

ORIGINAL RESEARCH

Biometrics and the metaphysics of personal identity

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Abstract

The vast advances in biometrics over the past several decades have brought with them a host of pressing concerns. Philosophical scrutiny has already been devoted to many of the relevant ethical and political issues, especially ones arising from matters of privacy, bias, and security in data collection. But philosophers have devoted surprisingly little attention to the relevant metaphysical issues, in particular, ones concerning matters of personal identity. This paper aims to take some initial steps to correct this oversight. After discussing the philosophical problem of personal identity, the ways in which the notion of biometric identity connects with, or fails to connect with, the philosophical notion of personal identity is explored. Though there may be some good reasons to use biometric identity to track personal identity, it is contended that biometric identity is not the same thing as personal identity and thus that biometrics researchers should stop talking as if it were.

KEYWORDS

person re-identification, philosophical aspects

Biometric technologies have long since crossed over from the realm of science fiction to the realm of the everyday. With over 1 billion iPhones currently in active use around the world, the practice of being digitally recognised by one's fingerprint or by one's face has become not only commonplace but completely unremarkable.¹ But even if a rapidly increasing number of individuals use their thumb or face to unlock their phones without a second thought, the vast advances in biometrics over the past several decades can be seen to give rise to a host of pressing concerns. Philosophical scrutiny has already been devoted to many of the relevant ethical and political issues, especially ones arising from matters of privacy, bias, and security in data collection (see, e.g. Lyons [1] and Karkazis and Fishman [2]). But philosophers have devoted surprisingly little attention to the relevant metaphysical issues raised by biometrics, in particular, ones concerning matters of personal identity.² This paper aims to take some initial steps in correcting this oversight.

1 | THE PHILOSOPHICAL PROBLEM(S) OF PERSONAL IDENTITY

In a philosophical discussion, the phrase “the problem of personal identity” refers not to a single problem but to a cluster of related problems: the identification question, the reidentification question, and the characterisation question.³

The identification question asks what properties a being must have in order to count as a person. In this context, philosophers take the notion of a person to be distinct from the notion of a human being (see, e.g. Locke [8] where this distinction originates). The notion of human is a biological notion, defined in terms of facts relating to reproductive isolation, genetics, and/or phylogenetics, but the notion of person is not. Sometimes *person* is used as a legal notion and sometimes as a moral notion, but here we will focus on its use as a metaphysical notion. In any of these uses, however, it is conceptually possible that there be non-human persons, be

¹Apple announced this statistic in January 2021. TouchID was first introduced with the iPhone 5s in 2013; FaceID was first introduced with the iPhone X in 2017.

²One exception comes from the work of Irma van der Ploeg [3]. Some related issues are also briefly raised by Emilio Mordini in his own work [4] and in joint work with Sonia Massari [5]. Outside of the philosophical literature, the metaphysical issues have been occasionally addressed by researchers working on biometrics. For one example, see Wayman [6].

³See Kind [7] for an in-depth discussion of these three questions. This source also contains numerous suggestions for further reading on philosophical debates about personal identity.

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they sophisticated aliens from a distant world, higher mammals in our own world or artificially intelligent systems of the future. It is also conceptually possible that there be non-person humans. A corpse with human DNA is still a human, for example, but a corpse is not a person. Other examples are likely to be controversial, but the ones that are usually considered involve humans at the very beginning and very end of life. An embryo has human DNA but may not be a person, and a human being with severe neurological damage who is in an irreversible persistent vegetative state may not be a person. In answering the identification question, philosophers attempt to provide a framework for distinguishing the notion of human from the notion of person, explicating the notion of person, and adjudicating these examples like the ones just mentioned.

The identification question, in asking about a given identity at one moment in time, is a synchronic question. In contrast, the reidentification question is a diachronic one. It asks about the identity of a person over time, and in particular, it asks what makes a given person the same person over time (see Locke [8]). For example, consider the individual in 1984 playing the role of *The Terminator* and the individual in 2003 who was the winner of the recall election for the office of California governor, both of whom go by the name Arnold Schwarzenegger. What makes these individuals the same person? Answers to the reidentification question typically rely on facts about psychology or facts about biology, either singly or in combination with one another.

Though the identification question and the reidentification question are distinct, certain kinds of answers to the reidentification question can be seen to presuppose certain kinds of answers to the identification question and vice versa. For example, answers to the reidentification question that rely solely on facts about psychology go along with psychologically based answers to the identification question. On some psychologically based answers to the identification and reidentification questions, two individuals separated in time might be the same human without being the same person and vice versa. Consider an influential thought experiment from John Locke in which the consciousness of a prince and a cobbler were to be swapped. Should this happen, Locke says, then when we consider the body of the cobbler, “everyone sees that he would be the same person as the prince, accountable only for the prince’s actions; but who would say it was the same man [i.e. human]?” [8].

The last of the three questions, the characterisation question, asks what makes a given person the person that they are. Rather than focus on the notion of identity as *sameness*, as in the reidentification question, the characterisation question focuses on the notion of identity as *self*. Among the many characteristics that an individual has, some of them seem more central to that individual’s identity, to who they are, than others do. In exploring which characteristics of a person are those that go towards making them who they are, we are addressing the characterisation question.

Though these three questions are different from one another, notice that all three of them are metaphysical rather than epistemological. They concern facts about the nature of a

person rather than about how we know those facts. So, the identification question does not ask: “When encountering an alien for the first time, how can we tell whether it’s a person?” or “What would be the best test to use to determine whether the alien is a person?” but rather, what makes it the case that the alien is (or is not) a person. Likewise for the reidentification question and the characterisation question—we are not asking how we can tell that the 1984 individual is the same person as the 2003 individual, or how we can tell which characteristics of a given person are central to their identity.⁴ This will prove to be crucially important as we turn to take a closer look at the notion of biometric identity in Section 2.

2 | BIOMETRIC IDENTITY

Suppose one wants to determine who a given individual is or verify that a given individual is who they say they are. This process can proceed by various different methods. One might rely on information that is meant to be known exclusively by the given individual, as is the case with passwords or personal identification numbers (PINs). This is a knowledge-based method. Alternatively, one might rely on some physical item that is meant to be possessed exclusively by the given individual, as is the case with passports, drivers’ licences, or other identification cards. This is a token-based method. Though these methods are importantly different from one another, they both rely on what we might think of as “surrogate representations of identity” [10, p. 2]. As such both methods face significant problems. Surrogate representations of an individual’s identity need not be tightly connected to the individual themselves. Passwords can be shared, forgotten, or guessed by others. Passports can be lost, stolen, or forged.

The way that biometrics approaches the process of recognition promises to avoid these problems. As defined by the ISO/IEC JTC1 SC37 committee on biometrics in ISO/IEC 2387-37, biometrics is the “automated recognition of individuals based on their behavioural and biological characteristics.”⁵ Anil Jain, Arun Ross, and Karthik Nandakumar give a similar though slightly broader definition in their textbook, *Introduction to Biometrics*: biometrics is “the science of establishing the identity of an individual based on the physical and/or behavioral characteristics of the person either in a fully automated or a semi-automated manner” [10, p. 2]; see also ref. [11]. Rather than relying on passwords or passports, biometric recognition relies on one or more of a varied set of indicators, including fingerprint, palmprint, face, iris, retina, signature, odour, or gait. As Jain and coauthors suggest, “Since the biometric identifiers are inherent to an individual, it is more difficult to manipulate, share, or forget these traits” [10, p. 2].

⁴One might hope that the answers to these metaphysical questions will shed light on the epistemological matters. But they might not. For example, it might be that in ordinary life we rely on both biological and psychological facts to adjudicate identity over time, even though only one set of these facts is responsible for that identity. See also the discussion of persistence versus evidence in Olson [9].

⁵Available online at <https://www.iso.org/obp/ui/#iso:std:iso-iec:2382:-37:ed-2:v1:en>

This last claim that the biometric identifiers are “inherent to an individual,” highlights an important potential disconnect between the way that biometrics researchers are thinking about these matters and the way that philosophers think about these matters. For the philosopher, the question of whether the biometric identifiers are really inherent to the individual will depend on what the term “individual” refers to, in particular, whether it refers to the person or to the human. As we have seen, for the philosopher these are different notions. But that does not seem to be the case for the biometrics researcher—or, at least, as James Wayman [6] notes, their use of the term “individual” might be seen as skirting this philosophical issue.

How might we sort this out? On the one hand [9, 10] explicitly refer to the goal of biometrics as one of *person recognition*, where the process of person recognition requires one to “be able to determine a person’s identity or verify the identity claim of an individual whenever required.” This suggests that “individual” should be understood as synonymous with “person.” Traore et al [11] too refer to biometrics in terms of the identification of a person. But, on the other hand, Traore et al [11] also note that biometrics is “first and foremost about the *human body*” (my emphasis). Wayman makes a similar point: Given that biometrics involves behavioural and biological characteristics, the field “clearly focuses on bodies and their movements, ultimately equating them with individuals.” [6, p. 30]. But bodily and biological characteristics do not necessarily settle questions of person identity; rather, they seem more relevant to questions of human identity. Moreover, in laying out the biometrics standards, the international standards committee explicitly notes that the field of biometrics uses the word “individual” in such a way that it is “restricted in scope to refer only to humans.” This would exclude any non-human persons from consideration in the discussion.⁶

Construing the goal of biometrics as one of *person recognition* is thus philosophically misleading. But there are further philosophical issues raised by the biometrics literature that need to be uncovered as well. Consider, for example, the following claims made by Jain et al:

The ability to identify individuals uniquely and to associate personal attributes (e.g. name, nationality etc.) with an individual has been crucial to the fabric of human society. Humans typically use body characteristics such as face, voice, and gait along with other contextual information (e.g. location and clothing) to recognise one another. The set of attributes associated with a person constitutes their personal *identity* [10, p. 1].

In this passage, the term “personal identity” seems to be used in a way that is very different from the way that philosophers use the notion. One might try to argue that it picks out the sense of personal identity used in the characterisation question. But while the characterisation question does concern

personal attributes, including bodily characteristics, it focuses on picking out those that are most central in making a person who they are. Thus, it is only a subset of the full set of attributes associated with a person that is relevant towards their personal identity in the sense of the characterisation question. Furthermore, there is no special reason to think that the kinds of attributes mentioned by Jain et al—the kinds of attributes on which biometrics focuses—would generally be among those counted as most central. Were you to ask a given individual which features make them who they are, it seems likely that their responses would be more likely to cite features such as their commitment to social justice, their religious devotion, or their status as a veteran or a parent or orphan, than to features such as their fingerprints and gait, or even their face.

Here, we also need to recall that biometrics is not concerned with figuring out what features make you the person that you are. Rather, it is interested in figuring out what features make you *recognisable* as the person you are. In diagnosing the disconnect between biometric identity and the philosopher’s notion of personal identity, then, we need to take more seriously the fact that biometrics is engaged in a process of biometric *recognition*. Recognition concerns questions about the justification that we have for our beliefs about a given person, not questions about the nature of the person themselves. In short, recognition is an epistemological notion. While philosophers engaged in questions of personal identity are typically engaged in a metaphysical inquiry, researchers taking up questions of biometric identity are typically engaged in an epistemological inquiry. Perhaps it is to keep this clear that Mordini advises that “identity is a notion full of metaphysical implications, it should be handled with great care and if possible avoided.” [4, p. 381].

That said, it would be a mistake to conclude that issues about biometric recognition should be seen as completely orthogonal to philosophical discussions of personal identity.⁷ Generally, it seems reasonable to expect one’s epistemological enquiries to rest on solid metaphysical foundations. To give just one example, questions about the justification for our beliefs in (and about) numbers depend on facts about the nature of numbers. If one takes numbers to be physical objects akin to rocks or cucumbers or pencils, then the justification of our numerical beliefs would proceed in a manner akin to the justification of our beliefs in (and about) physical objects. It is precisely because numbers are not typically taken to be physical in nature that epistemological questions about the domain of numbers seem especially fraught.

There is good reason to push back a little here. Even if numbers are nonphysical, one might think that we can nonetheless learn something about them and their nature by interacting with purely physical things. Can’t we learn that three is a greater number than two by seeing that a group of three rocks contains more things than a group of two rocks? Also, can’t we learn that four is an even number by seeing that a

⁶There are a whole host of interesting issues here about biometric recognition of non-humans. For example, one might wonder what happens when you present a non-human thing to a human-recognition system. At this time, the answer is unknown, since biometric research has not really explored the issue. Thanks to a referee for raising this point.

⁷The relationship between biometrics and philosophical discussions of personal identity was addressed in the National Academies of Science, Engineering, and Medicine in their 2010 report *Biometric Recognition: Challenges and Opportunities* [12].

group of four rocks can be evenly divided into two different groups? So perhaps something similar occurs with respect to biometrics, that is, even if persons are nonphysical, we might be able to learn something about them and their nature by way of physical facts about them.

Still, it often turns out that one's answers to epistemological questions about a given subject matter are not neutral with respect to the metaphysical questions, that is, they presuppose certain answers to those questions. This, I think, is what happens in the case of biometrics. To determine the success of biometrics' epistemological approach to identity or at least to determine this from a philosophical perspective, we thus need to look more closely at its metaphysical presuppositions. In particular, we need to ask what exactly they are and whether and to what extent they are philosophically defensible.

3 | BIOMETRICS AND THE REIDENTIFICATION OF PERSONS

Recall the three different questions (distinguished in Section 1) that constitute the philosophical problem of personal identity: the identification question, the reidentification question, and the characterisation question. Part of our goal in looking more closely at the notion of biometric identity was to determine to which of these three questions it is most closely connected. Given that biometric identity seems to be an epistemological rather than a metaphysical notion, we cannot *equate* it to the sense of personal identity utilised in any of these questions. But, that said, it looks like the most natural connection to draw is one between biometric identity and the sense of identity employed by the reidentification question.

We have already seen why biometric identity is not a great fit for the characterisation question, since the features picked out by biometric recognition are not necessarily ones that are central to an individual's sense of who they are. They also do not seem to be the kinds of features that go towards making something a person—or even the kinds of features that go towards making something a human. Great apes like gorillas and chimpanzees have fingerprints, as do koalas, and while the Face ID technology used by Apple for their iPhones does not currently work on animals, there are other facial recognition technologies in use that do; to give just one example, Hau and de Mitcheson [13] describe how one can use complex facial patterns to pick out individual fish, specifically, humphead wrasse. Moreover, even though many of the biometric identifiers in use for humans do not apply directly to animals, there are various analogues that are in various stages of development. Canines might be recognized by way of nose prints rather than fingerprints, cows and sheep by their muzzles, and bottlenose dolphins by their dorsal fins.

While the connections between biometric recognition and the identification and characterisation questions seem tenuous at best, there does seem to be a much closer connection to the reidentification question. The reidentification question asks what makes a person the same person over time. Take an individual at a given time t_1 , call them A , and an individual at a

given time t_2 , call them B . The reidentification question can thus be seen to ask: What makes A the same as B ? The goal of biometric recognition can be put in roughly parallel fashion: How can we tell that A is the same as B ? The parallelism is not perfect, since the reidentification question should really be clarified as: What makes A the same *person* as B , whereas the question of biometric recognition is probably better put in terms of the same *human*, especially in light of our discussion above. But the rough parallel structure seems more than sufficient to mark out a close and genuine connection here.

Philosophers have historically given three kinds of answers to the reidentification question. The first kind of answer, often called the *further fact view*, sees personal identity over time as dependent on some further fact, typically a fact about the existence of a soul. In an effort to streamline our discussion, and since I do not want my conclusions to depend on matters as dubious and controversial as the existence of souls, I here set this view entirely aside.

The second view follows a tradition associated with John Locke, whose work we briefly encountered earlier. Though Locke himself was focussed specifically on facts about an individual's memory, most accounts in the Lockean tradition look at an individual's psychology more broadly—for this reason, they are called *psychological theorists* (or sometimes *psychological continuity theorists*). What makes A the same person as B is not just that B has first-person memories of the experiences of A , but also that A and B share continuity of intentions, desires, beliefs, character traits, and so on. That is not to say that all of the psychological features need to be exactly the same—individuals form new intentions and desires, they gain new beliefs and shed certain character traits—but it is to say that there must be adequate continuity between the psychological features of A and the psychological features of B . The idea, roughly, is that there will be a significant overlap between A and the next temporal stage A_1 , and then a significant overlap between A_1 and the next temporal stage A_2 ... all the way up to B , where there might no longer be a significant overlap with A , but where there will be a significant overlap with the immediately preceding temporal stage. I sometimes like to put the point in terms of an analogy to a long braid of rope [7]. Even if it is the case that no single fibre runs through the entire rope, the ends are connected by way of a continuity of fibres, and we can thus see both ends as the same rope.

In contrast to the psychological theory, the third view focuses not on facts about psychology but on physical facts. Unsurprisingly, its adherents are typically referred to as *physical theorists* (or sometimes *physical continuity theorists*). There are different versions of this view, some focussing on physical facts relating to the body, some on physical facts relating to the brain, and some on physical facts relating to the human organism (or the human animal). These views are known as the *bodily continuity view*, the *brain continuity view*, and *animalism*, respectively. Though bodily continuity theories are no longer popular, the other two views are considered to be viable. For those adopting the brain continuity view, our continued survival should be seen in terms of the survival of

the brain. Even though brain cells die and new neural connections are forged, as long as there is sufficient brain continuity, I continue to exist. For the animalist, our continued survival should be seen in terms of the survival of the human animal. As long as the same human animal exists, I exist. When it ceases to exist, so do I. I am simply that human animal.⁸

When reflecting on these two different views, it seems immediately clear that biometrics aligns better with a physical theory than it does with psychological theories. After all, as Mordini and Massari note, it is the ideal aim of biometrics to “turn persons into mere living objects” [5, p. 494]—a claim that sounds a lot like the animalist’s assessment of personal identity.⁹ Perhaps the biometrics researcher is completely untroubled by the outright dismissal of the psychological theory. Perhaps this theory seems like an outdated vestige of pre-20th century supernaturalism. The biometrics researcher might take the view proffered by van der Ploeg that the emphasis on psychology in philosophical accounts of identity is “unwarranted” and simply reflects philosophy’s “longstanding denial of the relevance of embodiment” to matters concerning personal identity [3, p. 40]. As I will suggest in the next (and final) section, this kind of response would be a mistake. In short, biometrics seems to be at odds with widely held beliefs that what makes me the person I am has to do with my psychology, not with my body.

4 | PSYCHOLOGICAL THEORIES OF REIDENTIFICATION IN THE 21st CENTURY

To see this, it is important to note that there are good reasons to maintain a psychological theory even if one fully embraces the naturalistic worldview of the 21st century. In fact, one might think that it is in large part due to the vast technological advances of the past 70 years or so—advances relating to computers and artificial intelligences—that the psychological theory has such continuing allure. Consider the fact that many of today’s leading technological innovators aspire to being able one day to upload their consciousness to a machine. Inventor and futurist Ray Kurzweil is a good case in point. Currently serving as the director of engineering at Google, Kurzweil predicts that we will be able to upload ourselves to a computer or android body via a straightforward scan-and-transfer procedure as soon as the late 2030s. Other technologies involving nanobots might allow for a more gradual transfer such that we transition to a non-biological being without ever even noticing. Were he himself to undergo these procedures, Kurzweil suggests that “There will be no “old Ray” and “new Ray”, just an increasingly capable Ray” [16, p. 202]. His personal identity will be completely maintained. If this is the case, though, his identity cannot consist in his body or in his being a certain

human organism, since he might not have a body and will no longer be a biological organism at all.

In addition to the upload scenario, there are numerous other hypothetical scenarios that point towards a psychological approach to the reidentification question. To take just one additional example, consider transporter-like teleportation of the sort depicted in *Star Trek*. One starts on a spaceship and then is “beamed down” to a planet. There is no physical continuity between the pre-teleported individual and the post-teleported individual. The individual on the planet is made of wholly different matter from the individual on the spaceship. But given that the two individuals share psychological continuity in a very strong sense, we are inclined to view the individual on the planet as the same person as the individual who was on the spaceship. Someone might be queasy about teleportation, but this queasiness surely derives from worries about the reliability of the technology itself and not from worries about the lack of physical continuity. Yet anyone inclined towards animalism would have to view such teleportation not as a fast means of travel but as a fast means of death!

In fact, the psychological theory has more adherents among professional philosophers than any other views about reidentification. In a survey conducted in 2009 of over 900 philosophy professors at leading universities throughout the world, 34% claimed that they accepted or leaned towards some kind of psychological approach, 17% claimed that they accepted or leaned towards some kind of physical approach, and 12% claimed that they accepted or leaned towards the further fact view (The remaining 37% were either undecided, did not feel they knew enough to answer the question, or accepted another view.) While this is by no means decisive support for the psychological theory, it nonetheless shows that the view has twice as much support as physical theories like animalism.¹⁰

Suppose that these 34% of professional philosophers are right and the psychological theory is the correct answer to the reidentification question. Does that mean that biometrics is philosophically misguided? Though I think there is reason to worry here, I also think that we can avoid an affirmative answer to this question. There are three important points worth considering.

First, we need to think more closely about the relationship between biometrics and the physical theory. As I noted above, biometrics seems closely aligned with this view. But I do not think that means that biometrics needs to presuppose its truth. Suppose, for example, that biological features and psychological features closely covary with one another (or even track one another). Of course, this does not seem at all plausible for some biometric identifiers. It seems highly unlikely that one’s unique fingerprint patterns in any way covary with or track the features underlying one’s psychological continuity. But it seems

⁸See McMahon [14] for one influential development of the brain continuity view. See Olson [15] for one influential development of animalism.

⁹Consider also the claim that, for the purposes of biometrics, “an individual can only be a ‘body.’” (Pato and Millett [12, p. 18])

¹⁰Though I don’t have survey results on the matter, I’d guess that the psychological theory has even stronger support among the general public than it does among philosophers. Consider, for example, the role that intent and other psychological states play in legal proceedings or even in everyday interactions. Moreover, the psychological theory seems presumed by a wide variety of plot lines in fiction and film.

more plausible for some other biometric identifiers like face and voice. It's perhaps even more plausible for some of the behavioural identifiers used in biometrics. So it might be argued that, even if the psychological theory is the correct answer to the reidentification question discussed by philosophers, the close connections between psychological features and physical features make it good sense to use biometrics for recognitional purposes. Though the biometric identifiers do not play any role in making an individual at time t_2 the same person as an individual at time t_1 , they can nonetheless be fruitful in allowing us to recognise whether an individual at time t_2 is the same person as an individual at time t_1 .

Moreover, it is not clear that we have any better means of recognising psychological continuity (For relevant discussion, see Brook [17]). In most cases, much of the evidence we have for someone else's psychological continuity comes from what they tell us. But of course, they might lie or be otherwise deceptive. Perhaps we might also rely on someone's behaviour to recognise psychological continuity. But here too there could be deception.

Second, even if biological features do not covary with or usefully track the psychological features, one might argue that the same problem arises for other identity recognition systems such as passports or drivers' licences—or, more generally, for any kinds of photo ID. A photo ID cannot track psychological continuity. Certainly, it does no good in the kinds of situations imagined above where individuals upload themselves to computational systems. Of the systems currently in use, knowledge-based methods seem to be the only ones that function by measuring something about psychological continuity rather than physical continuity. But even when there are strong psychological connections between A at time t_1 and B at time t_2 , B might have forgotten the PIN that A chose. Arguably, then, knowledge-based methods do not seem to be successful in providing the right kinds of measures of psychological continuity. Thus, insofar as there is a need for recognition systems, and insofar as we do not seem to have a good way of measuring psychological continuity, one might argue that the pragmatic considerations outweigh the metaphysical ones. It is a philosophical trade off that must be made. Here is another way to put the point: Recognitional systems need not be anywhere near perfect in order to be extremely useful to us. (Indeed, given its probabilistic nature, biometrics does not even aim at perfection.) Even though biometrics would get things wrong in the upload case, for example, it gets things right in the vast majority of cases. So it may well be our best bet.

Third, one might note that the kinds of cases where biometrics will run into the most trouble—cases like the upload scenario—are even on the most optimistic assessments still likely to be more than a decade away. So, in line with the previous points, we might think that given the current state of play, (1) there is enough covariation between biometric features and psychological features to make them highly reliable; and (2) this is the highest degree of reliability we are presently able to achieve. Once upload technology is nearing viability, we will have to undertake a serious re-evaluation of our

reidentification techniques. But until then, we can use biometrics without much metaphysical worry.

My discussion of these three points was conducted against the background assumption that the psychological theory is correct. It is interesting to note, however, that at least some of these issues would still arise even if we were to drop this assumption. So suppose that the psychological theory is false and that some version of physical theory is true, in particular, the brain continuity theory. Even in this case, the biometric facts might depart from the metaphysical facts. Consider the frequently discussed transplant case. In this hypothetical situation, we suppose that two individuals are in a horrible accident such that one (call them C) ends up with a fully functioning body but a severely damaged brain, and the other (call them D) ends up with a severely damaged body but a fully functioning brain. Neurosurgeons take D 's functioning brain and transplant it into C 's body. When we consider the individual with D 's brain and C 's body, who is it? Is it C or is it D ? Most people have the very strong intuition that it is D and that is also what the brain continuity theorist says. According to most of the biometrics measures, however, the individual is C .

Perhaps not all physical theorists have the same problem here. Animalists will likely deny that the C -body/ D -brain individual is the same biological organism as D . So perhaps animalism is able to match up with the biometric results in this case, even if other physical theories cannot. But it does so at the cost of having to deny the intuition that the individual is D , an intuition for which there is extremely widespread support.

It is time to take stock. As we have seen, the metaphysical worries about biometrics cannot be easily dismissed as merely a vestige of an outmoded sense of ourselves. The psychological theory of personal identity is still alive and well in the 21st century, and even if we focus on brain continuity rather than psychological continuity, there can be disconnects between biometric identity and personal identity. Put simply, biometric identity is not the same thing as personal identity, and so biometrics researchers should stop talking as if it were.

That said, however, the fact that biometric identity cannot be equated with personal identity does not necessarily mean that it cannot be used to track personal identity. If we focus on biometric measures that nicely correlate with psychological features, and if we work towards developing further such measures going forward, then pragmatic considerations might well come down decisively on the side of biometrics. Just as one may well be able to address many of the ethical worries about biometrics by way of careful attention to the relevant issues, one might be able to address the metaphysical worries in a similar fashion.

CONFLICT OF INTEREST

I have no conflict of interest to declare.

DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analysed in this study.

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