Thought experiments, sentience, and animalism

Forthcoming in *Synthese*.

Margarida Hermida

University of Bristol
Department of Philosophy
Cotham House
Bristol BS6 6JL
margarida.hermida@bristol.ac.uk

Abstract

Animalism is prima facie the most plausible view about what we are; it aligns better with science and common sense, and is metaphysically more parsimonious. Thought experiments involving the brain, however, tend to elicit intuitions contrary to animalism. In this paper, I examine two classical thought experiments from the literature, brain transplant and cerebrum transplant, and a new one, cerebrum regeneration. I argue that they are theoretically possible, but that a scientifically informed account of what would actually happen shows that in none of the cases would the person be separated from the animal. Our intuitions in these cases, when adequately informed by neuroscience, do not conflict with animalism – rather, they suggest a correction of the animalist position: the persisting animal should be at least minimally sentient. Sentience animalism is a new formulation of the animalist account of personal identity that allows us to reconcile facts about our biological persistence conditions with the intuition that human persistence should involve some kind of psychological continuity.

Keywords: animalism; brain transplant; personal identity; sentience; thought experiments

1. Introduction

'What are we?' is arguably the most important question in the personal identity debate. It is a question about our fundamental nature. There are mainly two candidate answers. One is the view that we are essentially, or fundamentally, animals, i.e. biological organisms – this is the view known as animalism.[1] Animalism claims that 'each of us is identical with, is one and the same thing as, an animal' (Snowdon 2014, p. 7). That is to say, each of us is numerically identical with an animal, and not merely constituted by an animal, having the body of an animal, etc (Olson 1997a, p. 17; Olson 2007, p. 24). In contrast, personalism or neo-Lockeanism is the view that we are essentially persons, and that our relation to the animal we see when we look in the mirror is not one of identity, but some other relation, for instance constitution. For personalists, our persistence conditions are essentially psychological, mental, or first-personal (Baker 2016: 50).

The two theories are not exactly on a par in terms of what they offer. Animalism is primarily concerned with answering the personal ontology question, i.e. the question 'what are we?', and does not strictly speaking provide an account of our persistence conditions, although most animalists additionally offer some account of our persistence

[1] Some animalists (e.g. Olson 2015; Bailey 2014; Blatti & Snowdon 2016) understand animalism as involving only the simple identity claim that we are animals – this is known as 'weak' or 'modest' animalism, as opposed to 'strong' or 'robust' animalism, which involves additional claims such that we are animals *essentially*, or *fundamentally* (Olson 2015; Duncan 2021; Francescotti 2022). Duncan (2021, 2022) argues that the former claim, which he calls 'animalism light', is uninteresting; but Bailey et al. (2021) counter that it is still an important view. See also Thornton (2016) on various possible formulations of animalism.

conditions, which are in some sense biological. Personalism, on the other hand, is mainly concerned with out persistence conditions, and can sometimes be vague as to exactly what kind of thing we are (Olson 2015, p. 85).

Animalism is, prima facie, the most plausible view; we certainly seem to be animals. When we look in the mirror we see an animal of the species *Homo sapiens*. It is also the most parsimonious view, as it postulates only one entity, the human animal, where personalism postulates two distinct entities, the person and the animal; furthermore, if the person and the animal are one and the same, there is no need for complex metaphysical explanations of the relation between them; it is simply one of identity.[2]

It may seem surprising, then, that animalism is not the most widely held view in the philosophical debate on personal identity. However, personalist or neo-Lockean views of personal identity seem to align better with our intuitions. For one thing, our psychological features, including our memories, personality, preferences, etc, are very important to us. That alone might incline us towards a view that gives them centre stage in determining our persistence over time. But the main consideration in favour of personalist views is that our intuitions seem to favour psychological over biological continuity, whenever the two conflict. These intuitions can be generated by thought experiments involving the brain (Olson 2018, p. 394).

The thought experiments in question are supposed to establish the possibility of our physical and mental features coming apart (something which does not ordinarily

---

[2] For recent defences of animalism, see Bailey (2014), Bailey (2017), Bailey & Pruss (2021), Francescotti (2022), Olson (2018), Snowdon (2014), Thornton & Bailey (2021), Yang (2015), and various essays in Blatti and Snowdon (2016).

happen in real life), the most interesting cases being those where psychological features would seem to be present in the absence of physical continuity (Meier 2022). For example, suppose that your cerebrum was removed from your skull and transplanted into the skull of another human being. It is highly intuitive to think that you would be transported along with it. But no animal is thus transported. On the contrary, a decerebrated living animal is left behind. Thus the thought experiment apparently constitutes an objection against animalism.

There are at least three possible animalist responses to such cases. One is to accept the 'brain intuition' or 'transplant intuition' (Lim 2019; Skrzypek & Mangino 2021), but deny that it falsifies animalism. For example, it might be argued that the human animal can actually persist as an extracted cerebrum (Madden 2016). This is very implausible from a biological perspective, since the cerebrum on its own does not have the capacity for life regulation (for criticism of this view, see Skrzypek & Mangino 2021).[3] A more plausible way the transplant intuition can be accommodated within animalism is to argue that animalism is compatible with *both* biological and psychological persistence conditions, but at the cost of dropping the essentialist claim (e.g. Sauchelli 2017; Lim 2018, 2019). It is unclear, however, whether the resulting hybrid view is still animalism, or is in fact an alternative to both animalism and personalism (Curtis & Noonan 2021).

---

[3] By 'life regulation' I mean a living organism's self-regulation, which encompasses two aspects: one, which is common to all organisms, is *homeostasis*, defined as "a self-regulating process by which an organism can maintain internal stability while adjusting to changing external conditions" (Billman 2020). In complex organisms, particularly multicellular ones, life regulation of the whole organism also requires *somatic integration*, which refers to "the regulation of dedicated homeostatic mechanisms that maintain physiological homeostasis conducive to cellular metabolism" (Brown 2019).

A second possible animalist reply is to again accept the transplant intuition and admit that it constitutes an exception to the rule that all human persons are animals, but to deny that these kinds of exceptions constitute an objection to animalism, by claiming that ‘we are animals’ is a generic claim that admits of exceptions (Bailey & van Elswyk 2021) or, similarly, that it refers only to “typical human persons” (Francescotti 2022). Just as there can be exceptions to the generic ‘tigers have stripes’, and the existence of stripeless tigers does not falsify that generic claim, perhaps the same might be true of ‘human persons are animals’; most of them are, but not necessarily all of them.

Neither of these strategies will be adopted in this paper. Here, I endorse the stronger animalist claim that we are biological organisms essentially, and therefore could not exist without being organisms.[4] I do not understand animalism as a generic claim that is only true of typical or most human persons, but as one that necessarily applies to each and every one of them. If brain or cerebrum transplant thought experiments show that there can be human persons who are not biological organisms, even if only in exceptional cases, then that is a problem for my view. The strategy of this paper will be to argue that, when brain transplant thought experiments are adequately interpreted in the light of neuroscience, they do not in fact conflict with animalism – even understood as a robust claim about what we are essentially.

They do, however, offer an important correction to the animalist view – namely, brain transplant thought experiments indicate that the persisting human animal should be minimally sentient. This suggests a new formulation of the animalist view, *sentience*

[4] Formulating the claim in terms of organisms avoids problems concerning essential membership of biological taxa (Hermida 2022).

animalism. This view is well placed to reconcile animalism with our intuitions about our persistence in these kinds of cases.

Sentience animalism is the view that we are essentially sentient organisms. Organisms persist as long as they continue to live, and the continuation of the same life is tied with the continuation of the capacity of an organism to regulate and coordinate its life processes. For many animals, the nervous system plays an essential role in this regulatory and coordination capacity. In humans, the brainstem is an essential regulatory system of the life processes of the entire organism. Yet in this same ancient brain region, primitive forms of sentience are instantiated as felt representations of the internal state of the organism. This strongly suggests that, far from being a purely psychological property, sentience, at least in its minimal form, is an essential feature of how some complex multicellular organisms regulate and coordinate their life processes. For this reason, sentience is essential for the persistence of living human animals, which means that, even though our persistence conditions are biological, they also necessarily involve a very important kind of psychological continuity, namely continuity of sensation and feeling.

The structure of the paper is as follows. In section 2 I briefly discuss thought experiments, and argue that they can be useful, as long as they are theoretically possible according to our best science. I then proceed to examine in detail three thought experiments involving the brain: brain transplant (section 3), cerebrum transplant (section 4), and cerebrum regeneration (section 5). I argue that these thought experiments do not show that the person can be separated from the animal; rather, they show that persistence of the human animal requires a minimal form of psychological continuity, namely continuity of sentience, which is involved in biological continuity.

This new animalist view, sentience animalism, is developed in section 6, and some objections to the view are addressed. Section 7 offers a brief conclusion.

2. Thought experiments and theoretical possibility

Thought experiments are widely used in science and philosophy. Examples of scientific thought experiments include Einstein's imagining observing a beam of light while travelling at the speed of light, and Schrödinger's cat in quantum mechanics. Philosophical thought experiments include Putnam's (1973) Twin Earth thought experiment about a liquid similar to water in all respects but not composed of H_2O, and Shoemaker's (1963) brain transplant thought experiment, which in turn can be seen as a modern take on Locke's story about a prince and a cobbler who exchange souls (1689/1997).

Thought experiments have been the target of much criticism (e.g. Wilkes 1988). In a recent paper, Meier argues that they fall short of the standards of good scientific research in several ways: they lack objectivity, presenting us with worlds that differ from our own in multiple ways rather than isolating a single variable of interest; and, because they tend to involve highly fanciful scenarios, they are unreliable, with people reaching different conclusions from the same setup (Meier 2022). Thought experiments involving personal identity are often inadequately informed by neuroscience, and can be misleading, by "making unwarranted assumptions about physiological facts" (Meier 2022). For example, Parfit's (1984) brain bisection thought experiment makes precisely such an unwarranted assumption. Facts about brain anatomy and physiology strongly suggest that the impossibility of splitting the brainstem is not merely technical, but a "physical, and consequently a biological impossibility" (Meier 2022).

Nevertheless, critics of thought experiments, such as Kathleen Wilkes and Lukas Meier, do not discount them entirely. The usefulness of thought experiments depends on their validity. For a thought experiment to be valid, it should establish a phenomenon that is theoretically possible. All the relevant background conditions must be specified, and their theoretical, or 'in principle' possibility must be established (Wilkes 1988, p. 18).

Whether or not something is a genuine theoretical possibility can only be determined by our best science. For example, the theoretical possibility of an imagined procedure involving the human brain depends on empirical facts such as neuroanatomical and physiological features of the brain regions in question. This means that "philosophers are under a clear obligation to learn a lot more science than the analysts of old deemed relevant" (Johnston 2016, p. 99).

In sum, thought experiments can be useful in adjudicating questions of personal identity, as long as we are careful to establish their theoretical possibility according to our best science. In the following sections I examine three thought experiments involving the brain, in order to assess whether or not they provide evidence against animalism. For each thought experiment, I first establish (i) whether the scenario envisioned is theoretically possible and, if so, (ii) what would actually happen, according to our best scientific theories. Only then can we have any confidence in the conclusions we derive from the thought experiment.

3. Thought experiment 1: brain transplant

Shoemaker (1963, p. 22) introduces the brain transplant thought experiment as 'the "change-of-body" argument'. He first asks us to suppose that the extraction of the brain from the skull of a patient and its later re-attachment can be done, and is a safe and routine procedure. One day, in the course of surgical procedures on the brains of two men, Brown and Robinson, their brains are inadvertently swapped. One of the men dies, but the other, the one that consists of Robinson's body and Brown's brain ('Brownson') survives and regains consciousness:

> Upon regaining consciousness Brownson exhibits great shock and surprise at the appearance of his body. Then, upon seeing Brown's body, he exclaims incredulously "That's me lying there!" Pointing to himself he says "This isn't my body; the one over there is!" When asked his name he automatically replies "Brown." He recognizes Brown's wife and family (whom Robinson had never met), and is able to describe in detail events in Brown's life, always describing them as events in his own life. (Shoemaker 1963, pp. 23-24)

Shoemaker's conclusion is that, in such a situation, we would be strongly inclined to say that, despite having Robinson's body, Brownson is actually Brown. This seems to show that we have a psychological criterion of identity which overrides any 'physical' or 'bodily' criteria.

3.1. Is the thought experiment theoretically possible?

Shoemaker states that physiologists think transplanting human brains is impossible, but that the scenario is conceivable or logically possible (1963, p. 23). Nevertheless, the procedure does not seem to be 'deeply impossible'. While no serious discussion of brain transplants has been found in the scientific literature, there has been some discussion of the possibility of head transplants, which are relevantly similar (Furr et al. 2017; Lei & Qiu 2020). Head transplants, or body-to-head transplantation, would involve transplanting the head of a terminally ill patient with a healthy brain onto the body of a brain-dead donor. Head transplants might seem science-fictional; yet present-day surgical techniques for head and neck reconstruction are technically more challenging that those that would be required in head transplantation (Furr et al. 2017).

The main practical obstacles to head transplants are fourfold. One problem has to do with reducing ischemia time. Since lack of oxygenation to the brain can cause death in a matter of minutes, maintaining proper oxygenation throughout would be of the utmost importance. This could be achieved by extracorporeal membrane oxygenation and induced hypothermia, to slow metabolism and protect cells from ischemic death (Moreau et al. 2023). The separation and reattachment of the head do not pose major surgical challenges that are not adequately addressed by current techniques, with the exception of spinal cord reattachment. It is not yet possible to completely restore function after spinal cord injury, although encouraging results have been reported (Furr et al. 2017). There are reasons to be confident that biomedical science will eventually achieve the means for complete recovery from spinal cord injury.

A third problem is the lack of an exit strategy in the case of rejection. Transplant failure would result in certain death, since there would be no time to procure an alternative donor body. This, along with the fact that candidates for the procedure would most likely be dying, raises tremendous ethical problems, as does the use of animals in the research that would be required. Nevertheless, these ethical problems do not directly bear upon the theoretical possibility of the thought experiment. Finally, recovery from such a surgery would be extremely challenging, especially since it involves recovery from a state of tetraplegy. However, it is reasonable to suppose that complete recovery from spinal cord injury will be possible in the future and, in any case, incomplete recovery with lasting disability would still be a case of survival. To conclude, body-to-head transplantation does seem to be theoretically possible.

Brain transplants are not the same as head transplants, though, and it is even less likely that they will ever be attempted. The main difference is that in the case of head transplantation, a significant part of the organism is maintained – namely, the entire head, which includes the face and several sensory organs. A naked brain transplant would be a much more radical procedure in which the only part that remains of the original organism is the brain itself. Brain transplantation would be significantly more challenging, due to the additional anatomical structures (in particular, cranial nerves) that would need to be severed and reattached.[5] Nevertheless, the obstacles seem to be on the whole technical; there does not seem to be a deep impossibility. I conclude that brain transplants are possible in principle, and therefore valid as a thought experiment.

3.2. What would actually happen, according to our best scientific theories?

Brain transplants and even head-to-body transplantation differ from other solid organ transplants principally in that the amount of donor tissue far exceeds the amount of recipient tissue. This has led several people to argue, in the case of head transplants, that it is unclear who benefits from the operation or, in other words, who is the donor and who is the recipient (Pascalev et al. 2016; Lei & Qiu 2020).

It is implausible that the amount of matter, per se, should constitute an important criterion of persistence for organisms. As Locke (1689/1997) argued, "in the state of living creatures, their identity depends not on a mass of the same particles, but on something else. For in them the variation of great parcels of matter alters not the

---

[5] I am grateful to an anonymous reviewer for this point.

identity" (II.xxvii.3). Besides growth and gradual replacement of matter, it also seems possible for organisms to survive the sudden loss of most of their mass, as long as the structures removed are not essential to the life of the organism. Luper (2022) considers a hypothetical example of an extremely obese cat, Bigly, that undergoes a surgical procedure where 75% of its mass (consisting mainly of fat) is removed. It seems reasonable to hold that an organism could survive such a procedure. The question, then, is which structures are essential for the life of the organism to continue. There is a good case to be made for the essential role of the brain in the coordination of the vital processes in organisms with central nervous systems (CNS).

In humans and other vertebrates, the brainstem coordinates essential vital functions, including respiratory function, heart rate and blood pressure, the sleep-wake cycle, reflexes such as swallowing, coughing, and vomiting, and activation of other brain regions necessary for complex behaviour (Blessing 2004). Other coordination functions are carried out by the hypothalamus (e.g. endocrine and body temperature regulation) (Saper & Lowell 2014). There is no reason why this capacity for coordination of vital functions could not continue to be instantiated in a situation where many of the cells and organs are allochthonous. But, granted that these structures are essential for the continuation of the life of the organism, are they also sufficient? In other words, can an organism be reduced to its brain?

Some animalists are convinced that an organism can in fact be reduced to a small portion if this portion maintains the capacity for coordination of the life processes of its component cells, which is arguably true of the brain. Van Inwagen argues that a human organism may become a severed head and even a naked brain (1990, p. 172), because, given a suitable life support system that kept its cells alive, it would be able to coordinate its own activities, whereas the head- or brain-complement would not, under the same circumstances. Olson (1997a) also argues that in whole brain transplant the ‘control centre’ that directs the vital functions of the organism is transplanted with the brain, and therefore “some think that the entire human organism would get pared down to a naked brain in that case” (p. 45).

According to Olson, the difference between a detached head on life support and headless remains on life support is that the former is an organism, because “it retains its capacity to coordinate and regulate its metabolic and other vital functions” (1997a, p. 133). It retains this capacity even if it is unable to carry out some of these functions. In contrast, the latter is not an organism, even if it is made of living cells, since “it does not itself have the ability to coordinate the activities of those cells in the way that is characteristic of [multicellular] living organisms” (p. 134).[6]

Brain transplant is a more extreme case than head transplant, but since the areas responsible for coordination of vital processes in the human organism are in the brain, the organism which contributes the brain has a better claim to being the recipient organism. In Shoemaker’s thought experiment, we might say that the reason Brown survives the operation is that, after the surgery, Brown’s brain starts to coordinate Brownson’s vital processes.

---

[6] Olson has been criticised for holding the view that a human organism could be reduced to the brainstem (Tzinman 2016), but he states that he does not actually hold that view, and admits that other subcortical areas of the CNS, such as the hypothalamus, also have important coordination functions (Olson 2016, p. 297). However, I think he concedes too much to Shewmon’s (2001) view that the human organism does not require *any* central control. Although there is a significant debate on this issue, the scientific consensus, as I see it, is that the brain has essential coordination functions, and that these are required for the persistence of the human organism as a whole.

Shoemaker describes Brownson after the operation as claiming to be Brown and remembering Brown’s life from before the operation. The idea is that Brown’s self would survive the operation. Is this a reasonable expectation? It is certainly plausible. Neuroscientists seem to be reasonably certain that cognition, memory, emotion, and the sense of self happen in the brain, so it is not unreasonable to expect that preservation of the brain would entail preservation of the self. There is a significant worry, however, that severing the connections between brain and body might destroy the self. Damasio (2010) argues that the self does not arise exclusively from the brain, but from the interaction between brain and body proper, and requires a feedback loop involving interoceptive signals from the viscera. If his account is correct, then it is highly problematic to assume that a brain transplant would preserve the self.

On the other hand, the transplanted brain might be able to re-establish a feedback loop of signals with its new visceral millieu. If the establishment of this interaction went smoothly, then the individual who would wake up from the operation would be both biologically and psychologically continuous with the recipient organism that existed prior to the transplant. However, if animalists accept a coordination criterion of animal life, the brain transplant thought experiment fails to identify any important point of disagreement between the animalist and personalist views since, if it were successful, both animal and person would be preserved.

4. Thought experiment 2: cerebrum transplant

Since the brain is responsible for the coordination and maintenance of vital processes in the human organism, the brain transplant thought experiment does not show that the person can be separated from the animal. But a slightly different version seems to offer a more promising argument for personalism. In the cerebrum transplant thought experiment, only the cerebrum, which includes the cortex, is transplanted. Here is Olson's description:

> Imagine that an ingenious surgeon removes your cerebrum – the organ that is most directly responsible for your higher mental capacities such as reasoning and memory – and implants it into another head. (...) Your cerebrum comes to be connected to the rest of that human being in just the way that it was once connected to the rest of you. (…) The result is a human being who is psychologically more or less exactly like you. She can apparently remember your past and act on your intentions. (Olson 1997a, pp. 9-10)

In contrast with the brain transplant, the structures which are not transplanted, namely the brainstem, thalamus, hypothalamus, cerebellum, and pituitary gland, are capable of coordinating the vital functions of a living human organism. So here is the second part of the thought experiment:

> Imagine, then, that our surgeon leaves the rest of you intact when she removes your cerebrum, so that your brainstem continues to do its job of directing your heartbeat, circulation, breathing, and digestion; your hypothalamus continues to control the rate of your metabolism; and in general all of your organs but your cerebrum continue to carry out their life-sustaining functions as well as circumstances allow. (…) Are you the biologically living but empty-headed human being that has inherited your vegetative functions? Or are you the person who ends up with your cerebrum and your memories? (Olson 1997a, p. 10)

Olson goes on to argue for the merits of the biological approach; yet our intuitions seem to go the other way. It seems as though, in this case, the animal is left behind, still alive, in a decerebrated condition, whereas the person is transported with the cerebrum, and goes on to instantiate her psychological properties in a new body. Here, then, is a thought experiment that seems to provide an adequate challenge to animalism.

4.1. Is the thought experiment theoretically possible?

Although a cerebrum transplant is relatively similar to a brain transplant, it presents additional problems. One problem is that the connections within the brain are established during development, and are specific to the individual, although they follow a general pattern for the species. Another problem is the poor regeneration capacity of the adult brain. Although transplantation of large segments of brain has been accomplished in amphibian, chicken, and rat embryos, similar attempts in adult mammals were always unsuccessful (Wallace & Das 1982). However, recent research into the transplantation of small amounts of tissue into the central nervous system of adult mammals has been more successful (Dunnett 2013).

As for the possibility of transplanting the cerebrum, while certainly outside of current technological capability, the establishment of connections between brain areas could hypothetically be achieved through the use of stem cells to promote neuronal growth in the interface areas. Although achieving fusion between the severed brain structures would be extremely challenging, and would no doubt involve significant connective loss, this does not by itself render the thought experiment deeply impossible. Depending on the proportion of lost to successfully established connections, it is in principle possible that sufficient connectivity might be established that the fused structures would behave as a whole brain.

A cerebrum transplant would also be more demanding than either head or brain transplants in terms of life support and limitation of ischemia, because it would require transection and reattachment of many small blood vessels, which would significantly prolong operating time.[7] Again, however, these are mainly technical difficulties, which could conceivably be overcome. I will refrain from discussing the intractable ethical challenges involved, since these do not directly bear on the question of theoretical possibility; overall, cerebrum transplants are theoretically possible.

4.2. What would actually happen, according to our best scientific theories?

Suppose the operation consists in removing the cerebrum from patient X and introducing it into the cranium of patient Y. I will start by considering the outcomes for the two organisms that result from the operation: organism C, which is composed of the transplanted cerebrum of patient X plus the subcortical hind- and midbrain structures, and the body proper, of patient Y; and organism D, which consists in the decerebrated organism that results from removing the cerebrum from patient X.

Let us first consider the outcome for organism D. The assumption that this organism would survive the extraction of the cerebrum is reasonable. This organism retains a functioning brainstem, cerebellum, thalamus, hypothalamus, and pituitary gland. Although higher brain functions are no longer possible, the remaining brain regions are sufficient for the coordination of vital functions, including breathing, cardiovascular function, etc. So organism D survives the operation and is, furthermore, the same organism as patient X before the surgery.

Next, let us consider the outcome of the operation for organism C. The structure transplanted is the cerebrum, which includes the cerebral cortex, hippocampus, basal

---

[7] Thanks to an anonymous reviewer for pointing this out.

ganglia, and olfactory bulb. By themselves, these structures are unable to coordinate the life processes of a human organism. Therefore, it is not possible to claim that the preservation of the cerebrum suffices for the continuation of the organism. Organism C, then, is clearly not the same organism as patient X before the operation. Patient Y, on the other hand, is a living organism throughout. Just as the organism that used to be patient X survives in a decerebrated condition as organism D, so too does the organism that used to be patient Y. Since there is no reason to think that transplanting a new cerebrum into it would destroy the organism, we may conclude that organism C is the same organism as patient Y.

So far, we have merely described what would happen in terms of biological continuity; we haven't said anything yet about psychological continuity. Animalists and personalists alike have assumed that transplanting the cerebrum would suffice to preserve the person. But, although often taken for granted in philosophical discussions of personal identity, this assumption is far from straightforward.

Most neuroscientists agree that "healthy humans and other animals both often have conscious feelings, and that subcortical activation is necessary for the generation of primary conscious emotional experiences" and that "neocortical processes alone, without interaction with subcortical processes, are insufficient to generate affective/emotional reactions" (Panksepp et al. 2017). Where they disagree in on whether subcortical structures are also *sufficient* to generate conscious emotional experiences, a claim which is accepted by 'affective neuroscience' approaches but rejected by 'cognitive neuroscience' ones (Panksepp et al. 2017). Here I adopt the view from affective neuroscience, which, despite still being a minority view in neuroscience, is better supported by evolutionary considerations (see for instance Fabbro et al. 2015; Feinberg & Mallatt 2016; Ginsburg & Jablonka 2019; Godfrey-Smith 2019, 2020). On this view, consciousness, an in particular interoceptive awareness, is an ancient evolved feature of animals that, in vertebrates, is primarily instantiated in subcortical structures, including in particular the brainstem and hypothalamus.

According to neuroscientists Antonio Damasio and Jaak Panksepp, the self is built in layers. The base layer is the proto-self or primordial self (Panksepp 1998, p. 308; Damasio 2010, pp. 190-201). The proto-self is the most ancient, minimal subjectivity, an organism perspective shared by all vertebrates, and possibly some invertebrates.[8] It generates the primordial feelings which form the basis of emotions and the felt map of the organism, which is subsequently modified by any internal imbalance or interaction with the world (Damasio 2010, p. 193). In humans and other vertebrates, the proto-self is primarily instantiated in the brainstem (Parvisi & Damasio 2001; Damasio 2010). The brainstem is not a passive transmitter of signals between the body proper and the upper brain, and is not restricted to basic maintenance of vital functions. It also has important roles in the generation of sentience, pain, awareness, and consciousness, and it instantiates the primary layer of self (Damasio 2010; Fabbro et al. 2015). Areas in the brainstem and hypothalamus are essential for the experience of emotions (Damasio et al. 2000; Merker 2007; Venkatraman et al. 2017).

For simpler animals, the proto-self is probably the full extent of the self. For vertebrates, and possibly some invertebrates, the proto-self forms the base upon which another layer of self is generated, the core self. The core self consists in the pre-reflective consciousness of oneself as an immediate, embodied subject of experience

---

[8] By 'minimal subjectivity' I mean a basic level of subjectivity that involves phenomenal awareness of sensations (especially interoceptive sensations originating within the organism), but does not involve higher cognitive functions such as awareness that one is a thinking subject.

(Damasio 2010, pp. 201-208; Parvizi & Damasio 2001). It implies a sense of ownership and agency, and some knowledge of the world in the form of semantic memory (Fabbro et al. 2015). Above this layer, Damasio identifies the autobiographical self as distinctly human (2010, p. 210), whereas Panksepp and others divide this section of the self into two sub-layers: self-consciousness, which is typically attributed to animals who are able to recognise themselves in a mirror, and the narrative self, which requires language, and is therefore likely to be restricted to humans (Fabbro et al. 2015).

The crucial thing about how the self is realised in the brain is that it is built from the bottom up: the autobiographical or narrative self cannot exist without the proto-self and core self. While neurological disease or accident can result in the impairment or complete loss of upper layers of self without damage to the proto-self, the reverse is not possible. The autobiographical and even the core self cannot emerge in the absence of the proto-self. Since the brainstem is required to generate the proto-self, then, without the brainstem, the cerebrum on its own is unable to generate the sense of self.

Furthermore, if this account is correct, the proto-self, and hence subcortical areas, especially the brainstem, are essential for the generation of all subjective experience. Even mental experiences that take place largely at the cortical level, including the experiencing of internally generated images, such as memories, and the perception of external objects, occur through a modification of the proto-self: "[a] modification of the protoself's primordial feelings now becomes differential feelings of knowing relative to the engaging objects (...). A sense of ownership of the images, as well as a sense of agency, arises from such feelings of knowing" (Damasio 2010, p. 191). Although transplanting the cerebrum of patient X into the skull of patient Y would preserve (quasi-)memories and other information that is stored in the cerebrum, it is insufficient to preserve the person that patient X used to be, because these memories will be experienced from a distinct subjective perspective based on another human individual's proto-self. If the account of the self developed by Damasio, Panksepp, and others is correct, then a cerebrum transplant would not preserve personal identity.

What about the assumption that there is no psychological continuity between patient X and organism D? Organism D is a decerebrated human organism. The general assumption is that, despite being the same organism, patient X and organism D cannot be psychologically continuous because the latter has no mental properties. But this assumption might be unjustified.

Certainly, the decerebrated organism D has no higher mental properties. It would not be able to remember episodes from its own life, reflect on the meaning of life, or even recognise its own name. Organism D is not a person, at least if we agree with Locke that a person needs to have reason and reflection and be able to think of itself as itself. Nevertheless, the living human animal deprived of a cerebrum still has a functioning brainstem, hypothalamus, and cerebellum. The brainstem is intact and connected to its original body, directing its vital functions, and, presumably, generating a proto-self, as usual. If the proto-self is the first instance of subjectivity of the human animal, then we might say that organism D is still a sentient being, possessed of at least a minimal subjectivity. Several lines of evidence suggest that would indeed be the case.

Observations on surgically decorticate cats show that although the animals exhibit little behavioural initiative, they respond to stimuli, and it is possible to evoke fear, rage, and sexual behaviour (Bard & Rioch 1937). Similarly, decorticate birds show little or no spontaneous initiation of behaviour, but are still driven by thirst, hunger and visceral impulses (Ashcraft 1929). If the animal is decorticated while very young, as in Panksepp's study on rats, the animals will behave almost normally, if somewhat disinhibited, with little perceptual impairment, exhibiting emotional reactions and even playfulness (Panksepp et al. 1994).

In humans, some developmental defects can cause the cerebral cortex to fail to develop altogether. Long assumed to be unconscious 'by definition', due to the lack of a cerebral cortex, many hydranencephalic children in fact exhibit conscious awareness of their own bodies and their environment, can feel pain, and have emotional reactions, for example smiling when spoken to, giggling when played with, and preferring certain types of music over others (Shewmon et al. 1999). These cases show that sentience and an emotional life can be present without a cortex.

In the case of children and young animals, however, there might be an important effect of brain plasticity. Neuroscientists generally believe that if the neocortex were to be removed from a normal adult human being, the individual would probably fall into unresponsive wakefulness syndrome (UWS) (Panksepp et al. 2007). This state is characterised by the inability to interact with others or with the environment, absence of voluntary behavioural responses to a variety of stimuli, and no language comprehension or other higher cognitive capacities. UWS patients are often assumed to have no awareness of self and environment.

Nevertheless, in UWS, sleep-wake cycles are preserved, and raw affective experiences, including pain, may be preserved as well (Panksepp et al. 2007; Yu et al. 2013). In fact, the notion that PVS patients, despite exhibiting 'grimace-like or crying-like behaviours', 'apparent anger attacks', and so on (Panksepp et al. 2007), lack awareness by definition because awareness is defined as arising exclusively in the cortex, as the Multi-Society Taskforce on PVS (1994) concluded, seems as unjustified as Descartes' claim that animals can't feel pain, even though they behave exactly as if they did, simply because they don't have human minds. More recently, the Royal

College of Physicians (2003) has recommended administration of sedatives after treatment withdrawal, recognising the possibility of suffering in these patients. In fact, patients with damage to the cortex may experience *more* pain than normal subjects, as empirical evidence suggests that pain may be experienced in the brainstem (Baron & Devor 2022), with the cortex being involved mainly in pain *modulation* (Matthies et al. 1992; Starr et al. 2009; Baron & Devor 2022).

If sentience is indeed preserved in UWS patients, then it is not the case that they have no mental properties whatsoever. They may lack memory, language, and other higher mental functions characteristic of persons, but they do have some mental properties. Being hungry, thirsty, angry, or in pain are mental properties. Furthermore, these emotional states do not occur in a vacuum, but are instantiated as part of the individual's most basic locus of subjectivity, the proto-self, which is generated by the brainstem in its continued interaction with the rest of the body.

In light of these considerations, there is a case for saying that there is some psychological continuity, albeit minimal, between patient X and organism D. Although most accounts of psychological continuity focus on continuity of memory, intentions, and other features that require higher cognitive capacities, in this case psychological continuity is limited to continuity of *the same subjective perspective*, which does not rely on memory. This continuity of sentience means that the subject is aware of their own sensations, and even aware of their existence in a pre-reflective, purely sensory way. Damasio argues that "interoception is a suitable source for the relative *invariance* required to establish some sort of stable scaffolding" for the self" (2010, p. 193). He also notes that, although the *thoughts* that cause a state of fear or happiness may be quite different at different times within a person's life, "the profile of one's emotional reaction to those causes is not" (p. 194). This invariant emotional response system based on interoceptive feelings provides a basic kind of psychological continuity.

This limited psychological continuity, coupled with biological, material and spatio-temporal continuity, is arguably sufficient to justify the conclusion that organism D is the same sentient organism as patient X, although not the same person as patient X, because organism D is no longer a person. Nevertheless, the fact that organism D is not only the same organism, but the same sentient organism, as patient X, should be grounds for prudential concern on the part of patient X about what will happen to organism D. The minimal psychological continuity afforded by the continued generation of the proto-self in the brainstem guarantees that the sensations and emotions experienced by organism D are continuous with those experienced by patient X. If organism D will be in pain, that is a matter for prudential concern on the part of patient X, since patient X and organism D are one and the same sentient organism.

Admittedly, there is also some psychological continuity between patient X and organism C, because organism C inherits quasi-memories from patient X (since memories are stored in the hippocampus, which is located in the cerebrum). According to Parfit, personal identity over time just consists in the holding of such relations of psychological continuity (1984, pp. 206-207). But if the above considerations on how the self is produced by the brain are broadly correct, it is not clear that the kind of psychological continuity that holds between patient X and organism C is sufficient for the continuity of the same person, even on Parfit's psychological criterion of personal identity.

Memories are certainly important for the autobiographical or narrative self. But surely the preservation of their information content by itself is not sufficient for psychological continuity; memories can only form the basis of psychological continuity if they are retrieved and experienced by a conscious subject. However, if the subjective experience of any kind of mental content involves a modification of the primordial feelings of the proto-self, then the transfer of someone's quasi-memories through a cerebrum transplant is not sufficient for survival, since they will be experienced from a different subjective perspective. After the cerebrum transplant, patient X's quasi-memories will be experienced from a subjective perspective based on organism C's proto-self. Thus the psychological continuity that holds between patient X and organism C is insufficient for personal identity.

A bottom-up approach that sees the proto-self as foundational to all subjective experience should be preferred. And on this approach, we have no reason to believe that patient X survives the operation as organism C, despite the psychological continuity that holds between them in virtue of their shared quasi-memories. The severing of the connections between the lower and upper parts of the brain would be sufficient to destroy the person. No person can be instantiated in an extracted cerebrum. And there is no good reason to think that connecting the cerebrum to a different sentient organism would bring the person who was thus destroyed back into existence.

Finally, what about the psychological continuity between patient Y and organism C? Here too there is no reason to say that the same person exists first as patient Y and then as organism C, since no person survives the operation. But again, there is psychological continuity between the two, albeit minimal. Despite its extraordinary acquisition of new personality traits and quasi-memories, organism C is still psychologically continuous with patient Y for the same reason that organism D is psychologically continuous with patient X – that is, insofar as both instantiate the same proto-self. Although the psychological continuity may be minimal, since the proto-self grounds the subjective perspective of the organism, that is sufficient to ensure that all future sensations, emotions, and experiences of organism C are continuous with the sensations, emotions, and experiences of patient Y. Therefore, it is organism C who will subjectively experience the quasi-memories that used to belong to patient X.

In conclusion, cerebrum transplant thought experiments do not show that it is possible to transplant a person along with the cerebrum, nor that the person can be separated from the animal. But they do suggest that biological continuity of the human organism involves some degree of psychological continuity, namely continuity of sentience, which is sufficient to ground the subjective perspective of the organism. They suggest that biological continuity with the same sentient organism *is* survival, and merits prudential concern, even when the sentient organism falls short of the Lockean definition of personhood. The same cannot be said of purely psychological continuity with a numerically different sentient animal.

5. Thought experiment 3: cerebrum regeneration

Some vertebrates, in particular the salamander axolotl, are able to regenerate large portions of their brains. Suppose a technology is developed that enables this capacity in humans, for instance by applying axolotl-based gene therapy to brain damaged patients. This procedure quickly becomes the preferred treatment method in cases of brain damage caused by accident, stroke, and other illnesses. The method is very effective, albeit slow. People who had lost the ability to speak and move parts of their bodies make a complete recovery, but they have to relearn those capacities. Relatives sometimes complain that the patients end up speaking differently, and some have a strange new accent. This is due to many of the neurons in the speech areas of the brain being new; the connections are built de novo. Nevertheless, the benefits of the therapy far outweigh these minor issues.

One day a patient comes into the hospital in a coma; her entire cerebrum has been damaged in a car crash. The remaining parts of the brain, however, are unaffected. These include the brainstem, cerebellum, hypothalamus, and related structures. These areas are sufficient to maintain a functioning human animal, so patient A can survive without mechanical assistance. She recovers from the coma only to enter UWS. She breathes on her own, has a normal sleep/wake cycle, and even responds to some stimuli, but shows no awareness of who or where she is, cannot speak, and has no higher mental functions. Patient A' parents are asked whether they would like their daughter to receive cerebrum regeneration therapy. If she does, she will recover all the mental faculties typical of healthy human adults; however, she will have to relearn everything from scratch, including learning to walk, talk, read, write, etc, and she won't have any memories from before the accident. The alternative is that she will remain in a minimally conscious state, possibly for years, until she dies. Her parents agree to the therapy, and patient A makes a full recovery, although she remembers nothing from before the accident.

5.1. Is the thought experiment theoretically possible?

Brain regeneration occurs, to a limited extent, in fish, amphibians and reptiles. The amphibian axolotl (*Ambystoma mexicanum*) has a particularly impressive regenerative ability, and is able to regenerate large parts of the brain (Maden et al. 2013). Successful regeneration of at least a third of the telencephalon (cerebrum) has been experimentally observed, and includes structural regeneration, re-establishment of connections with severed nerves, and functional recovery, although there is some deficiency in regenerated long-distance projections of the new neurons (Maden et al. 2013; Joven & Simon 2018).

Extensive regeneration of the CNS is not a natural capacity of either birds or mammals. Nevertheless, there is ongoing research into the mechanisms of CNS regeneration in fish, salamanders, and other animals, in the hope that new medical therapies might be developed to combat the effects of brain injury, stroke, and neurodegeneration (Diotel et al. 2020). Research into regenerative medicine is clearly operating under the assumption that at least some regenerative capacities found in amphibians might be successfully implemented in humans. While the possibility of inducing the regeneration of the entire cerebrum in a human being is very unlikely, it does not appear to be theoretically impossible. The main obstacles are practical, due to the size and complexity of the human brain in comparison to that of the axolotl, but this seems to be a difference of degree.

5.2. What would actually happen, according to our best scientific theories?

In the thought experiment, we are supposing that the accident destroyed the cerebrum in its entirety, which is the reason for resorting to such drastic measures. Regeneration of the cerebrum would allow the individual to reacquire all lost cognitive capacities, but would not permit the recuperation of memory, and might lead to significant changes in personality, preferences, mannerisms, speech, etc. Many kinds of brain damage, either due to stroke or trauma, can also cause personality changes, as well as changes in speech patterns, such as in ‘foreign accent syndrome’ (Hackett et al. 2014; Moen 2000). In cases like these, relatives might say things like ‘she’s not the same person anymore’, but we would tend to interpret these statements as meaning that the person is qualitatively different in noticeable ways; not that the person has literally been replaced by a numerically different individual.

These kinds of changes would limit the amount of psychological continuity between the individual before and after the cerebrum regeneration. Nevertheless, there is an important aspect of psychological continuity that remains throughout: the individual is the same sentient animal as before. The person with a regenerated cerebrum might be, to some extent, a blank slate, in that she has to relearn everything, and it is unlikely that the synapses formed during this second brain development would be identical to those formed during the original brain development, resulting in personality changes and other differences.

Nevertheless, the clear intuition is that undergoing cerebrum regeneration would be far better than dying. From a prudential perspective, losing all of one's memories and possibly acquiring different personality traits would be unfortunate, but would be a price worth paying for being able to continue to enjoy life. And however qualitatively different the individual might become, the minimal psychological continuity that would hold between the individual before and after the cerebrum regeneration would make it the case that the same sentient organism would enjoy life both before and after cerebrum regeneration. Again, this does not provide evidence for personalism, but for sentience animalism. Our intuition is that as long as the same sentient organism is present, we have reason to care about its wellbeing. And the reason is that we *are* the sentient organism throughout.

6. Sentience Animalism

As we have seen in the previous sections, thought experiments involving the brain do not constitute a decisive objection even to a robust kind of animalism. But the intuitions they elicit, when adequately informed by neuroscience, point to a slightly different animalist view to the traditional one. It is generally thought that, if our persistence conditions follow from animalism, they must be *purely biological*. This is what is implied by Olson's biological approach: animals have whatever persistence conditions they have in virtue of being living organisms (Olson 1997a, p. 36).

What, then, are the persistence conditions of living organisms? One popular view is that an organism persists as long as its life continues (Locke 1689/1997, van Inwagen 1990, Olson 1997a, Liao 2006). I will assume that this is the correct view.[9] In particular, I will adopt something like Liao's formulation: roughly, organisms come into existence when they acquire the capacity to regulate and coordinate metabolic and other life processes, they continue to exist while they have this capacity, and they cease to exist when this capacity is permanently gone (Liao 2006, p. 337).

How organisms are able to regulate and coordinate their life processes, however, varies among organisms. For example, for unicellular organisms the regulation and coordination of life processes is fairly straightforward, whereas complex multicellular organisms require whole-organism systems that help maintain and coordinate the life processes of their component cells. These include, for example, circulatory systems, hormones and, in most animals, nervous systems.

In humans, the brainstem is critically important for survival (Nicholls & Paton 2009). Among other things, it coordinates the functioning of the respiratory and cardiovascular systems, regulates blood pressure, and maintains a sleep/wake cycle. But how does the brainstem accomplish its regulatory function? Interoceptive signals coming from various parts of the organism are relayed to the brainstem, indicating

---

[9] This view implies that organisms cease to exist when they die. For reasons of space I will not argue for, but will assume the truth of the termination thesis (formulated, but rejected, by Feldman 1992). For the alternative view, that we continue to exist as corpses, see Ayers (1990) and Mackie (1999).

whether the internal parameters of the organism are within the appropriate homeostatic range, or whether there is a need to implement physiological corrections. Importantly, the brainstem integrates these signals to produce a felt map of the internal state of the organism, which forms the basis of the proto-self (Damasio 2010, pp. 190-195).

It is not a coincidence that the same areas of the brain that have the function of regulating and coordinating the life processes of the organism also happen to form the basis of the most ancient part of the self, the proto-self, which is a form of minimal sentience. It is rather that sentience, i.e. the capacity of the organism to *feel* its internal states, is the basis of how organisms with central nervous systems regulate and coordinate their life processes. Sentience is not something additional to, and independent from, the biological processes that constitute the life of the animal; it is part and parcel of the way that complex multicellular animals maintain their life. The minimal sentience of the proto-self is therefore required for the persistence of animals such as ourselves. As a result, it turns out that our 'purely biological' persistence conditions necessarily involve what is usually seen as a psychological property, namely sentience.

From an evolutionary perspective, this is only moderately surprising. Nervous systems did not evolve in the first instance to implement highly complex cognitive processing of the kind that adult human beings are usually capable of, but to solve a biological coordination problem facing complex multicellular organisms with a behavioural repertoire involving self-directed movement and active food acquisition, features which require "maintaining a suitable internal homeostasis at a multicellular level by means of complex physiological processes" (Keijzer & Arnellos 2017, p. 432). The primordial feelings of the proto-self are a solution to this problem: a way for the organism to feel its own internal states, in order to make the necessary adjustments to maintain its homeostasis and, therefore, its survival. More complex forms of experience and subjectivity are elaborations on this primitive basis.

It is clear, then, that sentience animalism is a kind of animalism. It is neither a form of personalism, a hybrid view, nor a way to sneak in psychological persistence conditions into an otherwise animalist view, but a genuine, and arguably more adequate, formulation of animalism. And it also has the unique advantage of making it possible to reconcile the fact that, as animals, our persistence conditions are biological, with the intuition that some kind of psychological continuity must be involved in our persistence.

There may, however, be a drawback to sentience animalism, which has to do with development. If we are essentially sentient organisms, then that seems to imply that we are not identical with the early, pre-sentient foetus. Some studies suggest that 18-25 weeks is the earliest stage at which the human foetus could plausibly be sentient (Tawia 1992), although this estimate may reflect a bias toward higher brain structures. Electrical activity in the brainstem has been observed from 10 weeks gestation (Tawia 1992, p. 156), which could indicate the presence of minimal sentience at this stage.[10]

Olson (1997b) considers the verdict that we are numerically identical with the foetus to be an important advantage of animalism over personalist views.[11] Certainly, the lack of appropriate psychological features of even late-stage foetuses is a problem for personalist views. By not requiring *any* psychological properties to be present, animalism is in a much better position to claim a straightforward numerical identity

---

[10] That roughly corresponds to the transition from embryo to foetus.

[11] Not all animalists see it as an advantage. Snowdon (1991, p.111) says that "If we say that we were, prior to birth, foetuses, then according to animalism as presently stated, we must count the foetus as an animal. This is not an entirely happy thing to have to say."

between the foetus and the adult human being it will develop into. Sentience animalism is somewhere in the middle here; it does better than personalism, but has the disadvantage, when compared to classical animalism, of having to say that we are not identical with the early, pre-sentient foetus.

However, it is very likely the case that *all* accounts of personal identity have to contend with the fact that we are not identical with some early developmental stages. Even on the classical animalist view, it is implausible to hold that we are identical with the zygote or even the very early embryo which, arguably, is a mere aggregate of cells that are not yet integrated into a multicellular organism (Brown 2019). The question of when human beings begin to exist is a difficult problem, but it may be a problem for everyone. It is not a problem that is specific to sentience animalism.

7. Conclusion

In this paper, I have argued that thought experiments involving the brain, such as brain transplant, cerebrum transplant, and cerebrum regeneration, when appropriately assessed in the light of neuroscience, do not provide decisive evidence against animalism. What they do is suggest a new formulation of animalism that incorporates a requirement of sentience. By looking carefully at the role of sentience in the regulation and coordination of the life processes of highly complex animals, we can see that subjective experience is not a purely psychological property divorced from our biology, but a minimal form of sentience is actually essential to our persistence. Sentience animalism thus allows us to maintain the strong animalist claim that we are essentially biological organisms, while at the same time validating our intuition that our persistence must involve some kind of psychological continuity.

Acknowledgements

I am grateful to Samir Okasha and James Ladyman for discussion. I am also grateful to two anonymous reviewers for comments and suggestions that greatly improved the manuscript. This work was supported by the British Society for the Philosophy of Science through a doctoral scholarship, by the Royal Institute of Philosophy through a Jacobsen studentship, and by the Aristotelian Society through a student bursary.

References

Ashcraft, D. W. (1929). Decerebration of the domestic fowl. *Science*, *70*(1815), 357-358. 10.1126/science.70.1815.357.d

Ayers, M. (1990). *Locke, Vol. 2*. Routledge.

Bailey, A. M. (2014). The elimination argument. *Philosophical Studies*, *168*, 475-482. https://doi.org/10.1007/s11098-013-0132-8

Bailey, A. M. (2017). Our animal interests. *Philosophical Studies*, *179*, 2315-2328. https://doi.org/10.1007/s11098-016-0800-6

Bailey, A. M., & Pruss, A. R. (2021). Human beings among the beasts. *Pacific Philosophical Quarterly*, 102(3), 455-467. https://doi.org/10.1111/papq.12348

Bailey, A. M., Thornton, A. K., & van Elswyk, P. (2021). Why animalism matters. *Philosophical Studies*, *178*(9), 2929-2942. https://doi.org/10.1007/s11098-020-01593-x

Bailey, A. M., & van Elswyk, P. (2021). Generic animalism. *The Journal of Philosophy*, *118*(8), 405-429. https://doi.org/10.5840/jphil2021118829

Baker, L. R. (2016). Animalism vs. constitutionalism. In S. Blatti & P. F. Snowdon (Eds.), *Animalism: New Essays on Persons, Animals, and Identity* (pp. 50-63). Oxford University Press.

Bard, P., & Rioch, D. M. (1937). A study of four cats deprived of neocortex and additional portions of the forebrain. *Bulletin of the Johns Hopkins Hospital*, *60*, 73-148.

Baron, M., & Devor, M. (2022). Might pain be experienced in the brainstem rather than in the cerebral cortex? *Behavioural Brain Research*, *427*, 113861. https://doi.org/10.1016/j.bbr.2022.113861

Billman, G. E. (2020). Homeostasis: The Underappreciated and Far Too Often Ignored Central Organizing Principle of Physiology. *Frontiers in Physiology*, *11*, 200. https://doi.org/10.3389/fphys.2020.00200

Blatti, S., & Snowdon, P. F. (Eds.) (2016). *Animalism: New Essays on Persons, Animals, and Identity*. Oxford University Press.

Blessing, W. W. (2004). Lower brain stem regulation of visceral, cardiovascular, and respiratory function. In G. Paxinos & J. K. Mai (Eds.), *The Human Nervous System* (pp. 464-478). Elsevier.

Brown, M. T. (2019). The somatic integration definition of the beginning of life. *Bioethics*, *33*(9), 1035-1041. https://doi.org/10.1111/bioe.12638

Curtis, B., & Noonan, H. (2021). The Hybrid Account of personal persistence. In J. Noller (Ed.), *The Unity of a Person: Philosophical Perspectives* (pp. 23-39). Routledge.

Damasio, A. (2010). *Self Comes to Mind: Constructing the Conscious Brain*. Random House.

Damasio, A. R., Grabowski, T. J., Bechara, A., Damasio, H., Ponto, L. L. B., Parvizi, J., & Hichwa, R. D. (2000). Subcortical and cortical brain activity during the feeling of self-generated emotions. *Nature Neuroscience*, *3*(10), 1049-1056. https://doi.org/10.1038/79871

Diotel, N., Lübke, L., Strähle, U., & Rastegar, S. (2020). Common and distinct features of adult neurogenesis and regeneration in the telencephalon of zebrafish and mammals. *Frontiers in Neuroscience*, *14*, 568930. https://doi.org/10.3389/fnins.2020.568930

Duncan, M. (2021). Animalism is either false or uninteresting (perhaps both). *American Philosophical Quarterly*, *58*(2), 187-200. https://doi.org/10.2307/48614005

Duncan, M. (2022). Animalists on the run, *Inquiry*. Advance online publication. https://doi.org/10.1080/0020174X.2022.2074877

Dunnett, S. B. (2013). Neural tissue transplantation, repair, and rehabilitation. In M. P. Barnes, & D. C. Good (Eds), *Handbook of Clinical Neurology Vol. 110*: *Neurological Rehabilitation* (pp. 43-59). Elsevier.

Fabbro, F., Aglioti, S. M., Bergamasco, M., Clarici, A., & Panksepp, J. (2015). Evolutionary aspects of self-and world consciousness in vertebrates, *Frontiers in Human Neuroscience*, *9*, 157. https://doi.org/10.3389/fnhum.2015.00157

Feinberg, T., & Mallatt, J. M. (2016). *The Ancient Origins of Consciousness: How the Brain Created Experience*. MIT Press.

Feldman, F. (1992). *Confrontations With the Reaper: A philosophical study of the nature and value of death*. Oxford University Press.

Francescotti, R. (2022). Who are “we”? Animalism and conjoined twins. *Analytic Philosophy*. Advance online publication. https://doi.org/10.1111/phib.12269

Furr, A., Hardy, M. A., Barret, J. P., & Barker, J. H. (2017). Surgical, ethical, and psychosocial considerations in human head transplantation. *International Journal of Surgery*, *41*, 190-195. https://doi.org/10.1016/j.ijsu.2017.01.077

Ginsburg, S., & Jablonka, E. (2019). *The Evolution of the Sensitive Soul: Leaning the Origins of Consciousness*. MIT Press.

Godfrey-Smith, P. (2019). Evolving across the explanatory gap. *Philosophy, Theory, and Practice in Biology, 11*, 1. https://doi.org/10.3998/ptpbio.16039257.0011.001

Godfrey-Smith, P. (2020). *Metazoa: Animal Minds and the Birth of Consciousness*. William Collins.

Hackett, M. L., Köhler, S., T O'Brien, J., & Mead, G. E. (2014). Neuropsychiatric outcomes of stroke. *The Lancet Neurology*, *13*(5), 525-534. https://doi.org/10.1016/S1474-4422(14)70016-X

Hermida, M. (2022). Cats are not necessarily animals. *Erkenntnis*. Advance online publication. https://doi.org/10.1007/s10670-022-00588-w

Johnston, M. (2016). Remnant Persons: Animalism's Undoing. In S. Blatti, & P. F. Snowdon (Eds), *Animalism: New Essays on Persons, Animals, and Identity* (pp. 89-127). Oxford University Press.

Joven, A., & Simon, A. (2018). Homeostatic and regenerative neurogenesis in salamanders. *Progress in Neurobiology*, *170*, 81-98. https://doi.org/10.1016/j.pneurobio.2018.04.006

Keijzer, F., & Arnellos, A. (2017). The animal sensorimotor organization: a challenge for the environmental complexity thesis. *Biology & Philosophy*, *32*(3), 421-441. https://doi.org/10.1007/s10539-017-9565-3

Lei, R., & Qiu, R. (2020). Impassable scientific, ethical and legal barriers to body-to-head transplantation. *Bioethics*, *34*(2), 172-182. https://doi.org/10.1111/bioe.12675

Liao, S. M. (2006). The organism view defended. *The Monist*, *89*(3), 334-350.

Lim, J. (2018). Strategy for animalism. *Axiomathes*, *28*(4), 419-433. https://doi.org/10.1007/s10516-018-9378-2

Lim, J. (2019). Are We Essentially Animals? *The Philosophical Forum*, *50*(3), 383-409. https://doi.org/10.1111/phil.12230

Locke, J. (1689/1997). *An Essay Concerning Human Understanding*. Penguin.

Luper, S. (2022). *Mortal Objects: Identity and Persistence through Life and Death*. Cambridge University Press.

Mackie, D. (1999). Personal identity and dead people. *Philosophical Studies*, *95*(3), 219-242.

Madden, R. (2016). Human persistence. *Philosophers' Imprint*, *16*(17), 1-18.

Maden, M., Manwell, L. A., & Ormerod, B. K. (2013). Proliferation zones in the axolotl brain and regeneration of the telencephalon. *Neural Development*, *8*, 1. https://doi.org/10.1186/1749-8104-8-1

Matthies, B. K., & Franklin, K. B. J. (1992). Formalin pain is expressed in decerebrate rats but not attenuated by morphine. *Pain*, *51*(2), 199-206. https://doi.org/10.1016/0304-3959(92)90261-9

Meier, L. J. (2022). Can thought experiments solve problems of personal identity? *Synthese*, *200*, 211. https://doi.org/10.1007/s11229-022-03637-7

Merker, B. (2007). Consciousness without a cerebral cortex. In H. Liljenström, & P. Århem (Eds.), *Consciousness Transitions* (pp. 63-81). Elsevier.

Moen, I. (2000). Foreign accent syndrome: A review of contemporary explanations. *Aphasiology*, *14*(1), 5-15. https://doi.org/10.1080/026870300401577

Moreau, A., Levy, B., Annoni, F., Lorusso, R., Su, F., Belliato, M., & Taccone, F. S. (2023). The use of induced hypothermia in extracorporeal membrane oxygenation: A narrative review. *Resuscitation Plus*, *13*, 100360. https://doi.org/10.1016/j.resplu.2023.100360

Multi-Society Task Force on PVS (1994). Medical aspects of the persistent vegetative state. *New England Journal of Medicine*, *330*(21), 1572-1579. https://doi.org/10.1056/NEJM199406023302206

Nicholls, J. G., & Paton, J. F. R. (2009). Brainstem: neural networks vital for life. *Philosophical Transactions of the Royal Society B: Biological Sciences*, *364*(1529), 2447-2451. https://doi.org/10.1098/rstb.2009.0064

Olson, E. T. (1997a). *The Human Animal: Personal Identity Without Psychology*. Oxford University Press.

Olson, E. T. (1997b). Was I ever a fetus? *Philosophy and Phenomenological Research*, *57*(1), 95-110. https://doi.org/10.2307/2953779

Olson, E. T. (2007). *What Are We? A Study in Personal Ontology*. Oxford University Press.

Olson, E. T. (2015). What does it mean to say that we are animals? *Journal of Consciousness Studies 22*(11-12), 84–107.

Olson, E. (2016). The role of the brainstem in personal identity. In A. Blank (Ed.), *Animals: New Essays* (pp. 291-302). Philosophia.

Olson, E. T. (2018). For animalism. In J. Loose, A. J. L. Menuge, & J. P. Moreland (Eds.), *The Blackwell Companion to Substance Dualism* (pp. 296-306). Wiley-Blackwell.

Panksepp, J. (1998). *Affective Neuroscience: The Foundations of Human and Animal Emotions*. Oxford University Press.

Panksepp, J., Normansell, L., Cox, J. F., & Siviy, S. M. (1994). Effects of neonatal decortication on the social play of juvenile rats. *Physiology & Behavior*, *56*(3), 429-443. https://doi.org/10.1016/0031-9384(94)90285-2

Panksepp, J., Fuchs, T., Garcia, V. A., & Lesiak, A. (2007). Does any aspect of mind survive brain damage that typically leads to a persistent vegetative state? Ethical considerations. *Philosophy, Ethics, and Humanities in Medicine*, *2*(1), 32. https://doi.org/10.1186/1747-5341-2-32

Panksepp, J., Lane, R. D., Solms, M., & Smith, R. (2017). Reconciling cognitive and affective neuroscience perspectives on the brain basis of emotional experience. *Neuroscience & Biobehavioral Reviews*, *76*, 187-215. https://doi.org/10.1016/j.neubiorev.2016.09.010

Parfit, D. (1984). *Reasons and Persons*. Clarendon Press.

Parvizi, J., & Damasio, A. (2001). Consciousness and the brainstem. *Cognition*, 79(1-2), 135-160. https://doi.org/10.1016/S0010-0277(00)00127-X

Pascalev, A., Pascalev, M., & Giordano, J. (2016). Head transplants, personal identity and neuroethics. *Neuroethics*, *9*(1), 15-22. https://doi.org/10.1007/s12152-015-9245-4

Putnam, H. (1973). Meaning and reference. *The Journal of Philosophy*, *70*(19), 699-711. https://doi.org/10.2307/2025079

Royal College of Physicians. (2003). The vegetative state: Guidance on diagnosis and management, *Clinical Medicine*, *3*(3), 249–254. https://doi.org/10.7861/clinmedicine.3-3-249

Saper, C. B., & Lowell, B. B. (2014). The hypothalamus. *Current Biology*, *24*(23), R1111-R1116. https://doi.org/10.1016/j.cub.2014.10.023

Sauchelli, A. (2017). The animal, the corpse, and the remnant-person. *Philosophical Studies*, *174*(1), 205-218. https://doi.org/10.1007/s11098-016-0677-4

Shewmon, D. A. (2001). The brain and somatic integration: Insights into the standard biological rationale for equating "brain death" with death. *Journal of Medicine and Philosophy*, *26*, 457-478. https://doi.org/10.1076/jmep.26.5.457.3000

Shewmon, D. A., Holmes, G. L., & Byrne, P. A. (1999). Consciousness in congenitally decorticate children: developmental vegetative state as self-fulfilling prophecy. *Developmental Medicine & Child Neurology*, *41*(6), 364-374.

Shoemaker, S. (1963). *Self-Knowledge and Self-Identity*. Cornell University Press.

Skrzypek, J. W., & Mangino, D. (2021). Should Animalists Be "Transplanimalists"? *Axiomathes*, *31*(1), 105-124. https://doi.org/10.1007/s10516-020-09482-y

Snowdon, P. F. (1991). Personal identity and brain transplants. *Royal Institute of Philosophy Supplements*, *29*, 109-126.

Snowdon, P. F. (2014). *Persons, Animals, Ourselves*. Oxford University Press.

Starr, C. J., Sawaki, L., Wittenberg, G. F., Burdette, J. H., Oshiro, Y., Quevedo, A. S., & Coghill, R. C. (2009). Roles of the insular cortex in the modulation of pain: insights from brain lesions. *Journal of Neuroscience*, *29*(9), 2684-2694. https://doi.org/10.1523/JNEUROSCI.5173-08.2009

Tawia, S. (1992). When is the capacity for sentience acquired during human fetal development? *The Journal of Maternal-Fetal Medicine*, *1*, 153-165.

Thornton, A. K. (2016). Varieties of animalism. *Philosophy Compass*, *11*(9), 515–526. https://doi.org/10.1111/phc3.12340

Thornton, A. K., & Bailey, A. M. (2021). The feeling animal. *Ergo*, *7*(2), 554-567. https://doi.org/10.3998/ergo.1118

Tzinman, R. (2016). Against the brainstem view of the persistence of human animals. In A. Blank (Ed.), *Animals: New Essays* (pp. 255-289). Philosophia.

van Inwagen, P. (1990). *Material Beings*. Cornell University Press.

Venkatraman, A., Edlow, B. L., & Immordino-Yang, M. H. (2017). The brainstem in emotion: a review. *Frontiers in Neuroanatomy*, *11*, 15. https://doi.org/10.3389/fnana.2017.00015

Wallace, R. B., & Das, G. D. (1982). Behavioral effects of CNS transplants in the rat. *Brain Research*, *243*(1), 133-139. https://doi.org/10.1016/0006-8993(82)91126-X

Wilkes, K. V. (1988). *Real People: Personal Identity Without Thought Experiments*. Clarendon Press.

Yang, E. (2015). Unrestricted animalism and the too many candidates problem. *Philosophical Studies*, *172*(3), 635-652. https://doi.org/10.1007/s11098-014-0323-y

Yu, T., Lang, S., Vogel, D., Markl, A., Müller, F., & Kotchoubey, B. (2013). Patients with unresponsive wakefulness syndrome respond to the pain cries of other people. *Neurology*, *80*(4), 345-352. https://doi.org/10.1212/WNL.0b013e31827f0846