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Behaviourism Is Back!

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Abstract

It was not long ago that behaviourism was almost a contemptuous epithet, if not a contretemps career epitaph, and few theorists wished to be mistaken for behaviourists. However, there has been a recent shift of alliances with the emergence of a new breed of researchers that openly advocate the incorporation of behaviourism into the study of consciousness. This critical essay is therefore devoted to the examination of Rodney Cotterill's work whose theoretical orientation in the field of consciousness positions him among the eminent members of this growing group of theorists.

Behaviourism was once a dominant movement in psychology, and, even as late as 1976, it was not uncommon to come across claims that 'since the days of Chicago functionalism and Columbian Thorndikianism, no one has seriously doubted the hegemony of behaviourism' and that any other theoretical predilection in psychology 'existed more by contrast with behaviourism than as a school of thought in its own right.' (Wispé & Thompson, 1976, 346) Yet shortly thereafter, the "cognitive revolution" displaced behaviourism from psychology's front page and, increasingly, from departments of psychology. But, what did happen?

In his historical re-evaluation of behaviourism with an unreserved recommendation for its reintroduction into the mainstream psychology, John Staddon traces the eclipse of behaviourism by cognitive revolution back to two principal factors: the digital computer and the theoretical paucity of Skinnerian behaviourism. (Staddon, 1993) The appearance of digital computers

provided a feasible framework for mentalistic ideas to be simulated for the first time, and thereby cognitive psychology was enabled to parry behaviouristic criticisms that cognitive theories were inexact and anecdotal. Secondly, the appropriation of behaviourism by the Skinnerian radical rendition of it — with its strong bias against formal theory and its belief that psychology is nothing but the collection of orderly behavioural experimental data — deprived behaviourism of the necessary means to understand the multifarious manifestations of the mind and its inner workings. Staddon laments that the atheoretical excesses of radical behaviourism went to the extent that they 'blocked advances within behaviourism so that *connectionism*, the next evolutionary step in the associationistic tradition of the early behaviourists, was forced to find home in cognitive, rather than behaviouristic, psychology.' (Staddon, 1993, 108)

With appropriate theoretical chastisement, however, we are given to understand that the reformed behaviourist can offer a framework for scientific psychology that far surpasses conventional cognitive psychology in its explanation and prediction of mental phenomena. The new theoretical behaviourism, Staddon suggests, can deal with mentalistic problems like consciousness without ignoring them, obscuring the distinction between what is inside as opposed to what is outside the organism, or confusing what is felt with what can be measured, while remaining faithful to its fundamental insight about the mind, *viz.*, behaviour. That is, "renaissance" behaviourism is promised to provide theoretical links between *behaviour* and the *brain* that have allegedly eluded cognitive psychologists thus far. It is, therefore, against this backdrop that the aims and achievements of researchers like Rodney Cotterill could be better appreciated.[1]

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In the *Enchanted Looms*, Cotterill is primarily concerned with the contentious core of the mind/body problem, namely, consciousness, within the broad framework of a computational approach, as suggested by the subtitle, *Conscious Networks in Brains and Computers*. Among the most profound puzzles like the origin of the Universe, the nature of time, and the relationship between the four fundamental forces of nature, Cotterill believes that 'consciousness is fast becoming one of the last major bastions of mystery.' (Cotterill, 2000, xi) Yet, Cotterill's contention is nothing other than to demystify consciousness. The tome is, thus, intended to answer questions such as how it is possible for conscious states to depend upon brain states, how technicolour phenomenology can arise from soggy gray matter, what makes the bodily organ called brain so radically different from other bodily organs like lungs, and how the combination of millions of individually insentient neurones can culminate in sentience and consciousness. In short, 'how consciousness arises from the brain's anatomy and physiology.' (Cotterill, 2000, 10) For Cotterill, however, the justification for delving into such matters substantially stems from the 'ultimate need to judge whether conscious computers are likely to emerge in the foreseeable future.' (Cotterill, 2000, 172)

To set the scene for discussion, it would help to give an outline of Cotterill's eleven-chapter odyssey in the *Enchanted Looms*. The book could be effectively divided into three parts. Part one, consisting of the first two chapters, offers an overall view of the project, its problems and the history of mind in terms of its physics. The second part, covering the next six chapters, describes the cortical anatomy and neurophysiology of brain in great details with an emphasis on

how a computational theory could be used to explain cerebral activities. Concerning the latter, however, Cotterill is very insistent on distinguishing between computational constructions inspired by the brain and the actual neuronal networks present in the brain, where it is the latter that one should aim for in the quest for understanding consciousness. In the final part, forming the last three chapters, Cotterill attempts to explain the emergence and functioning of a range of mental phenomena such as sensation, thought, emotion, intelligence, introspection, and language from a neurological-*cum*-philosophical perspective.

It should be noted that Cotterill himself is one of the leading researchers in the field with an expertise in biophysics, and naturally his approach to the question of consciousness is heavily informed by his empirical background. His account could, therefore, be embedded within the greater camp of *constructive naturalism*, according to which consciousness is a purely natural phenomenon and its explanation must be solely constructed in terms of physical notions and concepts. In this spirit, Cotterill develops a scientific approach to consciousness by linking conscious experience to observations from neuroscience and cortical anatomy about correlated brain activity and function, and to the descriptions of mental processing that come from psychology and cognitive science. A characteristic feature of Cotterill's naturalistic approach is its *bottom-up* strategy, whereby the aim is to synthesise a multi-cellular picture from the available knowledge of how individual nerve cells behave. (Cotterill, 2000, 29) That is, to present an explanation of conscious phenomena in terms of the underlying processes at the neuronal level. Whereas a *top-down* route takes its starting point observations on the behaviour of the complete person and uses these to draw conclusions about the nature of the underlying

mechanisms. Although Cotterill agrees that a full and complete explanation should include both strategies (Cotterill, 2000, 321), he insists that a proper appreciation of the top-down route could be obtained only through prior consideration of what the bottom-up strategy is able to offer. From a philosophical perspective, however, the merit of Cotterill's work lies in its sensitivity to and concern for issues surrounding consciousness in philosophy.

Obviously, the first port of call in the quest for a constructive account of consciousness is to give a delineation of what one is looking for, *viz.*, 'what consciousness actually is.' (Cotterill, 2000, 9) However, as Cotterill concedes and most other researchers in the field readily attest, the concept has turned out to be very elusive and hard to elucidate. Nonetheless, Cotterill offers an interesting diagnosis for the difficulty to pin down the 'bare essentials' of consciousness: it is the failure to separate consciousness from its products. Cotterill contends that the elusiveness emerges from the sheer abundance of mental and experiential phenomena mediated by consciousness which has eclipsed the nature of this fundamental attribute. On his reading, one must differentiate between the underlying mechanism of consciousness and its mere consequences, *i.e.*, 'the tall and richly varied oaks of our conscious experiences and the little acorn of the underlying mechanism.' (Cotterill, 2000, 332) Cotterill thus proposes that '*it is the mind that is the product of consciousness*.' (Cotterill, 2000, 10; original emphasis)

With this ontological reversal and in pursuit of exposing the bare essentials of consciousness, Cotterill adopts a paradoxically "refreshing" approach by appealing to behaviourism and motor theory of mind. Within the constructive naturalist camp, Cotterill is espousing a type of neo-

behaviourism — he in fact calls it *quasi-behaviourism*. (Cotterill, 2000, 344) According to classical behaviourism, there was nothing over and above behaviour or disposition to behaviour to the mind. However, behaviourism came under heavy attack especially for its neglect of *internal states*, and through the sustained criticism of people like Noam Chomsky the appellation became almost a term of abuse! Yet, interested parties like Cotterill, while avoiding the excesses of behaviourism such as the rejection of internal states and indeed deeming them as necessary constituents, have availed themselves of its idea of constructing mental activities in terms of bodily behaviour and motor movement.

It is in this vein that Cotterill describes the brain as 'a stimulus-response device' and states that what constitutes the unifying characteristic of all animal responses including humans' — with their varying degrees of sophistication, of course — is that 'our goals are all accomplished by muscles.' (Cotterill, 2000, 21) He claims that, except in those cases where the movement is part of a reflex, the muscular output is determined by processes taking place in the brain: mechanisms that produce an appropriate response for a given sensory input. He thus views the challenge of accounting for the mind, unlike the classical behaviourists, in terms of obtaining a clear picture of those intervening events. This naturally leads Cotterill to an extended treatment of brain functioning, but he argues that there is a certain continuity as things progress from the obviously simple devices to the manifestly more complex ones like human brain. Steadily increasing demands on the performance of our brain does not require any radical change in what could be called the physics of its behaviour, nor should it suggest that the processes underlying brain function involve principles not previously encountered in the scientific enterprise.

Against the backdrop of an evolutionary outlook on the brain's function in terms of its unique contribution to the body's survival and reproduction, Cotterill suggests that the evolution of the brain from its simplest configuration to the apex of its complexity in human beings has been only for the furthering of those goals. The cerebral cortex, as much as the limbic system, is nothing other than an embellishment that simply serves the same general cause, and the acquisition of a widened inventory of operational choices is only a means to enhance the organism's chance of survival. In this light, it should not come as a surprise when thinking — the "pinnacle" of mental manifestation — is characterised by Cotterill as '*a bodily function*.' (Cotterill, 2000, 59; original emphasis) More specifically, 'thought proceeds through the *simulation* of muscular movements.' (Cotterill, 2000, 338; original emphasis)

Cotterill uses the same strategy to extend his neo-behaviouristic explanatory paradigm to other cerebral phenomena. He argues that the role of memory, for example, in the functioning of the real brain is to render it robust against externally imposed variations in its operating conditions, which, he claims, is achieved through muscular movements. He then goes on to marshal certain empirical evidence to show that memory is conditional on muscular activity. Similarly, "the oaks" of consciousness is subjected to the mechanistic modelling. However, before presenting Cotterill's account, two preparatory points are in order.

First, although Cotterill admits that there is no unanimous and uncontentious definition of consciousness, he proposes, *à la* John Searle, a consciousness agenda that homes in on six

structural characteristics of consciousness. These are the features that a successful theory of consciousness must meet: namely, *subjectivity* and *qualia*, *unity* and *continuity* of consciousness, *intentionality*, *central* and *peripheral* consciousness, *familiarity*, and *boundary conditions* or *situatedness* of consciousness. [2] Second, one should recognise that an essential evolutionary element in the emergence of consciousness is *time*. That is: 'If the organism is to have the ability of responding to the temporal texture of its environment, on the time scale inherent in that texture, it will have to be able to retain a temporary record that spans a sufficient amount of that texture. And it will need cognitive mechanisms which extract relevant information from the texture, in the time available. Only then will a response be possible which exploits the choice implicit in the existence of that texture. Failing this, the information in that texture will be lost, and the resulting synaptic changes (if any) will merely reflect the statistics of the texture.' (Cotterill, 2000, 333)

Now, subjectivity and qualia refer to how we as subjects of experience undergo experiential episodes with their qualitative/phenomenal features. Whereas the unity of and the continuity of the stream of consciousness refer 'to the fact that our experiences occupy a single conscious field, irrespective of whether we are sensing external events or are occupied by our thoughts', and our 'experiences and thoughts are retained for a few seconds' thus enabling 'us to build upon them.' (Cotterill, 2000, 320)

With the 'time' factor in mind and ensuring that environmental changes are not wasted on us, Cotterill claims that qualia arose 'naturally from the need to monitor the significance for the

body of the environment's response to a volition-provoked stimulus.' (Cotterill, 2000, 357) Subjectivity and its related qualia are thus seen in terms of the interplay between internal and external reafference of nerve signals. Cotterill also cites clinical cases such as 'the observations on victims of multiple personality disorder' as further justification for the idea that qualia are inextricably related to the body's musculature. (Cotterill, 2000, 370) In the same spirit, he explains the unity and continuity of consciousness thus: 'The unity of conscious experience stems from the fact that the premotor area acts as a bottleneck, policing planned movements so as to prevent them from bringing the body's muscles into mutual conflict; the unity therefore stems from the fact that a muscle can adopt only one state at any given time, and this forces the system to follow only a single muscular path, which essentially determines the direction taken by the stream of consciousness.' (Cotterill, 2000, 374)

There are, however, several ways of engaging critically with Cotterill's conception of consciousness. At one level, one may attempt to assess his extensive empirical descriptions and interpretations of the workings of brain's neuronal machinery. But, the difficulty with this type of critical engagement is that even if one unhesitatingly accepts the accuracy of all the empirical observations at the *micro*-level, one is still in the dark about the *macro*-level: that is, how certain neuronal activities in the brain culminate into a conscious experience. Why, for example, certain neuronal firings feel like the taste of avocados or a deliberate decision to go to an opera, whereas other neuronal firings feel like nothing at all? It is this reductive gap that is still yawning! This is not an attempt to set up an anti-reductionist roadblock but a plea for an explanatory causeway. Cotterill maps out a series of stepping stones in the trail of consciousness, but at a few

challenging places along the track we are encouraged to make a fairly acrobatic leap from one stone to the next and ultimately to the mosaic of the mind.

At another level of critical assessment, one may take issue with Cotterill over some specific topics such as his account of *concept* formation, his predilection for a *connectionist* model of brain, his intimation of *modularity* of brain, or his evolutionary assumptions about cognition. For one thing, there are theoretical tensions between modularity and connectionism concerning, for example, the issue of *innateness*; yet Cotterill does not seem to be concerned about the urgency of addressing these doctrinal conflicts. For another thing, Cotterill himself concedes the limitations of the principle of *association* underlying neural networks and recognises the inadequacy of connectionism in tackling the somewhat classical "Fodor-Pylyshyn-esque" criticism of connectionism that it fails to account for the *productivity* and *systematicity* of cognition. (Fodor & Pylyshyn, 1988) But, in a bit more detail, I am going to look at Cotterill's account of concept formation and his evolutionary assumptions about cognition.

Concepts are considered to be the most fundamental constructs in theories of mind, and naturally Cotterill attempts to shed some light on this all-important mental machinery. Given their importance to all aspects of cognition, it is also no surprise that concepts raise so many controversies and questions in philosophy and cognitive science. These range from the relatively local one like "Should concepts be thought of as bundles of features, or do they embody mental theories?" to the most global one like "Are concepts mental representations, or might they be

abstract entities?" Indeed, it is even controversial whether concepts are objects, as opposed to cognitive or behavioural abilities of some sort.

Uncharacteristically, however, Cotterill's treatment of concept formation is insufficiently detailed and is limited to such general statements as: 'Our sensory systems generalize without us being aware of the fact. They effortlessly interpret the particular in terms of the general, thereby converting a *percept* to a *concept*.' (Cotterill, 2000, 162-3) Concept formation, Cotterill hints, is a matter of detecting 'the underlying logic in' input patterns and 'making abstractions.' (Cotterill, 2000, 174) But, this is very much reminiscent of the classical abstractionist theory of John Locke which has been found highly problematic and guilty of, *inter alia*, what Jerry Fodor has termed the *inductivist fallacy*. (Fodor, 1980a) That is, theories purporting to explain new cognitive acquisitions like concepts can offer explanation on pain of presupposing the availability of the very concepts involved in the new acquisitions. The underlying thought here is that a stronger representational system cannot arise from a weaker one by means of general learning. (Fodor, 1980b) Overall, Cotterill's account of concept formation fails to grapple with any of the important issues surrounding the nature, structure and acquisition of concepts.

The other contentious aspect of Cotterill's work is his evolutionary assumptions about cognition. His theory is built on the applicability of evolutionary criteria to cognition where it is assumed that natural selection is a sufficiently *fine-grained* process to be able to have an impact on cognitive capacities. Despite the appeal of explaining cognition as the result of evolution through natural selection, there are serious qualms about administering evolutionary explanations to

cognitive capabilities. Natural selection is often deemed to be too *coarse-grained* to be sensitive to such traits, and evolutionary explanations of cognition seem to be founded at best on an analogy with biological evolution. Notwithstanding the consideration that analogies are often poor means of persuasion, as genetics/evolution experts like Richard Lewontin, amongst others, have been persistently arguing, even if it were true that selection operated directly on cognition, we have no way of measuring the actual reproductive advantages. (Lewontin, 1998) It is very important to recognise that the nature of any advantage accrued has to be couched in *reproductive* terms.

Also, any evolutionary reconstruction of that advantage must show that individuals or family groups, rather than the species as a whole, had such an advantage, since natural selection operates within populations to increase the frequency of some types and decrease others through differences in reproductive rates of individuals. Unless a more cognitively competent individual or its immediate family leaves more offspring than other families, selection will not increase the frequency of the selected character. Moreover, there is no necessary relation between the selective increase of a character in a species and any benefit to the species as a whole. There is no general principle of natural selection that operates to benefit a species as a whole. Generally, the problem is that there may have been no direct natural selection for cognitive ability at all. Cognition may have developed as the purely epiphenomenal consequence of the major increase in brain size, which, in turn, may have been selected for quite other reasons.

Yet, at another level of critical evaluation, Cotterill is also facing challenges, of principle and not of detail, from his fellow naturalists, in particular, *eliminative* and *anti-constructive* naturalists. Like Cotterill, eliminativists maintain that the story of "the brain's anatomy and physiology" will tell the tale of mental life, but unlike Cotterill they claim that consciousness is not going to be a character in that narrative. It is simultaneously too simplistic, too vague, and too historically embedded in false and confused theory to designate a genuine phenomenon or set of phenomena in need of explanation. Consciousness is a relic of a dark ignorant past! However, Cotterill's silence on the eliminativits' animadversions on *folk psychology* is rather conspicuous.

The other rival naturalist camp that Cotterill ignores is anti-constructivism. Basically, the position holds that although the mind is a natural phenomenon, it is, in Colin McGinn's terms, *cognitively closed* to us. (McGinn, 1989) There cannot be a naturalistic construction of consciousness because of our very cognitive constitution. Interestingly, Cotterill himself mentions the issue of cognitive closure and readily agrees with McGinn that '*certain things are beyond us*' but somehow fails to see that the case of consciousness itself could indeed be one of those very '*holes in the mind*.' (Cotterill, 2000, 402; original emphasis)

Nonetheless, structurally speaking, the fate of Cotterill's behaviouristic brand of constructive naturalisation of consciousness is very much dependent on the fortunes of the *motor theory of mind*. But, the theory, despite its legendary lineage, has had a chequered history. Charles Sherrington, as one of its early prominent proponents, was renowned for statements such as: 'To move things is all mankind can do, and for such the sole executant is muscle, whether in

whispering a syllable or in felling a forest.' (Eccles & Gibson, 1979) [3] He was convinced that despite the richness of human cognitive capabilities, our species has at its disposal only one type of external response: activation of appropriate muscles. Similarly, Edgar Adrian, another kindred spirit of the same era, states in his influential work, *The Mechanism of Nervous Action*, that: 'The chief function of the central nervous system is to send messages to the muscles which will make the body move effectively as a whole.' (Adrian, 1932)

Yet, the idea could not manage to secure a strong foothold for itself in the debates concerning consciousness. At the time, in a very provocative passage in his celebrated *The Natural History of Mind*, Arthur Ritchie vehemently protested that,

> At the suggestion that muscular movement may be intellectual I feel that there will be a stirring of indignation among the highbrows. They will say, "Why all these talk about acrobats and muscular activity? Granted that what the acrobat does is perfect of its kind it is not properly an intellectual activity, like the mathematician's for instance". In reply to this I should admit at once that what the mathematician does is much more useful than what the acrobat does; but is there any reason apart from snobbery for saying it is more intellectual? In effect the acrobat thinks with the muscles of his whole body while the mathematician thinks with — well, whatever it is he thinks with. Of course it may be that the mathematician does not think with anything but just thinks. Even if this were true, which is doubtful, I find it hard to see why thinking with nothing should be more truly thinking than thinking with your muscles. Because thinking is mental it does not follow that it is not bodily too. (Ritchie, 1936, 127)

Still two decades later in 1952, with the exception of William Ashby's foundational proposal of *mind as motion* (Ashby, 1952), Roger Sperry, another mentor of the motor theory of mind, was complaining that,

> An analysis of our current thinking will show that it tends to suffer generally from a failure to view mental activities in their proper relation, or even in any relation, to motor behaviour. The remedy lies in further insight into the relationship between the sensori-associative functions of the brain on the one hand and its motor activity on the other. In order to achieve this insight, our present one-sided preoccupation with the sensory avenues to the study of mental processes will need to be supplemented by increased attention to the motor patterns, and especially to what can be inferred from these regarding the nature of the associative and sensory functions. In a machine, the output is usually more revealing of the internal organisation than is the input. (Sperry, 1952, 296)

It is against this historical background that Cotterill recommends that it 'is high time we resuscitated the old motor theory', whereby he attempts to marshal evidence for the tenability of the theory. (Cotterill, 2000, 338) Cotterill contends that an explanation of the functioning of the underlying neuronal circuitry of our brains provides a particularly compelling evidence for the hypothesis. Indeed, in this quest, Cotterill is joined by a coterie of researchers, notably Rodolfo Llinás, [4] to reinstate the motor theory of mind.

Llinás' gloss on the motor theory of mind is that "automatic" motor acts provide an exceptional window into the nature of consciousness. He calls such movements "fixed action patterns" and argues that they are where thinking and consciousness begin. Active movement is the very source and main stem of mental life: '*that which we call thinking is the evolutionary*

internalisation of movement'. (Llinás, 2001, 35; original emphasis) Llinás points out that only moving organisms have brains: in contrast to animals on the prowl that rely on environmental monitoring and manipulation for their survival, a tree, for example, has no need of a central nervous system because it is not going anywhere. According to Llinás, the mind is just the nervous system and the nervous system evolved to control active movement. In Llinás' view, the tunicate (a "sea squirt") best exemplifies this close connection between movement and mentality. This marine creature starts life as a motile larva, equipped with a rudimentary brain-like ganglion of about 300 neurons that receive sensory information about its surrounding habitat. [5] But after a day or two of cavorting in the shallows, the larva finds a hospitable stationary substrate and proceeds to implant its head end into the selected location, thus becoming sessile. As a sessile organism, the sea squirt then 'absorbs much of its brain and returns to the rather primitive condition of the adult form of the species'. (Llinás, 1987, 341) [6]

Now, whether or not the empirical evidence amassed in favour of a motor theory of mind withstands criticism has almost become a peripheral issue for the behaviourism enthusiasts. From their perspective, what is significant is that a new lifeline has been thrown to behaviourism. The doctrine of behaviourism has been frequently declared dead. Obituaries and services for behaviourism abound, and yet the corpse keeps creeping out of the coffin. 'The disinterested observer', surmises Staddon, 'might well conclude that vigorous attacks on an allegedly moribund movement are a signal that behaviourism threatens to resurrect.' (Staddon, 1993, 10) To the delight of its disciples, Cotterill's "consciousness" certainly corroborates the reports of resurrection: behaviourism is back! [7]

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NOTES

[1] For the sake of accessibility, the following discussion is largely focused on Cotterill's *Enchanted Looms*, which not only conveniently collects the findings of years of investigation into a single volume but also provides a comprehensive account of Cotterill's approach.

[2] However, in the subsequent discussion, only the first two characteristics are going to be considered.

[3] Sherrington was an influential English physiologist whose book, *The Integrative Action of the Nervous System*, summarised most of what was known at the turn of the twentieth century about the reflex and exerted a strong influence on the evolution of psychology, especially behaviourism. Among his pioneering efforts, Sherrington is credited for coining the term *synapse*. Unsurprisingly, Cotterill has adopted the title of his book, *Enchanted Looms*, from a passage in Sherrington's *Man on His Nature*.

[4] Llinás is a leading neuroscientist who has made major contributions to the understanding of the properties of nerve cells and how they communicate within the brain. Much of his work has been in the biophysics of mammalian central neurons, where he has been able to make important advances in the ontogeny and phylogeny of brain development.

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[5] The rudimentary central nervous structure of sea squirts consists of a statocyst (organ for balance), a primitive eye, and a notocord (primitive spinal cord).

[6] Llinás then goes on to compare the adulthood of sea squirts to 'a process paralleled by some human academics upon obtaining university tenure'!

[7] I would like to thank Anthony Freeman for his helpful comments and suggestions.

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