greenfield.

CONFLICT OF INTEREST

The author declares no conflict of interest.

ORCID

Tim Lewens https://orcid.org/0000-0002-4617-9216

AUTHOR BIOGRAPHY

Tim Lewens is Professor of Philosophy of Science, and Head of Department, in the Department of History and Philosophy of Science at the University of Cambridge. He is a former member of the Nuffield Council on Bioethics, and was a member of the Council working party that produced the 2012 report 'Novel techniques for the prevention of mitochondrial DNA disorders: an ethical review'.

How to cite this article: Lewens, T. (2021). The fragility of origin essentialism: Where mitochondrial 'replacement' meets the non-identity problem. *Bi* 35, 615–622. https://doi.org/10.1111/bioe.12910

[40]See also Palacios-González, C. (2016). Mitochondrial replacement techniques: Egg donation, genealogy and eugenics. *Monash Bioethics Review, 34*, 37–51.