

THE MORALITY OF HEAD TRANSPLANT: FRANKENSTEIN'S ALLEGORY

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Abstract: In 1970 Robert J. White (1926-2010) tried to transplant the head of a Rhesus monkey into another monkey's body. He was inspired by the work of a Russian scientist, Vladimir Demikhov (1916-1998), who had conducted similar experiments in dogs. Both Demikhov and White have been successful pioneers of organ transplantation, but their scientific attempts to transplant heads of mammals are often remembered as infamous. Both scientists encountered important difficulties in such experiments, including their incapacity to link the spinal cord, which ended up by creating quadriplegic animals. In 2013, neurosurgeon Sergio Canavero claimed his capacity and plan to carry out the first human head

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transplantation. According to Canavero, spinal linkage offers now the possibility of successfully transplanting the head and, by doing so, circumventing many of the somatic diseases afflicting human beings. In this article, we anticipate and discuss some ethical problems associated with the potential practice of human head transplants, and we consider how the possibility of a head transplant deals with our long-held metaphysical views on personal identity. Finally, we resolve for a moratorium of head transplants due to its lack of biomedical consensus.

Keywords: *head transplant, ethics, yuck factor, personal identity.*

1. HEAD TRANSPLANTATION: A HISTORY OF INFAMY

Cephalosomatic anastomosis (CSA) is the surgical transfer of a healthy head to a decapitated body. According to Dr. Sergio Canavero, this procedure, most commonly known as “head transplant” or “whole body transplant” –depending on who are identified as donor and recipient–, is becoming a feasible intervention once its greatest technical hurdle, the reconnection of the donor’s and recipient’s spinal cords, could be overcome. The procedure would involve a patient suffering from an incurable medical condition but with a healthy and functioning head and brain –arguably the recipient–, and a person who has been declared brain-dead, but still has a healthy body –the donor. According to this understanding of the terms, the recipient receives a *whole body transplant* from a brain dead donor².

The idea of transplanting human heads into decapitated bodies has interested scientists and doctors for over half a century. One of the motivations to consider such a complicated medical procedure is the opportunity it offers to help patients suffering from multiple organ failure or other chronic conditions, such as quadriplegia. The first experimental attempts to implant the head of a mammal into another individual were conducted by Russian surgeon Vladimir Demikhov. His consecutive successes in transplanting organs in dogs –he was the first to successfully transplant a dogs’ heart (1940) and lung (1947)– led him to attempt in

² Although we believe that “whole body transplant” is a more accurate description of the procedure under discussion, we will use “head transplant” to keep with the commonly held expression.

1954 the graft of a living dog's head into another's dog neck. Demikhov successfully transplanted the head and forelegs of a smaller dog, called Shavka, onto the body of a bigger one, and called Brodyaga. They survived the procedure with complete mobility, but finally both died four days later. Supported by Stalin, Demikhov's experimental head transplantation program produced a total of twenty animal transplants (See Langer 2011). Despite these arguably being his most complicated and impressive technical achievements, the international public opinion considered such experiments abhorrent, resulting in Demikhov's worldwide infamy and oblivion (Langer 2011).

The United States heard about the head transplants during the Cold War and started funding research for their own head transplants program. Cleveland-based neurosurgeon Robert White was the ideal person to lead the effort. He was a talented surgeon with a keen interest in experimental research. White and his colleagues at Case Western Reserve University School of Medicine in Cleveland, Ohio, were the first to accomplish the total isolation of the brain in an experimental animal (1963). White was also the first to successfully transplant and hypothermically store the brain of a dog in 1983. For these experimental results we have now a more accurate understanding of cerebral physiology and biochemistry at low temperatures, which is relevant for modern resuscitation techniques. More importantly, in 1970 White transplanted the entire head of a Rhesus monkey onto another monkey's body (White 1999). The monkey had all sensory modalities completely functional, he could see, taste, smell... Nonetheless, White did not think to fuse the spinal cord due to the technical limitations of the day. The monkey survived the procedure and lived for several days. Despite these efforts and achievements, like Demikhov, White also fell from grace and was not entirely recognized for his scientific merits, largely due to the ethical controversies raised by his primates experiments (Berko 2013).

Cephalosomatic anastomosis relies on the reconnection of the spinal cord. White reached the conclusion that a severed spinal cord cannot be reconnected, and that leaving the person paralyzed was an insurmountable obstacle for head transplantation. In 2013, Canavero explained how this difficulty could now be overcome (Canavero 2013). A combination of three modern technologies that were either not available or proved efficient at the time of Demikhov and White, could make head transplant a success during the first quarter of the 21st century, according to Canavero. First, Canavero proposes the use of a micro knife or ultra shape blade in clear

contrast from what happens in clinical spinal cord injury where gross damage hinder regeneration. Over the years there have been great advances in human nerve repair but peripheral nerve injury in humans is often not optimal (Höke 2006). Nevertheless, theoretically speaking the application of this nano-knife would cause a critically lower cell-impact in the spinal cord section. Secondly, he considers the use of inorganic polymers, i.e. fusogens, that have the capacity to fuse severed nerves and immediately reconstitute cell membranes damaged by mechanical injury (Chang et al. 2010; Canavero 2013). Thirdly, with the application of an hypothermia protocol he contends that the neurological damage can be reduced. And finally, Canavero believes there is no reason why such a patient would not be able to walk again within a year after the procedure, a process accelerated by electrical stimulation straddling at the fusion point. (Canavero 2015).

The announcement by Canavero has been received with both optimism (Ren et al. 2014) and skepticism (Cartolovni and Spagnolo 2015, Caplan 2015). On the one hand, optimistic voices such as that of Dr. Xiaoping Ren who has been surgically transplanting the heads of mice –until today he has performed more than one thousand transplants– declare head transplant in humans is eventually possible, although a very complex operation is required. Ren is based at the Harbin Medical University in China and is prepared to host Canavero and his team alongside a team of Chinese neurosurgeons lead by Ren himself to perform the operation in December 2017.

In January 2016 Canavero working with other scientists, including Dr. Ren, from China and South Korea claims to have taken important steps toward the goal of head transplant after a series of experiments in animals (mice and monkeys) and human cadavers. The news has spread all over the world and several media reported it (Wong 2016). As we see below with previous announcements made by Canavero, Arthur Caplan, of the Division of Ethics at the NYU Langone Medical Center in New York is skeptical and said that the fact that Canavero has gone public before publishing the experiments in proper academic journals raised many eyebrows, “It’s science through public relations,” says Caplan. Other scientists, Thomas Cochrane, a neurologist at Harvard Medical School’s Centre for Bioethics, is positioned with Caplan and states that is at least unorthodox to make the announcement before presenting the results to the scientific community, and quoting him “As far as I can tell, that operation has mostly been about publicity rather than the production of good science.” (Wong 2016)

To get an idea of this complicated operation it will involve a crew of 150 medics (nurses included), between 36 and 80 hours long and of course it will be very expensive (around 15 million Euros). On the other hand, the skeptics raise ethical concerns and in particular how the body and brain will regain a healthy state. For instance, Arthur Caplan, this past year said in May (Caplan 2015) that this is an irresponsible operation, unscientific, utterly nonsense and ridiculous. According to Caplan, Canavero based his reasons to attempt the head transplant only on some reports about nerve repair with special substances but at best they were preliminary because we do not know how to fix an injured spinal cord. Another issue pointed out by Caplan is that it is not as simple as transplant a head onto a new body. The mammal nervous system is bathed with chemicals and sends signals to the brain. A complete new head with a new brain could become “crazy” or demented because the neural inputs will be different. Our brains get used to the signals send by our bodies; in a new body it would be totally different.

Despite the clash of opinions from both sides of the debate, it is fair to say that experts of one stripe or another overlook the fact that there is no scientific impossibility to transplant a head onto a new body as the history of organ transplantations shows. It seems the norm for every new radical concept that receives a lot of attention to arouse a sharp division of opinion among expert commentators. It happened when Christiaan Barnard performed the world's first human heart transplant in 1967. According to some experts, perhaps Dr. Barnard's mayor medical contribution was his courage to proceed with the heart transplant at a time when other surgeons were happy enough to perform the operation only in animals pondering if it would be possible to transplant a human heart. However, we cannot know for sure the scientific viability of a human head transplant until it occurs. Criticism might be justified but the possibility of a human head transplant arises strong reactions in most of us and these are about the way we conceive ourselves; that it is the reason why we believe that the bioethical community needs to reflect on the conditions that makes a human head transplant morally repugnant or dubious, if there is something repugnant after all, to know the reason why we reject it morally and the way we can avoid it as well.

2. ETHICAL ASPECTS OF THE HEAD TRANSPLANT

By the time Demikhov and White's surgical achievements were rejected by both the scientific community and the public opinion as outrageous, other transplant champions, such as Joseph E. Murray (first kidney transplant in 1954), Thomas Starz (first liver transplant in 1967), and Christiaan Barnard (first heart transplant in 1967), were extolled as world heroes. What are the unique concerns underlying head transplantation that makes it so different from the transplantation of other organs? What beliefs and fears can explain the historical infamy associated to head transplantation? What are the specific ethical concerns raised by cephalosomatic anastomosis?

The head is a unique part of the body in many respects. On the one hand, it is commonly believed to contain the organic structures supporting life and what makes it human. On the other, psychological identity is often thought to be a phenomenon supported by the brain, and individual recognition relies on the facial muscles and skin. Does head transplantation necessarily threaten the life of a whole body recipient and its chances to remain a *human*? Would that individual remain a person, and *the same person*?

In this paper we are arguing that the moral repugnancy generated by this procedure is linked to these two sorts of problems. On the one hand, head transplants raise questions about the boundaries of human life. Decapitation has been historically understood as a sufficient cause of death. Now, head transplants offer the puzzling possibility for decapitated bodies, *and* decapitated heads to reconstitute a living human being. Can the recipient survive along the process? On the other hand, head transplants raise vexing questions about the identity and the individuality of the subject resulting from such procedure: is the transplantee the same person as the former head's owner? To what extent the former owner of the body survives the surgery? Although we believe these two problems may account for the moral repugnancy generated by head transplants, they certainly do not exhaust the challenges raised by this procedure. We are mentioning here some of them: As any innovative or experimental procedure, head transplantation needs to be subjected to all the requirements of the *regulatory ethics paradigm*, including appropriate informed consent and benefit-risk analysis. Some specificities can be found here. People, who would agree to donate their internal organs, might have reasons not to donate their body for a whole body transplant.

Ordinary organ donors often give specific instructions not to donate parts of their body, such as their face or eyes, most likely due to concerns about privacy and a sense of identity ownership. It is uncertain how much weight individuals place on the whole body as the basis for the self, but visible parts of the body seem to be particularly sensitive from the point of view of the interest in preserving anonymity. This sort of concerns would justify specific consent requirements for whole body transplant. Assuming that the risk of undergoing such a complicated surgery is very high, head transplant would only be morally acceptable for cases where alternatives were nonexistent, making this intervention the last hope to save a life, re-establish health or alleviate unbearable suffering. Patients with life-threatening conditions such as multi-organ failure, severe forms of spinal muscular atrophy³, end-stage non-neurological degenerative diseases or terminal cancer should most probably go first. This being said, if this procedure became safe, it might eventually turn to be the standard of treatment for non life threatening conditions, such as transgender operations, or even become a powerful mechanism for biomedical enhancement.

Other types of ethical implications of head transplant concern decision, freedom, responsibility and even intersubjectivity. With respect to decision it is better to focus on which type of decisions a given IRB (Institutional Review Board) has to make when confronted with a case of head transplant. More on this in sections 6 and 7. Concerning freedom, we conceived freedom as the possibility of the patient to choose which treatment is better for them. Responsibility is related to the consequences of the decision made by the patient and medical staff. And finally, intersubjectivity is the most thorny issue from our point of view. Because it has to do with how a patient who has received a head transplant is treated socially by his peers, family and society in general. You can think of many tricky situations. As an example, imagine that a recent head transplantee has the body some person recognizes to be the body of the one who killed that person's son.

Finally, whole body transplants also raise an important question from the public policy perspective. In a context of organ shortage, the efficiency of using one healthy body to save one person, when that same

³ In June 2015, Canavero met a man who volunteered for the world's first head transplant. A Russian, 30 year-old computer scientist suffering from Werdnig-Hoffmann disease.

body could save several lives and increase the life expectancy and the quality of life of some others, is in doubt. We believe the types of questions outlined ought to be addressed before head transplantation becomes a practice. We will not deal with them any further in this paper, but we will focus on the two fundamental ones.

3. HEAD TRANSPLANT AND THE LIMITS OF LIFE AND DEATH

The hypothetical scenario of a head transplant generates important insights to our understanding of what life in general, and human life in particular, is. This is partly due to the fact that the technique would require severing the part of the body which not only has been believed to be essential for organic integration, but also the center of consciousness, cognition and the self. Interestingly, both proponents and critics of brain death as a criterion for human death have referred to the decapitation analogy. Alexander Capron, one of the “intellectual parents” of brain death, has mentioned “physiological decapitation” as “perhaps the easiest way to think of” brain death [1999, 125]. According to him and other supporters of brain death, “brain death individuals are dead” is an idea often defended on the basis that brain death is a sort of physiological decapitation.

In 1970, Robert White transplanted the entire head of a Rhesus monkey onto another monkey’s decapitated body (White 1971). White did not fuse the spinal cord due to the technical limitations of the day, he claimed the monkey had functional sensory modalities, he could see, taste, smell... The monkey survived the procedure and lived for several days. It is rarely questioned that the head plays a necessary role in the maintenance of physiological life in all chordates, including humans. Such belief accounts for the beheading being an archetypical way of causing death. Head transplants would challenge this traditional view, insofar as it promises the possibility of preserving –and even expanding– the life of a decapitated individual. What is the mechanism by which the head play such important role in preserving life? If a body could physiologically survive without a head, and a head survive after being separated from its original body, would the traditional belief about the vital role of the head still make sense?

A closer look at contemporary medical practices shows that it is not so clear that head plays such a vital role. On the one hand, individuals

with a total and irreversible loss of brain functions can maintain spontaneous heartbeat and many other integrative functions of the organism as a whole for years and even decades, with the assistance of mechanical ventilation. Controversies around the vital status of so-called brain-dead individuals are not solved (Rodriguez-Arias 2017), and the objections against the mainstream view which equates brain death to human death are far beyond philosophy or religion: they are scientific (biological and medical). On the other hand, and this is even more problematic, the regulations of most developed countries accept that a person can be declared dead on the basis of cardio-circulatory criteria *alone*, without any direct evidence that the individual has totally and irreversibly lost brain functioning. In that case, the assumption is that a prolonged loss of circulation to the brain stem and its hemispheres necessary provokes total brain loss.

4. HEAD TRANSPLANT AND PERSONAL IDENTITY

The philosophical problem of personal identity deals with questions such as What is ontologically necessary and sufficient for some past or even future “self” to be you? What makes who you are? What am I? When did I begin? and, of course, How to understand our identity over time? Contemporary debates on the metaphysics of personal identity have focused on its practical and moral dimension as well. They attempt to explain several conundrums that arise by virtue of humans being persons but also moral selves. Personal identity matters for any ethical theory because people often have an interest in remaining the same. In the case at hand, a head transplant may imply for an individual to “become another person” not recognized by others, which may have important implications for personal relationships.

Some of the mainstream accounts in contemporary debate about personal identity take a very individual stance forgetting the influence that other people’s beliefs and attitudes have towards personal identity (Daniels 1988). And this leads us to another important issue: What role family, friends and society at large play in conceiving personal identity, principally, if you drastically change your identity by means of a head transplant? The possibility of human head transplant translates all these issues to a new level of inquiry. Consider this: if someone takes my arm, am I still the same individual? Almost everyone would agree that I am

still the same person. The same with one leg, with both legs, with all limbs and with most, if not all, internal organs. Almost no one doubts that people with a heart transplanted are no longer the same and the one who doubts it is usually criticized as being superstitious. The announcement of the attempt to carry out the first human “head transplant” has revived these and other issues that had troubled many philosophers throughout history and recent times (Locke 1836, Ch 27 S. 16; Perry 1975 and Parfit 1984).

Of special interest here, as pointed by Canavero himself (2013), is the ethical dilemma raised by the head transplant in terms of biological identity. The resulting head transplant would create a “chimera” and a loved one (a husband or wife) could be in love with the personal identity as reflected by the “head” but, should he or she want to reproduce, the offspring would carry the genetic material of the donated body (donor person).

Biomedical advances have made it possible to successfully transplant kidneys, livers, hearts, lungs, limbs, uteruses or faces. A pressing question is: Would a head transplant constitute a qualitative change or moreover an ontological one? The possibility of a head transplant raises the traditional questions of where the self lies. To show how head transplants affect the problem of personal identity we need to draw the basic theoretical framework in which the problem of personal identity falls.

In the Introduction of one of the most celebrated books in philosophy concerning personal identity, Derek Parfit (1984) declares that many of us think we understand what persons are. He claims that we do not and asks the following questions central to the metaphysical problem of personal identity:

What makes me the same person throughout my life and a different person from you?

What makes the individual identical to himself that allows, at the same time, be different from other individuals?

As you can imagine if the announcement of the first human head transplant becomes a reality another battery of questions portraying equally challenging ethical issues will be necessary to confront:

Where is the location of the mind?

What is the physiological substrate of the mind? Is it the brain; is it the brain plus other body parts?

Is the mind an emergent property of the interaction between both the body and brain?

and more importantly,

If scientists could transplant my head to another body, I would be he or he would be me?

These are difficult questions that philosophy has tried to answer for centuries. Although we will certainly not solve them here, we can anticipate that the first brain transplantation might suddenly answer them.

Using traditional arguments in the debate on personal identity the philosopher Derek Parfit presents a classical distinction. There are two kinds of sameness or identity: *qualitative identity* and *numerical identity*. Following Parfit's example (1984, p. 201) two white billiard balls are not numerically but qualitatively identical and if I paint one of these balls red it will cease to be qualitatively identical with itself as it was. The red ball now and the white ball that I painted red are numerically identical.

Traditionally there are two criteria suggested for establishing personal identity. On the one hand the physical criterion and on the other the psychological criterion. The physical criterion of personal identity tries to find an answer to three questions: What is the nature of a person? What makes one person in two different time points the same person? What is involved in the continued existence of a person over time? In the following sections we would like to introduce briefly some issues concerning the metaphysical problem of personal identity and how several core concepts such as unity, individual, identity and personhood relate and can be transformed with the possibility of a head transplant.

5. METAPHYSICAL APPROACHES TO PERSONAL IDENTITY: PSYCHOLOGICAL APPROACH AND SOMATIC APPROACH

The metaphysics of personal identity is concerned with a very important aspect: The question of persistence. The three questions presented above make up the persistence question. Each and every material object, including persons, has persistence conditions. What is the ontological basis for the persistence of persons? From the physical criterion is not the continued existence of the entire body, but the continued existence of enough brain to be the brain of a living person. For example, X today is one and the same person as Y in a past time if and

only if Y's brain continued to exist and is now X's brain. This view denies the hypothetical scenario of teletransportation. For advocates of the physical criterion teletransportation is not a way of travelling but of dying. The teletransportation is a thought experiment, one that generates intuitions or beliefs that those who believe in the physical criterion do not accept. Physical disintegration of the body and the brain within a scanner on Earth although recording all cells to create a replica on Mars is a way to interrupt the necessary and sufficient continuity for personal identity.

5.1. PSYCHOLOGICAL APPROACH

The psychological criterion is similar to the physical approach but this time is a kind of psychological continuity. The psychological approach focuses on the continuity of our experiences or memory. Perhaps because memory allows us to be aware of our identity over time. The personal identity problem in its modern form is first found in Locke's 'Essay Concerning Human Understanding', where he suggested that our experiences are those that provide the criterion of personal identity. The psychological criteria derived from Locke may be part of a correct view of personal identity but on its own it is not a plausible view. If we take only memory as a psychological criterion of personal identity this is too demanding. It would not be possible for someone to forget things he has done or experiences he has had. For example, right now, I do not remember where I left my keys but I am still me. You can extend this exclusive criterion of experience-memory to cover such cases. It would be a revision of Locke's argument. For Locke only X would be Y today 10 years after if X has a direct memory connection with Y. The revision of Locke's argument would appeal to other facts besides direct memories. There are other direct psychological connections, for example, between the intentions and the actions to take. Other connections are among beliefs, desires and other psychological states.

Parfit defines two general relations:

- *psychological connectedness* the holding of particular direct psychological connections
- *psychological continuity* the holding of overlapping chains of strong connectedness.

According to Parfit personal identity per se is not what matters. Personal identity just involves certain kinds of connectedness and continuity and when this holds in a one-to-one manner these relations are what matters. As Marya Schechtman (1990) suggests, the question of Who am I? might be answered slightly differently by an amnesic patient and by a confused adolescent. The former is asking which history is a continuation of and the latter probably knows her own history but is asking which beliefs, desires etc. that seems to have are truly her own. So personal identity in the form of psychological continuity can be called, respectively, the *question of reidentification* and the *question of self-knowledge*. Our philosophical discussion on the possibility of a head transplant regarding its impact on the conception of personal identity from the psychological approach which differentiates two general relations according to Parfit, is generally considered to be concerned with the *question of reidentification*.

Parfit starts discussing his own version of the psychological continuity with some fundamental definitions. Then, Parfit shows that none of these criteria, connectedness or continuity, that constitute psychological continuity –memory, connections between intentions and actions or temporal parts of psychological features– assumes any facts on personal identity. Parfit sees identity as a transitive relation but continuity is not. I can be connected to myself two days ago, but not too much connected to myself two years ago. In a nutshell, Parfit describes psychological continuity in terms of another relation, which he calls: Psychological connection (Parfit, 1984, 205-6). There is a psychological connection when a psychological state at a certain time is causally related in the appropriate way to another psychological state at another certain time. In a way, if I believe something because you intended something, if I do something because you experienced it, if I remember something because you learned it, then you and I are psychologically connected. And is this psychological connection, or relation R, the one which is important rather than personal identity itself.

5.3. SOMATIC APPROACH

The somatic approach is similar to the physical criterion only that continuity is continuity of the body and not of a part of the body such as the brain. People would cease to exist if they lose or they cease to use some part of their bodies. The imagined case of teletransportation is in-

conceivable for the advocates of the somatic approach. The somatic approach is pretty common sense at first glance, very intuitive. The somatic approach basically says you are identical to conditions of your body or the thinking animal you are. But as many thought experiments like teletransportation, body swapping cases etc. and not so imaginary cases like the possibility of head transplantation in humans, this makes the somatic approach very objectionable. Our approach is mainly analytical but other philosophers from other traditions could address the debate on the relationship between mind-body in different ways with different implications for the possibility of a head transplant. For example, Popper (but also Eccles) defends an interactionist theory of mind and to solve the mind-body problem he introduced the doctrine of the three worlds. Why three worlds rather than one? Because Popper believed that either materialist monism or any instantiation of the classical Cartesian dualism did not work. Against monism, he thought that monism is unable to account for the emergence of consciousness and the mind. And against dualism, he thought dualism is unable to account for its claim that the mind is some unique non-physical substance impossible to be accounted for in terms of natural selection since non-material substances cannot emerge out of material objects and through natural selection. Popper also wanted to analyze the interaction among the material world (W1), mental processes (W2), and the cultural products of the human mind (W3). He really thought of the effects of linguistic, artistic, musical content and other various aspects of W3, on W1, working through W2. How to relate this position of Popper on the mind-body problem with the possibility of head transplant or for that matter those positions held by authors such as Searle, Bunge or Marcus Gabriel when each of them has a different approach to the mind-body problem? It is not our main objective to make here a review of the literature on the mind-body problem. Only to confront the main metaphysical intuition, say personal identity, with the possibility of a head transplant. For the interested reader we recommend Bunge (1980). Other well known philosophers with different approaches to the classical problem of the mind and its relation to the body are, among others, John Searle (1992), or Markus Gabriel (2015). It is orthogonal to the main topic of this paper, but we can point out very briefly some tenets of their respective positions to have a snapshot of how different ways of seeing the mind-body problem have different consequences for the idea of personhood in a head transplant. For example, Searle believes to have been offered a simple solution to the mind-body problem with his “biological natural-

ism". In his much celebrated work "The Rediscovery of the Mind" John Searle states: "the famous mind-body problem, the source of so much controversy over the past two millennia, has a simple solution." (1992, 1.) His proposal to solve the millennial mind-body problem is to acknowledge that "Mental phenomena are caused by neurophysiological processes in the brain and are themselves features of the brain." (1992, 1). On his part, Markus Gabriel (2015) and his defense of hyperrealism suggests that there are different epistemic worlds or fields of sense. Besides the things that exist in the universe which are the proper study of science there is also a world of epistemic realities such as abstract objects, fairy tales, unicorns etc. For him, asking about the problem of mind in relation to matter is a misguided metaphysical question before we resolve what we are trying to mean by the different premises and terms.

5.4. THE FISSION PROBLEM

Within the somatic approach there is what is known in the literature as the fission problem. A series of imagined cases that if accepted present problems for the psychological criterion of personal identity.

Imagine, the following scenario:

A surgeon removes and divides my brain; the halves are then taken and will be transplanted into the bodies of two other persons. I share half of my brain with each of them, the fission outcomes body 1 and body 2, so they are both psychologically continuous with me and by the psychological criterion are identical with me.

Callosotomy or hemispherectomy involves the surgical transection of the corpus callosum, the bundle of cells connecting bidirectionally both hemispheres of a single brain; it was a treatment for epilepsy in the 50's and 60's (Gazzaniga, Bogen and Sperry 1962; Nagel 1971). However, fission cases assume the possibility of dividing subcortical structures of the lower brain which forms a single entity and this is not physically possible if you want to maintain higher order cortical functions. Nonetheless, the logical possibility of the fission cases is considered by many authors a theoretical challenge to personal identity. Should fission be an acceptable thought experiment it presents problems for the psychological criterion. The fission outcomes, body 1 and body 2 are not identical to each

other; they differ in spatio-temporal location and by the proviso of the psychological criterion that entails that a thing could be identical to two non-identical things which of course violates the transitivity relation of personal identity. Let us suppose a head transplant is possible. Given the theoretical framework of the metaphysics of personal identity reviewed above and conceding that the psychological criterion is the most plausible one, it is the continuity of our psychological experiences through memory as a criterion of personal identity, but now a crucial question arises. The resulting person of a head transplant: who would this person be?

It may seem that the psychological and physical criterion are in disagreement. The resulting person is psychologically continuous to the owner of the transplanted head but will not have the same body although as noted the physical criterion ought not to require the continued existence of the entire body. If the brain continues to exist and is the brain of a living person who is psychologically continuous with whom he was before, personal identity continues to exist. And this is true regardless of what happens to the rest of the body. However, it will be important what the new body is like. In contemporary cognitive science some researchers are even hinting at a possible paradigm shift in the study of the mind/brain and refer to this new movement as “postcognitivist” where the body, and its sensorymotor systems, has a central place; meanwhile the traditional paradigm “cognitivism” (i.g. Chomsky, Neisser, Miller among others as mayor advocates) views the mind/brain as an information processing device and cognition refers to all the processes by which sensory inputs from the world are manipulated, stored and used in order to produce intelligent behavior in analogy to a computer. “Postcognitivism” or more accurately “situated cognition” or “embodied cognition” (Gomila and Calvo 2008) sees the mind/brain as embedded within the environment grounding cognition in sensory and motor systems and therefore the body seems to be vital to understand the mind. In some sense, in a head transplant operation if the new body is quite unlike the old body, “situated cognition” would assert that this would affect what a person could do and might thus indirectly lead to changes in psychology. So according to situated cognition the possession of the right sort of psychology requires the possession of the right sort of body. We wonder if an advocate of situated cognition would keep the idea of the continuity of personal identity in a head transplant where the body is not the same. However, the “situated cognition” or “embodied cognition” acknowledges a more complex interaction between mind, brain and the environ-

ment. Giovanna Colombetti (2014) develops an enactive view of how affected are part of the body and related to action dispositions that can shed light on how to maintain a fruitful dialogue between those who defend a pure computational perspective of the mind in which representations are manipulated, stored and use and those who champion the view that our brain states are shaped by development, the environment and learning.

6. GENERAL OBJECTIONS TO HEAD TRANSPLANT

Before embarking in such an uncertain task like a head transplant, we should try or perform less drastic, dangerous or invasive interventions such as brain-machine interfaces to restore body movement. Research on brain-machine interfaces is yielding promising results on the possibility to restore movement in patients with spinal cord injuries, traumatic brain injuries, ALS disease, severe amputations, etc. These interventions are less drastic, less dangerous and have more reversible consequences than head dissection (Donoghue 2008). Head transplant would require an enormous amount of immunosuppression that the body might not support without causing cancer or kidney failure; it is an expected possibility. On the other hand, the public and media response could cause a big social alarm. The mere idea of trying a head transplant could scare people. This response could be mediated in large part by the “yuck factor” that lead to moral disapproval, moral outrage or moral disgust on people (Midgley 2000). It is a matter of philosophical controversy granting disgust the normative power to justify arguments in favor or against, but we need to recognize that disgust or the yuck factor serves as a social tool to accept or reject ideas. Irrespective of the value, good intentions and even the technological feasibility of a head transplant, there is a visceral or gut reaction in all of us, more or less tamed, but nevertheless instinctive, to reject something because causes us (moral) disgust. And this instinctive reaction is clear and very strong when thinking about the possibility of a head transplant.

7. DISCUSSION: FRANKENTIN'S ALLEGORY

One of the first indisputable examples of art was found in the Stadel cave, Germany, (Conard 2003). It is an ivory carved figurine of a lion-man (or lioness woman). Its body is human but the head is leonine. Since

32.000 thousand years humanity is still fantasizing about combining different parts of the same species or different parts of different species. In 1818 Mary Shelley published *Frankenstein*, the story of a scientist who wants to create a perfect being but fails and creates a monster. This masterpiece of literature has been told over and over again in countless versions. It becomes entrenched in our collective imagination and scientific mythology. *Frankenstein* seems to warn us that if we play God engineering life the consequences will be disastrous. Yet *Frankenstein*'s story has a deeper meaning. Beyond the argument of playing God, *Frankenstein*'s story confronts us, like it or not, with the fact that science and technology someday will transform us. The replacement of *Homo sapiens* and the coming of post-humans or even transhumans (Buchanan 2013; Savulescu, Meulen and Kahane 2011) is no longer in the realm of science-fiction. Engineering biotechnology is making planned and intelligent design possible. Biologists and educators all over the world are fighting against the intelligent-design movement which opposes the teaching of darwinian-wallacian evolution by natural selection in the educational system. For close to 4 billion years life have been subjected to the old regime of natural selection, but now hundreds of thousands of biologists and geneticists are manipulating life in the lab. Ironical as it seems biologists are right about the past, but defenders of intelligent-design movement are right about the future. Now humans have the technological power to transform the world and themselves. So the real questions facing us are, what do we want to become? and what identity do we want to have? seems to me that moral and ethical caveats aside the possibility of a head transplant do not matter too much for our long held intuitive musings about what personal identity really is. The real issue here is moral and ethical regarding the harm we can provoke to desperate people who want to recover their motor functions and well-being by means of a head transplant. By all ethical lights, a head transplant should be banned or subjected to a moratorium until consensual scientific evidence is found.

As of April 2018 there hasn't been a human head transplant and probably there may never be. But Sergio Canavero and his Chinese colleague Xiaoping Ren now just say it's imminent. But many bioethicists disagree and argue to stop paying attention and ignore this issue because if not we are contributing to a circus. This case does not represent innovative neurosurgery, but blatant self-promotion. (See, Wolpe 2017 and the whole special issue number 4 of *American Journal of Bioethics Neuroscience* devoted to head transplants).

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