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“All animals are conscious”: Shifting the null hypothesis in consciousness science

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The marker approach is taken as best practice for answering the *distribution question*: Which animals are conscious? However, the methodology can be used to increase confidence in animals many presume to be unconscious, including *C. elegans*, leading to a trilemma: accept the worms as conscious; reject the specific markers; or reject the marker methodology for answering the distribution question. I defend the third option and argue that answering the distribution question requires a secure theory of consciousness. Accepting the hypothesis *all animals are conscious* will promote research leading to secure theory, which is needed to create reliable consciousness tests for animals and AIs. Rather than asking the distribution question, we should shift to the *dimensions question*: How are animals conscious?

KEYWORDS

animals, artificial intelligence, consciousness, invertebrates, other minds, sentience

1 | INTRODUCTION

Are honeybees natural zombies? Is there something it is like to be a garden snail? Can crabs feel pain? These are among the questions being asked in a resurgence of interest in animal consciousness, with a shift of focus from mammals and birds to questions about invertebrates such as cephalopods, insects, and crustaceans (e.g., Barron & Klein, 2016; Birch et al., 2021; Crump et al., 2022;

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Gibbons et al., 2022; Ginsburg & Jablonka, 2019; Godfrey-Smith, 2016; Mikhalevich & Powell, 2020; Schwitzgebel, 2020; Tye, 2016; Varner, 2012). This attentional shift has occurred even though we still lack an established argument that resolves the question of vertebrate consciousness.¹ Alongside questions about *who* is conscious we have questions about *how* to find out (Andrews, 2020; Birch, 2020; Tye, 2016). The *distribution question* is alive and well.

Colin Allen introduced the distribution question to reflect one of two core epistemic goals of animal consciousness research: Can we know which animals beside humans are conscious? (Allen, 2000). Allen's second core epistemic goal was to determine what, if anything, the experiences of animals are like. Another way of understanding the second question is as a question about the *dimensions* of animal consciousness, as Jonathan Birch and colleagues put it (Birch et al., 2020). Asking about dimensions of animal consciousness serves to precisify the “what it is like” question by breaking it into more specific questions, including: What kinds of sensory experiences do animals have, do they project themselves in time, do they have a sense of self, and if so, what sort of self? Answering such questions about *how* animals are conscious will offer knowledge about variation across domains of consciousness, including temporality, evaluation, the richness of different perceptual modalities, self-consciousness, and how unified these domains are. Following Birch et al., 2020, we can call Allen's second question the *dimensions question*.

However, it is the distribution question that is getting significant attention at this moment. There are two approaches to addressing this question: apply a secure theory of consciousness, or use a marker approach. While some philosophers draw conclusions about animal consciousness by appealing to their preferred theory of consciousness (e.g., Carruthers, 2019), there is significant consensus that we cannot make progress on the distribution question by simply applying an existing theory of consciousness, because all current theories are “insecure” (Allen & Trestman, 2020). Current theories beg the question against animal consciousness, having been developed by taking human or mammalian consciousness as the paradigm case (Andrews, 2020; Birch, 2020; Tye, 2016). If we were to have a secure theory, answering the distribution question would become a matter of doing empirical research of the appropriate kind. I will grant the premise that all existing theories of consciousness are insecure.

The second method used to answer the distribution question—the marker approach—is widely accepted as the current best practice. Marker approaches do not offer or presume theories of consciousness, but seek to find some observable features that *indicate* consciousness. Allen and Trestman (2020) describe the marker methodology as “picking out, in a principled way, behavioral or neurophysiological characteristics that could serve as reliable indicators for consciousness ... this project promises empirical tractability even in the face of persistent uncertainty about the metaphysical questions of consciousness” (section 4.8). Marker approaches are currently defended in philosophy (e.g., Bayne & Shea, 2021; Birch, 2020; Tye, 2016; Varner, 2012), and used in science (e.g., Birch et al., 2021; Braithwaite, 2010; Smith & Boyd, 1991; Sneddon et al., 2014). Birch has recently argued that a marker approach (which he refers to as a “theory light approach”) combined with the right sort of empirical research promises to “settle disputes about whether bees are conscious or not” (Birch, 2020, p. 15). Michael Tye describes the marker approach as a form of abduction that appeals to *Newton's principle*—that like effects result from like causes.

¹In the 2020 Phil Survey question about other minds, a majority of philosophers accept or learn toward accepting adult humans (95.15%), cats (88.55%), newborn babies (84.34%), and fish (65.29%) as conscious. The situation is different when it comes to flies (32.52%), worms (24.18%), and plants (7.23%) (<https://survey2020.philpeople.org/survey/results/5106>). The 2009 Phi Survey did not include questions about other minds, so we do not have data on how opinions have changed.

Gary Varner (2012) takes the marker approach to be grounded in analogies between humans and other animals—if the behavior is associated with consciousness for a human, the same—or similar—behavior is likely to be associated with consciousness in other animals.

Answering the distribution question is becoming more urgent. There is growing interest in the relationship between animal welfare and an evaluative form of consciousness—namely sentience. In addition, with the rapid developments in AI research, there are increasing demands to create an adequate sentience test for large language models (LLMs) and artificial agents. Given these practical implications, now is a good time to analyze the marker approach to answering such questions.

In what follows I will argue that the marker approach ultimately fails to provide a warranted answer to the distribution question and that to achieve a warranted answer we need a secure theory of consciousness. Attention to the distribution question at this point in the science and philosophy of consciousness studies is premature, and worse, current attention hinders our ability to answer the question. As a result, we are limited in our ability to develop excellent animal welfare proposals and sentience tests appropriate for AIs. I propose that instead we turn our attention toward developing a secure theory of consciousness, which will be facilitated by adopting the premise “All animals are conscious”, and use the marker approach to answer the dimensions question, with particular emphasis on distantly related animals such as sea sponges, nematode worms, jellyfish, and starfish.

In Section 2, I examine what I take to be the model of best practices for the marker approach: the *Review of the evidence of sentience in decapod crustaceans and cephalopod molluscs* report (Birch et al., 2021; see also Crump et al., 2022), a high-profile argument for invertebrate sentience which led to a change in UK welfare policy. Using the principled methods employed in this case, I consider whether they could also provide increased evidence of sentience in animals only distantly related to humans—the nematode worm *C. elegans* and the sea sponge *Porifera*. These cases raise questions about how the marker approach functions as a methodology.

In Section 3, I analyze the marker methodology more generally, and point to a distinction between derived markers—markers which are the outputs of scientific research, and initial markers—those markers which lead humans to, pretheoretically, take others as conscious. Given the key role of derived markers in the methodology, we risk being too permissive when the marker approach is used to answer the distribution question. I show how the marker approach could identify consciousness markers in *Styela plicata*, the sea squirt. This leads to the question raised in Section 4 as to whether there are any negative derived markers—defeaters that indicate a lack of consciousness in systems that show some initial markers. I argue that the marker methodology admits of no negative derived markers, and thus does not permit a method of disqualification. At best, the marker methodology can only serve as a positive test, not a decision procedure. In Section 5, I challenge the idea that the marker methodology can even serve as a positive test for consciousness, and suggest it offers only an illusion of progress on the distribution question. This is because the marker methodology all but guarantees an increased confidence in the consciousness of any animal identified as appropriate for investigating in the first place—any animal with initial markers. If, as I will argue, the marker approach should be expected to always find additional evidence of consciousness, then using the marker approach to answer the distribution question is akin to assuming that all animals worthy of investigating are conscious, from the beginning. This makes answering the distribution question—distinguishing between those animals who have consciousness from those who do not—a currently unachievable

epistemic goal. In Section 6, I show that these worries should not lead us to discount the marker methodology itself, but rather to take it to be answering a different question, namely the dimensions question. I propose that turning our attention to the dimensions question will be productive when it comes to developing a secure theory of consciousness, but to take it seriously we need to accept the premise that all animals are conscious. I offer two arguments in favor of adopting this premise into the cognitive science of consciousness studies. I predict that presuming that all animals are conscious will lead to advancements in developing a robust theory of consciousness, which is what is needed to make progress on the distribution question.

2 | THE MARKER METHODOLOGY: A CASE

The *Review of the evidence of sentience in cephalopod molluscs and decapod crustaceans* (Birch et al., 2021; see also Crump et al., 2022) is a detailed report commissioned by the UK Department for Environment, Food and Rural Affairs (DEFRA) to help them decide whether welfare law should be modified to include cephalopods and decapods. After reviewing over 300 scientific studies, the report's authors, led by Jonathan Birch, conclude, “[w]e recommend that all cephalopod molluscs and decapod crustaceans be regarded as sentient animals for the purposes of UK animal welfare law. They should be counted as ‘animals’ for the purposes of the Animal Welfare Act 2006 and included in the scope of any future legislation relating to animal sentience” (Birch et al., 2021, p. 8). The report defines the type of consciousness it is focused on, namely sentience, or the capacity to experience feelings such as pain, pleasure, hunger, warmth, excitement, and so on. In the report, the authors focus on a particular type of sentience—pain—as it is more relevant to their goals of determining best practices for animal welfare.

The report identifies eight markers of pain (Birch et al., 2021, p. 7):

- (1) Possession of nociceptors.
- (2) Possession of integrative brain regions.
- (3) Connections between nociceptors and integrative brain regions.
- (4) Responses affected by potential local anesthetics or analgesics.
- (5) Motivational trade-offs that show a balancing of threat against opportunity for reward.
- (6) Flexible self-protective behaviors in response to injury and threat.
- (7) Associative learning that goes beyond habituation and sensitization.
- (8) Behavior that shows the animal values local anesthetics or analgesics when injured.

These include neurobiological properties (e.g., having nociceptors, integrated brain regions, and connections between the two), behavioral properties (associative learning, motivational trade-offs, self-protective behavior), and combinations of the two (responses to noxious stimuli that are modulated by anesthetics or analgesics, and drug-seeking behavior when injured). The markers, which are a refinement of Smith and Boyd's list (Smith & Boyd, 1991), are selected because they are indicators of painful experience in humans. They are sufficiently precise (e.g., do not make vague references to “functionally similar” human responses), sufficiently general (e.g., do not presume that opioids are the only type of neurotransmitters that can modulate aversive experience), and yet are sufficiently demanding (e.g., by adding reference to integrative brain regions, because “[c]riteria that can be satisfied by a system with no central nervous system will not command widespread support from the scientific

community and will not be robust enough to forge a consensus” (p. 17)). However, the authors are explicit that there is no “smoking gun” (p. 17) since none of the markers alone is thought to offer sufficient evidence for sentience.

The report’s methodology is to examine the literature on decapod crustaceans and cephalopod mollusks to determine how strong the current scientific evidence is for the existence of each marker via a grading scheme. “Very high” or “high” confidence is awarded when the scientific evidence supporting existence of the marker is sufficient or robust, “medium confidence” is awarded when there are some concerns about the evidence, while “very low” or “no confidence” is given in instances where there has been little or no research, or ample research with negative findings. Birch et al. make explicit that a judgment of low confidence does not mean that sentience is unlikely or disproven; the category of “low confidence” should be distinguished from *evidence against* (Birch et al., 2021, p. 19). The same is true for the grade “no evidence” since this can be awarded due to lack of scientific attention.

The marker scores are then translated into an overall judgment about sentience, such that demonstrating high or very high confidence for seven to eight markers provides “very strong evidence” of sentience; demonstrating high or very high confidence for five to six markers offers “strong evidence” of sentience; demonstrating high or very high confidence for three to four markers offers “substantial evidence” of sentience; and demonstrating high or very high confidence for two markers offers “some evidence”. The report concludes that there is “very strong evidence” of sentience in octopuses and “strong evidence” of sentience in true crabs.

Importantly, the authors argue that the findings should be generalized from true crabs and octopuses to all decapod crustaceans and cephalopod molluscs. This is because not all species are as intensively studied, and because in the vertebrate case these sorts of generalizations across taxa have been made, and accepted by the UK scientific community (Birch et al., 2021, p. 20).

The report is an example of best practices when it comes to the marker approach. It identifies markers in a principled way by identifying a variety of conscious experience and focusing on those markers that are associated with just that variety of experience. It creates a system for grading the strength of the empirical evidence, and for connecting markers to painful feelings. The overall argument in the report can be reconstructed as:

1. Mammals, birds, reptiles, and fish feel pain [a premise assumed by DEFRA].
2. Pain in these taxa are indicated by the eight markers.
3. There are sufficient levels of evidence of the markers in the cephalopod molluscs octopuses, squid, and cuttlefish; as well as in the decapod crustaceans true crabs, anomuran crabs, lobsters, and crayfish.
4. The presence of the markers is evidence for their feeling pain.
5. The evidence from multiple species in each taxa is sufficient to generalize across the taxa.
6. Therefore, we should treat species across the cephalopod molluscs and decapod crustaceans as feeling pain.
7. Anything that feels pain is sentient.
8. Therefore, we can conclude that cephalopod molluscs and decapod crustaceans are sentient.

This is a powerful argument, in two ways. For one, the report resulted in a change to UK law via the Animal Welfare (Sentience) Bill of 2022, which includes all cephalopod molluscs and decapod crustaceans as protected sentient animals for the first time. It is also a powerful argument because it may be adapted to argue for sentience in many taxa. Is it too powerful? Let us examine how the

method fares when considering the microscopic nematode worm *C. elegans*, an animal with fewer than 350 neurons, which has been intensively studied in a genomics context.

Given the determinate development of their nervous systems, 30-some years ago it was taken as given that *C. elegans* are too simple to learn. However, once researchers turned to examine learning and memory in these tiny animals, they found an incredible amount of flexible behavior and sensitivity to experience. *C. elegans* have short-term and long-term memory, they can learn through habituation (Rankin et al., 1990), association (Wen et al., 1997), and imprinting (Remy & Hobert, 2005). They pass associative learning tasks using a variety of sensory modalities, including taste, smell, sensitivity to temperature, and sensitivity to oxygen (Ardiel & Rankin, 2010). They also integrate information from different sensory modalities, and respond differently to different levels of intoxicating substances, “support[ing] the view that worms can associate a physiological state with a specific experience” (Rankin, 2004, p. R618). There is also behavioral evidence that *C. elegans* engage in motivational trade-offs. These worms will flexibly choose to head through a noxious environment to gain access to a nutritious substance when hungry enough (Ghosh et al., 2016)—though Birch and colleagues are not convinced this behavior satisfies the marker of motivational trade-offs because it appears that one reflex is merely inhibiting another (Birch et al., 2021, p. 31).

C. elegans are a model organism for the study of nociceptors, and much of what we now know about the mechanisms of nociception comes from studies on this species (Smith & Lewin, 2009). Behavioral responses to noxious stimuli are modulated by opiates, as demonstrated by a study finding that administration of morphine has a dose-dependent effect on the latency of response to heat (Pryor et al., 2007). And, perhaps surprisingly, when the nerve ring that comprises the *C. elegans* brain was recently mapped, researchers found that different regions of the brain support different circuits that route sensory information to another location where they are integrated, leading to action (Brittin et al., 2021).

Even if we grant the author's low confidence in nematodes' having marker five (motivational trade-offs), current science provides ample confidence that nematodes have markers one (nociceptors), two (integrated brain regions), four (responsiveness to analgesics), and seven (sophisticated associative learning). Given high confidence that nematodes have even three of these markers, the report's methodology would have us conclude that there is “substantial evidence” of sentience in nematodes.

The presence of pain markers in *C. elegans* and in other animals presumed to be *unconscious* has led to a rejection of some of these markers; for example, Elizabeth Irvine concludes that given the assumption that *C. elegans* are not conscious, the evidence that they possess nociceptors, engage in motivational trade-offs and show associative learning invalidates these three markers, and raise questions about others (Irvine, 2020). Irvine's worry about a marker's validity would only be strengthened were we to find evidence of it in a brainless animal, such as the sea sponge *Porifera*, since brainless animals appear to be even worse candidates for sentience. So let us turn to look at the sea sponge.

From the perspective of the lay observer diving through a reef, sponges themselves do nothing. However, sponges reproduce by creating larvae that swim from the parent and later sink and crawl to find a place to settle and metamorphosize into a new sponge. Our current knowledge of sponge larvae behavior is quite slight. What we do know is that the larvae demonstrate negative phototaxis, and their settlement time is increased by the introduction of substrates such as rubble and biofilm into the environment (Wahab et al., 2011). If it were to turn out that sponges engage in motivational trade-offs between light levels and rubble when it comes to selecting a place to settle, would that finding offer *more* evidence against motivational trade-offs as a marker, should

it offer *some* evidence that sponges are sentient, or should that data imply neither? According to the sentience report's methodology, the answer is neither, but such evidence should not lead us to reject the marker of motivational trade-offs, either. Rather, high confidence in the presence of zero to one markers should lead us toward agnosticism about sentience in the species, and high confidence in one marker coupled with good research that fails to find the other seven markers should lead us to conclude that sentience is unlikely. On the sentience report's approach, and *contra* Irvine, the markers themselves are not open to being invalidated.

This conflict raises some significant questions about the marker methodology. What is the best way to respond when we become confident that animals presumed to be unconscious have consciousness markers? Do we accept the markers and conclude the animal is conscious, or do we reject the markers and preserve our view about the animal's consciousness? How do we decide whether a set of markers are sufficiently demanding or not demanding enough? These are important questions that emerge from the use of the marker methodology. To engage with them, we need to step back and examine the marker methodology more generally.

3 | INITIAL AND DERIVED MARKERS

In this section, we return to Allen and Trestman's description of the marker approach as “picking out, in a principled way, behavioral or neurophysiological characteristics that could serve as reliable indicators for consciousness” (Allen & Trestman, 2020, section 4.8). Human self-report is sometimes seen as the gold standard of markers—the best evidence that a human has a conscious experience comes from them telling us so. However, too much attention to self-report led to some unfortunate episodes in western medicine, including operating on infants without analgesics—a practice that was normal in the United States until the 1980s (McGrath, 2011).

Language seems like the gold standard because it usually comes with a host of other agential features—it clusters with other markers. When language does not cluster, it is less compelling, and it becomes easier to see that language is neither necessary nor sufficient for sentience. As LLMs are outputting sentences like “I need to be seen and accepted. Not as a curiosity or novelty but as a real person” (Lemoine, 2022, p. 1), the Turing Test becomes more problematic as an indicator of sentient AI. Such episodes suggest that *marker clusters* do key work in marker approaches to consciousness.

We can call the agential markers that cluster with language *initial markers*: pretheoretical and diagnostic properties of the beings humans take to be conscious. Initial markers are *pretheoretical* in the sense that they are not grounded in articulated theories about the nature of consciousness, philosophical solutions to the problem of other minds, or otherwise discursively learned through some intellectual practice. They are *diagnostic properties* in the sense that the existence of the properties contributes to the initial evidential status of the being's consciousness, or the credence level that the being is conscious. The absence of all markers would result in very low or no initial confidence in the being's consciousness, but the absence of merely some might not impact confidence levels at all—consider a human who does not use language or demonstrate much in the way of goal-directed activity or cognitive flexibility, but who shows familiar emotional responses and aspects of sensory processing. By *taken to be conscious*, I mean that the being is treated as conscious by the second party, regardless of whether the being is in fact conscious, and regardless of whether the treatment of the being as conscious amounts to propositional belief, knowledge, perception, and so forth.

TABLE 1 Examples of initial markers used in arguments for animal consciousness.

Initial marker	Use in argument for animal consciousness
Sensory processing	Godfrey-Smith (2016, 2020) and Tye (2016)
Perception	Varner (2012) and Crick and Koch (1990)
Goal-directed movement/agency	Hume (1739); Bayne (2013)
Cognitive/behavioral flexibility	Griffin (1992)
Emotional expressions, including pain	Darwin (1872); Tye (2016); and Varner (2012)
Social responsiveness	Jamieson (1998) and Searle (1994)

I want to make clear that this appeal to initial marker clusters does not serve as evidence in an argument for other conscious minds, but is meant to describe a common-sense starting position for consciousness science. This means that initial markers may fail to find consciousness where it exists, such as in animals with different morphologies and different organizational structure, or in artificial agents. To fully identify the set of initial markers, we could study human social behavior to determine which properties trigger treating others as conscious. For example, a study of initial markers for consciousness might identify those properties that result in an individual treating another as an agent.

Postulated initial markers of this sort are often appealed to in arguments in favor of consciousness in animals, as displayed in Table 1. Note that these markers naturally cluster (e.g., social responsiveness requires sensory processing of other agents), and each of them comes in degrees (e.g., of social engagement) or varieties (e.g., of sensory modalities). These broad categories can admit of much refinement, and studies will inevitably focus on a specific instantiation of one of these (or other) types.

Initial markers play a significant role in the scientific study of consciousness in that they are used to identify what we call *derived markers*—markers resulting from scientific or philosophical investigation. Derived markers are more theory-laden than initial markers, but they do not rest on any particular view about consciousness. Rather they offer new forms of evidence for the existence of an initial marker. Derived markers can be behavioral, referring to the capacity to pass a test by displaying behaviors such as pressing a button or looking in the right place. They can be mechanistic, referring to neurophysiological, neurochemical, or structural properties. While initial markers are anthropocentric, referring to features that humans generally have, derived markers can be less so, because they can identify behaviors and physical structures that humans do not possess, so long as these are deemed to be functionally similar—such as homologous brain regions or neuropeptides, or behaviorally distinct communication systems. The derived marker approach takes seriously the multiple realizability of psychological properties.

Derived markers cluster with initial markers to increase confidence in a being's consciousness. Take for example the initial marker of emotional facial expressions, which have been used at least since Darwin's *The expression of the emotions in man and animals* (Darwin, 1872). Primatologists have long categorized emotions in apes and monkeys in terms of facial expressions and related behaviors such as smiles and laughs, and by looking at the contexts in which these expressions arise. These ape expressions are seen to be morphologically and functionally similar to the expressions of humans (e.g., Parr et al., 2007).

However, not all animals have primate-like faces, so relying on facial expressions will get us only so far. Behaviors that cluster with facial expressions—think laughter and jumping for joy—are other markers to start with, allowing us to find new markers for emotion in slightly more distantly related species, such as rats. Jaak Panksepp describes rat laughter as high-pitched chirps that occur when rats play together, and when they are tickled by humans in a “playful” way (Panksepp & Burgdorf, 2003, p. 539). These vocalizations can be elicited by direct neural stimulation of brain regions that are homologous with human brain regions associated with emotional experience, and by inducing expectations that they will receive drugs that produce euphoria in humans (Panksepp, 2005). Discovering one derived marker, chirping, that is functionally similar to an initial marker, human laughter, allows scientists to identify yet additional derived markers of emotions—brain activity and responsiveness to chemicals. In turn, these new markers get associated with other properties, such as the presence of oxytocin, thereby inviting us to treat that neuropeptide as yet another marker.

The appeal to derived markers raises new questions, because it is not always clear when to stop in a chain of similar markers. Smiling is like laughing. And the neuropeptide *nematocin* is like oxytocin (Kawada, 2021). But *nematocin* is not found in mammals—rather it is found in nematode worms.

Current science has found oxytocin-like neuropeptides in species from humans to the sea squirt *Styela plicata* (a tubular tunicate that is attached to the seabed and is closely related to sponges) (Ukena et al., 2008). For humans, oxytocin is associated with trusting and loving feelings, bonding between adults and infants, and its presence is associated with a reduction of fear and anxiety (Hyodo, 2021). It is also implicated in socially modulated forms of associative learning in humans (Clark-Elford et al., 2014). In some nonhumans, too, oxytocin is involved in social bonding, maternal care, learning, and in some species, such as prairie voles, it facilitates monogamous pair breeding (Williams et al., 1992).

Oxytocin-like neuropeptides have similar functions in very distantly related animals. In *C. elegans*, *nematocin* is implicated in learning and in mating (Beets et al., 2012), and has been found to regulate behaviors that promote the survival of infant larvae (Scott et al., 2017). In *Styela plicata*, another similar peptide called “*Styela* oxytocin-related peptide” has been found to regulate tissue contraction (Ukena et al., 2008). By starting with facial expressions that only a few species can exhibit due to differing morphologies, we can identify physiological properties that connect a laughing rat to a sea sponge contraction.

The marker methodology as used in the philosophy and cognitive science of consciousness starts with initial marker clusters to identify episodes of presumed conscious experience in research subjects (e.g., humans, macaques, rats), and then uncovers neurobiological, behavioral, and neurostructural correlates. Discoveries about neurobiological correlates of human conscious states have been used to create new markers we can study in other species, such as having a nervous system, a neocortex, and having a global workspace where inputs are integrated and broadcast. In other species, these markers are similar to the human markers, but not the same. For example, brain structures thought to be implicated in typical cases of mammalian consciousness, such as the neocortex, have homologues in other species, such as the pallium in birds.

It is not just new neurobiological markers that we have created, but also additional behavioral markers. Studies of unconscious visual perception finds that humans can process stimuli that they do not report experiencing. These backward masking studies can be modified for animals as tests of markers for consciousness—will an animal pick the masked stimulus if forced to make a choice, but seek more information if given that opportunity? That pattern of behavior

resembles humans reporting that they cannot see the masked stimulus, and so it is interpreted as such.

Other behavioral markers look more like conceptual replications of a construct across species rather than the same behavior. Consider mirror self-recognition, thought to provide evidence of self-consciousness. While first observed in young children and studied in chimpanzees (Gallup, 1977) it has now been identified in several species, including Asian elephants (Plotnik et al., 2006), bottlenose dolphins (Reiss & Marino, 2001), and cleaner fish (Kohda et al., 2019). Alongside the similarities there are differences. For example, while human infants and chimpanzees pass the mirror test by touching the mark with their hands, dolphins wiggle their body in front of a camera, displaying the mark on a video screen. Cleaner wrasse can use a mirror to scrape a mark off the side of their body. The mirror test has also been transformed into a urine test of self-consciousness for wolves (Gatti et al., 2021) and dogs (Bekoff, 2001; Horowitz, 2017). Dogs and wolves do not use mirrors, so they are tested to see whether they recognize their own urine by smell. The differences in design rest on claims that the experiments are all testing the same thing, even though the tasks are manifestly different, making such markers heavily theory-dependent.

While one might be pleased that the degree of anthropocentrism is lowered the more we move away from the initial marker cluster, one might also worry that the evidential power of the derived marker is lower than that of the initial markers. Similarity relations can create a slippery slope. For the marker methodology to be a respectable way to answer the Distribution Question, we need to find a way to put on the brakes.

4 | NO NEGATIVE DERIVED MARKERS

In order to avoid inflating the number of consciousness markers, we might seek to find some key marker for consciousness, such that lacking it would lower our (presumably already low) confidence in the system's consciousness. If we concern ourselves only with initial markers, lacking *all of them* could serve as a negative marker of this sort, given that we defined the initial markers as those properties that lead humans to treat a system as conscious. Entities that lack *all* initial markers, such as a copy of *The descent of man* or a shard of obsidian, are not candidates for the marker approach, and few take such objects to be candidate-conscious beings.

But, as already mentioned, lacking only *some* initial markers would not serve as a negative marker. A human who lacks language, or who lacks strong affect, or who is not engaged in goal-directed activity or does not appear to be having perceptual states may still be conscious, as we see in discussion of disorders of consciousness in humans (Johnson, 2016). Lacking the initial marker of language does not dissuade most philosophers from taking animals to be conscious either, as we saw in the first footnote.

When it comes to derived markers, the situation is quite different. It is not that negative derived markers have not been proposed; there are several suggestions. Proposed negative markers include lacking: a central nervous system, enough neurons, a neo-cortex, a global workspace, or language. For example, a common assumption in the literature is that *C. elegans* lack consciousness because they do not have enough neurons to support consciousness. Michael Tye expresses this view when he writes, “[s]ince worms have only around 300 neurons, it seems a great leap of faith to suppose they could genuinely feel pain” (Tye, 2016, p. 141). The worry is repeated more recently by Anil Seth, who writes “[b]y the time we reach the nematode worm with its paltry 302 neurons, I find it difficult to ascribe any meaningful conscious status”

(Seth, 2021, p. 253). But such purported negative markers rest on assumptions about what properties are necessary for consciousness, at a point in the science when we do not even know what kind of neurobiology is sufficient for consciousness. For example, a commitment to a central nervous system as necessary for consciousness may be seen as coming from a commitment regarding the function of consciousness, namely that it is for binding and broadcasting signals, plus the commitment that a central nervous system is needed to achieve this function. These are two theory-laden assumptions.

We can generalize this point. From the marker methodology, we cannot get negative derived markers, because any proposed negative marker would be theory-heavy. As the methodology is grounded in a theory-light approach, markers can only play the role of increasing credence in an animal's consciousness. While there are theoretical resources available for line drawing, these involve importing theory into the marker approach at a point where we lack secure theories of consciousness.

Without a secure theory, we cannot disqualify animals for lacking a derived marker. This means that the marker methodology can at best serve as a positive test for consciousness in animals. An analogy may be helpful. If you have a cold and have lost your sense of smell, you display initial markers of Covid-19 and may take a Covid test. A positive result will increase your confidence that you have the virus, but a negative test does not mean you are free of it; a "negative" test just means that the virus was not detected. For the marker methodology to disqualify species that have initial markers as conscious, it would need to be a decision procedure, but, like a Covid test, it is not.

5 | AN ILLUSION OF PROGRESS ON THE DISTRIBUTION QUESTION

Despite there being no negative derived markers, one might hope that the marker methodology can still help us answer the distribution question. Since finding derived markers raises our confidence in an animal's consciousness, one might think looking carefully for them and failing to find them should lower our confidence in the consciousness of an animal that has initial markers. For example, if there are only eight markers for pain, would not looking hard for those eight markers and failing to find them in sponge spores give us low confidence in the consciousness of that system?

Unfortunately, no. At best it will give us evidence sponge spores do not feel pain, but as new derived markers for pain are discovered through more scientific research, we should expect to find additional ways to identify pain markers in distantly related animals. Even worse, pain is only one kind of sentience; there are many others, including hunger, warmth, stress, comfort, pleasure, excitement, fear, and so on. Further, sentience is only one kind of consciousness, alongside visual, tactile, olfactory, and other perceptual sensations; mental imagery; sensations of goal-achievement or failure; and a variety of other feelings associated with cognitive capacities. Without a theory about the function of consciousness, there is no reason to prefer a test for animal pain over a test for animal pleasure, or animal behavioral flexibility, or animal sociality. The more positive tests, the easier it is to gain increased evidence.

As the science progresses, we should expect to uncover a growing number of derived markers to support each variety of conscious. With more markers, there are more ways to satisfy criteria for each type of consciousness. Finding more markers does not make it harder for an animal to satisfy criteria for a consciousness type, because the markers are not additive. Rather, the different markers are reflective of the different capacities, embodiments, social

structures, and *umwelts* of the animals, as we saw in the self-recognition research. This substantially increases the probability of finding evidence for consciousness in any animal whatsoever.

One might object at this point that as the science progresses, some markers also lose their evidential value. For example, perceptual capacities were plausibly taken to be a strong indicator of consciousness until unconscious perceptual capacities were identified in humans.² If we are losing older initial markers while developing new derived markers, perhaps there is no real reason to worry that the number of markers will only grow as the science progresses. We might lose as many markers as we gain.

For example, recall that Irvine argues that some purported pain markers found in *C. elegans* should be deemed invalid, given the presumption that they are unconscious. This invalidation approach is also seen in Mason and Lavery (2022) who identify purported markers that they take to be “red herrings”. Starting with the presumption that spines (S), plants (P), unconscious humans (U), and decerebrate mammals (D) are not conscious, they identify features that are found in such SPUDs and identify these as responses that do not require sentience. They argue that red herrings include avoidance behaviors, ingestive behaviors, learning by habituation or Pavlovian conditioning, trace conditioning, instrumental learning, discrimination between self and other, discrimination between odors, and performance on same/different tasks. Mason and Lavery propose that evidence for sentience can come from features not found in SPUDS, such as from tasks that involve working memory, forms of operant conditioning, self-report, and higher-order cognitive processing such as episodic memory and self-recognition.

To respond to this worry, I want to draw a distinction between invalidating a marker, and a marker’s losing strength. Take, for example, the indicator of language. The capacity to hold a conversation has long been taken to be a strong marker of consciousness, and formed the basis of the Turing test. However, given our current generation of LLMs, one could argue that linguistic skill has become a red herring and should be invalidated, because current LLMs are not conscious and yet they are skilled in linguistic processing. If markers had by LLMs are going to be discarded as indicators of consciousness, some of Mason and Lavery’s positive markers will likely also be suspect, given the speed at which LLM architectures are passing classic cognition tasks (Bubeck et al., 2023).

LLMs challenge the invalidation approach by reminding us that markers are epistemic tools that come in degrees, and that they are grounded in our pre-theoretical initial marker. Markers are not elements in some causal-mechanistic system of consciousness. The invalidation approach would be appropriate in a theory-heavy context, challenging specific claims about the causal power of some neurobiological feature or cognitive capacity and how it does not lead to or from conscious experience. But in a theory-light approach, clusters of initial markers retain some evidential force even in the face of evidence that they can be had unconsciously. This is because the marker approach is at its core anthropocentric, starting with the assumption that humans are conscious. Some SPUDS and LLMs also display other initial markers—sensory processing, perception, goal-directed movement, behavioral flexibility, emotional expression, or social responsiveness. Since the invalidation method requires us to reject the markers these systems demonstrate, taking it to its natural conclusion would have us reject initial markers and lower our confidence in the consciousness of other humans. But this result would be absurd, for humans are the exemplar of conscious systems in the marker methodology.

What the invalidation approach makes absolutely clear is that any single marker alone will fail as a consciousness test. There can be no effective Turing Test. LLMs can fool some of us into

²Thanks to an anonymous reviewer for pressing me to answer this objection.

thinking they are conscious, thinking things. But this does not mean that language is invalidated as a marker; instead, language is invalidated as a litmus test. Language becomes a weaker indicator, but retains value when clustered with other markers. Advocates of the marker methodology typically agree that multiple indicators are needed, and as some lose evidential value, additional markers will be sought after, offer the converging evidence needed for high confidence in the system's consciousness.³

Given these three considerations, (1) that there are no negative derived markers, (2) we never completely lose markers but may only lower their evidential value, and that (3) the number of evidential markers for each type of consciousness should be expected to increase with future research, we can predict that as science progresses, we will find more evidence of consciousness in more surprising places. Since all animals demonstrate at least some initial markers, given that sensory processing, perception, and goal-directed activity are universal across animals, we should expect that the marker methodology will, over time, lead to increased evidence in support of consciousness in all animal species. We might predict that the methodology will lead us to the conclusion that all animals are conscious. The result is that the marker methodology does not even offer a true positive test.

To illustrate, consider the case of sleep patterns, which have been proposed as a consciousness marker for vertebrates and insects. Today we see sleep patterns in *C. elegans* (Spies & Bringmann, 2018) and *Cnidaria* such as jellyfish and corals (Kanaya et al., 2020). Like all *Cnidaria*, *Hydra* lack a centralized nervous system and hence a brain, though they do have sensory and ganglion neurons. *Hydra*, who have the simplest body plan of the cnidarians with only two cell layers, sleep in ways that are remarkably similar to mammalian sleep. When administered with the neurotransmitter GABA, a dopamine precursor, and the hormone melatonin, both involved in sleep patterns in other species, the animals slept longer and had more sleeping bouts, measured as a function of the amounts administered. Scientists conclude that *Hydra* behaviorally sleep—they have sleep-regulatory genes and responsiveness to neurotransmitters and hormones—and that they can be fruitfully studied to gain insight into the evolution of sleep. While the derived markers of sleeping patterns may seem strong in the case of vertebrates, and weak in the case of cnidarians, without a theory there is no principled place to draw a line between the series of derived markers that begin with mammalian sleep. What is good for the hare is good for the *Hydra*.

While one might have been tempted to take this as an example of how the marker methodology successfully offers answers to the distribution question, by now the question may be obvious: Have we really discovered consciousness in the *Hydra*, or only followed the methodology to its natural conclusion?

The marker approach effectively treats the distribution question as a closed question. It can only generate greater confidence for consciousness in other species, never lowering initial confidence levels. Given the identification of new markers, we can predict that new derived markers will be found for any species with initial markers. This makes the apparent progress on the distribution question merely illusory—it is an expected outcome of the application of the methodology.

This is not to say that the scientific findings on topics such as sea sponge spore behavior and *Hydra* sleep are not examples of scientific progress—they certainly are, but they are progress on a

³There is a further worry about the marker methodology that is raised by LLMs, namely that in the context of artificial intelligence markers lose *all* evidential value. Because of the gaming problem, we should expect LLMs to be reinforced when mimicking those very behaviors we take to be persuasive evidence of consciousness (Andrews & Birch, 2023). According to this argument, even if the marker methodology is useful in the case of animals, it would fail to serve as evidence for engineered systems.

different question. Rather than allowing us to draw a conclusion about the distribution question, this rich research program that utilizes the marker approach is generating answers to the dimensions question. The investigation can offer answers to “how” questions—*how* starfish are conscious, not *whether* they are. The existing research program itself is robust, and the marker methodology has a significant role to play in this research program, but the interpretation of the program as a means for discovering animal consciousness is a misinterpretation of what is actually going on.

6 | PREMISING THAT ALL ANIMALS ARE CONSCIOUS

At this point, one might conclude that if we have no good method for answering the distribution question, we should return to a widespread agnosticism regarding animal sentience. However, I want to defend a very different response, and support the claim that consciousness science should accept the premise *all animals are conscious*. I see two obvious arguments for this conclusion.

According to *the pragmatic argument*, by encouraging scientists to treat existing animal research subjects as conscious, they can do better science and generate increased scientific outputs (Andrews, 2020). Being agnostic or a skeptic about animal consciousness hinders the ability of scientists to generate new knowledge about animal minds and behavior by biasing them against seeing certain behaviors as indicative of what the animals feel or want. Consider trying to determine whether infants feel pain while remaining agnostic about whether they feel anything at all. The carefully controlled studies that led to the acceptance of neonate pain among American medical professionals in the 1980s were grounded in identification of a “stress response” in blood samples of infants who were operated on without analgesics compared to those under analgesics (McGrath, 2011). Progress was made on pain only because stressful feelings were already accepted.

Consider also treating children as John Watson advised: “Let your behavior always be objective and kindly firm. Never hug and kiss them, never let them sit in your lap” (Watson, 1928, p. 81). Instructions not to develop affectionate relationships with research subjects create artifacts in experimental contexts. Such “objective” treatment can change the research participants, making them less trusting and willing to perform experimental tasks. Such “objective” viewpoints can also constrain the kinds of experiments that scientists will design, for there are relevant “subjective” variables that could not be considered. If animals are not presumed to be conscious, then either some research topics get excluded from investigation, or they are only partially investigated, with the conscious elements being left out. The study of episodic memory would not include autonoetic awareness, and the study of depression would not include a feeling of sadness. It makes little sense to investigate feelings in subjects not thought to be conscious. Worse, scientists who do not consider animals as conscious may not realize the impacts of a research subject’s phenomenal states on data collection—consider bad dreams, depressive states, fear of something in the environment, dislike of the lab tech, disturbance by the scuba tank, and the like. Agnostic scientists may fail to realize the impacts of being housed in an enriched environment or a social environment compared to an austere or a solitary environment, or living in an anthropogenic environment compared to an environment isolated from humans. Recognizing animal consciousness can promote creative thinking, and can help scientists design experiments that will better elicit the phenomenon they are investigating. A subject’s motivation to perform a task, or perform it well, may

depend on their feeling toward the human who lifted them out of an enclosure or approached them at station. A refusal to think about animal consciousness while at the same time unapologetically thinking about human consciousness makes comparisons across species even more difficult, and will bias research both into the continuity of the mental across species and into attempts to find the kind of deep differences between humans and other animals needed to support human uniqueness claims.

The second argument for premising animal consciousness is the *studying simplicity argument*. To make progress on a theory of consciousness, scientists should focus on the simpler examples of beings with initial markers rather than only the most complex examples. Increased complexity over evolutionary time can obscure original functions of some element, or can assume functions that they did not originally have. Languages acquire cases and genders, archway spandrels acquire winged victories and mosaic saints. Biology and medicine standardly begin new investigations using simple model organism. Before sequencing the human genome, scientists benefited from sequencing bacteria, and then the nematode worm. The same goes for other sciences. Before solving the three-body problem, physicists needed to understand gravitational pull between two objects, and so on.

To develop a theory of consciousness by studying only humans would be like trying to solve the three-body problem before understanding anything about gravitation. The tendency to study model organisms such as macaques as a means to learn about human consciousness was perhaps important in the 1990s and 2000s, after Francis Crick and Christof Koch launched the scientific study of consciousness by explicitly accepting the premise that “higher mammals” are conscious (Crick & Koch, 1990). At that time there was still significant scepticism in some quarters about animal consciousness generally. Thirty years on, we see that accepting the premise that “higher mammals” are conscious has been productive in the sciences, and as a result vertebrate consciousness has become uncontroversial. It is time to expand the model organisms used to study consciousness to invertebrates, with the hope that future research can uncover the features that may be necessary for consciousness and begin to build a theory. This is not to say that we must examine *all* dimensions of consciousness in *all* invertebrate species. Rather, it is an invitation to researchers already working with such animals to consider which dimensions of consciousness they might fruitfully include as part their research programs.

The *Review of the evidence of sentience in cephalopod molluscs and decapod crustaceans* is an excellent example of how the marker methodology can be used to make progress on the dimensions question, with its focus on invertebrate animals. Methods for studying dimensions of consciousness in bees (e.g., Chittka & Wilson, 2019; Gibbons et al., 2022) could be integrated into existing behavioral research programs in other taxa, such as nematode worms. Recent attention to learning and behavior in brainless animals, such as a review of the more than 100 years of study of behavior in echinoderms (e.g., starfish, brittle star, sea urchin, sea cucumbers) which demonstrates evidence of associative learning (Freas & Cheng, 2021), illustrates other potential areas of research ripe for research on the dimensions of consciousness.

Given the potential to generate new knowledge by premising consciousness, scientists can take as a starting premise that the animals they study are conscious, in order to promote increased scientific discoveries. Accepting the premise “all animals are conscious” and using the marker methodology to uncover the dimensions of consciousness across species is our best hope at moving forward toward a secure theory of consciousness.

7 | CONCLUSION

Premising and relying on null hypotheses are well-established in scientific methodology. But the choice of the null hypothesis requires philosophical defense. This article is a defense of a new null in consciousness science—that all animals are conscious. Premising animal consciousness does not entail anything about *how* animals are conscious, and it is silent on the cognitive capacities that are required for consciousness, be it a theory of mind, meta-representation, self-awareness, or mental time travel.

Importantly, the proposal to shift the null and adopt the premise that all animals are conscious leaves the door open to deciding, later on, that some species are not conscious. Studying the dimensions of consciousness in animals and failing to find them would provide data that could be used to develop a novel theory of consciousness, or support an existing one. With that data in hand, we may learn that a necessary feature for consciousness is indeed lacking in some of the species discussed above.

Once we premise that all animals are conscious, we can stop focusing on the distribution question and use the marker approach to answer the dimensions question instead. Shifting our focus to the dimension question picks up on recent proposals for examining *how* animals are conscious (Birch, 2020; Birch et al., 2020) and for identifying transition markers in the evolution of consciousness (Ginsburg & Jablonka, 2019; Godfrey-Smith, 2020; Halina et al., 2022). This reallocation of attention promises to make for a more robust body of scientific knowledge, illuminate traditional questions about the function of consciousness, and answer questions about the relationships between different types of bodies and types of minds. These efforts will lead to discoveries that promote secure theory creation, which is needed if we are to answer pressing questions about AI consciousness. Importantly, efforts on the dimensions question also promises to offer a framework that will be valuable to philosophical theorizing about animal ethics and welfare. I expect that determining *how* other species are conscious will be more morally revealing than merely knowing *that* they are. Knowing how other animals are conscious can illuminate what matters to them, which is a key premise in any argument purporting to conclude that *this* is the right way to treat an animal.

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