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How Free is Free?

Reflections on the Neuropsychology of Thought and Action

It is widely recognised that some of the implications of rapid developments in neuroscience raise with a fresh urgency questions of human freedom and responsibility. These are issues for humanists and atheists as much as for Christians since all claim that their often deeply held beliefs were rationally considered and freely embraced. However, the evidence from bottom-up neuro-scientific research points to the ever-tightening links between brain processes and mental processes and have been interpreted by some as pointing to a reductionist view of human nature. At the same time, with the use of new brain imaging techniques the evidence for the efficacy of top-down processes also accumulates at an accelerating pace. This paper argues that there is an irreducible interdependence between cognitive and neural processes calling for a duality of description but without necessitating belief in a dualism of substances.

Keywords: dualism, determinism, neuropsychology, genetics, behaviour, cognition, mind/brain relations

Introduction and background

'Determinism is not a boring and ancient problem… but something that calls for really new thinking', wrote Professor Ted Honderich.[1] In his recent publications Honderich links current thinking about determinism with developments in neuroscience and speculations about mind and brain. Over the last fifty years the rate of increase in our knowledge of the mind-brain relationships has accelerated at an ever-increasing pace. A key issue is noted by the neurologist Adam Zeman[2] who, after a detailed discussion of consciousness and its neural correlates, identified as one of the three issues at the heart of the debate the question 'What are the implications of the intimate relationship between consciousness and brain events for human freedom and responsibility?' Problems which in the past could be noted but set aside with comments such as 'That is interesting but of course you will never be able to show how a particular cognitive event depends on particular brain processes', or 'You can't

1 From Abstract of paper by Ted Honderich, Grote Professor of the Philosophy of Mind and Logic at University College London, editor of *The Oxford Companion to Philosophy*, and author of *A Theory of Determinism: the Mind, Neuroscience, and Life*, recently reissued as *Mind and Brain and the Consequences of Determinism*.The paper was delivered at the annual conference of Academia Europaea in Graz in 2003 and will be published in European Review, C.U.P.

2 Zeman, A. *Consciousness : A user's guide*, New Haven and London: Yale University Press (2002), p.303.

prove that this or that aspect of moral behaviour is linked to activity in selected brain regions…', now warrant a fresh look. All this notwithstanding, the fact remains that lack of scientific data has not stopped philosophers from arguing about such issues for centuries.

Fifty years ago David Hubel[3], whose work with Torsten Wiesel ushered in a new era in neuro-scientific research, and who was awarded a Nobel Prize for his work, commented: 'Fundamental changes in our view of the human brain cannot but have profound effects on our view of ourselves and the world.' Scientific advances shape our assumptions about reality. Another Nobel laureate, Francis Crick[4], writing twenty years after Hubel, argued that developments in cognitive neuroscience necessitated a radical shift in the way we think about our human nature and, in particular, the abandonment of widely held and traditional dualistic ways of thinking about the relation of mind and brain or soul and body. Crick was noting the background of pervasive (though not universal) dualism so familiar in the Western world. So long as an immaterial soul/mind was able to influence a material body/brain, freedom from physical determinism seemed safeguarded, but even this was only if you assumed that the soul/mind is not determined by brain events.

Pervasive dualism

Dualistic beliefs are widely held in both Christian and Islamic thinking still today. The dualistic views of great thinkers of the past such as Plato, Galen, Origen, Nemesius, Augustine and Descartes were not however universally held. In the late Middle Ages St Thomas Aquinas attempted an impressive synthesis of Christian and Aristotelian ideas which became Catholic orthodoxy. Leslie Stevenson[5] has written that Aristotle believed that the human soul or mind should be understood not as a thing, but as a way of functioning or, more precisely 'a distinctive cluster of faculties including reasoning, which are fundamental to the human way of living and functioning'. However, as Stevenson also points out, when Aristotle suggested that 'there is something specially different about the human intellect, namely our faculty for purely theoretical thought' and that this faculty, this kind of functioning, can exist separately from the body 'as the everlasting can from the perishable' (de Anima for 431b 26), he provided an escape hatch readily seized upon by some Islamic and Christian thinkers. Stevenson wrote, 'Some of Aristotle's Islamic and Christian successors were happy to exploit this apparent backtracking in his philosophy of mind.'

Strongly dualistic views also remained prominent in the writings of some of the Protestant reformation leaders such as John Calvin. These dualistic views

3 Hubel, D. 'The Brain', *Scientific American*, September 1979, 45-53.
4 Crick, F. *The Astonishing Hypothesis*, London: Simon and Schuster (1994).
5 Stevenson, L.& Haberman, D.L. *Ten Theories of Human Nature,* 4th. Edition, New York: OUP (2004).

are also an intrinsic part of the beliefs widely held by New Agers. For New Agers, you are a soul or mind who inhabits a body. You can travel out of the body, you can read others' minds, you can glimpse the future. Your soul or mind may have inhabited another being, and may again be incarnated in someone to come. At your body's death you will meet a gentle being of light (which is said to have been experienced by those near-death survivors whose spirits temporarily vacated their bodies).

Some of the views of New Agers resonate with some of the intuitions widely shared by psychic researchers that have sufficient face validity to have warranted sustained investigation over many years. David Myers[6] has comprehensively reviewed and penetratingly analysed the powers and perils of our intuitions, but his findings lend no support to these intuitions about either the reality or the powers of a nonmaterial soul or mind. There remains however a widespread reluctance to accept the results of years of such careful research that continue to add to the mountains of negative findings. David Myers quotes Ray Hyman as noting that the scientific research for psychic phenomena is replete 'with examples of psychical researchers claiming they finally proved the existence of the paranormal. In each instance, subsequent generations of parapsychologists have had to discard as badly flawed what had seemed to the previous generation to be irrefutable proof of psi, or psychic phenomena.' Myers also quotes the parapsychologist Rhea White, writing in the Journal of the American Society for Psychical Research that 'the image of parapsychology that comes to my mind, based on nearly forty-four years in the field, is that of a small aeroplane that has been perpetually taxiing down the runway of the Empirical Science Airport since 1882… its movements punctuated occasionally by lifting a few feet off the ground only to bump back down on the tarmac once again.' After thousands of experiments no reproducible ESP phenomenon has ever been discovered, nor has any researcher produced any individual who can convincingly demonstrate psychic ability. Myers concludes 'The scientific attitude – test to see if it works – has led both believers and sceptics to agree that what parapsychology needs to give it credibility is a reproducible phenomenon and a theory to explain it.'

Dualism, in a word, remains a crucial component of many but not all such beliefs. And it is not surprising when we remember that 'there is a powerful human tendency to conceive of the mind as an immaterial substance, an ethereal being that breathes psychological life into the physical body'.[7]

Freedom and Determinism

Was Ted Honderich himself free to write the opening quotation of his paper? He believes that he was. Those of us who were listening to him believe that he

6 Myers, D. *Intuition: Its Powers and Perils*, New Haven: Yale Univ. Press (2002).
7 Zeman *op.cit*. [2], pp.50,151.

was. We also believed that rational debate could clarify the viewpoints he was presenting and that we ourselves were free to modify our views in the light of what he said. There was a tacit shared belief that in some important sense we are free to consider evidence, evaluate it, see how it challenges our current beliefs and then modify those beliefs in ways that we judge appropriate in the light of the evidence and the rational debate about that evidence. As we have already noted, determinism is not a new problem. Wiser people than us have thought and argued about it for millennia, even though they had the option of a dualistic view that in its simplistic format posited an immaterial mind free from the constraints of our physical embodiment and therefore able to solve the problem of our freedom to choose at a stroke. But to postulate some sort of mere randomness, such as unpredictable quantum jumps in the soul, does not seem to preserve our rationality – our responsiveness to evidence and arguments presented through our eyes and ears. However, as we have also noted, there is today an emerging consensus that developments in science, and in particular in genetics and neuroscience, seem to make it increasingly difficult to square the scientific evidence for the biological determinism of behaviour and cognition with our personal feelings and convictions about our own freedom. A similar argument could be made for the effects of the cultural environment – the influences of advertising, the media and 'fashion'. The choices that we make are not confined to whether or not we have sugar in our coffee. They have moral implications for how we treat ourselves, other people, and the society in which we live. Consider a recent case report graphically illustrating biological determinism.

In the year 2000[8] a schoolteacher began collecting sex magazines and visiting pornographic web sites, focusing attention on images of children and adolescents. In his own words 'he could not stop himself doing this'. When he started making subtle advances to his stepdaughter his wife called the police. He was arrested for child molestation. He was convicted and underwent a twelve-step rehabilitation programme for sexual addicts. The day before his sentencing he voluntarily went to the hospital emergency department complaining of a severe headache. He was distraught and contemplating suicide. The medical staff who examined him said that 'he was totally unable to control his impulses' and that 'he had propositioned the nurses'. An MRI scan of his brain revealed an egg-sized tumour pressing on his right frontal lobe. The frontal lobe tumour was removed. His lewd behaviour and paedophilia faded away. Psychiatrists specialising in behavioural changes associated with brain disorders commented, 'this tells us something about human behaviour, doesn't it?' If one's actions are governed by how well the brain is working does it mean that we have less free will than we think? A year later the tumour partially grew back and the man started once again to collect pornography. A further operation removed the re-growing tumour and his urges again subsided.

8 Swerdlow, Russell & Burns, Jeffrey *Archives of Neurology* 2002.

There was widespread comment on this case. A neurologist[9] said that 'he saw people with brain tumours who would lie, damage property, and in rare extreme cases, commit murder'. He further commented, 'the individuals simply lose the ability to control impulses or anticipate the consequences of choices'. A second psychiatrist[10] specialising in behavioural changes associated with brain disorders and who had studied the way in which brain tumours can affect a person's behaviour commented, 'this tells us something about being human, doesn't it?' And he went on, 'if one's actions are governed by how well the brain is working does it mean we have less free will than we think?' All these specialists know that human behaviour is governed by complex interactions in the brain. Many neuroscientists believe that so-called executive functions – that is, decisions with major consequences – are dependent upon the intact functioning of systems within and/or linked to the frontal lobes, regarded as the most highly evolved area of the brain. Tumours in this area can squeeze enough blood from the region effectively to put it to sleep thus dulling someone's judgment in a way similar to drinking too much alcohol. Only in very rare cases, however, will the tumour turn the person to violence or deviant behaviour.

Was the schoolteacher with a frontal lobe tumour free to act in the way that he did, whether he wished to or not? The obvious answer to the question is 'no he was not free'. We say this because we can identify a specific biological cause for the behaviour that we observe. It is all the more striking in this 'experiment from nature' because of the reversal in his behaviour as the tumour began to regrow and the further reversal when that was again removed. As the neural substrate changed so did the freedom to act in line with his personal intentions. But could it be the case that if only we knew more about the subtle changes in the neural substrates underlying all of our behaviour and cognition, more doubt might be cast on our firm conviction of our personal freedom to choose to behave in this way or that? And might that apply also to our 'scientific' behaviour when we construct and defend theories according to the relevant evidence? And if that were the case, would that empty any and all of our actions of deserving praise or blame? All these questions are predicated on the basis of our current scientific understanding of the relation of brain and mind. The extent to which this will stand or fall in the constant process of revision in light of accumulating scientific evidence remains an open question. At any one time we face the extrapolation from evidence that *some* behaviours seem neurologically determined the view that *all* behaviours might be! Such extrapolations have been going on for centuries. Sir William Osler, believed to be the first person to use the term 'neuropsychology',[11] is reported to have warned a group of newly qualified doctors at the turn of the twentieth century 'Gentlemen, I

9 Tranel, Daniel T. quoted by Chris Kahn in 'Paedophile "Cured" After Surgery' July 28, 2003.Associated Press.
10 Yudefsky, Stuart C. quoted by Kahn in Associated Press as above [9].
11 Jeeves, M.A. 'Neuropsychology',in Gregory, R.L.(ed.) *The Oxford Companion to the Mind*, Oxford:OUP (1987) pp.545-548.

must tell you that half of what you have been taught is wrong, and we don't know which half.' The point is well taken in regard to our present understanding of brain-behaviour relations. But it would be a cop out to seize upon this as an excuse for not facing up to the clear direction in which the evidence on brain and mind relations for the past fifty years has been pointing. The details will doubtless change beyond all recognition but it is a reasonable assumption that the main thrust of the tightening of these links will remain. There is a problem and it becomes more acute with every fresh discovery in the genetics and neuroscience of behaviour and cognition.

Genetics, Behaviour, Cognition

Though the genetics of behaviour and cognition is not the focus of this paper, it is sufficiently relevant to warrant a brief comment on current views. Where better to look than a recent issue of the British Journal of Psychiatry which, conveniently for our purposes, has its main Editorial devoted to the complex interactions of genes, environment and behaviour? Professor Leon Eisenberg[12], its author, noted that April 2003 marked the fiftieth anniversary of the deciphering of the DNA code by Watson and Crick and was also the month and the year when Francis Collins and his colleagues announced the completion of the human genome. Eisenberg describes 'the dogma of one gene/one protein, as a useful fable for its time'. But this fable is widely believed, ignoring, as Eisenberg notes, that

> alternative splicing permits multiple proteins from a single gene, thirty thousand plus genes code for one hundred thousand plus proteins; epigenetic post translation modifications create the potential for one million different proteins that must interact to produce a viable human being. The assembly of these components reflects not merely the code but biological and social pulls and pushes at work during its fabrication. Men and women, in all our diversity, emerge from these intricate and unpredictable interactions.

Eisenberg argues that we must replace the rhetoric of 'nature versus nurture' with 'nature, *niche* and nurture' to emphasise the conjunctions rather than the oppositions that shape the developmental trajectory. There are, of course, limiting cases at either extreme. But 'in most clinical circumstances the gene effects that we identify have been modified by the environments the organism has encountered; the environmental effects that we see are dependent on the genomes upon which they have acted'. But 'niches' do not just happen. The understanding of 'niche construction' is today seen as a 'fundamental problem for science'.[13]

12 Eisenberg, Leon 'Social Psychiatry and the human genome: contextualising heritability' *B. J. Psychiatry* (2004),184, 101-103.
13 Olding-Smee, F.J., Laland, K.N.& Feldman, M. *Niche Construction-The Neglected Process in Evolution. Monographs in Population Biology*. Princeton: Princeton University Press (2003), p.xi.

Eisenberg's critique of some of the current dogma about genes finds further support in the newly recognised importance of so-called 'junk genes'. Wayt Gibbs notes that 'Journals and conferences have been buzzing with new evidence that contradicts conventional notions that genes…are the sole mainspring of heredity and the complete blueprint for all life…there is no longer any doubt that new theory is needed to replace the central dogma that has been the foundation of molecular genetics and biotechnology since the 1950s.'[14]

It is perhaps no coincidence that in the same issue of the British Journal of Psychiatry in which Eisenberg's paper appeared there is a paper entitled 'Predictors of antisocial personality'.[15] This is a follow-up study, extending in some instances over twenty-five years, to explore the independent and joint effects of childhood characteristics on the persistence of antisocial behaviour into adult life. The researchers concluded 'Childhood disruptive behaviour has powerful long-term effects on adult antisocial outcomes, which continue into middle adulthood. The importance of number of symptoms, the presence of disruptive disorder, and intermediate experiences highlight three areas where interventions might be targeted.' To sum up, genetic loading has an effect but intermediate experiences and interventions are also powerful influences of outcome in terms of behaviour.

The challenge is to arrive at and present a balanced view. If determinism is a problem, the way it is often presented is at times one of our own making, in the sense that there is an almost universally shared belief that within wide bounds we are free to choose how to act and what to believe, even whilst remembering that there are pathological conditions, as in the case of the teacher cited above, to whom such normal freedom no longer applies. Those who write so persuasively about the pros and cons of the myriad 'isms' proposed to provide solutions to these problems seldom seem to have any doubt that *they* at least were acting freely and rationally in putting forward *their* proposed solutions.

For those who are committed to any of the great religious traditions of the world these issues come very close to home. Within each religion and humanistic ethical system there are widespread shared beliefs about appropriate ways of behaving. Certain behaviours are acceptable and honouring to God whilst others are unacceptable and dishonour their high calling. But is it easier, because of different genetic make ups and different brain mechanisms for some to love others, to be compassionate, to control their anger and their sexual drives than for others? In a word is discipleship and the quest for holiness a function of genetic endowment and neural circuitry? Lindon Eaves' demonstration of 'a strong prima facie case for some role of genes in the origin of sig-

14 Wayt Gibbs, W. 'The Unseen Genome: Gems among the Junk' *Scientific American* Nov. 2003. 48-53.

15 Simonoff, E., Elander, J., Holmshaw, Pickles, A., Murray, R., & Rutter, M., *British Journal of Psychiatry* (2004) 184,118-127.

nificant dimensions of religion and values',[16] should make us pause before giving a knee-jerk 'yes' or 'no' to this question.

Dualism: a revered and ready solution

It is a gross oversimplification and caricature to pretend that dualism is necessarily a totally outmoded way of thinking about the relation of soul and body or mind to brain. As indicated above, it has a long and illustrious history of more than two millennia as a view held and championed by some of the wisest people from the past. One of the great attractions of dualism arises by positing a non-material part of our nature where we can locate our freedoms to think and act freed from any constraints of our physicality. The soul or mind, being non-physical, is not influenced by changes in our physical make up whether genetic or neural. Hence our freedom is protected. Nevertheless, in fact, most plausible versions of dualism do allow that perceptual experiences, sensations (e.g. pain) and emotional experiences (e.g. disappointment) are *caused* by the world acting on our bodies.

The dualisms held by New Agers and those interested in parapsychology certainly have immediate attractions. They guard our reluctance to accept that those who are dead have left us forever. There is little doubt that the majority of the world's population firmly believes that the mind can, as Zeman[17] puts it, 'quietly slip its moorings in the brain and depart temporarily as in near death experiences or permanently as at physical death'. Zeman wrote, 'Dualism respects our belief that experience is special, but leaves the interaction of mind and matter deeply mysterious. Physicalism, which tries to redescribe experience in one or other kind of physical vocabulary, explains how mind can trade with matter, but does so by cheating our first intuition-and "leaving out mind".'

In passing we should note that what was previously soul and body talk has, since the seventeenth and eighteenth centuries, become mind and brain. Kenan Malik has written,

> The difficulty in finding a common language in which to talk of the immortal soul and the body-machine led many seventeenth and eighteenth-century natural philosophers to speak increasingly of the 'mind' rather than of the 'soul'. The mind was not simply a synonym for the soul in a more mechanistic language. Rather, those aspects of the soul's relationship with a world that were amenable to naturalistic explanations – memory, perception, emotions and so on – were recast as problems of the mind. This transformation helped minimise conflict between theologians and natural philosophers: the soul eventually became the domain purely of theology,

16 Eaves, L. 'Genetic and Social Influences on Religion and Values', chapter in Jeeves, Malcolm (ed.) *From Cells to Souls-and Beyond*, Grand Rapids: Eerdmans (2004), pp.102-122, p.122.
17 Zeman *op.cit*.[2], p.341.

> while natural philosophers developed the 'science of mind'. But it did not resolve the underlying problem of how to talk about an immaterial entity using a language developed for describing machines. It simply transformed the terms of that problem: the question of how the transcendental soul acted upon the physical body became replaced by the question of how the immaterial mind could arise out of fleshy matter. It still remains a central question for the science of mind. [18]

The issue is, however, not quite as straightforward as Malik suggests. As Stevenson points out, whilst as a broad generalisation we may say that for the past two millennia a dominant view of soul-body or mind-brain relations was expressed in some form of dualisms, there were other views. These included those of Aristotle, Spinoza and materialists such as Hobbes and de la Metrie. The pitfalls faced by those of us who are scientists when discussing mind-brain become all too evident. E.O. Wilson[19], a distinguished sociobiologist not unacquainted with controversy, did not endear himself to philosophers when he wrote that 'the history of philosophy consists largely of failed models of the brain'. Malik turned the tables on Wilson by suggesting that 'the history of the science of man consists largely of failed philosophical theories'. Malik made the important point that it is necessary to recognise that 'the separation of science and philosophy meant that scientists exploring the meaning of humanity can remain blind to the philosophical assumptions that animated their work, and at the same time pass off philosophical speculation as scientific fact'. He continued 'Philosophers…debate the nature of human subjectivity without considering its rootedness in biology…(whilst)… natural scientists consider the biological origins of humanity's special qualities without entering into discussion of human agency.' As a result he believes two mutually hostile camps are created, 'one viewing man from a purely naturalistic viewpoint, the other seeing him as an entirely cultural being'. We need to pay attention to Malik's conclusion that 'Each is equally one-sided and equally flawed in its attempt to understand what makes us human.' As Eisenberg wrote above, neither biological determinism nor social constructionism fit all the available evidence. As we now give a brief overview of some of the contemporary evidence we shall do our best to avoid such one-sidedness.

Bottom-up Effects

Brain, behaviour and cognition

The dramatic changes and then the reversal in the behaviour of the school teacher described earlier provided a vivid illustration of how our moral behav-

18 Malik, K. *Man,Beast and Zombie*, London: Wiedenfeld and Nicholson (2000).
19 Wilson, E.O. quoted in Malik, K. *op.cit*. [18].

iour is embodied in our physical make up. Similar dramatic effects have been on record for a long time. Every student of neurology and neuropsychology has heard about Phineas Gage, who damaged his frontal lobe in an accident and whose behaviour was permanently changed for the worse. From being a reliable industrious pillar of society he became dissolute and irresponsible. As Frans de Waal[20], when commenting on two similar patients recently studied by Antonio Damasio[21], has written, 'It's as if the moral compass of these people has been demagnetised, causing it to spin out of control…What this incident teaches us is that conscience is not some disembodied concept that can be understood only on the basis of culture and religion.' Morality, he claimed, is as firmly grounded in neurobiology as anything else we do or are.

Such dramatic reports are necessarily oversimplified when summarised in the media and inevitably give the impression that there are very specific parts of the brain doing very specific things. Within certain narrow limits this is true. For example, damage to the small V4 area of the cortex subserving vision can strip colour from the visual world leaving only a variety of greys. It is natural therefore to describe V4 as a 'colour area'. But it is important to remember that this should not imply that this area functions in isolation to give rise to colour vision: it is a necessary but not a sufficient area. Most often in the waking brain very large numbers of small cortical regions work in parallel on their specialised tasks. Thus whilst the dramatic changes observed in Phineas Gage and in others are often described as part of the frontal syndrome, it is important to remember that aspects of that same frontal syndrome can appear as a consequence of damage to a much more basal part of the brain known as the pedunculopontine tegmental nucleus. Whilst much of the data on this part of the brain has been gathered from lesions studies in rats, it seems likely from as yet limited evidence that damage to similar areas in humans may produce similar results. Philip Winn in his review of this literature notes that Ogden, for example, has commented that 'often no obvious or extensive damage to the frontal lobes can be seen in patients who display many frontal lobe deficits'.[22] Supporting such a view further is the work of Trevor Robbins[23]and his group who have examined frontal deficits in many types of neurological patients including a group with progressive supranuclear palsy. This group of patients showed deficits on all the tests of frontal function used in their examinations. Progres-

20 de Waal, F. *Good Natured. The Origin of Right and Wrong in Humans and other Animals*, Cambridge MS: Harvard (1997).pp.216-217.

21 Anderson, S.W., Bechara, A., Damasio, H., Tranch, D. & Damasio,A.R. 'Impairment of social and moral behaviour related to early damage in human prefrontal cortex. *Nature Neuroscience*, vol. 2.no.11, pp. 1032-1037.

22 Winn, Philip 'Frontal Syndrome as a consequence of lesions in the pedunculopontine tegmental nucleus: A short theoretical review' *Brain Research Bulletin*, vol. 47, no. 6.pp.551-563, 1998.

23 Robbins, T.W., James, M., Owen, A.M., Lange, K.W., Lees, A.J., Leigh, P.N., Marsden, C.D., Quinn, N.P., Summers, B.A. 'Cognitive deficits in progressive supranuclear palsy, Parkinson's disease and multiple system atrophy in tests sensitive to frontal lobe dysfunction', *J.Neurol.Neurosurg. Psychiatry* (1994) 57: 79-88.

sive supranuclear palsy involves the significant loss of neurones in this area as well as elsewhere in the brain stem, thus raising the possibility that damage to this area in humans produces a frontal syndrome. Much further work remains to be done. The take-home message for us is that it is necessary studiously to avoid reverting to a twenty-first-century version of the outdated phrenology so popular in the nineteenth century. This danger has not always been avoided by some of those who write so enthusiastically today about neurotheology and who are looking for a 'God spot'[24] in the brain.

The central point, however, remains that normally, providing we have sufficiently sensitive techniques to pick them up, we can demonstrate that changes occurring in the neural substrates correspond to changes occurring in behaviour and/or cognition, and vice versa. But correlation does not imply one way causation. The scale of the physical components of the nervous system targeted for study by different investigators varies enormously, from a metre down to the molecular level. Accounts given at one level do not make superfluous accounts given at other levels. Neural networks, in the middle of any such hierarchy, may enable us to bring together results of investigations at the highest and lowest levels.

Before we leave this brief indication of the close links between the intactness of our brains and our capacity for moral behaviour, which we claim depends upon our free choices, we should perhaps pause and reflect on the results of a recent study reported by Gesch[25] and colleagues showing that physical changes that affect behaviour may be very small and subtle and independent of widespread damage to neural structures. Gesch and colleagues reported that by reducing the intake in the diet of vitamins, minerals and fatty acids there was an increase in antisocial behaviour.

The majority of the discoveries of the relations between brain and behaviour have arisen either from the study of patients who have suffered from a wide variety of locations and types of damage to the brain due to accident and disease, or, increasingly over the last fifty years, from carefully controlled lesion studies on animals. The latter are an extremely important source of new information since in some instances it is possible, using biochemical methods, to create a lesion in a part of an animal's brain and then to reverse the process, something not possible with destructive lesion techniques. All the work in this field depends on studies showing that when the neural substrates are changed there are observable changes in behaviour and cognition. To this should be added the important area of the study of changes in subjective feelings and of awareness and consciousness. That we shall turn to later.

24 Albright, C.S. & Ashbrook J. *Where God Lives in the Human Brain*, Naperville Illinois:Sourcebooks Inc.(2001).

25 Gesch, C. B., Hammond, S.M., Hampson, S.A., Eves, A. & Crowder, M.J. 'Influence of Supplementary Vitamins, Minerals and Essential Fatty acids on the Antisocial Behaviour of Young Adult Prisoners', *British Journal of Psychiatry* (2002) 181, 22-28.

Top-down Effects

Now we must ask whether there is evidence that suggests that by modifying behaviour and cognition we can observe changes in the neural substrates. Is there any evidence to show that what we think, or how we habitually behave, changes the physical structures in our brains? Any practising clinical neurologist will give you examples of how patients suffering from epileptic seizures may in some cases develop psychological tricks which enable them to avert a fit. One patient described how if, when she felt a fit was about to start, she asked someone to read to her so that she could avert its happening. She said that listening intently to music apparently had a similar result. In effect an ordinary experience and the determination to avoid the fit and a sustained effort to resist it are, as one neurologist has written, 'plainly doing business with a rebellious brain'. Such conscious devices would be examples of what the late Nobel laureate neuroscientist Roger Sperry[26] called top-down processes. These he contrasted with the so-called bottom-up effects which we have been describing in earlier paragraphs. Here I have extended the meaning of top-down to include not only the cognitive processes that were Sperry's focus of concern, but also habitual patterns of behaviour.

Some illustrative examples

Consider some recent examples of research adding to our confidence in the importance of such top-down effects. Sadata[27] and his colleagues studied people who had been born blind and then become extremely efficient at Braille. They discovered that the parts of their brains normally devoted to vision were in part being taken over by touch. These reports from the studies of humans were subsequently replicated in monkeys using single cell recording techniques.

One dramatic and widely reported top-down effect was that observed by Maguire and his colleagues using modern brain-imaging techniques to study the brains of London taxi drivers. It is well known that licensed London taxi drivers are renowned for their extensive and detailed navigation experience and skills. Maguire studied[28] structural MRIs of their brains and compared them with those of matched controls who did not drive taxis. They reported that the posterior hippocampi of the taxi drivers were significantly larger than those of control subjects. The hippocampal volume also correlated with the amount of time spent as a taxi driver. The researchers concluded 'it seems that

26 Sperry, R. W. 'American Psychological Association', Psychological Science Agenda (September-October 1994):10-13

27 Sadato, N. et al. 'Activation of the primary visual cortex by Braille reading in blind subjects', *Nature* (1996) 380, pp. 526-528.

28 Maguire, E.A., Gadian, D.G., Johnsrude, I.S., Good, C.D., Ashburner, J., Frackopwiak, R.S.J. & Frith, C., '(2001) Navigation–related Structural Change in the Hippocampi of Taxi Drivers', *Proceedings of the National Academy of Sciences* (2000) 4398-4403.

there is a capacity for local plastic changes in the structure of the healthy adult human brain in response to environmental demands'. If, when the hippocampus is used extensively, there are changes in its shape and size, it is evidently not a matter simply of the hippocampus being predetermined exclusively by genes

A study, published the same year as Maguire's, by O'Craven and Kanwisher[29], beautifully illustrates how the mind can selectively mobilise specific areas and systems in the brain. They asked their subjects either to look at pictures of faces or houses or to imagine them. They showed how imagining faces or houses selectively activated the same areas of the brain as when the subjects were seeing the pictures of houses or faces. Specifically, seeing or thinking about faces activated the fusiform face area whilst seeing or thinking about houses activated the parahippocampal area. The experimenters showed that they could actually 'read the minds' of their subjects by observing their brain activity. They could tell whether the subjects were thinking about faces or houses by measuring activity in the respective brain areas. This was certainly a dramatic illustration of the rate of progress of research in cognitive neuroscience. Only four years before O'Craven and Kanwisher's report appeared, Grabowski[30] and Damasio had written 'the imaging of the neural correlates of single and discrete mental events, such as one image or one word, remains the most desirable dream'. Four years later O'Craven and Kanwisher had realised that dream. Hence the danger highlighted at the beginning of this paper of reacting to the perceived threat to our traditional models of human nature with responses along the lines of 'You can show so and so but you will never be able to show so and so.'

A recent study reported[31] at the annual meeting of the American Association for the Advancement of Science (AAAS) in 2004 has extended our knowledge of the importance of the intactness of particular brain areas for particular conceptual and cognitive tasks. The researchers note how the fusiform gyrus processes faces and how this ability emerges during childhood, normally to become well developed by the age of twelve. They also note that another part of the brain, the inferior temporal gyrus, processes visual information about objects which do not convey the emotional signals often found in faces. The researchers report that their brain-imaging studies indicated that in people with autism the object processing areas of the brain were activated when they were looking at faces. In all the normal subjects the fusiform gyrus was activated when viewing faces and the inferior temporal gyrus when viewing cars.

29 O'Craven, K.M. & Kanwisher, N., 'Mental imagery of Faces and Places Activates Corresponding Stimulus –specific rain Regions', *Journal of Cognitive Neuroscience* (2000) 12, 1013-1023.
30 Grabowski, T.J. & Damasio, A.R. 'Improving Functional Imaging Techniques: The Dream of a Single Image for a Single Mental Event', *Proceedings of the National Academy of Sciences* (1996) 93, 14302-14303.
31 Dawson, Geraldine & Aylward, Elizabeth, Press report *The Times* Feb.2004, see also papers by Elizabeth Aylward on eaylward@u.washington.edu.

The autistic subjects however used the inferior temporal gyrus – the object processing centre – for both cars and faces.

What is evident is that the brain is not hardwired, nor is it a blank slate. Neural substrates, genes and environment interact in complex ways and the process of postnatal development plays a crucial role in this dynamic interaction as indicated earlier in our brief digression into genetic determinism and behaviour. Annette Karmiloff-Smith, awarded the 2003 Latsis Prize by the European Science Foundation for her distinguished work in developmental cognitive neuroscience, has warned against the dangers of looking for a one-to-one relationship between complex behaviours on the one hand, and specific genes or locations in the brain on the other. Such a view has been given wide publicity by Steven Pinker, leaning heavily on research from adult neuropsychology and genetic disorders. Karmiloff-Smith has argued that Pinker's interpretation of the data is flawed. She points out that it is based on a static model of the human brain, which ignores the complexities of gene expression in the dynamics of postnatal development. She has written, 'understanding the complex pathways from gene to brain to cognitive processes to behaviour is like a detective story in which seemingly unimportant clues early in development play a vital role in the final outcome'.[32] Karmiloff-Smith recognises that at first blush there are indeed a number of genetic disorders that seem to fit such a nativist model. Dyslexia is one such disorder with a clear genetic component.

However, another study reported by Elizabeth Aylward[33] and her group at the 2004 AAAS meeting comes as a very necessary warning of the danger of concluding that, because there may be a genetic basis for dyslexia, it is therefore irreversible. In their study they investigated a group of dyslexic children and monitored changes in the activity of particular brain regions when these children were given three weeks of special training to help them recognise the relationships between a word's letters, sounds and meaning. They reported that after three weeks of such training the brains of the dyslexic children began to work in similar fashion to those of children without any reading disability. The findings were based on the study of the children's brains using functional magnetic resonance imaging. They reported that the fMRI's showed that the training greatly enhanced brain activity in several regions usually relatively inactive in dyslexic children. Noting that more and more evidence suggests that dyslexia has a strong genetic component, they emphasise that this predisposition to reading difficulty can be overridden by carefully constructed teaching programmes. The press report quoted one of the authors, Dr Berninger, as saying 'Just because there is a genetic basis to dyslexia, doesn't mean dyslexics can't learn to read. These children's brains can function normally with extra help.'

Another example is Williams syndrome which Stephen Pinker has claimed

32 Karmiloff-Smith, Annette in *The Psychologist* (2002) 15 (12)
33 Berninger, Virginia & Aylward, Elizabeth, AAAS meeting reported in *The Times* Feb.2004.

as a prime example of how impaired and intact cognitive modules are directly linked to genes. Karmiloff-Smith[34] in her own research has shown conclusively that 'there is no one-to-one direct mapping between a specific gene and a cognitive-level outcome. Rather, there are many-to-many indirect mappings, with the regulation of gene expression contributing to broad differences in developmental timing, neuronal type, neuronal density, neuronal firing, neurotransmitter types and so on. She further argues that 'data from adult neuropsychology and genetic disorders cannot be used by Nativists to bolster claims about genetically specified, modular specialisations of the human brain. We need to understand how genes are expressed through development, because the major clue to genotype/phenotype relations turns out to be the very process of development itself.'

The Primacy of Consciousness and Personal Agency

The qualities of our experience, our consciousness, are the point of departure for all our efforts in science as in everything else. Adam Zeman[35] has written: 'I have described consciousness as a "further fact", but it might be described more accurately as the fundamental fact of our human lives.' This thought does not supply a solution to the problem of consciousness. But it cautions us wisely against accepting facile solutions which assume what they claim to explain.

Some of the scientists who have contributed most over the past decades to our understanding of the biological bases of cognition and behaviour have been at pains to alert us to the dangers of being oversimplistic in our understanding of the implications of their discoveries. Consider the views of three Nobel laureate's working in this field. Sir John Eccles[36] cautioned 'let us be clear that for each of us the primary reality is our consciousness, everything else is derivative and has a second order quality'. Roger Sperry[37] wrote of his new model that 'it adds a downward to the traditional upward micro determinism and it is claimed to give science a conceptual foundation that is more adequate, valid and comprehensive'. Another, Gerald Edelman,[38] wrote, 'the evolutionary assumption implies that consciousness is efficacious-that it is not an epiphenomenon.' Roger Penrose,[39] an eminent mathematician, wrote 'consciousness is the phenomenon whereby the universe's very existence is made known'. Simplistic reductionism has no place in any of their thinking.

When analysing human nature from the perspective of neuroscience we can easily forget the primacy of the role of consciousness and of the cognitive agent

34 Karmiloff-Smith, Annette *op.cit.* [32]
35 Zeman *op.cit*. [2], p. 324.
36 Eccles, J.C. *Evolution of the Brain: Creation of the Self*, London: Routledge (1989), p. 327
37 Sperry, R.W., in Gregory, R.L. (ed.) *The Oxford Companion to the Mind*, Oxford: OUP (1987), pp.164-165.
38 Edelman, G. *Bright Air, Brilliant Fire: On the Matter of the Mind*, London: Penguin (1982).
39 Penrose, R. *The Emperor's New Mind*, Oxford: OUP (1989).

in everything we do. We take for granted that everyone recognises that research that is reported was the result of someone's personal agency. There was a personal initiative, experimental data gathering, long personal reflection on the results before writing them up and presenting them at a conference for peer scrutiny and submitting them to a journal. At every stage personal agency was at work. Without this personal agency none of the work would have been done and without rational evaluation it would never have been appropriately appreciated.

But, as Wilder Penfield is reported to have put it fifty years ago, 'There is no room or place where consciousness dwells.' The brain stem, vital though it is for maintenance of conscious awareness, is nevertheless not the elusive place where consciousness dwells. Rather than the home of consciousness it is an activating system contributing a number of key centres or nodes to a widely distributed network. At a different level research focuses on opioids, derived as the term suggests from opium, the brainstem neurotransmitters which activate a descending system. The views of researchers such as Roger Penrose, referred to above, which are highly controversial, highlight the likelihood that explaining consciousness may require a fundamental shakeup in physical theory.

We all have deep intuitions about our own personal freedom. If we are to make sense of the relationship between the physical and mental, between brain processes and our cognitions, some of our intuitions are inevitably going to come into conflict. As this happens we do well to remember both the powers and perils of intuition as spelled out in detail by David Myers. However, 'when we ponder the relationship between experience and the brain several deep intuitions come into conflict. If we cling to them all we may never make sense of the relationship between the physical and the mental…One thing at least is certain: our favourite intuitions may be wrong.'

Intuitively we have little doubt about the reality of our experience or at least for most of the time. Intuitively we are aware that our experience is connected to our physiological state: whether that be tiredness, hunger or overindulgence in alcohol or other drugs, we are left in no doubt about that. This latter intuition has been the focus of much of the science reviewed earlier in this paper. We now know so much more about the neural basis of our state of awareness and the neural correlates of the contents of our awareness. As Adam Zeman put it 'We have enough to have framed a tentative law: every distinction drawn in our experience and behaviour will be reflected in a distinctive pattern of neural activity… A neurobiology of consciousness is no longer a distant dream.'[40]

Looking for plausible models of mind/brain relations

The science presented points to the intimate relationships between mind, brain and behaviour. Some of these relationships were bottom–up and some were

40 Zeman *op.cit*. [2], p.305.

top-down. The emerging consensus is well summarised in the views of a neurologist, Antonio Damasio,[41] and a psychiatrist, Robert Kendell[42]. Damasio wrote, 'The distinction between diseases of "brain" and "mind", between "neurological" problems and "psychological" or "psychiatric" ones, is an unfortunate cultural inheritance that permeates society and medicine. It reflects a basic ignorance of the relation between brain and mind'. Robert Kendell, a past President of the Royal College of Psychiatrists in Britain wrote, 'not only is the distinction between mental and physical ill founded and incompatible with contemporary understanding of disease, it is also damaging for the long-term interests of patients themselves.'

It is one thing to observe this consistent pattern of the intimate links between mind and brain but it is an enduring problem to know how most appropriately to conceptualise it. In recent years the contributions of Warren Brown and Nancey Murphy[43] have been significant in our attempts to make sense of the neuroscience data reviewed earlier. Their book entitled 'Whatever Happened to the Soul?' represented an important step forward. They gathered together contributors from a range of scientific and philosophical disciplines and in his concluding chapter Warren Brown observed 'The authors of this book have attempted to present a consistent picture at least as regards nonreductive physicalism (i.e., seeing the person as the unitary physical entity without a separate nonphysical soul, but not reducible to "nothing but" the physiology of cells or the chemistry of molecules).' They also claim to have found physicalism to be more compatible with biblical faith than dualism. Reviewing different contributions in his final chapter Brown writes,

> Jeeves argues for physicalism (monism) a necessary dualism of aspect. Although it is unnecessary to posit the existence of a nonphysical mind or soul, two views of mental phenomena must be maintained and kept distinct – one is a view of the neurobiology of the physical system; the other, a view of an efficacious subjective mental life. Any mixture or attempt to interchange descriptors from these two views of cognitive events only serves to obscure the meaning of the respective data and diminish understanding. Both Jeeves and Mackay consider the aspect of subjective experience to be 'ontologically prior' in that it is the thing we know about first and most inescapably.

In the attempt to escape from reductionism Nancey Murphy in 'Whatever happened to the soul?' and elsewhere dealt with some of the knotty philosophical problems raised by a physicalist approach to the brain and mind/soul problem. In doing so she drew heavily upon the notion of supervenience. As Brown

41 Damasio, A. *Descartes Error,* New York: Putnam (1994).
42 Kendell, R.E., 'The Distinction between Mental and Physical Illness', *British Journal of Psychiatry* (2001) 178, 490-93.
43 Brown, W., Murphy, N. & Malony, H.N. (eds.) *Whatever Happened to the Soul?* Minn: Fortress Press (1998).

put it 'If higher-level explanations can be shown to supervene on explanations based on lower-level phenomena, then the concept of supervenience allows an escape from the seemingly inevitable tendency for physicalism to become reductionistic.' Murphy's views have been taken very seriously and have prompted further philosophical debate. One aspect of her view, however, namely the use of the concept of supervenience has come in for particular scrutiny and criticism by the Princeton philosopher Jaegwon Kim[44]. Murphy[45] has recognised the force of some of his comments and has responded in a paper in this journal. What we, the non-philosophers, would like to know is whether Kim's views and those of others means that the usefulness of a nonreductive physicalism is fatally flawed or whether it merely needs revision.

Whether my views and those of Mackay referred to in the Brown quotation in the preceding paragraph are sufficiently different from Murphy's non-reductive physicalism to escape Kim's critique remains to be seen (see the papers by Torrance and Richmond in this Issue). It is, however, worth repeating that whilst I believe non-reductive physicalism has served us well, nevertheless it could be argued that it overemphasises the physical aspect at the expense of the mental. To do so is especially surprising and unnecessary at a time when cognitive neuroscientists are working overtime to flag up that they are eager to take with full seriousness the cognitive/mental aspects of our nature. With a veritable flood of books and papers appearing that attempt seriously to discuss the nature and function of consciousness we should be using a more neutral term. For that reason, on balance, I still prefer 'dual–aspect monism', the term I used to describe the mind/brain relationship in my chapter in the book edited by Brown and Murphy[46] which championed the benefits of non-reductive physicalism. One might add, that at a time when physicists studying 'dark matter' are reminding us that it makes up 95.6% of all that there is and that so far we have studied only the remaining 4.4%, it might be prudent to draw a parallel and say that in our efforts to understand mind and brain it may well be that the brain part of our mysterious nature is only a very minor, though crucially important, part of the whole and that consciousness is the 'dark matter', so to speak, of the mind/brain whole and that it makes up the vast majority of what remains to be investigated. Such a view would be further endorsed by noting how in the latest convergence of large and small physics, scientists using NASA's orbiting Chandra X-ray telescope confirmed that the universe is in the grip of a mysterious 'dark energy'. Although scientists don't know what dark energy *is*, they can measure what it *does.* Likewise, though we may not yet know what 'consciousness' *is*, we are already able to study what it *does*, as in the top-down studies listed earlier.

44 Kim, Jaegwon *Supervenience and the Mind*, Cambridge: C.U.P.(1993) and *Mind in a Physical World: an essay on the mind-body problem and mental causation*. Boston: MITUP (1998).
45 Murphy, N. 'The problem of mental causation: how does reason get its grip on the brain?' *Science and Christian Belief* (2002) 14(2), 143-158.
46 Brown, W., Murphy, N. & Malony, H.N. *op.cit.* [43]

Griffin[47] notes 'No one can consistently deny the reality of mental causation' and 'Materialists still face the problem of how a brain consisting of non-experiencing neurons could produce conscious experience' and comments that 'the most candid of materialist philosophers…admit that they cannot solve this problem'. Griffin further observes of one leading materialist philosopher, 'Colin McGinn,[48] for example, says that we have no understanding of how "the aggregation of millions of individually insentient neurons [constituting the brain] generate subjective awareness".' These topics are taken up by Alan Torrance in his paper in this Issue.

Others discussing mind/brain talk about a relationship of identity, some of interaction, yet others characterise it as a relationship of interdependence. Interdependence, at least, has the virtue of not going beyond the available evidence. Given this interdependence how can we take proper account of the primacy of self-conscious human agency in modelling the relationship of mind and matter? We may project this concept of human agency on to the outside world in terms of an image of brain events or may take the standpoint of the agent herself experiencing mental events. These two are best seen as complementary descriptions and it is a distortion of reality to say that they are 'nothing but' the one or 'nothing but' the other. *There is an intrinsic duality about the reality we have to deal with but this does not need to be seen as dualism of substances*. We may regard mental activity and correlated brain activity as inner and outer aspects of one complex set of events that together constitute conscious human agency.[49] Two accounts can be written about such a complex set of events, the mental story and the brain story, and these demonstrate logical complementarity. In this way the irreducible duality of human nature is given full weight, but it is a duality of aspect rather than a duality of substance. It is noteworthy that Mackay, unlike Murphy, studiously avoided any reference to 'downward causation'. Norman[50] sees this as a key difference between the two authors' views.

Writing twenty years after Mackay, during which time evidence pointing to the correlations between brain events and mind events at many levels has accumulated at an ever increasing pace, Adam Zeman,[51] after reviewing the pathologies of consciousness, concluded that

> the nervous system is the stuff of consciousness. But there is a powerful human tendency to conceive of the mind as an immaterial substance, an ethereal being that breathes psychological life into the physical body…

47 Griffin, D.R. 'Scientific Naturalism: a Great Truth that got Distorted, *Theology and Science* (2004) vol. 2, no.1, pp.9-30.
48 McGinn, C. *The Problem of Consciousness: Essays Toward a Resolution*, Oxford: Basil Blackwell (1991), p.1. (as quoted by Griffin).
49 Mackay, D. *Behind The Eye*, Oxford: Blackwell (1991)
50 Norman, D.A. 'Beyond Reductionism and Dualism: Towards a Christian Solution to the Mind Body Problem', *Science and Christian Belief* (2004) 16(1), pp. 3-16.
51 Zeman *op.cit*. [2], p.150.

> Whatever its source, the belief is seriously challenged by the wealth of evidence that damaging the brain can damage and fragment consciousness. It may be arrogant to deny that consciousness can ever slip its moorings in the brain – after all much of the world's population believes firmly that it can – but the evidence in favour of this happening is tenuous at best.

Whilst the evidence from the so-called top-down effects may, in some instances, be helpfully described as showing interaction, nevertheless the warnings given by Roger Sperry about the inadequacies of this description should be taken seriously and for that reason I prefer interdependence to interaction. Sperry[52] wrote, 'The resulting mind-brain model, in which mind acts on brain and brain acts on mind, is classified as being "interactionist" in contrast to mind-brain "parallelism" or mind-brain "identity".*The term "interaction", however, is not the best for the kind of relationship envisaged,* in which mental phenomena are described as primarily supervening rather than intervening in the physiological processes.' (my italics)

Interaction normally is used to describe causal relationships between events at the same level but here we are describing relationships between events at different levels. We have no idea how what happens in the mind and through habitual behaviour produces changes in the brain, even though, as I have tried to show, there is lots of evidence that it does. Typically (e.g. Webster's Third New International Dictionary,1961) 'interaction' refers to 'reciprocal action' whereas 'interdependence' is 'a mutual dependence' without specifying the nature of that dependence. The evidence for interdependence is so widespread, one might almost say universal, in all the work that I have described, that it seems to be the way the world is. At the same time, as many have pointed out, descriptions in terms of personal agency and at the level of cognitive processes cannot be reduced to descriptions in terms of neurotransmitters or synapses. In other words the interdependence we observe is best described as an irreducible interdependence.

Conclusions

1. The scientific reports briefly surveyed earlier in this paper all point towards evidence, at a variety of levels of investigation, of the ever tightening links between mind and brain. It is our common experience, for most of us for most of the time, that under normal conditions we make free choices and engage deliberately in freely chosen actions. As the philosophers say, our experience of freedom of choice has an ontological priority over anything that we may subsequently say about the basis of this in our brains. It could be argued that the greater knowledge we have of the biological foundations of our behaviour and of how what we do to ourselves affects the workings of the neural substrates of

52 Sperry *op.cit*. [37], p.165.

our minds, the more responsible we become for our actions. This would suggest that the appropriate attitude to adopt towards ourselves is to give primacy to the exercise of our personal freedom.

Unfortunately, at times, we readily blame our genes and/or the environment for our failures whilst being all too ready to take credit for our successes. When we think of attitudes towards others, there is surely wisdom in taking seriously research that shows how people may be significantly shaped by their genes, social, environmental and cultural contexts. On this view, we should regard ourselves as agents responsible for our actions whilst always being ready to entertain the possibility that others have been unduly influenced by their social and physical environment and to make allowances accordingly. Our knowledge of the biological substrates of mental life and behaviour, of the variability of this as with any other biological systems, suggests that we are habitually confronted with varying degrees of responsibility. This applies to behaviour in the domains of sexual orientation, aggression, alcoholism and, as we saw, also many aspects of the behaviour which are part of the 'Standing Orders' for the normal Christian. There seems little doubt that because of genetic endowments, the biochemistry of the brain, or undetected abnormalities in its structures, some people may find it easier to make some decisions than others and some may find it more difficult to follow a particular course of action than others. That being so, the problem becomes that of rightly and compassionately understanding the degree of responsibility for making moral choices for which, according to Scripture, we are accountable. There is nothing in Christianity, however, to deny that people differ and certainly nothing to suggest that persons will be judged for failing to make decisions which, by their very constitution, they could not make.

It is at this point that we look to the theologians and seek a theological framework which takes these concerns with the seriousness they deserve. The need for such a framework will steadily increase as further research is undertaken in which brain processes are linked to spiritual dimensions of personality. For example, Jacqueline Borg[53] and her colleagues recently reported that in normal people the neurotransmitter serotonin system may serve as a biological basis for spiritual experiences. They speculate that 'the several-fold variabilty in $5HT_{1A}$ receptor density may explain why people vary greatly in spiritual zeal'. There is much food for thought here?!

2. Towards the end of this paper frequent reference has been made to aspects, descriptions and levels. This way of trying to make sense of the occurrence of our unitary experience of freedom to choose in terms of mental descriptions and brain descriptions was the conclusion also drawn by Adam Zeman[54] at the end of his recent extended discussion of consciousness. He wrote:

53 Borg, J., Andree, B., Soderstrom, H.& Forde, L. 'The Serotonin System and Spiritual Experiences', *Am.J. Psychiatry* (November 2003) 160,11, pp.1965-1969.
54 Zeman *op.cit*. [2], pp. 341, 342.

> The way forward from this impasse is not clear. Theories which depict experience and its neural basis as inseparable aspects of a single process may hold out the greatest promise. But we do not have any clear understanding of how a single process could have two such different aspects. We can see that the liquidity of water necessarily follows from the properties of molecules of water. We lack any comparable insight into the connection between experience and the molecules of the brain. It is not yet certain that science can supply this. Making sense of their relationship may require us to rethink the nature of matter, mind, or both.

And he goes on later,

> If we are, in a sense, biological machines, our actions are, in principle, predictable. Does this deny our freedom? We tend to suppose, without giving it too much thought, that we are the ultimate authors of our actions. This supposition is threatened by the scientific picture of our actions as events, just like others, in an unbroken chain of causes and effects. But several reflections helped to soften the blow. Our complexity makes this unpredictable in practice, whatever the theorists say. Predictability does not prevent our efforts and our forethought from making a difference to the world, nor does it prevent us from doing what we will. Perhaps this is freedom enough.

In our appeal to levels, descriptions, and aspects we should do well to recognise the pressing need to detail the conditions under which appeals to such multiple descriptions, levels or aspects are justified. Failure to do this will result in abusing the concepts of levels, descriptions and aspects in a way that, at times, the notion of complementary accounts of events given by science and Scripture was used fifty years ago. At that time Donald Mackay[55] warned

> Whenever a new concept swims into philosophical ken there is a danger that it will be overworked by the Athenians on the one hand and abused by the Laodicians on the other…Complementarity is no universal panacea, and it is a relationship that can be predicated of two descriptions only with careful safeguards against admitting nonsense. Indeed the difficult task is not to establish the possibility that two statements are logically complementary, but to find a rigorous way of detecting when they are not…

It is at this point that we look hopefully towards the philosophers to afford us some help and advice, (see the papers from Alan Torrance and Patrick Richmond in this Issue).

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55 Mackay, D.M. *The Christian Graduate* (1953) 6,4.