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Sentience and Consciousness as Bases for Attributing Interests and Moral Status: Considering the Evidence and Speculating Slightly Beyond

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Abstract
Sentient beings are capable of having pleasant or unpleasant experiences and therefore have interests, which I assume to be necessary and sufficient for moral status. But which animals are sentient? While sentience is sufficient for having interests, maybe it is not necessary. Perhaps some creatures are conscious—having subjective experience—yet are not sentient because their consciousness contains nothing pleasant or unpleasant. If so, do they nevertheless have interests and moral status? This chapter addresses both questions. After identifying several methodological assumptions, it proceeds to consider the state of the evidence for sentience in mammals and birds, reptiles, amphibians, fish, cephalopods, and arthropods (in particular, crustaceans and insects). It then takes up the possibility that insects are conscious yet not sentient. In exploring the mental life of insects, the discussion considers the possibility of robots who are conscious but not sentient, eliciting implications for moral status.

Keywords
Sentience · Consciousness · Interests · Moral status · Animals · Robots

2.1 Introduction

Sentient beings are capable of having pleasant or unpleasant experiences. This capacity entails having a quality of life or experiential welfare, from which it follows that sentient beings have interests. The possession of interests, I assume, is both

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necessary and sufficient for moral status. So sentient beings have moral status. But which animals are sentient?

While sentience is sufficient for having interests and moral status, perhaps it is not necessary. A fascinating possibility prompted by recent research on insects is that some creatures are conscious—that is, have subjective experience—yet are not sentient because their consciousness contains nothing pleasant or unpleasant. If so, do they nevertheless have interests and moral status?

This chapter addresses both questions. After identifying several methodological assumptions, it proceeds to consider the state of the evidence for sentience in mammals and birds, reptiles, amphibians, fish, cephalopods, and arthropods (in particular, crustaceans and insects). It then takes up the possibility that insects are conscious yet not sentient. In exploring the mental life of insects, the discussion considers the possibility of robots who are conscious but not sentient, eliciting implications for moral status.

2.2 Methodological Assumptions

Sentience is the capacity for having any pleasant or unpleasant experiences—or, as I use the term, any *feelings*. So evidence for the possession of any feeling is evidence for sentience. In this chapter, I will focus on one feeling: *pain*. By way of a working definition, pain is an unpleasant sensory experience that is typically associated with actual or potential tissue damage.[1] The capacity to experience pain presumably evolved—assuming it conferred a selective advantage to its possessors[2]—to help animals avoid or minimize harm, thereby increasing their chances for survival and reproduction. In considering evidence for pain in animals, I will mainly examine behavioral and neuroanatomical evidence. Although evolutionary considerations can favor or disfavor the attribution of a particular type of mental state, I will deemphasize such considerations because they are somewhat speculative and, relatedly, there are widely varying accounts of the selective advantage (if any) that consciousness—as compared to unconscious information processing—confers on an animal. We are not in a strong position to say which of these accounts is correct, so I won't rely on any such account.

In asking about animal sentience I will assume that there is no "problem of other minds" with respect to active human beings. While we might reasonably ask about *the basis* for our knowledge that human beings with whom we interact and converse have minds (and are sentient), it is not reasonable to doubt *that* they have minds. As for the basis of our knowledge, I assume it takes the form of an inference to the best

[1]Roughly this definition may be found in various sources. See, e.g., [1].

[2]This qualification is motivated by the possibility that consciousness and particular conscious states such as pain have no selective advantage over their unconscious, similarly information-processing counterparts.

explanation of other people's behavior—against the background of knowledge about common species membership and similar neuroanatomy.[3]

We know that ordinary human beings are capable of experiencing pain and many other feelings. Claims of knowledge are more interesting with respect to nonhuman animals, whose behavior and neuroanatomy are similar to our own only to varying degrees. In considering different types of animals, I will consider evidence for the following features and phenomena to be significant in supporting an attribution of sentience.

1. *Nociception or similar responsiveness to noxious stimuli.* Nociceptors are receptors, specifically neural end organs, that respond to potentially tissue-damaging (mechanical, thermal, or chemical) stimuli. Stimulating them causes an organism to withdraw a body part, displaying an immediate and very basic defense against harm. In humans, nociception constitutes part of the neuroanatomy of pain, but pain also requires processing in parts of the cerebral cortex (with rare possible exceptions[4]). Nociception—or something functionally similar—is ordinarily necessary, but is not sufficient, for pain.
2. *A central nervous system with a (suitable) brain.* A central nervous system seems necessary for pain and other feelings in order to process information from the environment to a central control system, the brain, which then sends information via the nervous system to various body parts to enable effective motor responses. A good reason to doubt that plants and extremely primitive invertebrates such as protozoa and sponges are sentient is that they lack a central nervous system and brain. On the other hand, lack of a brain that includes a *cerebral cortex* (as mammals have) is a contentious reason to doubt that an animal can feel pain, because in nonmammalian species some other brain part—such as the dorsal ventricular ridge in birds—may play an analogous role in transforming a nociceptive event into the experience of pain.
3. *Protective behavior toward injured body parts.* When we are injured or subjected to highly painful stimuli, we frequently experience not only immediate pain but also residual pain or soreness. In these circumstances we typically guard our injured body part—for example, by limping (thereby protecting a hurt leg), holding an injured arm, or favoring a healthy hand over an injured hand. We also sometimes rub an injured body part in an effort to reduce painful sensations. (In calling such behavior "protective," I expand the ordinary use of the term.)

[3]My approach may be inconsistent with classic foundationalism, since I help myself to knowledge of species membership and of the hardware in other people's heads when I haven't looked inside. For the record, I regard classical foundationalism as a time-dishonored approach to epistemology that leads, uselessly, to global skepticism. My approach to epistemology is consistent with both coherentism and moderate foundationalism.

[4]There is reason to believe that some human beings, despite being born without a cortex, nevertheless have conscious experiences [2]. If so, perhaps their experiences include pain, in which case there would be some exceptions to the rule that human pain requires cortical processing.

4. *Learned avoidance.* If a creature learns to avoid a noxious stimulus, this behavior indicates some form of memory of past encounters with the stimulus. It is possible, in principle, for such recording of and learning from past noxious instances to be unconscious—an automatic associative learning with no pain. But I will take learned avoidance to constitute one piece of evidence in favor of attributing pain, the idea being that in ordinary cases of learned avoidance an animal felt pain, remembered it, and was thereby motivated to avoid the stimulus.
5. *Opioid receptors, endogenous opioids, and/or behavioral responsiveness to anesthetics, analgesics, and opioids.* In humans, these compounds relieve pain or, if administered prior to an injury or noxious event, might prevent pain altogether. When pain causes guarding of a body part or motivates avoidance of a situation that has caused pain in the past, the administration of pain-relieving compounds often reduces such pain behavior. Thus, a football player with a leg injury might be willing to run and even run normally after receiving an analgesic. When an animal's behavior is *prima facie* pain behavior but becomes more "normal" in response to anesthetics, analgesics, or opioids, the behavioral difference provides some evidence that animal can indeed experience pain and therefore relief from pain. For example, following an injection of bee venom in the lips, a fish might rub its lips against a surface but discontinue rubbing after receiving morphine.
6. *Trade-offs between noxious stimulus avoidance and other health-promoting behaviors.* Nociceptive responses to noxious stimuli, as noted, are automatic and inflexible. Behavior that displays a willingness to endure a noxious stimulus in order to meet some other requirement such as obtaining food or water is more flexible. For example, a rat might endure an electric shock in order to reach desperately needed water. Such behavior suggests a mind that can weigh motivations—here, to avoid pain and to obtain water—in terms of urgency or importance rather than simply responding automatically to immediate stimuli.[5]

In the discussion that follows, I will assume that evidence of these six kinds are highly relevant in attributing pain and therefore sentience. (Occasionally, the discussion will also consider other suggestive phenomena such as sophisticated intellectual capacities and physiological responses associated with stress.) More specifically, evidence of the first two kinds—nociception and an apparently suitable nervous system—is necessary but not sufficient for a strong case; evidence of all six kinds constitutes a very strong case; and evidence of the first two kinds and some but not all of the other kinds of evidence constitutes a case of some intermediate degree of strength for attributing pain and sentience. My assumption that the six kinds of evidence together present a very strong case is not trivial, because it is possible in principle that all six criteria could be met in an insentient creature that possessed a highly complex system of unconscious information processing. While this sort of conjecture is possible, it seems to me less reasonable than the assumption that a creature displaying the foregoing six features and phenomena is sentient and can experience pain. Hence my assumption.

[5]Gary Varner [3] influentially presented a table of types of evidence for sentience. The types of evidence he catalogues overlap with my list of six criteria. I prefer my list because it combines several of his neurological criteria concisely into "a central nervous system with a (suitable) brain" and offers considerably more specificity regarding behavioral criteria.

2.3 Evidence of Sentience in Different Animal Classes

2.3.1 Mammals and Birds

The case for attributing the capacity to experience pain—and therefore sentience—to nonhuman mammals is overwhelmingly strong. Human pain features two largely discrete systems: a sensory-discriminatory system, which conveys information about the intensity and bodily location of a noxious stimulus to the somatosensory cortex, and a motivational-affective system, which registers unpleasantness and motivates adaptive action through the anterior cingulate cortex to the frontal lobe [4].[6] As human experience is our familiar starting point for asking about animal experience, our everyday concept of pain includes both dimensions: pain involves (1) information about the bodily location of a noxious event and (2) unpleasantness. One reason the case for attributing pain to some nonhuman animals is overwhelming is that mammals share the basic neurological architecture—the thalamocortical (thalamus-to-cortex) complex—in which pain processing occurs in humans [5, 6]. In addition, mammals as a class have nociceptors, display protective behavior toward injured body parts, have an endogenous opioid system similar to that of humans, and meet the other criteria listed above. That mammals meet these criteria is not controversial.

The thesis that birds can experience pain and are sentient is less obvious at first glance because avian neuroanatomy differs significantly from mammalian neuroanatomy. Birds lack a cerebral cortex, prompting the question of whether they have a brain part that functions in a relevantly similar way so that nociception can generate the conscious experience known as pain. An affirmative answer seems justified. Like mammals, birds do have a cerebrum, or telencephalon, even if not a cortex on its outer surface [7].[7] Moreover, as Edelman et al. state it, "the somatomotor circuitry within the avian dorsal pallium appears to be homologous to the mammalian basal ganglia-cortico-thalamic loop..." (p. 173 in [8]).[8] In addition, it seems plausible to hypothesize that the dorsal ventricular ridge in birds plays the same role as the cortex in mammals (p. 122–24 in Tye [9]). Birds appear to have a suitable nervous system and brain for sustaining conscious experiences, including pain.

[6]It is worth noting that these two systems are unlikely to be *entirely* discrete.

[7]The cited article is also illuminating about some of birds' more impressive intellectual feats, as discussed in the next paragraph.

[8]The authors cite Medina and Reiner [7]. See also Tye (p.124 in [9]). Tye cites Dugas-Ford et al. [10].

Birds also satisfy nearly all of our other criteria for animal pain: nociceptive and endogenous opioid systems (see, e.g., p. 63 in [11]; p. 113–6 in [12]; p. 211–4 in [13]), protective behavior ([9], p. 127–8), and learned avoidance [14]. However, I am not aware of evidence one way or another regarding trade-offs between noxious stimulus avoidance and other health-promoting behaviors. At the same time, the thesis that birds are sentient seems indirectly confirmed by evidence that they are capable of remarkable intellectual feats.[9] (More precisely, these intellectual feats are suggestive of consciousness; but given the aforementioned evidence for sentience, evidence for these feats strengthens the overall case for sentience.) These include crows' fashioning tools to help them accomplish goals [16]. They also include birds' storing "food of different kinds in hundreds of distinct places to retrieve later, [remembering] not only where they have put food but *what* was put in each place, so the more perishable items can be retrieved before the longer lasting ones" (p. 141 in [17]), [18, 19]. Now, it is conceivable that an entirely unconscious creature could perform such feats, but this seems unlikely in the world as we know it, especially when the creature has neural systems for nociception and endogenous opiates and exhibits protective behavior and learned avoidance. Overall, the case for avian sentience seems extremely strong. Based on what we currently know, it is far more reasonable to believe birds are sentient than to believe they are not.

2.3.2 Reptiles

Mammals and birds are warm-blooded, highly social animals. Nearly all other animals are cold-blooded and either asocial or social in ways that seem less likely to include emotional attachment. These and other differences tend to make reptiles and amphibians seem more alien than birds and nonhuman mammals. An impression of being alien, however, is not a reliable basis for denying mental states. So let us consider available evidence, beginning with reptiles, who share a common ancestor with mammals, birds, and the extinct dinosaurs, and with all of these animals fall under the general clade known as amniotes.

Reptiles satisfy at least several of our criteria for attributing pain. They have nociceptive systems, central nervous systems culminating in brains that bear substantial structural similarity to avian brains, and endogenous opioid systems.[10] Some further evidence comes from Michel Cabanac and colleagues, who contend that consciousness first evolved in early amniotes—with the implication that present-day reptiles, birds, and mammals are conscious creatures whereas amphibians, fish, and invertebrates are not [21]. (Note that the authors' inference that amphibians, fish, and invertebrates are insentient assumes that the evolution of consciousness has not

[9]The two examples that follow involve corvids and tits. The examples presented by Gunturkun and Bugnyar [15] involve corvids and parrots. So the claim that impressive intellectual feats bolster the case for sentience might apply only to corvids, tits, and parrots.

[10]For a helpful review of the scientific literature on these topics, see [20].

occurred two or more times in different animal lines.) They hypothesize that as land-based lifeforms evolved, "existence required more and more stimulus-response pathways; eventually, a point was reached where it became more efficient, in terms of speed and flexibility, to route all decision making through a single mental space ... according to the criterium [sic] of maximal pleasure" (p. 267 in [21]). These newly conscious creatures were capable of pleasure and pain, which afforded them a single hedonic currency for selecting behaviors. Consistent with the hypothesis that consciousness and sentience emerged with amniotes, the authors conducted trials involving "taste aversion learning"—in which animal subjects could learn to associate a food's pleasant taste with the unpleasant indigestion that followed, thereafter avoiding the food (an analogue to learned pain avoidance and an example of trade-off behavior)—and found reptiles but not amphibians to demonstrate such learning [22]. Further, the authors cite literature suggesting that reptiles, when handled, produce characteristic physiological responses that indicate stress (an emotional response)—similar to those found in mammals and birds—whereas amphibians and fish do not (p. 268 in [21]).

The case for reptilian sentience seems rather strong, though not quite as strong as the case for mammalian and avian sentience. Of the six kinds of evidence we are looking for, we have confirmed at least four of them in reptiles and, if we allow taste aversion learning to count as learned pain avoidance, five. Moreover, we don't have counterevidence with respect to protective behavior—just no evidence either way. What about Cabanac's interesting thesis that consciousness and sentience emerged with amniotes? Once again, we need to consider available evidence.

2.3.3 Amphibians

Descendants of fish, the amphibian class comprises such animals as frogs, newts, and salamanders, which live first in water and then, following a physical metamorphosis, the rest of their lives on land. There is reason to believe that amphibians lack an integrated perception or mental model of the world. Frogs, for example, apparently have one visual stream that allows them to detect and snap at moving objects such as flies and a distinct visual stream that enables them to walk around barriers. The lack of unified visual perception was demonstrated in an experiment in which surgical rewiring in a frog's brain resulted in a left-right reversal of prey detection while leaving untouched the ability to perceive right and left for purposes of walking around objects (p. 89 in [17]), [23]. Perhaps amphibians in general lack an integrated consciousness of the environment.

Would it follow that they are not conscious at all or that they lack sentience? It would not. The experience of pain is sufficient for sentience. Perhaps creatures like frogs and salamanders have certain sensations such as pain, hunger, and thirst and respond directly to these sensations in adaptive ways—escaping a noxious stimulus, finding and eating food, finding water and drinking—without any single representation of the world and of themselves within it. Unified consciousness might permit more efficient trade-off behavior such as tolerating pain in an effort to access needed food, but perhaps

On the other hand, if amphibian behavior appears consistent with simple reflexive behavior, it would be more doubtful that amphibians actually experience feelings. Maybe, for example, frogs' two or more visual systems involve unconscious visual perception. Maybe their nociceptive responses to noxious stimuli are never attended by pain. What does the evidence suggest?

My reading of the literature suggests a case of intermediate strength for amphibian sentience and, specifically, the capacity to feel pain [24–26]. It is well-established that amphibians possess systems for both nociception and endogenous opioids, but it is unclear whether their brains include anything functioning like a cortex that can allow nociceptive signals to be experienced consciously as pain. I am not aware of evidence of protective behavior toward injured body parts, of learned avoidance, or of motivational trade-offs. Indeed, the aforementioned reasons to believe that amphibians lack a unified perception of the world make it seem unlikely that they engage in motivational trade-offs. It is far from clear whether amphibians are sentient.

2.3.4 Fish

There seems to be more evidence for fish sentience than for amphibian sentience, but perhaps only because fish—a major food source for human beings—have been studied more extensively. Yet, in speaking about fish one has to be careful due to the enormous range of species this term covers.[11] Fish are gill-bearing aquatic vertebrates that, unlike amphibians, never live on land. They divide into jawless fishes such as lampreys and hagfish, cartilaginous fishes such as sharks and stingrays, and bony fishes, which include most extent fish species. It should not be surprising if different types of fish have significantly different cognitive and sensory capacities.

There is stronger evidence that bony fishes—or at least teleost (ray-finned) fishes, which comprise the vast majority of bony fishes—are sentient than the evidence for sentience in the other, more primitive (evolutionarily ancient) types of fish. In fact, there is some counterevidence in the case of the more primitive fishes. For example, careful efforts to identify nociceptors in stingrays have been unsuccessful and, in the case of lampreys, the evidence was ambiguous [28]. Sharks, meanwhile, appear to lack nociceptors and, as a result, are able to feed while being torn to pieces by other sharks and to feed on noxious prey that leave large numbers of barbs in their mouths [9, 26]. At the same time, the evidence is unclear as to whether some jawless and cartilaginous fishes have opioid receptors [29]. My overall sense is that the case for sentience in these more ancient types of fish is somewhat weak. Bony fishes, at least teleosts, are a different matter.

Let us consider the evidence. Rainbow trout, a commonly studied species, have been found to have nociceptive and endogenous opioid systems [28]; moreover, rainbow trout injected with acid rubbed the affected area against a surface (unlike controls who were injected with saline)—displaying a type of protective behavior—and decreased this behavior when given morphine [30]. Goldfish learned to avoid electric shock unless they were given morphine beforehand (p. 126–7 in [28]). In addition, goldfish have been found to engage in trade-offs between the need to feed and the avoidance of electric shock. As Tye describes the finding, "the number of feeding attempts decreased with increased shock intensity [whereas] with increased food deprivation, the number and duration of feeding attempts increased..." (p. 98 in [9, 31]).

[11]Colin Allen makes this point persuasively; see (p. 26 in [27]).

So far, then, representatives of teleost fish species have been found to meet five of our six criteria. The remaining criterion, possession of a central nervous system and a brain suitable for pain experience, has been a topic of dispute. Do teleost fish brains contain structures suitable to transform complex information processing into conscious experiences such as pain? James Rose has argued that fish—and other nonmammalian animals—are incapable of conscious experience (which is necessary for sentience) because they lack a neocortex (cerebral cortex) [32]. But, of course, the question is not whether fish have a neocortex but whether they have something that functions in a relevantly similar way. Recall that neither birds nor reptiles have a neocortex yet the case for their sentience is strong; presumably circuitry in their dorsal pallium can function analogously to the thalamocortical system in mammals. Several scholars have suggested that the fish forebrain may have evolved to support conscious experience (see, e.g., [33, 34]). Interestingly, there is reason to believe that even some human beings who lack a cerebral cortex are capable of conscious experiences (though not of a normal range or complexity) and purposive action; the author of an influential study suggests that midbrain and thalamic functioning are most crucial for basic consciousness in vertebrates, including humans, though it must be stressed that his thesis is controversial [2]. In any case, it would be unreasonable to require a cortex for an attribution of consciousness in nonmammalian animals if some other brain part or system appears to play an analogous role. Returning to teleost fish in particular, the case for sentience in these animals is not defeated by the absence of a cortex and seems fairly strong overall—stronger than the case for sentience in amphibians and the more primitive types of fish and perhaps as strong, or nearly as strong, as the case for reptilian sentience.

2.3.5 Cephalopods

Our discussion thus far has focused on vertebrates. While it is sometimes assumed that invertebrates are more primitive and less likely to be sentient than vertebrates *across the board*, this assumption is oversimplified. Probably the strongest candidates for invertebrate sentience are the cephalopods, a type of mollusk that includes octopuses, squid, and cuttlefish. Because mollusks and vertebrates developed from more primitive animals that branched apart some 600 million years ago, cephalopods present a compelling case of the evolution of consciousness and sentience that occurred in parallel with vertebrates [17]. In other words, conscious minds appear to have evolved independently at least twice.

Considering the phenomenon of parallel evolution, it would be unreasonable in looking for evidence of sentience to require cephalopods to have a nervous system that is very similar, structurally, to the mammalian nervous system. Indeed, cephalopods have more neurons in their semiautonomous tentacles than in their brains.[12] Instead of similarity, it is appropriate to look for complexity—which is consistent with the criterion "a central nervous system with a (suitable) brain"—and perhaps to give a bit more weight to behavioral criteria. With these points in mind, the case for sentience in cephalopods seems very strong.

To begin, cephalopods have a nociceptive system and, when they withdraw from a noxious stimulus, usually change bodily color and often produce a cloud of ink [26, 35, p. 26]. Speaking to the apparent suitability of their nervous system for conscious experiences, Edelman et al. state the following: "Cephalopods, particularly the octopus, have complex sensory receptors and nervous systems that, at least in numbers of constituent neurons alone, rival those of some vertebrates" (p. 177 in [8]). The cephalopod brain has a hierarchical structure with the higher centers dedicated to sensory analysis, memory, learning, and decision-making [35]. Although there is not clear evidence one way or another regarding whether cephalopods have an endogenous opiate system,[13] Elwood reports that they have "an adrenal system that releases adrenal hormones when the animal is exposed to noxious, potentially painful, stimuli, and noradrenaline and dopamine are released when the animal is disturbed..." (p. 178 in [37]), [38]. Because cephalopods, especially octopuses, have demonstrated a remarkable capacity to learn, it is difficult to be skeptical that they can learn to avoid noxious stimuli. Octopuses display the ability to learn mundane lessons such as how to pull levers to obtain food in a laboratory setting. But their learning ability is revealed more impressively when octopuses work out creative means to achieving their own ends—such as escaping from a tank when (and only when) nearby humans are not looking, unscrewing a jar from the inside, and squirting water at bulbs to turn off lights [17]. Octopuses have also been found to engage in motivational trade-offs between noxious stimulus avoidance and other requirements such as food intake [37]. There is, on the whole, a very strong case for cephalopod sentience—perhaps comparable in strength to the case for reptilian sentience.

What about other invertebrates? The most likely candidates for sentience, after cephalopods, are certain arthropods.

[12]Many people who reflect on octopuses' mental lives have wondered what it is like to be an octopus. I suggest an additional question: What, if anything, is it like to be an octopus tentacle?

[13]For a discussion of ambiguous evidence, see della Roca et al. (p. 79 in [36]).

2.3.6 Arthropods

The largest phylum in the animal kingdom, arthropods include crustaceans such a crabs and lobsters; insects such as bees, ants, and flies; and spiders of myria varieties. All have segmented bodies and exoskeletons. Given the fact that sentienc evolved in vertebrates and apparently evolved in a separate mollusk line th includes cephalopods, the possibility of arthropod sentience suggests the possibilit that sentience evolved independently in at least three different animal lines. Despi the enormous range of animals in the arthropod phylum, due to space constraints will confine my discussion to crabs and to insects, especially bees.

It is uncertain whether crabs are sentient. On the one hand, there have bee conflicting reports regarding nociceptive behavior or its absence; and as Lynn Sneddon comments in a review of evidence for pain in aquatic animals, little i known about the neurobiology of crustacean nociception [39]. Since nociception i generally a necessary condition for the capacity to experience pain, thes concessions might seem to doom any case for sentience in crabs. Yet other evidenc is fairly strong. For example, hermit crabs have exhibited grooming followin electric shocks and trade-offs between shock avoidance and access to preferre shell types; shore crabs have demonstrated avoidance learning and trade-offs simila to those found in hermit crabs [37, 39]. Moreover, morphine reduces apparent pai behavior in crabs, while glass prawns engage in rubbing or grooming if treated wit acid but reduce such behaviors if administered a local anesthetic [37]. On the whol there seems to be an intermediate case for attributing sentience to at least som crustaceans including crabs.

Turning to insects, the evidence is consistent with the intriguing possibility that a least some—such as bees—are conscious but not sentient. Bees appear to lac nociceptors but do respond to noxious stimuli and so may be said to engage i nociceptive behavior. But other aspects of their behavior—learned avoidance but n clear instances of protective behavior—seems ambiguous with respect to whethe they feel pain [9].[14] I remain agnostic on this matter. Yet it will be instructive t suppose, for the sake of discussion, that bees cannot feel pain or any other feelings entailing a lack of sentience.[15] If this is true, then some real-world creatures ar insentient yet conscious.

Consciousness is subjective experience or awareness. It is more basic tha sentience, which requires awareness that involves feeling, that is, experience wit a hedonic tone. Recently Andrew Barron and Colin Klein have advanced a powerfu argument that insects are conscious [41]. In the case of vertebrates, they argue, th capacity for subjective experience is supported by integrated midbrain structures tha

[14]One especially noteworthy aspect of insect behavior is an apparent lack of protective behavic toward injured body parts [40].

[15]Although Tye believes bees may not experience pain, he argues that they experience fear an perhaps anxiety [9]—unpleasant feelings that would entail that bees are sentient after all. So Ty would not accept the present supposition.

create *a neural model of the state of a mobile animal in space*—a thesis consistent with the claim that a mammalian neocortex is not necessary (even in humans) for basic consciousness. Structures in the insect brain function analogously, according to the authors. (Here it is noteworthy that the tiny brain of a bee has almost a million neurons, making it far denser in neurons than the human cortex [9].) In both vertebrates and insects this sort of integrated control system evolved to deal efficiently with the challenges of (1) sensory reafference (in which a creature needs to distinguish sensory data produced by its own actions and those produced by the external world), (2) multiple sensory inputs, and (3) navigating through space to locations outside of immediate sensory range. As the authors state, "[f]or active animals with well-developed spatial senses, it is computationally more effective to resolve the reafference problem once for a unified sensory model than to resolve it in a dispersed and peripheral way for each sense independently" (p. 4902 in [41]). They also contend that the midbrain's integration of different types of relevant information "provides the capacity to resolve competing behavioral priorities or motivations and rank needed resources by both urgency and availability" (p. 4902 in [41]). In view of both the authors' functional-neuroanatomical reasoning and the background understanding that bees are capable of remarkable communicative and navigational feats, I find the thesis that bees are conscious more reasonable than the thesis that they are not. Perhaps, as the authors contend, insects as a clade are conscious creatures. They may or may not be sentient as well.

2.4 Conclusion: From Bees to Bots and Back

At this point I would like to explore implications of the possibility that some animals—let's stick with bees—are conscious, even intelligent in some ways, yet insentient. This possibility motivates a question that brings us back to ethics: If bees are like this, do they have interests and consequently moral status? We assume, for the sake of discussion, that the bees cannot feel pain or experience other pleasant or unpleasant feelings. If they have interests, in what are they grounded?

Bees' efficient, complex navigation through space demonstrates that they have *aims* of some sort. They endeavor to do things, like find their way to food. But the idea of an aim is ambiguous. It might mean a built-in goal that, in itself, implies no *caring or concern* about its achievement. An autonomous vehicle presumably has the aim of reaching its assigned destination intact, but at least as I envision such machines they do not care about achieving this goal because they are not conscious and cannot care about anything. But now imagine an autonomous vehicle—or, if this is easier to imagine, a robot—that possesses not only built-in aims but also a type of consciousness that processes information about its environment (senses), about its own location and state (self-awareness), about its previous actions and their consequences for its system (memory), etc. There is something that it is like to be this machine. It has subjective experience of some complexity. Does it have interests? This, I submit, depends on further detail.

Suppose that the robot not only has built-in aims, but cares about, or desires, thei achievement such that the robot tends to *feel* frustrated at the frustration of its aim and to *feel* satisfied at the satisfaction of its aims. This robot, it turns out, *is* sentier because, whether or not it can feel pain in response to noxious stimuli, it ca experience the pleasant feeling of satisfaction and the unpleasant feeling of frustra tion. Clearly, then, the robot has interests and moral status.

Suppose, on the other hand, that the robot does not care about, or desire, anythin including achieving its aims. Indeed, unlike HAL in *2001*, this robot does not min the prospect of its own destruction. Suppose, then, that its experience is limited t perceptions, thoughts, and memories. And it simply does what it was built t do. This robot, I suggest, has no interests and no moral status. We might admire i as we might admire a beautiful rainbow or oak or painting, but we cannot sympathiz with it—since it has no conative point of view to appreciate and take on. This robc may strike us as very strange insofar as it has a point of view on reality but n interests to make it matter, from its point of view, what happens to it. Maybe bee and at least some other insects are like this.

But I suspect they are not, and here's why. (Admittedly, the following discussio is highly speculative.) If we can build an insentient yet conscious robot to perforr certain tasks, it is plausible to suppose that it will become more proficient at avoidin destruction and performing its tasks, other factors being equal, if it acquires *motiva tion*—in the form of feeling—beyond its original software-determined compulsio to perform its tasks. After all, I suggest, if it is conscious and intelligent it will mor reliably remain intact and do its job if it *cares* about these things rather than bein blasé about them. Now consider bees. If they are conscious and have certain actio tendencies or general aims built into them through natural selection, and if they don' care whether they can achieve them, then a better biological model could emerg through random mutations in which creatures have the same abilities but care abou achieving their aims—that is, have desires that tend to keep them and their hiv mates alive and available for reproduction. This model would seem to have selective advantage. And bees have existed for something like 100 million years Moreover, as noted, their brains are extremely dense in neurons. My guess, then, i that if bees are conscious, they are also sentient—having at least some capacity fo feelings whether or not they include pain—in which case they have moral status.

If it's slightly difficult, as I am suggesting, to imagine that present-day bees an perhaps some other insects are conscious yet insentient, it is easier to imagine tha some robots will be conscious but insentient—assuming (as I think we should) w can imagine robots being conscious at all. In that case, all we have to imagine is tha we didn't design them in a way that generated feelings. Then they would have n moral status, with the important implication that we could use them for our ow purposes without exploiting them in any morally relevant sense. But our dilemm might be that we *could* produce, for selfish purposes, more efficient robots wh would need feelings for their increased efficiency, but then, having done so, w would need to acknowledge their moral status and stop regarding them simply a tools or resources for our own use.

What if we created robots who could have pleasant feelings but not unpleasant ones? Would that eliminate the dilemma? That might help, morally, insofar as their quality of life would be good, but it might entail a cost in efficiency if the capacity for negative affect conferred additional motivation to achieve aims. Also, while increasing quality of life, such an engineering feat might leave untouched ethical issues concerning *respect for beings with moral status*—an area of deep uncertainty in cases, such as we are imagining, in which the beings with moral status seem to lack (given their built-in aims) even the potential to become autonomous. Further exploration of these fascinating issues will have to await another occasion.

Some philosophers and scientists treat sentience and consciousness as interchangeable and therefore as equally good bases for moral status. I have distinguished the two concepts, understanding sentience as involving not just consciousness but also the capacity for feelings—experiences that are pleasant or unpleasant. I have also argued that while sentience is sufficient for having interests and moral status, consciousness is sufficient for neither. This claim, of course, is independent of the empirical investigations on which most of this chapter focused before turning to speculations about bees and future robots.

To close on a personal note, if someday we are able to create conscious robots, I would prefer robots that are also sentient. Such robots would be more interesting and, in a sense, more "complete." I would love in my lifetime to befriend such a being. In the meantime, I need to figure out the best way to interact with the living animals of whose possible or likely sentience I have only recently become aware.

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