Fish and Microchips

On fish pain and multiple realization

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Abstract: Opponents to consciousness in fish argue that fish do not feel pain because they do not have a neocortex, which is a necessary condition for feeling pain. A common counter-argument appeals to the multiple realizability of pain: while a neocortex might be necessary for feeling pain in humans, pain might be realized differently in fish. This paper argues, first, that it is impossible to find a criterion allowing us to demarcate between plausible and implausible cases of multiple realization of pain without running into a circular argument. Second, opponents to consciousness in fish cannot be provided with reasons to believe in the multiple realizability of pain. I conclude that the debate on the existence of pain in fish is impossible to settle by relying on the multiple realization argument.

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Introduction

Consciousness seems to be a crucial feature for the moral status of non-human animals (hereafter: animals, for short). In a famous passage, Bentham (1789) addresses the issue of our treatment of animals with these words: "The question is not, Can they *reason*? nor, Can they *talk*? but, Can they *suffer*?". The belief that animals are conscious and can experience pain is a fundamental basis of our concern for them and provides reasons to bestow them a moral status, contrary to plants or inanimate objects (Singer (1975); Midgley (1983); Rollin (1989), although see Carruthers (2005); Dawkins (2015)). Contemporary utilitarians, such as Singer (1975), suggest that we cannot justify excluding from moral consideration animals who can suffer. The presence or absence of consciousness is therefore a key issue in order to determine the moral status of animals, and consequently, how humans ought to behave towards them. Animals are conscious if there is "something it is like" to be them (Nagel (1974)), that is to say, conscious creatures are able to have subjective feelings or experiences. Consciousness in that sense does not necessarily require self-consciousness: knowing that I, myself, have these experiences (Block (1995); Rosenthal (1986)). Although few would doubt that most mammals are conscious, debates revolve around the possibility of fish, cephalopods, crustaceans or insects being conscious, and more specifically, feeling pain (Allen (2004); Edelman et al. (2005); Edelman and Seth (2009); Elwood (2012); Godfrey-Smith (2017); Griffin (1976); Tye (2017)). The most central debate features proponents of consciousness in animals such as fish (Braithwaite (2010); Huntingford et al. (2006); Jones (2013); Sneddon (2011)) and insects (Barron and Klein (2016)) versus opponents to the existence of consciousness in those animals (Derbyshire (2016); Rose (2007); Rose et al. (2014); Key (2015, 2016); Key et al. (2016)). Here, I will mostly be concerned with the issue of the existence of pain in fish, as it is arguably the most contentious debate to date, although my arguments will also apply to other kinds of conscious states in other non-mammalian species.

I show that both proponents of and opponents to consciousness in fish go beyond the available evidence on this topic. I explain why they will most likely never be able to

convince each other. The crux of the issue is the premise that pain is multiply realizable. However, I show that no amount of evidence could ever demonstrate this premise to be true. The issue is thus underdetermined by the evidence.

1 The state of the debate

1.1 The no cortex, no cry argument

There is a difference between non-conscious and conscious states elicited by noxious stimuli (i.e., those stimuli that cause body tissue damage). Some nerve fibers, called nociceptors, respond to potentially damaging levels of pressure, chemicals, heat or cold. When these nociceptors are activated, they send signals to the brain, and the resulting non-conscious state is called nociception. Nociception, in and of itself, is not pain. Rather, it might be conceived as an unconscious signal that alerts the organism that body tissue might be threatened. Pain, on the contrary, is a conscious mental state. It is defined by the International Association for the Study of Pain (IASP) as "an unpleasant sensory and emotional experience associated with actual or potential tissue damage, or described in terms of such damage" (Loeser and Treede (2008)). Nociception and pain in humans are typically associated with a wide variety of behaviors, such as an active avoidance of noxious stimuli or trying to protect and heal damaged parts of one's body. I will refer to these behaviors as "pain-like behaviors" and assume that we generally attribute pain to other entities (humans or animals) based on the fact that they exhibit pain-like behaviors.

Here, I will focus on the following question: considering that a creature exhibits pain-like behaviors, should we attribute pain experiences to that entity or should we explain its behavior only in terms of non-conscious nociception? It seems that, in the absence of defeaters, that is, unless there is a good reason to think that an animal is not conscious, the presence of a pain-like behavior in an animal is a good reason to prefer the hypothesis that this animal can feel pain over the hypothesis that its pain-like behavior is driven only by non-conscious nociception. For the sake of argument, I will grant that in the absence of defeaters it just seems like the most rational thing to do (Tye (2017)). A defeater against

an attribution of consciousness to an entity is a good reason for rejecting the inference that an entity has conscious mental states based on the premise that it has conscious-mental-states-like behaviors. For example, one could build a simple robot programmed to do just three things: when exposed to a noxious stimulus, it moans and shouts, protects the area of its body exposed to the noxious stimulus, and runs away. Despite the fact that the robot exhibits pain-like behaviors, attributing pain to this robot would not be the most rational thing to do. The reason for that is that there are several defeaters against an explanation of the robot's behavior in terms of the robot feeling pain. One of them is that it certainly does not have the necessary machinery for feeling pain. As far as we know, having a brain or something that functions like a brain is necessary for feeling pain. The robot does not have a brain or anything resembling a brain. Therefore, despite the fact that it may exhibit pain-like behaviors, it is not rational to conclude that the robot feels pain. Here, the absence of a brain plays the role of a defeater against the attribution of pain to this robot. Consequently, its pain-like behavior should be explained only be appealing to non-conscious states and processes. However, if we were *not* able to find such defeaters, the most rational thing to do would be to attribute pain to it. This is because where there is similar behavior, such as pain-like behaviors in robots, mammals or fish, a simple hypothesis is that there is a common cause behind these similar behaviors: pain. Hence, in the absence of defeaters, it is rational to explain the pain-like behavior of an animal as we do for humans, namely, by attributing conscious states to this animal, instead of explaining this animal's behavior by appealing only to non-conscious nociception.

It does seem that fish have pain-like behaviors. For example, fish try to escape noxious stimuli, and such an escape response is reduced when fish are administered an analgesic (Sneddon et al. (2003)). Fish injected with a harmful chemical flee from enriched environments to barren tanks, provided that those alternative tanks are filled with powerful analgesics (Sneddon (2011)). Similarly, a signal which fish have been trained to associate with a noxious stimulus triggers an escape behavior prior to the onset of the noxious stimulus (Dunlop et al. (2006)). Fish can avoid for months places where they were previously

caught on a hook (Beukema (1969)). This means that unless one provides a defeater that would block the attribution of pain to fish, it is rational to conclude that fish feel pain.

At this point, it is important to differentiate between two main groups of fish, the Elasmobranchii, cartilaginous fish such as sharks and rays, and the Teleostei, bony fish such as trouts and salmons. Although cartilaginous fish exhibit at least some pain-like behaviors, the fact that they do not have nociceptors is a defeater against attributions of pain experiences to them (Rose et al. (2014); Smith and Lewin (2009); Snow et al. (1993)). On the other hand, bony fish have nociceptors (Sneddon et al. (2003)), which means that the absence of nociceptors cannot play the role of a defeater in this case[1].

Look up fish without nociceptors (wow!)

A candidate defeater could consist in the following argument, which, following Dinets (2016), I call the no cortex, no cry argument:

No cortex, no cry argument:

(1) If x feels pain, then x has a neocortex

(2) Fish do not have a neocortex

(3) Therefore, fish do not feel pain

The crucial premise in this argument is that a neocortex is necessary for feeling pain. Indeed, this premise enables one to take the fact that fish do not have a neocortex as a defeater against the attribution of pain experiences to fish, despite the fact that fish exhibit pain-like behaviors. In a nutshell, regions that seem necessary for pain in humans are the anterior cingulate cortex (Lieberman and Eisenberger (2015); Navratilova et al. (2015); Qu et al. (2011)), somatosensory areas SI and SII (Gross et al. (2007); Mancini et al. (2012); Lockwood et al. (2013); Omori et al. (2013)), and the insular cortex (Frot et al. (2014); Moayedi (2014); Ostrowsky (2002)). For example, a study by Segerdhal et al. (2015) showed that neural activity in the insular cortex correlated with the intensity of the experience of pain, and this region also contains somatotopic maps of noxious stimuli (Baumgartner et al. (2010); Brooks et al. (2005); Henderson et al. (2011); Mazzola et al. (2009)). Zhang et al. (2012) also found that high frequency gamma oscillations within

[1]In this article, the term "fish" will refer to bony fish, since the debate focuses mostly on this group. The case of cartilaginous fish such as sharks is particularly interesting nonetheless, as it shows that some animals exhibiting pain-like behaviors are poor candidates for feeling pain when considered from a neurophysiological perspective.

SI correlates with the felt intensity of pain, and not merely with the intensity of noxious stimuli. Moreover, lesion studies have confirmed that specific areas in SI were indeed necessary for feeling pain (Cerrato et al. (2005); Vierck et al. (2013)). Since these cortical structures seem crucial for feeling pain, any entity that lacks a cortex will therefore be unable to feel pain. Fish do not have a cortex, and thus cannot feel pain. Consequently, pain-like behaviors in fish are not to be explained in terms of fish feeling pain, but only in terms of them having non-conscious nociceptions.

1.2 The multiple realization argument

I see two main ways to reject the no cortex, no cry argument. The first way is to deny that a cortex is necessary for feeling pain in humans, and thus argue that it is not necessary for feeling pain in fish either. The second way is to accept that a cortex is necessary for feeling pain in humans, but deny that this necessary condition for feeling pain generalizes across species. I will examine these two arguments in turn.

The most straightforward way to defend consciousness in fish is to find a case in which an animal is undeniably conscious without a neocortex and thus reject premise (1). This argument is often based on the claim that consciousness, most notably, consciousness of pain, can be supported by subcortical structures (Damasio and Carvalho (2013); Merker (2007); Panksepp (2011)). Those who support this view (e.g., Barron and Klein (2016); Tye (2017)) generally appeal to rare cases of children born with near or complete absence of a cerebral cortex (i.e., hydranencephaly). Although most individuals with hydranencephaly die in utero or a few weeks after birth (Merker (2008); Pavone et al. (2014)), or are in a vegetative state (McAbee et al. (2000)), some of these children were able to exhibit behaviors typically associated with consciousness, such as responsiveness to sounds, visual fixation and tracking of objects (Shewmon et al. (1999); Werth (2007)). The presence of consciousness in these children would thus prove that one can be conscious without a neocortex. However, there are two problems with this argument. First, levels of remaining cortical tissues vary widely from case to case (Cecchetto et al. (2013)), and in the few children that survived with hydranencephaly and who are not in a vegetative state, there

is no precise assessment of the remaining cortical tissues. Without a specific assessment of the levels of unimpaired cortical tissue for each of these cases it is difficult to draw any conclusions over the possibility of having experiences without a cerebral cortex. Second, even if one assumes that patients with hydranencephaly do not have any remaining cortical tissue, their responsive behaviors could still be explained by appealing to mechanisms that are thought to operate unconsciously. Indeed, responsiveness to the environment is a general feature of biological systems and does not necessarily indicate consciousness. Visual fixation and tracking of objects can be achieved unconsciously: monkeys in which the visual cortex was ablated could make visual saccades towards targets, a capacity that was mediated by subcortical structures (Kato et al. (2011)), and blindsight patients can make saccades towards targets that they do not consciously perceive (Isa and Yoshida (2009); Ikeda et al. (2011); Weiskrantz (2009)). Across a wide variety of tasks and experiments, saccadic target selection has been shown to be independent from consciousness (for a review: Spering and Carrasco (2015)). Likewise, emotional responses in children with hydranencephaly could be triggered unconsciously via subcortical networks, such that these responses do not necessarily reflect emotional experiences (LeDoux (2012); LeDoux and Brown (2017)). Just as in the case of non-human animals, the absence of a cortex in patients with hydranencephaly could be a defeater against attributions of conscious experiences to them. Hence, knowing whether pain-like behaviors in patients with hydranencephaly should be explained in terms of pain experiences rather than unconscious nociception might be as difficult as in the case of non-human animals. Consequently, I will assume in the remainder of this article that cases of hydranencephaly do not provide clear evidence, and leave this argument aside.

Hereafter, I will focus on an alternative way to counter the no cortex, no cry argument, which I call the multiple realization argument. This argument states that pain might be realized differently in humans and fish, and that subcortical structures in fish could play the same role as the structures that allow mammals to feel pain. Consequently, while a cortex might be necessary for feeling pain in humans, it is not necessary for feeling pain in fish. This argument differs from the hydranencephaly argument in that it remains neutral

on the question of knowing whether a cortex is necessary for feeling pain *in humans* or not. One can both accept that a cortex is necessary for feeling pain in humans *and* that it is not necessary for feeling pain in fish.

To get a better grasp of the argument, here is a broad definition of multiple realization: a kind, a state or a property is multiply realizable when it can be realized by distinct physical kinds, states or properties (Block and Fodor (1972); Fodor (1974); Putnam (1967)). Realization is a relation that holds between higher-level properties and lower-level properties (Baysan (2015); Wilson and Craver (2006)). According to a popular line of thought in philosophy of mind, psychological states or properties such as *believing that it is raining*, *having a taste for anchovies* or *having a pain* are realized by physical states. Some properties, typically those defined by their functional role, can also be *multiply* realized. For example, the property of *being a corkscrew*, defined by the function of removing corks, can be realized by a waiters' model of corkscrew and a winged corkscrew. Both realize the same property, *being a corskcrew*, but they do so in different ways.

Multiple realization played a crucial role in the rise of functionalism, the view that psychological states can be defined by the role they play in cognitive systems (Levin (2017)). On functionalism, having a pain could be defined, for example, as the mental state caused by damage to one's body, which in turn causes the desire to relieve the pain, the belief that one is in pain, behaviors like seeking to relieve the pain or escaping from the cause of one's pain. Any mental state that fulfills a similar function is a mental state of pain, regardless of the specific type of physical mechanism that realizes this function. Hence, functionalism implies that having a neocortex is irrelevant to whether an entity realizes pain or not. Philosophers who endorse functionalism would thus see no reason for thinking that the way in which pain is realized in the human brain, namely, with a neocortex, is the only way for pain to be realized. This amounts to claiming that the absence of a neocortex in fish cannot play the role of a defeater against the attribution of pain to fish.

The multiple realization argument is the most prevalent strategy against the no cortex, no cry argument. For example, out of the forty commentaries on Key's version of the

no cortex, no cry argument (Key (2016)), eight contained one version or another of the multiple realization argument (Braithwaite and Droege (2016); Elwood (2016); Godfrey-Smith (2016); Manzotti (2016); Merker (2016); Ng (2016); Segner (2016); Seth (2016)). Researchers from different backgrounds defend the multiple realization argument, as does Seth:

> Might fish pain then depend on a different biophysical realization than human pain? On the face of it, this seems reasonable since conscious fish pain (if it exists) is likely to be qualitatively different from, and less differentiated than, human pain and suffering. (Seth (2016))

Or Godfrey-Smith:

> We know that this sort of capacity can be achieved by means of different neural architectures. It is "multiply realizable," as philosophers say. If so, then finding that the architecture that subserves these functions and hence underlies pain in animal X is not present in animal Y does not tell you that animal Y does not feel pain. (Godfrey-Smith (2016))

And Manzotti:

> Just to state the obvious, feathers are necessary for birds to fly. Yet, however important feathers are for birds, their absence does not imply that flying is impossible. In fact, bats fly without feathers. Likewise, certain neural structures can be perfunctory for pain in *Homo sapiens* but irrelevant in, say, trout. (Manzotti (2016))

In the remainder of this article, I will evaluate the multiple realization argument. In the next section, I argue that the multiple realization argument overgeneralizes, leaving us without the possibility to find rightful defeaters against attributions of consciousness.

2 Hard problems with multiple realization

2.1 Consciousness in decapitated frogs

Once it is recognized that pain could be realized by a variety of physical substrates, we are still in need of a criterion to arbitrate between plausible and implausible explanations of pain-like behaviors in terms of entities feeling pain. I will illustrate this with a short jump into the (pre)history of consciousness science. A longstanding debate about consciousness in decapitated frogs began in 1853 with Plfuger's experiments showing that decapitated frogs could exhibit purposive behaviors (Pflüger (1853)). Here is the case of interest, as described by Ferrier:

> When a drop of acetic acid is placed on the thigh of a decapitated frog, the foot of the same side is raised, and attempts made with it to rub the part. On the foot being amputated, and the acid applied as before, the animal makes a similar attempt, but failing to reach the point of irritation with the stump, after a few moments of apparent indecision and agitation, raises the other foot, and attempts with it to remove the irritant. (Ferrier (1876), p.20)

The problem of knowing whether this frog actually experienced pain occupied physiologists for half a century. Indeed, it is undeniable that this frog exhibits pain-like behaviors. Nonetheless, the fact that it has no brain acts as a defeater against the intuition that it is conscious. This experiment then led to many developments and analyses of the behavior of decapitated frogs; here are two other cases[2]:

> a brainless frog will swim if dropped in water (Lewes (1877), 190). If completely submerged, it will swim to the surface. And not only that; if one impedes the emerging, pithed frog by putting an inverted jar in its path, the frog will not easily be trapped. It will actually re-descend until it can swim out of the jar, and then will swim up to the surface (Goltz (1869), 70). This is

[2]For a thorough analysis of the decapitated frog cases, See Klein (2017).

> an astonishing sequence of behaviours for an animal that lacks a brain. (Klein (2017), p.7).

Physiologists like Lewes and Pfluger claimed that decapitated frogs were conscious and that the spinal cord could produce consciousness (Lewes (1873)), as demonstrated by the frogs' pain-like and purposive behaviors, while Ferrier and Huxley argued that these frogs were not conscious, and that all that these cases demonstrated was the existence of unconscious pain-like and purposive behaviors. To this extent, Ferrier's argument was akin to the no cortex, no cry argument: a brain is necessary for consciousness, a decapitated frog does not have a brain, and therefore, it is not conscious. However, the multiple realization argument could be used against Ferrier's identification of the brain as a necessary condition for consciousness. Indeed, the frog's spinal cord might realize consciousness differently from the way in which it is realized in humans and other animals.

It now becomes clear that accepting the multiple realization argument might lead down a slippery slope: once it is accepted that an entity could realize pain in (yet) unknown ways, no amount of data about the ways in which pain is realized in other animals could provide a rightful defeater against an explanation of an entity's pain-like behaviors in terms of that entity feeling pain. Consider, as an extreme example, the case of the paramecium. This unicellular organism covered with several thousand cilia can exhibit pain-like behaviors: if a paramecium encounters a potentially dangerous concentrated salt solution or acetic acid, it will back away and swim in a different direction or engage in defensive behavior by discharging trichocysts. *It could be* that paramecia realize pain in a (yet) unknown way. On the other hand, if one does not want to be committed to the view that paramecia or decapitated frogs can feel pain, one has to provide a criterion for demarcating between plausible and implausible explanations of entities' pain-like behaviors in terms of these entities feeling pain. Without such a criterion the multiple realization argument overgeneralizes and we are left with no possibility of providing defeaters to counter attributions of pain to entities that exhibit pain-like behaviors.

The upshot of this discussion is that if one accepts the multiple realization of pain, one must accept it only *to a certain extent*. In other words, one needs a criterion to determine

what counts as a good defeater against an explanation of an entity's behavior in terms of that entity realizing conscious states. For without such a criterion the multiple realization argument overgeneralizes. Hence, if one wants to defend the existence of pain in fish, one has to complement the multiple realization argument with a criterion for ruling out the extreme view that everything that has pain-like behaviors actually feels pain.

2.2 The criterion problem

At this point a proponent of consciousness in fish has to provide a criterion for demarcating between plausible and implausible cases of multiple realization. For example, one such criterion could be that consciousness and pain are multiply realizable only by creatures that have a brain. Which is another way of saying that the lack of a brain is a defeater against attributions of consciousness. Fish have a brain, and therefore they can realize conscious states. Decapitated frogs do not, and therefore, they cannot realize conscious states. Problem solved.

However, proponents of the no cortex, no cry argument are not thereby provided with any reason to believe in the validity of this criterion. If one accepts that conscious states are multiply realizable, what reason does one have to believe in this criterion rather than any other criterion which would imply that fish are not conscious? Coming up with a criterion that satisfies one's pre-theoretical intuitions about what is conscious and what is not is just as good as stipulating that some animals are conscious, and others are not, without arguing in favor of one's claim. Proponents of consciousness in fish have to bring support in favor of their criterion, for otherwise they would be begging the question. Consequently, proponents of the multiple realization argument not only need to show that consciousness is multiply realizable, but also that we have good reasons for thinking that it is actually multiply realized in fish, and not in decapitated frogs.

Now, let's imagine, for the sake of argument, that we want to provide support in favor of a criterion such as "consciousness is multiply realizable in all creatures that have a brain (including those without a neocortex) and not in creatures without a brain (e.g., decapitated frogs)". In order to tell that a condition C, such as having a brain, is

necessary for consciousness, we must test a hypothesis of the kind: for all entities, if an entity E is conscious, then E satisfies C. If one wants to determine the truth value of this hypothesis by testing it, one must know whether entities in which we test this hypothesis are conscious or not. For if we do not know if an entity in which we test this hypothesis is conscious or not, then we do not learn anything from the test. Therefore, the only way to test whether a condition is necessary for consciousness or not depends on already knowing which entities are conscious, and which are not. But this is precisely the problem that we are trying to solve in the first place. We cannot justify necessary conditions for consciousness in a non-circular way. To put this argument formally:

> (1) To find a criterion that demarcates between plausible and implausible cases of multiple realizations of consciousness, one must provide a necessary condition for consciousness.
>
> (2) To know whether a condition C is necessary for consciousness, one must test hypotheses of the form: for all entities, if E is conscious, E satisfies C.
>
> (3) In order to test these hypotheses, one both needs to know whether the tested entity E satisfies C, and whether E is conscious or not.
>
> (4) However, we do not know if E is conscious or not, since it is precisely what we try to assess.
>
> (5) Therefore, we cannot find a criterion that demarcates between plausible and implausible cases of multiple realizations of consciousness.

The consequence of this argument is that there is simply no amount of data that could rule out consciousness in a frog's spinal cord once multiple realizability is accepted. We do not have a criterion for knowing what constitutes a defeater against the attribution of consciousness to an entity, since this entity could always realize consciousness in a (yet) unknown way. What should count as a defeater against the attribution of consciousness then becomes genuinely underdetermined by the data. Hence, proponents of the no cortex, no cry argument could provide as much data as they want, they will never succeed in convincing the other side once it is accepted that pain is multiply realizable. On the other hand, proponents of the multiple realization argument cannot provide us with a

criterion for demarcating unconscious from conscious entities.

2.3 Why believe in the multiple realizability of pain?

It may be that some proponents of the multiple realization argument would be quite happy with the claim that a frogs' spinal cords could realize consciousness if this is the price to pay to reject the no cortex, no cry argument. But there is yet another problem with the multiple realization argument. So far, I have just assumed that conscious states such as pain are multiply realizable. Although the (almost) conventional wisdom in philosophy of mind is that psychological states are multiply realizable (Aizawa and Gillett (2009); Fodor (2000); Gillett (2003); Weiskopf (2011)), it is not unreasonable to doubt that psychological states are multiply *realizable* in the absence of actual (and compelling) cases of multiple *realization*. Would you believe my claim that eyes are multiply realizable if I could not bring one single example of different ways in which eyes could be realized? Similarly, if one does not find any psychological state that is multiply realized, there would be reasons to doubt that psychological states are multiply realizable. This would cast doubt on the hypothesis that conscious psychological states could be multiply realizable as well, and thus counter the central premise of the multiple realization argument. As Polger and Shapiro argue:

> The best evidence for the multiple realizability of psychological states is their multiple realization. (...) Lacking evidence of actual multiple realization, what kind of evidence for multiple realizability could we have? We think that the right answer to our question is to admit that, in the absence of evidence of actual multiple realization, we should be very cautious indeed about insisting that mental states are nevertheless multiply realizable. (...) Why think that multiple realizability is true for psychology if we don't have any examples of actual multiple realization? (Polger and Shapiro (2016))

Leaving aside the multiple realizability of psychological states in general, do we have good reasons to believe that pain is multiply realizable? One needs to find actual cases of multiple realization of pain in order to provide good reasons for believing that pain is

multiply realizable, and then that pain could be realized differently in humans and fish. Providing us with good reasons for thinking so would require finding pain in types of entities with brains that are sufficiently different from the brains of mammals. But, once again, finding any evidence in favor of the multiple realizability of pain will be impossible without running into a circular argument. Indeed, in order to test whether pain is multiply realized in a creature that is sufficiently different from us, we must know whether that entity has conscious experiences of pain or not. Without this information, we cannot validate nor invalidate the hypothesis that pain is multiply realized. Hence, one needs to provide examples of multiple realizations of pain in order to provide reasons for believing in its multiple realizability, but one can do so only if one already knows what is conscious and what is not, i.e., only if one already knows whether pain is multiply realized or not. Therefore, there is no way to validate or invalidate claims about the multiple realization of pain without begging the question. No amount of data could invalidate the claim that pain is multiply realizable, because one must decide on the multiple realizability of pain for interpreting the data. Consequently, it is impossible to convince proponents of the no cortex, no cry argument that pain is multiply realizable.

2.4 The root of the problem

At this point, the root of the problem in the debate on the existence of pain in fish becomes clear. There is a crucial asymmetry in the definitions of nociception and pain. Nociception is defined functionally, as a state caused by a specific set of stimuli, which triggers a signal through nociceptors, which in turn triggers a set of behaviors. On the other hand, pain is *not* primarily defined functionally. For example, inputs that might trigger pain experiences are not clearly defined: pain is an "experience associated with actual or potential tissue damage, or described in terms of such damage" (IASP). I could feel a sharp pain in my back even if there is nothing physically wrong with my back, just as in cases of centrally caused chronic pain syndromes. Rather than being defined functionally, pain is defined in terms of the specific phenomenology that comes with

having a pain[3]. What defines pain, what makes it important, and what separates it from nociception, is the *painfulness* of pain: the phenomenal property that is specific to that mental state. In what follows, I will assume that the concept PAIN primarily expresses the property *being painful*. Although pain might also have affective, emotional, imperative, motivational or evaluative aspects (See e.g., Bain (2011); Clark (2005); Hall (2008); Klein (2007)), it does not reduce to those. Therefore, for pain to be multiply realized, what has to be realized in different ways in different entities is primarily a phenomenal property, namely, the painfulness of pain.

Properties that are defined functionally, such as the property of *being a corkscrew* or the property of *believing that there is an apple* are relatively easy to spot. If you can use it to remove corks, it is a corkscrew. If a normally functioning organism is presented with an apple and behaves in a way that indicates that it can see it or does all the things that organisms typically do with apples, then it probably believes that there is an apple. The problem is that phenomenal properties such as the painfulness of pain are not straightforwardly reducible to a specific set of functions. Several philosophical arguments have been made to show that those properties are not, in principle, reducible to specific functions, and we call the seemingly impossible task of reducing phenomenal properties to functional properties "the hard problem of consciousness" (Block and Fodor (1972); Block (1978); Chalmers (1995)). The result is that properties that are defined functionally are "segregated" from phenomenal properties (Haugeland (1978)). As hinted above, I will not enter into the debate of knowing whether phenomenal properties, one glorious day, *could be* reduced to a set of functions being performed by cognitive systems. Rather, I assume that they are not *currently* reduced to a set of functions.

If phenomenal properties, such as the painfulness of pain, are not defined functionally, it is particularly difficult to assess whether organisms instantiate these properties or not.

[3]Reductive representationalists such as Tye (1995, 2000), Carruthers (2000) or Prinz (2012) would certainly disagree with this definition. Providing a detailed argument against this view is not the object of this paper and would likely require a paper of its own. For now, I remain agnostic on whether or not pain *could be* reduced to a set of functions. Below, I explain what proponents of the multiple realization argument would have to do in order to demonstrate the existence of pain experiences in fish if a functional definition of pain was found. Although this view could provide a way forward in this discussion, I will assume that we do not *currently* have a functional definition of pain and, for this reason, I will set the reductive representationalist view aside.

We now see why it is so easy to know if the property of being a corkscrew is multiply realizable or not, and why it is so hard to know if pain is multiply realizable or not. Contrary to the multiple realization of properties defined functionally, the claim that phenomenal properties are multiply realized seems particularly difficult to validate or falsify. Indeed, since it is widely assumed that phenomenal properties are not directly accessible from a third-person perspective, it becomes impossible to discover that fish feel pain without being oneself turned into a fish. Consequently, although one could verify and test claims about the multiple realization of functional properties, the claim that phenomenal properties are multiply realized is currently impossible to falsify. The word *currently* is important here. The claim that phenomenal properties are multiply realized is currently impossible to falsify, because we do not currently have a functional definition of pain.

On the other hand, if such functional definition of pain was found (see, e.g., Cutter and Tye (2011) or Carruthers (2018) for promising options), we would just have to verify that this function is indeed realized in fish to justify attributing pain to them. In this case, the burden of proof would lie on those who claim that pain is multiply realized in humans and fish. First, they would have to prove that fish have mental states that realize the right kind of function to qualify as pain, and not just a different function with similar behavioral outputs. Doing so would require showing that this function can be realized without a neocortex, such that fish realize *the same* function in a different way. Second, they would have to show that this function is not realized in creatures such as decapitated frogs (unless one accepts that decapitated frogs *do* feel pain).

To be clear, my argument is not that it is irrational to attribute the mental state of pain to entities that exhibit pain-like behaviors in the absence of defeaters. Rather, my argument is that it is irrational to justify the multiple realization of pain on the basis that an entity exhibits pain-like behavior if one is unable to distinguish between the functions associated with pain and those associated with nociception. Even if one assumes that pain is reducible to a set of functions, one can reasonably claim that pain is multiply realized *only if* one can find those functions realized in different ways in different entities.

However, without having an idea of the functions that could be specifically associated with pain rather than nociception, there is no basis for the claim that pain is multiply realized. If we do not even know *what* would have to be multiply realized for pain to be multiply realized in humans and fish, then there is no basis for justifying the claim that pain is indeed multiply realized in humans and fish. As it stands, the most crucial premise of the multiple realization argument is impossible to validate or to falsify. Moreover, even if a functional definition of pain were to be found, the burden of proof would still lie on proponents of the multiple realization argument.

3 Objections and replies

Before concluding, I need to mention three important objections. One possible way to move forward on the issue of consciousness in fish could be to use two kinds of inductive arguments to conclude that pain is multiply realizable. This could be done, first, by arguing that many psychological states are multiply realized in many different kinds of entities, and therefore, that there is no reason to think that it should not be the same for pain. A second way to do so would be to argue that cognitive science is successful, and that part of this success is due to the computational mind hypothesis, which considers psychological states to be multiply realizable. Since it is sensible to accept the conceptual framework of the most successful science of the mind, it is then equally sensible to accept the multiple realizability of pain. Giving full consideration to these objection is beyond the scope of this article. Let me mention, though, that the crucial question for researchers on animal consciousness is not really about the multiple realizability of pain, but about *the extent to which* pain is actually multiply realized. As such, even if one offers those inductive arguments in favor of the multiple realizability of pain, we are still in need for a criterion to demarcate between plausible and implausible cases of multiple realization, and I already gave an argument as to why such a criterion cannot be found.

Nonetheless, one could improve this objection by arguing that if the multiple realizability of pain turns out to be highly plausible for the inductive reasons I mentioned, this could shift the burden of proof against proponents of the no cortex, no cry argument.

Indeed, if we have good reasons to think that pain is multiply realizable, proponents of the no cortex, no cry argument will have to explain why they do not think that pain could be realized in fish. However, once it is accepted that pain is multiply realizable, it is difficult to see where the burden of proof lies. On the one hand, there is no way for opponents to pain in fish to prove their point once multiple realizability is accepted. On the other, proponents of the multiple realization argument cannot prove that pain is actually multiply realized in fish and not, say, in decapitated frogs. One could argue that, considering that proponents of the multiple realization argument have to make the costly hypothesis that pain could be realized in decapitated frogs, they should provide a proof that pain is actually multiply realized in fish. However, one could also argue that, for ethical reasons, we should apply a precautionary principle and require that the burden of proof lies on the proponents of the no cortex, no cry argument (Birch (2017)). There are good reasons on both sides for claiming that the burden of proof lies on the other side. Consequently, I fear that the issue of knowing who has to prove what in this debate will be almost as intractable as the problem of animal consciousness itself.

Conclusion

The no cortex, no cry argument states that having a neocortex is a necessary condition for consciousness. On the other hand, the multiple realization argument blocks the identification of necessary conditions for consciousness, and therefore leaves open the possibility for animals without a neocortex to have conscious states. However, the multiple realization argument overgeneralizes to the point that one is left with no possibility to find any defeater against the attribution of consciousness to various entities that exhibit behaviors usually explained by conscious states in humans, such as those of decapitated frogs. Moreover, the multiple realization of pain remains an unfalsifiable claim as long as we do not identify a set of functions specifically associated with pain. The debate between proponents of the no cortex, no cry argument and proponents of the multiple realization argument cannot be solved by data alone. The result is an underdetermination of our claims regarding animal unconsciousness. Although it is possible to find sufficient condi-

tions for consciousness in animals, the claim that conscious states are multiply realizable makes it impossible to find defeaters against attributions of consciousness. If one does not want to go beyond the current neuroscientific evidence, one should thus remain agnostic on the issue of consciousness in animals such as fish, unless we discover that they realize sufficient conditions for consciousness.

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