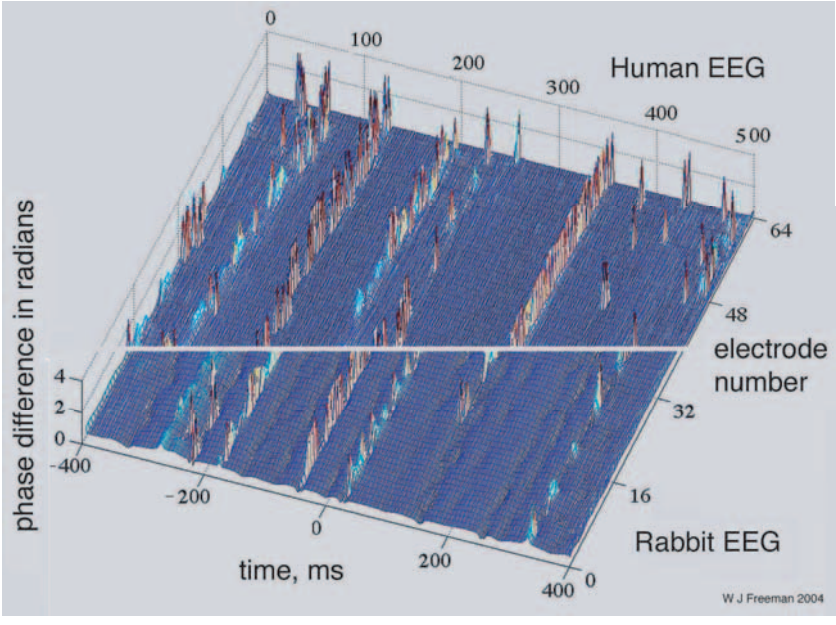

Plate 8.5. A Hilbert analysis of analytic phase differences in EEG across cortical surface measured over 400 ms in rabbit and human conscious processing. Phase differences are calculated in the beta band (12–30 Hz) for human EEG and in the gamma band (20–50 Hz) for the rabbit EEG. (With permission of the author.)

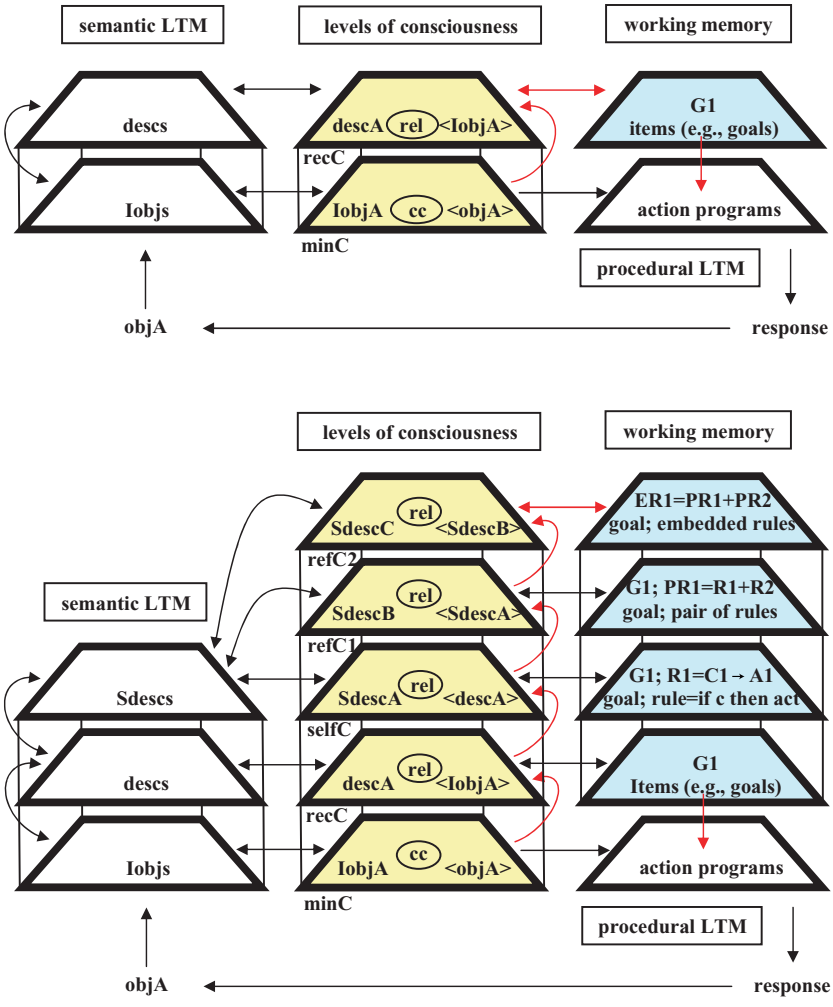

Plate 15.1. The implications of reflection (levels of consciousness) for rule use. (a, top): Relatively automatic action on the basis of a lower level of consciousness. An object in the environment (objA) triggers an intentional representation of that object (IobjA) in semantic long-term memory (LTM); this IobjA, which is causally connected (cc) to a bracketed objA, becomes the content of consciousness (referred to at this level as minimal consciousness or minC). The contents of minC are then fed back into minC via a re-entrant feedback process, producing a new, more reflective level of consciousness referred to as recursive consciousness or recC. The contents of recC can be related (rel) in consciousness to a corresponding description (descA) or label, which can then be deposited into working memory (WM) where it can serve as a goal (G1) to trigger an action program from procedural LTM in a top-down fashion. (b, bottom): Subsequent (higher) levels of consciousness, including self-consciousness (selfC), reflective consciousness 1 (refC1), and reflective consciousness 2 (refC2). Each level of consciousness allows for the formulation and maintenance in WM of more complex systems of rules. (Reprinted with permission from Zelazo, P. D. (2004). The development of conscious control in childhood. *Trends in Cognitive Sciences*, 8, 12–17.)

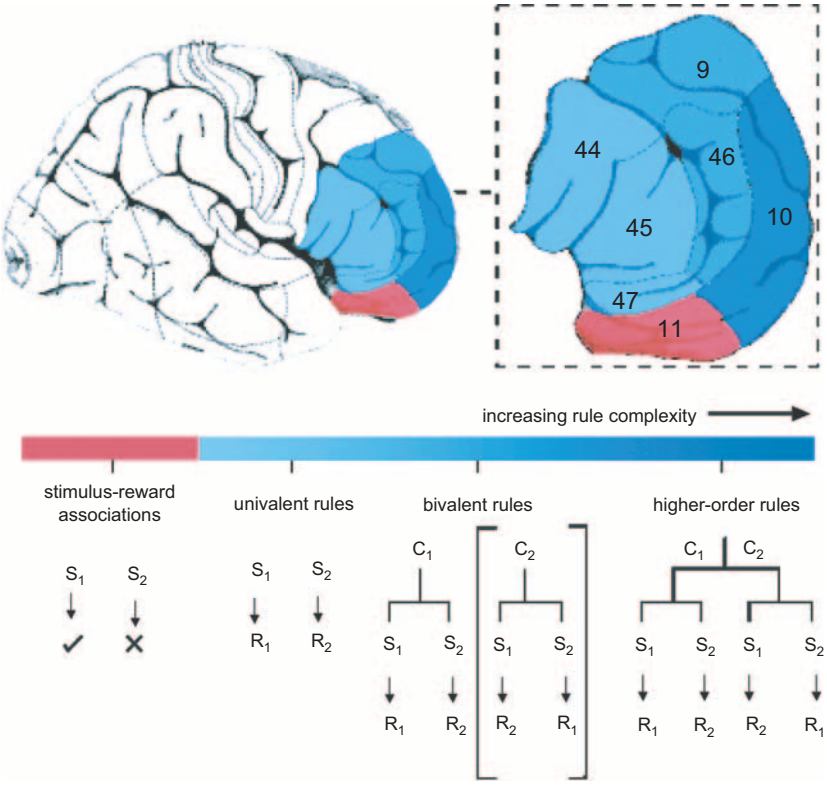

Plate 15.3. A hierarchical model of rule representation in lateral prefrontal cortex. A lateral view of the human brain is depicted at the top of the figure, with regions of prefrontal cortex identified by the Brodmann areas (BA) that comprise them: Orbitofrontal cortex (BA 11), ventrolateral prefrontal cortex (BA 44, 45, 47), dorsolateral prefrontal cortex (BA 9, 46), and rostrolateral prefrontal cortex (BA 10). The prefrontal cortex regions are shown in various colors, indicating which types of rules they represent. Rule structures are depicted below, with darker shades of blue indicating increasing levels of rule complexity. The formulation and maintenance in working memory of more complex rules depend on the reprocessing of information through a series of levels of consciousness, which in turn depends on the recruitment of additional regions of prefrontal cortex into an increasingly complex hierarchy of prefrontal cortex activation. *Note*: S = stimulus; check = reward; cross = nonreward; R = response; C = context, or task set. Brackets indicate a bivalent rule that is currently being ignored. (Reprinted with permission from Bunge, S., & Zelazo, P. D. (2006). A brain-based account of the development of rule use in childhood. *Current Directions in Psychological Science*, 15, 118–121.)

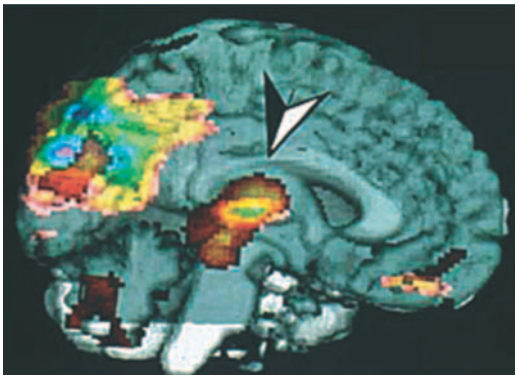

Plate 25.2. The relatively most pronounced effects of propofol (Fiset et al., 1999) are shown together with those induced by halothane and isoflurane inhalation (Alkire et al., 2000). Regional cerebral blood flow was measured in the first and regional cerebral glucose metabolism in the second study. (With kind permission from Michael Alkire.)

Part I

THE COGNITIVE SCIENCE OF CONSCIOUSNESS

A. Philosophy

CHAPTER 2

A Brief History of the Philosophical Problem of Consciousness

William Seager

Abstract

The problem of consciousness, generally referred to as the mind-body problem although this characterization is unfortunately narrow, has been the subject of philosophical reflection for thousands of years. This chapter traces the development of this problem in Western philosophy from the time of the ancient Greeks to the middle of the 20th century. The birth of science in the 17th century and its subsequent astounding success made the problem of mind particularly acute, and produced a host of philosophical positions in response. These include the infamous interactionist dualism of Descartes and a host of dualist alternatives forced by the intractable problem of mind-matter interaction; a variety of idealist positions which regard mind as ontologically fundamental; emergentist theories which posit entirely novel entities, events, and laws which 'grow' out of the material substrate; panpsychist, double aspect, and 'neutral monist' views in which both mind and matter are somehow reflections of some underlying, barely knowable ur-material; and increasingly sophisticated forms of materialism which, despite failing to resolve the problem of consciousness, seemed to fit best with the scientific view of the world and eventually came to dominate thinking about the mind in the 20th century.

I. Forms of Consciousness

The term 'consciousness' possesses a huge and diverse set of meanings. It is not even obvious that there is any one 'thing' that all uses of the term have in common which could stand as its core referent (see Wilkes 1988). When we think about consciousness we may have in mind highly complex mental *activities*, such as reflective self-consciousness or introspective consciousness, of which perhaps only human beings are capable. Or we may be thinking about something more purely *phenomenal*, perhaps something as apparently simple and unitary as a momentary stab of pain. Paradigmatic examples of consciousness are the perceptual states of seeing and hearing, but the nature of the consciousness involved is

actually complex and far from clear. Are the conscious elements of perception made up only of raw sensations from which we construct objects of perception in a quasi-intellectual operation? Or is perceptual consciousness always of 'completed' objects with their worldly properties?

The realm of consciousness is hardly exhausted by its reflective, introspective, or perceptual forms. There is distinctively *emotional* consciousness, which seems to necessarily involve both bodily feelings and some kind of cognitive assessment of them. Emotional states require a kind of evaluation of a situation. Does consciousness thus include distinctive evaluative states, so that, for example, consciousness of pain would involve both bodily sensations and a conscious sense of aversion? Linked closely with emotional states are familiar, but nonetheless rather peculiar, states of consciousness that are essentially other directed, notably empathy and sympathy. We visibly wince when others are hurt and almost seem to feel pain ourselves as we undergo this unique kind of experience.

Philosophers argue about whether all thinking is accompanied by or perhaps even constituted out of sensory materials (images have been the traditional favorite candidate material), and some champion the idea of a pure thought-consciousness independent of sensory components. In any event, there is no doubt that thought is something that often happens consciously and is in some way different from perception, sensation, or other forms of consciousness.

Another sort of conscious experience is closely associated with the idea of conscious thought but not identical to it: epistemological consciousness, or the sense of certainty or doubt we have when consciously entertaining a proposition (such as '2 + 3 = 5' or 'the word 'eat' consists of three letters'). Descartes famously appealed to such states of consciousness in the 'method of doubt' (see his *Meditations* 1641/1985).

Still another significant if subtle form of consciousness has sometimes been given the name 'fringe' consciousness (see Mangan 2001, following James 1890/1950, ch. 9), which refers to the background of awareness which sets the context for experience. An example is our sense of orientation or rightness in a familiar environment (consider the change in your state of consciousness when you recognize someone's face who at first appeared to be a stranger). Moods present another form of fringe consciousness, with clear links to the more overtly conscious emotional states but also clearly distinct from them.

But I think there is a fundamental commonality to all these different forms of consciousness. Consciousness is distinctive for its subjectivity or its first-person character. There is 'something it is like' to be in a conscious state, and only the conscious subject has direct access to this way of being (see Nagel 1974). In contrast, there is nothing it is like to be a rock, no subjective aspect to an ashtray. But conscious beings are essentially different in this respect. The huge variety in the forms of consciousness makes the problem very complex, but the core problem of consciousness focuses on the nature of subjectivity.

A further source of complexity arises from the range of possible explanatory targets associated with the study of consciousness. One might, for instance, primarily focus on the structure or contents of consciousness. These would provide a valid answer to one legitimate sense of the question, What is consciousness? But then again, one might be more interested in how consciousness comes into being, either in a developing individual or in the universe at large. Or one might wonder how consciousness, seemingly so different from the purely objective properties of the material world studied by physics or chemistry, fits in with the overall scientific view of the world. To address all these aspects of the problem of consciousness would require volumes upon volumes. The history presented in this chapter focuses on what has become perhaps the central issue in consciousness studies, which is the problem of integrating subjectivity into the scientific view of the world.

II. The Nature of the Problem

Despite the huge range of diverse opinion, I think it is fair to say that there is now something of a consensus view about the origin of consciousness, which I call here the *mainstream* view. It is something like the following. The world is a purely physical system created some 13 billion years ago in the prodigious event that Fred Hoyle labeled the big bang. Very shortly after the big bang the world was in a primitive, ultra-hot, and chaotic state in which normal matter could not exist, but as the system cooled the familiar elements of hydrogen and helium, as well as some traces of a few heavier elements, began to form. Then very interesting things started to happen, as stars and galaxies quickly evolved, burned through their hydrogen fuel, and went nova, in the process creating and spewing forth most of the elements of the periodic table into the increasingly rich galactic environments.

There was not a trace of life, mind, or consciousness throughout any of this process. That was to come later. The mainstream view continues with the creation of planetary systems. At first these systems were poor in heavier elements, but after just a few generations of star creation and destruction there were many Earth-like planets scattered through the vast – perhaps infinite – expanse of galaxies, and indeed some 7 or 8 billion years after the big bang, the Earth itself formed along with our solar system.

We do not yet understand it very well, but whether in a warm little pond, around a deeply submerged hydrothermal vent, amongst the complex interstices of some clay-like matrix, as a pre-packaged gift from another world, or in some other way of which we have no inkling, conditions on the early Earth somehow enabled the special – though entirely in accord with physical law – chemistry necessary for the beginnings of life.

But even with the presence of life or proto-life, consciousness still did not grace the Earth. The long, slow processes of evolution by natural selection took hold and ultimately led at some time, somewhere to the first living beings that could *feel* – pain and pleasure, want and fear – and could experience sensations of light, sound, or odors. The mainstream view sees this radical development as being conditioned by the evolution of neurological behavior control systems in co-evolutionary development with more capable sensory systems. Consciousness thus *emerged* as a product of increasing biological complexity, from non-conscious precursors composed of non-conscious components.

Here we can raise many of the central questions within the problem of consciousness. Imagine we were alien exobiologists observing the Earth around the time of the emergence of consciousness. How would we know that certain organisms were conscious, while other organisms were not? What is it about the conscious organisms that explains why they are conscious? Furthermore, the appearance of conscious beings looks to be a development that sharply distinguishes them from their precursors, but the material processes of evolution are not marked by such radical discontinuities. To be sure, we do find striking differences among extant organisms. The unique human use of language is perhaps the best example of such a difference, but of course the apes exhibit a host of related, potentially precursor abilities, as do human beings who lack full language use. Thus we have possible models of at least some aspects of our prelinguistic ancestors which suggest the evolutionary path that led to language.

But the slightest, most fleeting spark of feeling is a full-fledged instance of consciousness which entirely differentiates its possessor from the realm of the non-conscious. Note here a dissimilarity to other biological features. Some creatures have wings and others do not, and we would expect that in the evolution from wingless to winged there would be a hazy region where it just would not be clear whether or not a certain creature's appendages would count as wings or not. Similarly, as we consider the

evolutionary advance from non-conscious to conscious creatures, there would be a range of creatures about which we would be unclear whether they were conscious or not. But in this latter case, there is a fact whether or not the creatures in that range are feeling anything, however dimly or weakly, whereas we do not think there must be a fact about whether a certain appendage is or is not a wing (a dim or faint feeling is 100% a kind of consciousness, but a few feathers on a forelimb is not a kind of wing). It is up to us whether to count a certain sort of appendage as a wing or not – it makes no difference, so to speak, to the organism what we call it. But it is not up to us to *decide* whether or not organism X does or does not enjoy some smidgen of consciousness – it either does or it does not.

Lurking behind these relatively empirical questions is a more basic theoretical, or metaphysical, issue. Given that creatures capable of fairly complex behavior were evolving without consciousness, why is consciousness necessary for the continued evolution of more complex behavior? Just as wings are an excellent solution to the problem of evolving flight, brains (or more generally nervous systems) are wonderful at implementing richly capable sensory systems and coordinated behavior control systems. But why should these brains be conscious? Although perhaps of doubtful coherence, it is useful to try to imagine our alien biologists as non-conscious beings. Perhaps they are advanced machines well programmed in deduction, induction, and abduction. Now, why would they ever posit consciousness in addition to, or as a feature of, complex sensory and behavioral control systems? As Thomas Huxley said, 'How it is that anything so remarkable as a state of consciousness comes about as a result of irritating nervous tissue, is just as unaccountable as the appearance of Djin when Aladdin rubbed his lamp' (1866, 8, 210). We might, rather fancifully, describe this core philosophical question about consciousness as how the genie of consciousness gets into the lamp of the brain, or why, to use Thomas Nagel's (1974) famous phrase, there is 'something it is like' to *be* a conscious entity?

III. Ancient Hints

Of course, the mainstream view has not long been mainstream, for the problem of consciousness cannot strike one at all until a fairly advanced scientific understanding of the world permits development of the materialism presupposed by the mainstream view. A second necessary condition is simply the self-recognition that we are conscious beings possessing a host of mental attributes. And that conception *has* been around for a long time. Our ancestors initiated a spectacular leap in conceptual technology by devising what is nowadays called folk psychology. The development of the concepts of behavior explaining states such as belief and desire, motivating states of pleasure and pain, and information-laden states of perceptual sensation, as well as the complex links amongst these concepts, is perhaps the greatest piece of theorizing ever produced by human beings. The power and age of folk psychology are attested by the universal animism of preliterate peoples and the seemingly innate tendencies of very young children to regard various natural or artificial processes as exemplifying agency (see, among many others, Bloom 2004; Gergeley et al. 1995; Perner 1991). The persistence of the core mentalistic notions of goal and purpose in Aristotle's proto-scientific but highly sophisticated theorizing also reveals the powerful hold these concepts had, and have, on human thought. But to the extent that mentalistic attributes are regarded as ubiquitous, no special problem of relating the mental to the non-mental realm can arise, for there simply is no such realm.

But interesting hints of this problem arise early on in philosophy, as the first glimmerings of a naturalistic world view occur. A fruitful way to present this history is in terms of a fundamental divergence in thought that arose early and has not yet died out in current debate. This is the contrast