

IS CONSCIOUSNESS A USEFUL SCIENTIFIC TERM? PROBLEMS OF "ANIMAL CONSCIOUSNESS"

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ABSTRACT

Application of the normal procedures of scientific hypothesis testing to the question of animal consciousness is flawed, since it presupposes that consciousness (and more especially, its lack) can be reliably identified. Cognitive psychology has made little explanatory use of the concept of consciousness, and comparative psychology has no safe means of pursuing its evolution. It is proposed that the vexed issue of consciousness in animals is not linked to their welfare, which should instead be decided by objective ethological evidence, backed by firm presumptions of "conscious until proven otherwise".

Keywords: Null hypothesis - Animal welfare - Pain - Suffering - Evolution

CONSCIOUSNESS IN EVERYDAY HUMAN LIFE

There is no doubt that "consciousness" is a word of considerable use in human dialogue, stretching beyond the medical distinction between conscious and *unconscious*. We use it in two, rather different, ways. Firstly, we distinguish among different *states* of consciousness, including sleep (which may itself be subdivided into various forms, such as REM or deep, dreamless sleep), and the altered states that drug-taking can produce. Our everyday state of awake consciousness can also be altered without drug-taking, as anyone who has attempted meditation can testify. Then, consciousness seems to be focused at the self in the present instant, in contrast to the normal frenetic forward planning that occupies so much of our time. Eastern philosophers make further divisions among more-or-less voluntarily achieved states of consciousness; Crook (1988) describes the Buddhist classification of voluntary states of consciousness as using two dimensions to capture all the possibilities: time, present or future; and location, self or outside world. In meditation, one's consciousness is aimed inwards into the self and focussed in the present instant, whereas in everyday planning, it is oriented at the outside world in the future. Other locations on this 2D plane are possible: for instance, the awareness that traditional hunters use to tune in to the environment of their prey (and which any urbanite will experience after some time walking unarmed through dense African bush!), in which one is conscious of the present, but external to the self. According to the Buddhist scheme, all variation can be described in terms of these two simple co-ordinates - even if reaching some points on the

surface may take months of careful training in meditative technique. Whether we accept this augmented account of conscious states, or keep to the conscious states familiar in Western medicine, there would seem no difficulty in extending it to non-human animals (hereafter, "animals"): witness the recent report of sleep in an insect. While it is a matter of curiosity and some scientific interest to speculate on the altered states of animal consciousness, this presupposes that animals can *be* conscious, and brings us to the second way in which we use the word in everyday discourse.

An understanding of animal consciousness can inform debates about the ethical status of animals and the morality of potentially inflicting pain upon them. This makes the issue an important practical one, and here the main question is whether animals are conscious at all, in the sense implied by our commonest everyday use of the word. This is, as a way of describing a perceptual focus of attention. I may report that I am conscious of your stare, of my own nervousness, of a slight sound in the background, of a musky and attractive scent, of the beauty of the sunset, of a deep and unbearable pain, or of my deep misery. It has recently been argued that only humans can be conscious in any of these ways (Macphail, 1998). Clearly this has immense implications for animal welfare and in general for the way in which we use animals, so it is important to base any claim on scientific fact.

CONSCIOUSNESS IN PSYCHOLOGY

Cognitive psychology has been intimately concerned with focal attention since the 1950s, and work on visual and

auditory perception of course goes back far longer, to the seminal work of Helmholtz and Young in the 19th century. We know great deal about how, in some circumstances, the focus of attention can be directed, whereas in others the stimuli in the environment capture it without (or despite) any effort of will; this capture operates somewhat differently in the auditory and visual domains. These mechanisms of selective attention are understood as devices to avoid overload of limited capacity perceptual systems, ensuring that stimuli of biological importance are given priority of processing, and allowing us to select on the basis of our own priorities. The different senses can each contribute in an additive way to our eventual comprehension of meaning. We understand, in some considerable detail, the codes by which sensory information is registered and transduced over various neural pathways, from sense organs to cortical regions of the brain. Indeed, the modern understanding of perception is hailed as the greatest triumph of modern psychology (Barkow *et al.*, 1992), and used to illustrate the productive interplay between physics, physiology and psychology. Significantly, though, the concept of consciousness has no useful part in this enterprise. Occasionally, the phenomenon is attached as an interesting afterthought: a model of perceptual processing may include "conscious experience" as a property of one stage in the process, but not another - but no information-processing reason is usually given for this. Indeed, the mystery is why we should be conscious of any of it. The goal of cognitive psychology is a mechanistic understanding of how the brain controls behaviour: models of perception and attention should ultimately be realizable (and some are already) on machines. Despite much science fiction, these would not presumably be conscious.

Psychologists, like everyone else, love talking about consciousness. Many have speculated on its biological function, and international conferences are held on this topic alone. At these meetings, two very different strains vie for attention: information-processing psychology, which does not really seem to need the concept, and the study of more mysterious phenomena. The latter include the oddities of left-sided neglect of the visual field, produced by some sorts of brain injury, and the so-called blind-sight of patients with visual cortex damage, who can see where things are and how they move, but without conscious experience or knowledge of what they see. Consciousness and mystery seem to go together.

Despite the hype that often greets any publication or public discussion of consciousness, no very convincing theory of just why and when conscious experience is important has yet emerged. Mainstream cognitive psychology appears to manage fine without it. And in everyday talk, we *could* largely do the same: saying that "I am conscious of X" is entirely equivalent to saying "I notice X". Mentioning my mental phenomena may not help you to understand my meaning.

CONSCIOUSNESS IN EVOLUTION

For a proper biological understanding of any human characteristic, it is essential to understand how, when, and why it evolved, in addition to understanding its modern operation. The major tool available for this work is the comparative study of animals (Byrne, 1995). By finding patterns, in which a characteristic turns out to be unique to, and universal among, some particular clade, we can attribute its origin to the species that was the common ancestor of the clade. (A *clade* is a group of species sharing a single common ancestor.) In combination with molecular dating and paleontological evidence, we can thereby learn the antiquity of the trait. Often, we can go further, getting evidence of the environment in which it evolved, and thus hints about the selection pressures that led to its evolution. (In some cases, there may be clues as to original function if that was different to the function in modern descendants.) For instance, the mobile human shoulder-blade has an anatomy that is shared with all modern apes, but not with monkeys or more distant relatives. The apes, including humans, form a clade, stemming from a single common ancestor which lived about 20 million years ago (Begun, 1999). From fossil evidence, we know that this ancestor population was a forest animal; although some modern descendants of it walk on the ground. The shoulder anatomy must therefore have had a function in arboreal living - most likely, the same function that it subserves in the majority of the living apes, that of allowing suspensory feeding on items that the quadrupedal monkeys would have trouble reaching. (Only in the gibbons, or lesser ape clade, brachiation seems to have evolved further into a very rapid means of arboreal travel.) We can test hypotheses about function, again using comparative evidence. In this case, we examine a wide range of species to see what environmental characteristics correlate with possession of the trait of interest. For instance, on the basis of the intelligence of the highly social monkeys and apes, it has been hypothesized that social living selects for enlarged brains (Chance and Mead, 1953; Humphrey, 1976; Jolly, 1966). This can be tested by comparing species from a wide range of taxa, to see whether highly social ones are larger brained than their more solitary relatives. In a wide range of mammal species, they are (Eisenberg, 1981). Furthermore, in bats and cetaceans, as well as primates, there is a significant correlation between group size and neocortical enlargement (Barton and Dunbar, 1997).

If consciousness is as important a part of being human as most people believe, understanding its evolution should be a central part of evolutionary psychology. Yet, extending these potentially powerful methods to consciousness is problematic. Moreover, when we examine the problems that arise, we are led to fundamental concern about the use of consciousness as a descriptive term, and about the logic of hypothesis testing when applied to such an awkward concept.

To use comparative methods, it is essential to find out which species possess the trait - in this case, consciousness. We might begin in the following way. We know that humans are conscious; we do not know which animals, if any, are. Our null hypothesis H_0 , then, should be that a non-human lacks consciousness. For each species we examine, our experimental hypothesis H_1 would be that individuals of the species do share something of the human experience of consciousness. If we fail to find convincing evidence (replicable data that necessarily implies the rejection of H_0 at an acceptable confidence level, for instance $P < 0.01$), we must continue to accept H_0 , that this animal species lacks consciousness. By this logic, many people have convinced themselves that, scientifically speaking, some or all non-human animals do indeed lack consciousness (Macphail, 1998). The trouble starts when we examine some basic assumptions of the method of hypothesis testing.

THE PROBLEM OF NULL HYPOTHESIS

Above all else, to be a good null hypothesis H_0 must be potentially *dis-provable*. This is normally not a problem, even with behavioural traits. The trait will probably need to be operationalized as a particular performance; then, a test is devised for which the score represents a measure of the performance. In this way, trichromatic colour vision becomes the ability to see a certain number among a mass of coloured swirls, and intelligence becomes the ability to score over 100 on a standardized IQ test. But how do we "test" for consciousness in animals? What performance would an animal exhibit if it did experience the phenomenon we call conscious awareness, that a robot in a furry suit would not show? From the philosophy of Descartes' day to the contemporary science fiction of android invaders, the extreme difficulty of deciding whether an organism is conscious has been a source of endless debate and entertainment. However, if we cannot decide objectively and reliably that our animal is conscious, then according to the inexorable logic of hypothesis testing we are left with H_0 , and must sadly accept that it is not. It looks as if the dice are somewhat weighted.

The reality is even worse than that. My "logical process" was something of a trick, since I began with a false presupposition: I took it that we could we "know" that people are conscious. Strictly speaking, I *know* only that I, myself, am conscious; out of politeness, I talk as if you are too, but that is a fallible deduction, not something I know for sure. In general, we accept that all humans are conscious, based on a probabilistic assessment of several facts, none of which is unarguable. The facts are that (1) very large numbers of humans behave in sufficiently similar ways, in the same circumstances, as to be consistent with their sharing similar conscious experiences, (2) it would be biologically most unlikely to find a species with major variation in any important functional trait, and (3) those we can discuss the issue

with, assert that they are indeed conscious. Point (1) is the issue that has so absorbed philosophers and writers of science fiction, and clearly "consistent with" is very different from "surely indicating". Point (2) presupposes that consciousness is of major functional value, which as we have seen may be argued. However, the fact that we all share a word for conscious experience and can discuss it rationally surely must mean that we are right to accept it as a universal human trait?

MUTUAL MISUNDERSTANDINGS

This hope does not bear close examination. After all, what else *could* anyone say when asked whether they are conscious? Evidently, giving the answer "no" would be clear evidence they understood the concept; we would suppose them to be lying or joking. More telling would be if they said they did not understand the question. But how could anyone, brought up in a culture that uses the word as much as do Europeans and Americans, seriously contend they did not know what the word means? As Wittgenstein noted, all mental state terms are acquired without their having referents in the outside world at which to point. Children are equipped to fix upon meanings for words used in consistent ways by adults (Carey and Bartlett, 1978), and this process will inevitably ensure they all fix upon *some* meaning for the term "consciousness". But does that mean it is always the same meaning?

If one asks various different people a rather more answerable question, for instance about the content of thought in similar circumstances, the response is disconcertingly variable. Imagine, for instance, your own house: how many windows does it have at the back? Personally, when I respond to this simple test, I am conscious of *looking* at the back of the house, from a stance somewhere in the garden. The image is pictorial, and therefore definite (it happened to be summer, in my mental image, and good weather). The image is coloured, and to the extent there was sound it was of muttering - by myself, counting the windows. Perhaps you would describe your own phenomenal experience similarly? But perhaps not. A very good friend of mine at university, now a successful geophysicist, reported none of those things when I set him the same task: he spoke to me as if I was somehow deranged or under the influence of a drug, to claim such bizarre stuff. In his mind's eye (not a phrase he'd use), he saw no picture, coloured or otherwise, and heard no words. Yet, his answer was as quick in coming, and as accurate. I tried a whole series of tasks, accepted in psychology as depending on visual imagery, with the same result. Strangely, his complete absence of imagery made no obvious difference to his life. Indeed, when it came to complex 3-dimensional physics problems, where my own ability to imagine what was going on was severely taxed, he happened to be much better at reaching the answers. When two people - of the same country, culture, class, and scholastic aptitudes - differ so fundamentally in how they expe-

rience mental phenomena of a sort peculiarly able to be described clearly, we should be very wary of any claims about the more slippery concept of consciousness.

I suggest that it may very well be the case that there are significant differences in what is meant by different people when they use the term "consciousness", even within a tight-knit culture like Western academia. Whether that variety of usage has *anything* in common with words, translated as "consciousness", from languages outside our own philosophical traditions, I also doubt. Western countries, and at one remove, the Eastern tradition that includes Buddhist and Chinese philosophy, have a long history of discussing these tricky terms and agreeing on some shared meanings. If there indeed *is* any such word in the languages of stone-age communities of the Papuan highlands, of the gatherer-hunter peoples of the Congo rainforest, or of the former hunters loosely described as Eskimo, I suggest it would be unwise to assume it means anything remotely similar. Translation requires somehow identifying a precise referent of the word, and I am not confident that this could have been done in these cases. And if we cannot be sure of what we mean, when moving merely among different human cultures, how can we possibly be sure when it comes to non-human animals? It is seriously likely that everyone means different things by the same word; and good science cannot be done without an agreed lexicon of terms with unambiguous meanings.

CONCLUSIONS

What implications does all this have for the study of consciousness and its evolutionary origins? At least the following would seem to be true:

1. We should be deeply suspicious of any firm statement that individuals of an animal species are (or are not) conscious. On the usual logic of scientific hypothesis-testing, whichever of these statements is taken to be the null hypothesis will almost inevitably be accepted! What people choose to believe, in this circumstance, will be largely a matter of taste. Anyone asserting, as scientific fact, a claim about animal consciousness is likely to be wasting our time.

2. As a corollary, we should also be deeply suspicious of the method of hypothesis-testing applied to all cases where null hypotheses are by their nature extremely hard to disconfirm. Rather than using conventional, Fisherian statistics to test experimental against null hypotheses, we would be very much better off taking a Bayesian approach. On this procedure, we begin by setting out all the possible competing hypotheses, each weighted by its prior probability of being correct; then, in the face of new evidence, the probabilities are modified according to how the evidence could be squared with each of the hypothesis. If we were initially convinced that all humans, but no animals, *were* conscious (perhaps equating consciousness with possession of a soul in the Judaeo-Christian tradition), both approaches would give quite similar results when applied to current evidence.

However, if any attention were paid to the extremely close relatedness between humans and other African great apes (closer, it has been noted, than the several species of fruit fly that can be found in one bowl of rotting fruit, or between horse and zebra), then very different prior weights would be set. Just as one might argue that it is biologically implausible for me to be conscious, but you - a member of the same species - not to be, it is not plausible that one species of great ape should be conscious and not any of its closest relatives. If we are persuaded that it is initially rather *likely* that chimpanzees (say) are conscious, much as we are, I know of no convincing evidence at all against that hypothesis. Much has been discovered in recent years about the rich and complex societies of chimpanzees (Goodall, 1986) - based on long-term alliances (de Waal, 1982), built up within social grooming cliques (Dunbar, 1988; Harcourt and de Waal, 1992) and swiftly repaired by reconciliation after conflict (de Waal and van Roosmalen, 1979; de Waal, 1992); about their ability to predict others' intentional actions and understand their knowledge (Byrne, 1995; Call and Tomasello, 1998), there has even been a recent discussion of whether chimpanzees show empathic understanding of others' distress (de Waal, 1996). All of this work argues quite the other way - making the hypothesis of consciousness more, not less, likely. With a Bayesian approach, and a biological view of prior likelihood, consciousness in chimpanzees would be quite straightforward to prove.

3. However, even using a Bayesian approach to assess evidence, it is highly unlikely that we will ever be able to describe accurately the variation among consciousness in widely different species, or set any clear limits on where consciousness may be found. Certainly, the strongest evidence suggestive of consciousness is found in species most closely related to us - how could it be otherwise? We are in a much better position to study species with which we share a perceptual world and similar ways of acting upon it, so it is inevitable that we will find more evidence that suggests a chimpanzee is cognitively "like us", than is a marine turtle. If we were to take this evidence as a way of scaling consciousness in animals, the danger is that we would be simply cataloguing our research limitations. Some of the cognitive achievements of animals with which we share no common ancestry for hundreds of millions of years should give us pause. Consider the sea-slug *Aplysia*, popular among neuroscientists because its relatively few neurons are sufficiently large and predictable that they can be numbered, so that the same neuron can be examined in different individuals. *Aplysia* are often collected, for just such study, by going to the small areas where at particular times of year they congregate for mating displays. Put in cognitive terms, this means that *Aplysia* has a mental map, it has an annual body-clock, and it has social behaviour of some sort. Furthermore, it shows what in mammals would be called "fear conditioning". Perhaps slugs are conscious, too? Yet *Aplysia* has only about 20,000 neurons.

ANIMAL SUFFERING AND CONSCIOUSNESS

These pessimistic conclusions, if they are accepted, have clear implications for future decisions on animal welfare, the regulation of animal suffering, and the role of science in these issues. Rather than attempting to tie legislation to what will almost certainly prove unreliable beliefs about consciousness, I suggest that it would be very much safer to accept, as provisional truths, two very different null hypotheses.

Firstly, in the light of our major uncertainties, it is clearly essential to give animals the benefit of the doubt. We should accept that: **for ethical purposes, any animal should be assumed to be conscious until clear evidence against this assumption can be provided.** Such evidence, of course, will be long in coming. In the meantime, judgements about the appropriate welfare of individuals of the species, and the circumstances in which they may suffer, can be made on objective grounds. Anyone claiming, "Ah but it is not a member of a species known to be conscious, so, although this animal might be expected to be in pain, and looks indeed as if it is, we Cartesians can assure you that it cannot be," will simply be ruled out of court.

Secondly, we should use the observable evidence of animal behaviour - interpreted in the light of the known ethology of the species, not by means of anthropomorphic assumptions - to inform our judgements as to what procedure is painful or causes suffering (Bateson, 1991; Byrne, 1999). That is: **for ethical purposes, any animal which emits behaviours, and shows physiological responses, that are homologous with those of people undergoing pain or suffering, should itself be treated as suffering as much as a person would under similar circumstances, until such time as specific evidence changes this presumption.** In well-studied species, existing ethological research is often able to illuminate the sensory and mnemonic capacities, which govern individuals' capacity to experience suffering. The assumption of "human level" of suffering is merely a rough and ready starting point, unlikely to be precisely true for any species (some may suffer considerably more under certain circumstances, others less). As ethological work is extended to a wider range of species, especially domestic ones where issues of welfare are most important, replacement of that presumption by specific evidence is likely to be possible in more and more cases.

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