

The Indeterminacy of Plant Consciousness

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[Penultimate Version]

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Abstract: Are plants conscious? Most knowledgeable people say they aren't. A small minority say they are. Others say we don't know. Virtually all assume the predicate '...is conscious' is fully determinate; plants are or aren't in its extension. Appealing to Mark Wilson's work on predicates and concepts, I challenge that assumption, proposing that the predicate isn't determinate for plants. I offer the start of an explanation for why this is so. We tacitly rely on many empirical correlations when we correctly characterize creatures as conscious, but we have limited knowledge of those facts, and plants differ significantly from animals, while also being substantively similar to them. We don't yet know what it would be for them to be conscious.

1. An Unnoticed Assumption

Are plants conscious? Pointing to extreme differences with humans, especially the lack of a nervous system, most knowledgeable people say plants aren't conscious.¹ Citing their capacity to respond adaptively to changing circumstances and to integrate different sensory information, a small minority says they are.² Some say we don't yet know, leaving open the possibility.³

¹ For example, (Hamilton & McBrayer, 2020) and (Taiz & al., 2019)

² For example, (Trewavas, Baluška, Mancuso, & Calvo, 2020), (Gagliano, 2017), and (Godfrey-Smith, 2016, p. 491)

³ For example, (Maher 2017) and (Calvo, 2017)

Virtually everyone assumes the predicate ‘...is conscious’ is fully determinate; plants definitely are or aren’t in its extension. The only question is whether we have evidence one way or the other.

In this essay, I challenge that assumption, proposing that the predicate is not determinate for plants.⁴ Although I agree with some others that we don’t yet know whether plants are conscious, I offer a distinctive reason for thinking this; it’s that the predicate is not determinate. It’s not that there is merely a limitation in our knowledge of what happens to lie in the wholly settled extension of the predicate. In addition to providing reasons for thinking this, I start to explain why it happens to be so. I propose that we tacitly rely on many empirical correlations when we correctly characterize animals, like ourselves, as conscious, but we have limited knowledge of those facts, and plants differ significantly from animals, while also being substantively similar to them. We don’t yet know exactly what it would be for plants to be conscious.

2. Indeterminate Predicates

What do I mean when I say the predicate is indeterminate? What is it for a predicate to be indeterminate?

My topic is not vagueness. That is one topic many scholars reasonably address under the label of indeterminacy, but it is not my concern here. My contention is not that the predicate ‘...is conscious’ is vague or admits of borderline cases.⁵

⁴ When I say this, I intend to include also the two-place predicate ‘... is conscious of ---’ for the property of so-called transitive consciousness. For this two-place predicate, my more specific claim is that it is not determinate whether plants are the first element in any ordered pair that is in its extension.

⁵ Many scholars have addressed this topic. See, for instance, (Simon, 2017). Thanks to an anonymous referee for advising me to highlight this.

The sort of indeterminacy that interests me is articulated by Mark Wilson, who first presented it in “Predicate Meets Property” in *Philosophical Review* in 1982, and has subsequently developed it in staggering detail in *Wandering Significance* (2006) and *Physics Avoidance* (2017). He uses a pair of fictional scenarios to introduce it (2006, pp. 34-5).

Scenario 1. A tribe of Druids emigrated long ago to a remote island. They speak a form of antique English. One day a B-29 bomber appears in the sky. The Druids collectively cry out, ‘Lo, a great silver bird falleth from the sky.’ To them “‘bird’ seemed *exactly the right word* to capture the novel object.” They continue talking this way even after mastering “all of modern biology and allied fields.” They recognize the differences between the plane and other birds, such as chickens, so they use the term ‘aves’ for things in the same biological class as chickens.

Scenario 2. Same as Scenario 1, except the Druids first see the plane not in the sky but on the ground in the jungle, with its former occupants treating it as shelter. The Druids exclaim, ‘Lo! A great silver *house* lieth in the jungle.’ To them ‘house’ seems exactly the right word. They stick to it over time, holding that great silver houses aren’t birds, and that some houses fly.

Given these two scenarios, before the encounter with the bomber, what was the extension of the predicate ‘... is a bird’? Was it the set of flying things or the set of aves? Neither answer is very appealing, for after the encounter with the bomber, in both scenarios, the Druids’ use of the term is entirely consistent with past usage. Thus, Wilson holds that before the arrival of the bomber, it is indeterminate whether the bomber is or is not in the extension of the predicate (1982 pp. 549-50).

This is not a claim about what the Druids know or don't know about the extension of the predicate '...is a bird'. The claim is not that the Druids have limited knowledge of what the extension is. The claim is that the extension itself is not determinate. Put another way, there is no fact of the matter as to whether the bomber belongs in the extension.

The Druids do not use the predicate arbitrarily or haphazardly. They have standards governing their use of it. Some might use it incorrectly – by, for instance, calling a deceptive-looking leaf a bird. Wilson's claim is that those standards currently do not settle whether the predicate should or should not apply to the bomber; they do not settle whether the bomber does or does not belong in the extension of the predicate.

The two scenarios with the Druids are fictional, but there are many real-life cases, such as '...weighs 2 pounds.'⁶ In 1600 “when the peculiar behavior of spring and beam balances on the moon was unknown,” the extension of this predicate was indeterminate between the set of things that have a mass of .9kg and the set of things that are under an impressed gravitational force of .9 newtons (ibid., p. 573). That is, the predicate was indeterminate between those properties.

To clarify his basic idea, Wilson proposes an analogy: people using predicates are analogous to (imperfect) measuring instruments (ibid., p. 555).

For instance, we say thermometers measure temperature. But, Wilson observes, mercury thermometers don't work properly “in an environment full of shock waves or if applied to objects at extremely high or low temperatures.” They measure temperature only in a “range of appropriate conditions” (ibid., p. 563). Wilson elaborates:

⁶ In “Predicate Meets Property,” Wilson mentions other predicates: ‘red,’ ‘water,’ ‘gold,’ ‘chair,’ ‘salt,’ ‘acid,’ ‘butter,’ ‘electron,’ and ‘Grant’s zebra.’ In *Wandering Significance*, he discusses many more, focusing on weight on pp. 328-335.

thermometers do not give correct answers about the temperature of gases in ordinary sunlight. This is because their readings depend as much upon the radiant energy reflected from the nearby solids as the absolute temperature of the air. The thermometer is actually responding to some complicated average of temperature plus reflected radiation rather than simple gas temperature alone. Meteorologists actually employ a device consisting of a thermometer inside a complicated housing to measure true temperature. When one learns it is ‘90° F in the shade,’ one is thereby given the true air temperature measured by this device, rather than the misleading reading of an ordinary thermometer, which in this situation is not measuring temperature at all. The phrase ‘in the shade’ really means ‘true temperature’ and does not refer to fictitious differential in air temperature between a shady spot and direct sunlight. A thermometer can correctly be said to measure temperature only when such radiation effects are not extreme; if this reference class is enlarged to include sunlit gases, it is no longer accurate to say that it measures simple temperature. (ibid., pp. 564-5)⁷

Wilson emphasizes that the point about thermometers generalizes to virtually all measuring instruments. He says, “Except in trivial cases, almost no universal detection devices exist, instruments which can detect the presence or absence of P in any object whatsoever in any context” (ibid., p. 563). Virtually all measuring instruments respond to many properties at once, not just one (ibid., p. 579).

Analogous points hold for predicates. To specify accurately what property an instrument measures, we tacitly restrict that instrument’s range of application (ibid., p. 564). The same goes

⁷ See also (1982 p. 575).

for specifying the extension of a predicate. We implicitly limit its range of application. Before the Druids encountered the bomber, they implicitly limited the range of application of 'bird' to the sorts of things they'd encountered. Before people learned of the peculiar conditions of the moon, they implicitly limited the range of '...weighs 2 pounds' to things near the earth's surface (ibid., p. 573). Predicates apply correctly to multiple properties at once, not just one.

This illuminates the idea of an indeterminate predicate. Because the range of application of thermometers is tacitly limited, they are indeterminate with respect to things outside that range. The same goes for predicates. The indeterminacy of their extensions is like the indeterminacy of measuring instruments outside their tacitly limited range of application.

Given all this, we can return to my main contention that the predicate '...is conscious' is indeterminate with respect to plants. By this I mean that plants currently neither are nor are not in its extension. There currently is no fact of the matter as to whether plants belong in its extension. It might turn out that they do, or that they don't, but currently the issue is unsettled. This is not a claim about what we do or don't know about the extension, but about the extension itself. Just as the Druids use of '...is a bird' is not arbitrary or haphazard but governed by standards, so too our use of '...is conscious' is not arbitrary or haphazard but governed by standards. People can and sometimes do use this word incorrectly. I contend that our standards don't yet settle whether plants belong in the extension of the term. Appealing to the analogy with measuring devices, I am claiming that so far, the range of application of the predicate has been tacitly restricted. To what? Things sufficiently similar to humans. The predicate, like other predicates and measuring instruments, applies correctly to many properties at once, not only one. Which properties exactly it applies correctly to is not sufficiently settled to exclude or include plants.

Which sets is the extension of the predicate indeterminate between? It's hard to say. Answers to this sort of question are clearest primarily in retrospect, after we've developed ways to tease apart properties that happen to cluster together. Still, to focus discussion, here are three options connected to three current views of consciousness.

1. {x | x has a functioning central nervous system and brain} (Taiz et al. 2019)
2. {x | x is alive and is capable of Unlimited Associative Learning} (Jablonka & Ginsburg 2019)
3. {x | x is adaptive and autopoietic} (Godfrey-Smith 2016)

These are only some suggestions. It is reasonable to expect others. Part of the difficulty, which I will articulate further in due course, is that we have only limited knowledge of the supports on which we implicitly rely when correctly apply the predicate. At this stage, my claim is simply that the extension of the predicate is indeterminate between some sets such as these; it is not yet settled which set is *the* extension; it is thus not settled whether plants are in *the* extension or not.

My claim is not simply that '... is conscious' is ambiguous or polysemous in the linguist's usual sense of those terms, which would mean it has more than one distinct entry in the lexicon, different people using it to refer to different properties. This is true, and important, and is commonly acknowledged when discussing the topic of consciousness. As Michael Antony (2002) has helpfully noticed, this creates significant problems in ensuring that researchers are actually talking about the same thing. But this is not my claim. Even when we are agreed that we are talking about what-it's-likeness or point-of-view, there could be the sort of indeterminacy that interests me here. My claim is that the full or complete extension of the predicate is not settled; it is not determinate.

Now, why should we think that?

3. Evidence of Indeterminacy

Why think the predicate is indeterminate? I offer two reasons. (1) In the past, the predicate was indeterminate, undergoing various developments. (2) Contemporary competent users disagree about whether the predicate applies to plants.⁸

In the past four centuries, the extension of the predicate underwent various developments. I highlight two.

The term ‘consciousness’ didn’t always refer unambiguously to some psychological phenomenon. In “Seventeenth Century Conceptions of Consciousness” in *The Stanford Encyclopedia of Philosophy*, Larry Jorgensen writes:

In the seventeenth century, ‘consciousness’ began to take on a uniquely modern sense. This transition was sparked by new theories of mind and ideas, and it connected with other important issues of debate during the seventeenth century, including debates over the transparency of the mental, animal consciousness, and innate ideas. Additionally, consciousness was tied closely to moral identity, with both French and Latin lacking even a linguistic distinction between consciousness and conscience (i.e., a moral sensibility). This semantic shift marked a philosophical division between the psychological or phenomenal aspects of thought and a moral sensibility as well.

Jorgensen says that in *Leviathan*, first published in 1651, Thomas Hobbes offers the traditional definition of ‘conscious’:

⁸ In his discussion of hardness (roughly, the predicate ‘... is hard’), for example, Wilson suggests that disagreements among users portend indeterminacies (2006, pp. 335-355).

When two, or more men, know of one and the same fact, they are said to be CONSCIOUS of it one to another; which is as much as to know it together. And because such are fittest witnesses of the facts of one another, or of a third; it was, and ever will be reputed a very evil act, for any man to speak against his *conscience*; or to corrupt or force another to do so.... Afterwards, men made use of the same word metaphorically, for the knowledge of their own secret facts, and secret thoughts; and therefore it is rhetorically said, that the conscience is a thousand witnesses. (*Leviathan* 7.4)

On this definition, something is conscious when it is shared knowledge, reflecting the connection with the etymology of ‘conscience’.

Seventy years later, the significance of the term ‘consciousness’ had started to wander. In 1727, John Maxwell pointed out that in a dispute between Samuel Clarke and Anthony Collins, the term ‘consciousness’ was used variously to refer to: “The reflex Act, by which a Man knows his Thoughts to be his own Thoughts;” or “the Direct Act of Thinking; or (which is of the same Import;) simple Sensation;” or “the Power of Self-motion, or of beginning of Motion by the Will” (Thiel 1991, p.80). The connection to knowledge shared by more than one person is gone, while an individual person’s mental states or events are emphasized. Still, ambiguity remains. The term is used to refer to different sorts of thing.

This suggests that at least in the past, the extension of the predicate was indeterminate in at least one interesting way.

Consider now a second development in the use of the predicate. By the late 19th century many informed people thought at least some nonhuman animals were conscious, but that we must

rely on second-best evidence to tell. In 1874, in “On the hypothesis that animals are automata, and its history,” Thomas Huxley writes:

We can have no direct observation of consciousness in any creature but ourselves. But I must say for myself—looking at the matter on the ground of analogy—taking into account that great doctrine of continuity which forbids one to suppose that any natural phenomena can come into existence suddenly and without some precedent, gradual modification tending towards it, and taking into account the incontrovertible fact that the lower vertebrated animals possess, in a less developed condition, that part of the brain which we have every reason to believe is the organ of consciousness in ourselves, it seems vastly more probable that the lower animals, although they may not possess that sort of consciousness which we have ourselves, yet have it in a form proportional to the comparative development of the organ of that consciousness, and foreshadow more or less dimly those feelings which we possess ourselves. (p. 365)

Although we can't directly observe the consciousness of any nonhuman animal, given evolutionary continuity, and extensive anatomical similarities, Huxley thought we can be relatively confident many nonhuman animals are conscious.

This form of reasoning raised questions about where exactly the relevant similarities run out. People disagreed. In his book on David Hume, published in 1879, Huxley says:

In the absence of a distinct nervous system, we have no right to look for its product, consciousness; and, even in those forms of animal life in which the nervous apparatus has reached no higher degree of development, than that exhibited by the system of the spinal cord and the foundation of the brain in ourselves, the argument

from analogy leaves the assumption of the existence of any form of consciousness unsupported. With the super-addition of a nervous apparatus corresponding with the cerebrum in ourselves, it is allowable to suppose the appearance of the simplest states of consciousness, or the sensations; and it is conceivable that these may at first exist, without any power of reproducing them, as memories; and, consequently, without ideation. Still higher, an apparatus of correlation may be superadded, until, as all these organs become more developed, the condition of the highest speechless animals is attained. (pp. 106-7)

Huxley thought that if a creature lacks a certain sort of nervous system, then it isn't conscious. For him, having anatomy similar to humans is the main basis for inferring that a creature is conscious. Without that similarity, there are no grounds for including a creature in the extension of the predicate.

George Romanes viewed things differently. He agreed we had to rely on analogy to ascertain whether a creature was conscious, but he thought this made it difficult to draw a line between creatures that are conscious and creatures that are not conscious. To understand his remarks below on this issue, it helps to know that he held that learning, modifying one's behaviors in the light of prior events, showed a capacity for "choice," which he thought indicated consciousness.⁹ In *Mental Evolution in Animals*, published in 1884, he writes:

⁹ In *Mental Evolution in Animals*, Romanes writes, "What activities of an organism are to be taken as indicative of consciousness? The answer that comes most readily is, — All activities that are indicative of Choice ; wherever we see a living organism apparently exerting intentional choice, we may infer that it is conscious choice, and, therefore, that the organism has a mind" (p. 17). He adds, "the test of consciousness is the presence of choice, and the evidence of choice is the antecedent uncertainty of adjustive action between two or more alternatives" (p. 18). Quoting his own *Animal Intelligence* of 1882, he writes, "The criterion of mind, therefore, which I propose, and to which I shall adhere throughout the present volume, is as follows : — Does the organism learn to make new adjustments, or to modify old ones, in accordance with the results of its own individual experience? If it does so, the fact cannot be merely due to reflex action in the sense above described; for it is impossible that heredity can have provided in advance for innovations upon or alterations of its machinery during the lifetime of a particular individual" (pp. 20-1). He says, "agents that are able to *choose* their actions are agents that are able to *feel* the stimuli which determine the choice" (p.

[N]either Feeling nor Choice appears upon the scene of life suddenly. We cannot say, within extensive limits, where either can properly be said to begin. They both dawn gradually, and therefore in our everyday use of these terms we do not wait to consider where they are first applicable; we only apply them where we see their applicability to be apparent. But when we endeavour to use these same terms in strict psychological analysis, we are at once met with the difficulty of drawing the line where the terms are applicable and where they are not. There are two ways of meeting the difficulty. One is to draw an arbitrary line, and the other is not to draw any line at all; but to carry the terms down through the whole gradation of the things until we arrive at the terminal or root-principles. By the time that we do arrive at these root-principles, it is no doubt true that our terms have lost all their original meaning; so that we might as well call an acorn an oak, or an egg a chicken, as speak of a *Dionoea* [Venus flytrap] feeling a fly, or of a *Drosera* [sundew] choosing to close upon its prey. Yet this use, or rather let us call it abuse, of terms serves one important purpose if, while duly regarding the change of meaning which during their gradual descent the terms are made gradually to undergo, we thus serve to emphasize the fact that they [these terms] refer to things which are the product of a gradual evolution — things which came from other things as unlike to them as oaks to acorns or chickens to eggs. And this is my justification for tracing back the root-principles of Feeling and of Choice into the vegetable kingdom. If it is true that plants manifest so little evidence of Feeling that the term can only be applied to

20, italics in original). Romanes cautions: “The power of learning by individual experience is therefore the criterion of Mind. But it is not an absolute or infallible criterion; all that can be said for it is that it is the best criterion available, and that it serves to fix the upper limit of non-mental action more precisely than it does the lower limit of mental; for it is probable that the power of feeling is prior to that of consciously learning” (p. 60).

them in a metaphorical sense, it is also true that the power of Choice which they display is of a similarly undeveloped character; it is limited to a single act of discrimination, and therefore no one would think of applying the term to such an act, until analysis reveals that in such a single act of discrimination we have the germ of all volition. (pp. 54-55)

While Huxley thought we must refrain from saying creatures without a certain sort of nervous system are conscious, Romanes thought antecedent commitments to arguing from analogy and to evolutionary continuity force us to admit there is no line between conscious and nonconscious organisms, and that even plants such as the Venus flytrap and sundew might be conscious to some extent.

That issue remained open twenty years later. In *Behavior of the Lower Organisms*, published in 1906, in the first paragraph, Herbert Spencer Jennings writes:

The objective processes exhibited in the behavior of the lower organisms, particularly the lower animals, form the subject of the present volume. The conscious aspect of behavior is undoubtedly most interesting. But we are unable to deal directly with this by the methods of observation and experiment which form the basis for the present work. Assertions regarding consciousness in animals, whether affirmative or negative, are not susceptible of verification. (p. v)

He reiterates this at the end of the book: “The peculiarity of subjective states is that they can be perceived only by the one person directly experiencing them, — by the subject. Each of us knows directly states of consciousness only in himself. We cannot by observation and experiment detect such states in organisms outside of ourselves” (p. 328).

The fact that the issue remained open indicates that the predicate was indeterminate. Paraphrasing Mark Wilson, the proper ground for determining whether the predicate was true of a particular individual was uncertain or ambiguous (1982 pp. 549, 550, 553, 570). To John Watson, this difficulty made the predicate virtually useless. In his famous essay of 1913, he says:

One can assume either the presence or the absence of consciousness anywhere in the phylogenetic scale without affecting the problems of behavior by one jot or one tittle; and without influencing in any way the mode of experimental attack upon them.¹⁰ (p. 161)

Currently, competent users of the predicate ‘...is conscious’ continue to disagree about the proper grounds for its application to nonhuman creatures. For example, in “The Evolution of Consciousness” Peter Godfrey-Smith writes, “Which biological features are relevant to the evolution of subjective experience? There is no consensus on what matters – on what makes the difference between there being, or not being, ‘something it’s like’ to be an animal” (p. 219).¹¹ I take this to imply that the predicate remains indeterminate with respect to at least many nonhuman creatures, including plants. It is so far not determinate whether they are or are not in the extension of the predicate.

Many scholars will object to my reasoning so far.

¹⁰ In his subsequent book, Watson writes, “‘consciousness’ is neither a definable nor a usable concept” (Watson, *Behaviorism*, 1925, xix).

¹¹ Godfrey-Smith advises caution about the term: “My title uses the term ‘consciousness’ in a broad sense now common in the literature. In this sense, if there is ‘something it’s like’ to be an animal, then that animal is conscious (Nagel 1974, Chalmers 1996). I think this is not a helpful terminology. Historically, the term ‘consciousness’ has usually suggested a rich form of experience, not the simple presence of feelings. Confusion arises from the terminological shift, as talk of consciousness in animals inevitably suggests a sophisticated ‘here I am’ state of mind, not just a wash of feeling. Aside from the history of ideas, I expect the eventual shape of a good theory to be one that recognizes a broad category of sentience, something present in many animals, and treats consciousness as a narrower category” (pp. 216-17)

One might object that I am not adequately distinguishing between our criteria for judging whether something is in the extension of a predicate and that extension itself (between, roughly, evidence and meaning). Similarly, Wilson acknowledges his way of thinking will be “disdained by many as ‘operationalist’” (1982, p. 553). In the words of Percy Bridgman, operationalism is the idea that “we mean by any concept nothing more than a set of operations; the concept is synonymous with the corresponding set of operations” (1927, p. 5). The meaning of a term is the set of operations by which we measure or would or could measure whether something satisfies that term. Wilson’s way of thinking might look operationalist since it tightly connects the extension of a predicate with the “operations” by which people properly apply that predicate. As a general theory of meaning, operationalism is widely regarded as mistaken, since for many terms, there is more to their meaning than the “set of operations” for their application (Chang, 2019). Operationalism appears to conflate the meaning of a term with the evidence we have or could have for applying that term.

But Wilson’s view is not operationalist; it does not conflate the extension of a term with the evidence we have or could have for applying that term. Rather, Wilson’s proposal is that “The evidence for assignment of an extension to a predicate should be limited to such linguistic behavior as can be reasonably extrapolated from the community’s contemporaneous practice and should not reflect accidental features of the society’s later history” (1982, p. 553). Wilson does not propose to equate the extension of a predicate with the things that meet a linguistic community’s evidential criteria for applying that predicate. Rather, he proposes only that in assigning an extension to a predicate, we should restrict ourselves to reasonable extrapolations of the community’s criteria. We should do so because we should avoid stifling inquiry into things that might turn out to belong

in the extension (ibid., pp. 562-3). And we should avoid anachronism, reading later developments in the career of the predicate back into its earlier stages (ibid., p. 583).¹²

Other scholars will object to my reasoning on slightly different grounds, saying something like this: “Competent users disagree, but that doesn’t show the predicate is indeterminate. Some users are right; others are wrong; the difficulty lies only in our ability to ascertain the proper grounds for applying the predicate, not in the grounds themselves.” Similarly, they’d say that before the Druids encountered the bomber, the extension of ‘bird’ was determinate. Articulating this idea, Wilson says “the traditional response” is to “seek the ‘concept,’ ‘sense,’ or ‘universal’ the prebomber Druids had associated with ‘bird’ and study the extension determined by this intervening entity” (1982, pp. 549-51). Likewise, against my inference one might say we simply need to continue investigating the concept of consciousness, the concept that goes with the predicate.

What do I say to that? Wilson says, “the traditional response” to the problem with the Druids is “tantamount to a prediction about how the [prebomber] Druids will come to classify aircraft” (ibid., p. 551), which would be empirically unjustified. Nothing in their behaviors before encountering the bomber settles whether they will or should go on to apply ‘bird’ to aircrafts (ibid., p. 570). Saying the predicate is determinate is to treat the Druids as “perfect detection devices,” able to detect whether ‘bird’ applies to “any object whatsoever in any context” (ibid., p. 563). But it is implausible that there are such devices and that human beings are among them. Wilson: “For most physical quantities Φ at most historical moments in time, it is extremely unlikely that a linguistic community should be prepared, even collectively, to recognize all proper objects possessing Φ ” (ibid., p. 583).

¹² Thanks to an anonymous referee for urging me to address this objection.

For similar reasons, it is very improbable that our use of ‘conscious’ so far somehow anticipates and settles whether it applies to “any object whatsoever in any context.” Nor is it likely that our use so far settles whether the predicate applies specifically to plants. The relevant evidence is the classificatory behaviors of competent users, and we have seen that competent users are divided. They disagree about whether plants are sufficiently similar to humans in relevant respects. Trewavas et al. write, “Indicators for the ascription of plant consciousness are the same ones we use for the study of animal-based interactions. To wit, anatomical and morphological traits, (electro)physiological responses, and behavioral/ethological data” (2020). We can say that in asking whether plants are conscious we are asking whether they have the same thing we have. The trouble is we don’t yet know what would count as “the same thing” or “the same ones”.

A seemingly different but importantly similar objection to my reasoning so far would contend that ‘... is conscious’ is a natural kind term and consciousness is a natural kind. The situation is analogous to the situation of ‘...is water’ and water. The extension of ‘...is water’ is the set of all things that contain (mostly) H₂O. The term’s extension was settled by a “baptism” connecting this term to whatever kind or property is causally responsible for the behaviors in the sample objects to which it was applied, such that the extension contains all and only things of that same kind. Something similar goes for ‘...is conscious.’ Its extension was fixed by initial, “baptismal” uses of it, isolating that property, whatever it is, that is responsible for certain behaviors in the objects to which the term was applied. Although we do not yet know what the extension is, it is nevertheless fixed, settled, determinate.¹³

My response here is similar to my response to the previous objection. It is not plausible that the extension of ‘... is conscious’ was indeed fixed by some initial uses of it, settling the

¹³ Thanks to an anonymous referee for suggesting this.

standards for all subsequent usage, isolating some single property. Following Wilson, I accept the objection's suggestion that any predicate or measuring instrument that works does so in part because of "objective features of the objects catalogued" by that predicate or instrument (1982, p. 559-60; 2006, pp. 422-29). What belongs in the extension is not merely "up to us." That does not, however, imply the extension of a predicate is determinate. It implies only that there are objective ("non-human" or not "merely conventional") constraints on the extension, its determination.

4. Sources of Indeterminacy

Why is the predicate indeterminate? What explains this fact? In brief, my answer is that we lack fuller knowledge of the implicit restrictions on which we rely when we correctly apply it. Because we are unsure of these restrictions, we are unsure what should be in place to apply it correctly to the apparently rather different case of plants.

The idea that our proper use of a predicate relies on implicit restrictions is at work in the more familiar search for "correlates of consciousness" that goes back to the time of Romanes and Huxley. In looking for anatomical, physiological, and behavioral features that correlate with consciousness, we are trying to make explicit some of the restrictions on which we implicitly rely when we apply the predicate '...is conscious.' In these terms, my claim is that what we know about correlates of consciousness leaves open whether plants are conscious. The predicate is indeterminate because we don't have fuller knowledge of the correlates.

Here's an example. In *The Evolution of the Sensitive Soul*, Eva Jablonka and Simona Ginsburg aim to help explain how consciousness evolved by identifying something that marks the transition from preconscious animals to conscious animals (2019, p.1). For this role they propose "unlimited (open-ended) associative learning (UAL)," which is "an organism's ability to attach

motivational value to a compound, multifeatured stimulus and a new action pattern and to use it as a basis for future learning” (ibid, p.3). Their main support for their proposal is that “the features that neurobiologists and philosophers regard as essential for consciousness are also required for UAL” (ibid, p.3). They proceed by looking for consensus among researchers about what is required for consciousness or at least correlates with consciousness. Then, they look for something else that requires the same thing, landing on UAL.

Although they intermittently express high confidence in the consensus on specific correlates of consciousness (e.g., p. 192), in many places Jablonka and Ginsburg acknowledge significant uncertainties about which organisms are conscious. For instance, they write, “in the biological world, a *nervous system* and a *brain* are necessary for subjective experiencing to occur. ... Since bacteria and tomatoes do not have such central transmission-integration systems, most people would agree they seem to be unendowed with the phenomenal consciousness of animals—with felt needs and perceptions” (pp. 11-12). What about the non-biological world? What about the consciousness of non-animals? Later they add that “Suggestions about the presence of consciousness in a particular animal that are based on sophisticated behavior or on the complexity of the nervous system are always open to challenge: Why draw the line here and not there?” (p. 224). They observe that appeals to analogy “are less convincing as one moves from mammals and birds to lower vertebrates and even less so with invertebrates such as mollusks or crustaceans” (p. 198). When discussing the possibility of conscious robots, they stress they have been “discussing consciousness as we know it” (p. 467). These remarks do not express the generic thought that we can never be certain about anything. Nor do they voice a facile other-minds skepticism, since Jablonka and Ginsburg do believe some other creatures are conscious, and we can know as much. Rather these remarks express recognition that our knowledge of what correlates with

consciousness is limited, which limits our capacity to say which things are conscious. The predicate is indeterminate because we are not sure about the correlates, the implicit restrictions on which we've been relying when applying it correctly.

Why is it indeterminate whether plants specifically are conscious?

In short, they're so different from us. Consider the paradigm of a conscious thing, one of us. Leave aside how we might characterize consciousness in this thing, "what it's like" to be it, or "what it's like" to be it in some situation or other. Attend to some of its other traits. It is a human, hence a mammal, and an animal. A vertebrate, with a head, and a bilaterally symmetrical body, it has a nervous system, and locomotes by contracting muscles and moving limbs. It is heterotrophic and reproduces (only) sexually. It sees, hears, tastes, touches, and smells things. It feels pain.

A typical flowering plant appears not to have these traits. Which of them are relevant to being conscious? (For pre-bomber Druids, which traits are relevant to a thing being in the extension of 'bird'? Up to that point, all birds fly, live, aren't made by humans, and lack an outer shell of metal.) We don't know the answer a priori, simply by reflecting on the meaning of our words. By empirical investigations, researchers have devised ways of identifying correlations and extending the predicate. Some believe there are conscious invertebrates, such as octopi. Some hold bees are conscious, though they don't feel pain. Some hold corals, which are sessile, are conscious. Many knowledgeable people believe nervous systems are necessary. If that's right, since plants seem to lack nervous systems, they aren't conscious. (Might they have something analogous to a nervous system?¹⁴ What exactly are neurons?¹⁵)

¹⁴ See, for instance, (Baluška, 2010), (Calvo, Sahi, & Trewavas, 2017), (Muday & Brown-Harding, 2018).

¹⁵ See, for instance, (Jekely, Keijzer, & Godfrey-Smith, 2015).

Do such differences show plants are not conscious? They do so only if we take any of these correlates to be strictly necessary for being conscious. And that would go beyond what's warranted by our usage of the predicate so far.

However, such differences do make it difficult to figure out whether plants belong in the extension of the predicate. Consider the situation with another psychological predicate, '...learns by association.' Although Monica Gagliano and her colleagues (Gagliano et al. 2016) have now provided us with some good evidence that plants (garden peas) learn by association, previously it was unclear not only whether plants could do so, but what it would "look like," what it would be for plants to do that sort of thing. For instance, in 2014 in *Plant Behaviour and Intelligence*, Anthony Trewavas, who is a long-time proponent of plant intelligence, observed:

Two things mitigate against detecting conditioned behaviour in higher plants. First, plants use a single source of energy, the sun. Animals are heterotrophs and must seek their often variable supplies of food in a great variety of situations. Thus, they are open to learning by association. Secondly, and more problematic, is that plant behaviour appears largely as a result of changes in development, a continuous process of change. In a sense, you do not deal with the same plant twice because of changing development. Whereas Pavlov's dogs, unitary organisms, are in another sense the same stable organism throughout, although, of course, they continue the developmental cycle. (p. 250)

In their experiments on garden peas, Gagliano et al. had to devise a way to deal with these differences. In psychology textbooks, it is common to distinguish behavior proper from growth or irreversible morphological changes (e.g. Sternberg 2008, Domjan 2015). You investigate learning by investigating behavior, not growth. To check for Pavlovian or classical conditioning in the peas,

Gagliano et al. effectively had to treat growth of stems as behavior, effacing the distinction. Associative learning, it turns out, can be displayed in growth. Similarly, autotrophy—creating one’s own energy sources—doesn’t preclude being “open to learn by association.” Recognizing a place for it requires thinking about what a “situation” is for a plant rather than an animal. For a plant, but not an animal, typically “situations” won’t vary by place, since plants are sessile.

Turning back to the predicate ‘...is conscious,’ to figure out whether plants belong in its extension requires this sort of thing, devising and trying out ways of extending various allied predicates (‘learns by association’ or ‘behaves’ or ‘encounters a variety of situations’) to the interestingly different case of plants. Jablonka and Ginsburg say, “limited learning... has never been advanced as a criterion for consciousness. Ever since Romanes suggested that learning from experience is a good criterion for mind, only open-ended learning by alert animals, which can learn multiple contingent and often novel associations, has been put forward as a criterion for consciousness” (p. 202). Now that there is some positive reason to think plants are capable of classical conditioning, it makes sense to explore other sorts of classical conditioning (e.g. Domjan 2015), and perhaps eventually instrumental or operant conditioning, which undergirds Jablonka and Ginsburg’s Unlimited Associative Learning.¹⁶

In this section, I’ve taken for granted that the predicate ‘...is conscious’ is indeterminate for plants, and sought to explain why this might be so. It’s so because (a) we tacitly rely on various empirical facts (correlations) when we correctly characterize animals, like ourselves, as conscious, but (b) we have limited knowledge of those facts, and (c) plants differ significantly from animals, while also being substantively similar.

¹⁶ On the connection between learning and consciousness, Godfrey-Smith, for example, disagrees with Jablonka and Ginsburg, writing “I think the claim that learning is *the* key to consciousness is unlikely to be right” (p. 222.)

5. Predicate Engineering

Are plants conscious? In answering that question, most people assume the predicate ‘...is conscious’ is determinate, but I have proposed it isn’t. I’ve supported my claim by pointing to some history of the predicate and current disagreements among current competent users of it. I’ve proposed further that the predicate is indeterminate because we lack knowledge of the implicit supports on which we rely when we use it correctly, which leaves us unsure how it might behave when applied to plants, which apparently lack many of those supports.

Suppose I’m right. Then, the question of whether plants are conscious is not a question of whether there is good evidence that they are already in that predicate’s extension. Instead it is a question of crafting ways of further fixing the extension so that it does or doesn’t include plants. As we’ve seen, this involves scrutinizing the supports on which we implicitly rely when we correctly apply the predicate to various animals (the various correlates of consciousness), and devising ways to apply it possibly in the absence of those supports. Rather than merely surveying the predicate’s extension, we must continue to engineer it.¹⁷

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