1 Why clinicians should love neuroscience: the clinical relevance of contemporary knowledge

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1.1 Introduction

Clinicians at times appear to have an uneasy relationship with neuroscience. At a superficial level it may seem that there might be little need to question whether the relationship between neuroscience and clinical work is problematic. However, despite their now reasonably lengthy coexistence, there still exists a tension between these two fields of endeavour. This leads to misunderstanding, and even distrust, which inhibits the undoubted opportunities – if not necessity – for creative and fruitful interaction. Questions are still asked within the clinical domain about the relevance of neuroscientific study, and neuroscientists can become so absorbed and fascinated with their subject that they lose sight of the clinical relevance of what they are studying. It is the contention of this chapter that the relationship between neuroscience and clinical work should not be problematic, and that those on both sides of the divide can learn, not only to live together, but also to admire each other’s concepts.

Why should we love neuroscience? Of course, telling someone what he or she should love is a supremely arrogant and rather fruitless enterprise, as anyone who has tried to get their child to love eating, say, oysters will know. But neuroscience is not just an acquired taste; it does not require great familiarity to appreciate its qualities. It is certainly possible to comprehend the wonder, awe and excitement that this field of endeavour can evoke without having to fully understand its every detail. And without some appreciation of the currently available knowledge about the brain, clinicians are in danger of setting off down many a blind alley in carrying out clinical practice.

In order to support this argument, it is first necessary to review some fundamental problems. This will be followed by a brief, and highly condensed, overview of some
current neuroscience facts, which will then be reviewed within the context of current developments within the field of eating disorders.

1.2 The legacy of mind–body dualism

The tension between clinical work and neuroscience would seem to be supported by the continuing predominance of dualistic thinking, not only within scientific discourse, but in postmodern culture more generally. Given the lengthy history of dualism, from Plato, down through Descartes, to William James and beyond, it is not surprising that it does not easily throw in the towel. The fundamental problem with which Homo sapiens has wrestled for so long is how can we reconcile our sense of ourselves as free agents, capable of choosing our path through life, with a notion of our bodies (including our brains) being constructed of physical stuff that obeys the deterministic laws of nature.

Plato considered that humans had earthly bodies and ethereal souls, and put the mental properties of reason, desire and appetite firmly in the domain of the soul. Indeed, Aristotle thought that the brain was merely an organ for cooling the blood and that the heart was really where the passions lay. Continuing in the Platonic tradition, Descartes, in his pamphlet ‘On the Passions of the Soul’ [1], decided that bodies were made up of stuff such as blood, muscles, nerves and so on, and were controlled by ‘bodily spirits’, whereas our thoughts and our passions belonged to the soul, and our mental experiences were instances of awareness of the movements of the bodily spirits via contact between soul and body in the pineal gland. It is hard to know what Plato would have made of someone whom we might now diagnose as suffering from anorexia nervosa (AN). It is reasonable to surmise that he would probably not have considered them to be suffering from an illness. More likely he would have marvelled at the way in which they were able, with so much stoicism, to conquer their appetites and disentangle themselves from the world of the senses, thus liberating their ethereal soul from the constraints of the material body. For Plato and his successors, the passions were seen as something that needed to be subjugated, brought under control, an idea that presages the current interest in emotion regulation and AN.

Dualist accounts, particularly of emotion, have been hard to shake off, and continue beyond Descartes, through Locke and Hume, to William James, Popper and Eccles [2], and even perhaps to some elements of modern emotion theory such as the somatic marker hypothesis [3–6]. They remain alive and well in some clinicians’ apparently unshakeable belief that AN is a ‘brain’ disease, just as in others’ similarly unshakeable beliefs that it is a ‘mental’ illness without physical correlates. But to argue either way implies a distinction between brain and mind that really can no longer be justified.

In essence, all dualist accounts come up against the difficulty that there is no convincing explanation of how, if brain and mind are of different stuff, they can interact, and how mental events can have a causative role in behaviour. There would seem to be little doubt that despite Cartesian dualism’s refusal to go quietly, the general direction of neuroscientific endeavour has been inexorably towards a monist position. However, this has brought with it new difficulties.

The term ‘monist’ here refers to the view that the mind and the body are of one substance, as opposed to the two of the dualist position.
1.3 Free will and determinism

Despite the issue of free will and determinism having an indisputable and central relevance to ethical and legal debates about whether the state and its representatives have the right to intervene when a patient with AN asserts her right to starve herself to death, there is virtually no discussion of it in the clinical literature. The assertion that human beings are free\(^2\) to choose their own destiny can really only be upheld if one espouses a dualist position. To be free is only possible if the mind is free of the body. It seems reasonable to suppose that much of the objection to a monist position arises because of fear of confronting the logical, determinist consequence of that position: that is, we are actually not free to choose, in the sense that we cannot choose whatever we want.

This issue generates a number of complicated problems in relation to ‘mental’ illness. For instance, if we define a wish (to exercise the ‘freedom’) to hurt oneself, or to be reckless of danger (such as when one is refusing to eat), as a characteristic of a mental illness, then we are denying that it is an act of free will and claiming that it is not an infringement of the patient’s right to self-determination if we intervene. However, this often makes us uncomfortable, and if as a consequence we allow the patient to choose such a course of action, we can hardly define it as a sign of a mental illness.

If we accept that mind and body are two sides of a materialist, and hence deterministic, coin, then there can be no truly ‘free’ will, as any future event is deterministically caused by the past, and we have no control over that. Free will is incompatible with a materialist, monist position. Some authors have gone to considerable lengths to find a way out of this impasse. For instance, Hameroff and Penrose [7] have proposed that indeterminacy which can account for free will is introduced into a material deterministic system such as the brain by ‘quantum effects in cytoskeletal microtubules within neurones’. But we do not need to go as far as this to find a way out of the problem. Let us instead take a simpler, clinically-based perspective.

1.4 Clinical implications

Let us consider a common clinical scenario of a teenage girl who has ‘never been a problem’ to her parents (by which it might be meant that she has not before asserted herself or easily engaged in conflict), has worked hard at school and achieved well, and has been compliant at home. She is likely to have been described as ‘sensitive’ in that she takes things to heart and can be quite easily hurt or upset by comments from friends. Not infrequently, her family has accommodated to her sensitivity by adapting to a life in which conflict is avoided, or in which, in order to avoid upset, her parents have become overly solicitous and protective.

Often, because of this previous experience of an ideal child, parents are deeply shocked and bewildered by what seems to be a very rapid change into someone they feel they hardly know. Compliance has been replaced by opposition, which at times is violent and extreme, although this may only occur in situations in which food is involved. Their sense of themselves as competent parents is under threat and they feel a bewildering range of emotions, including resentment, anger and frustration, about which they usually then feel guilty. What is the clinician to make of this?

\(^2\) In the sense of not being bound by a physical deterministic universe.
Specialists in the field are now clear that what is disordered in ‘eating disorders’ is far more than attitudes to eating, food, weight and shape. But given their prominence, let us begin by considering the issue of food intake and energy balance.

1.5 Restriction of energy intake and increase in energy output

From a clinical perspective, the restriction of energy intake manifests itself in a number of different ways. The patient is often preoccupied with ‘healthy eating’ (which in reality is very unhealthy, in that the amount of energy that her diet is providing is substantially less than that required to sustain normal life). She will often have a particular fear of, or revulsion towards, energy-dense foods, which in essence means foods that contain fat. Very often she will have a belief that any fat that is consumed immediately reappears as fat on her body. Even when all fat has been eliminated from her diet, she will continue to reduce the amount of food consumed until either she has reached zero intake or she has been admitted to hospital. To the clinician it is obvious that this fear of energy intake is very far removed from the popular idea of someone who is dieting or slimming in order to lose weight. It has all the features of a genuine phobia with the attendant intense and frequently overwhelming anxiety that makes it impossible for the patient to approach food voluntarily.

Along with the avoidance of energy intake, those suffering with AN are frequently dominated by an intense drive to expend energy. Again, the intensity of this drive is far removed from the activity of those who want to ‘get fit’ or to use exercise as a way of losing a little weight. The activity can take almost any form. If she has previously enjoyed sport, the patient will intensify the amount of time she spends in swimming, running, cycling or gymnastics. It is clear that the motivation is no longer that of enjoyment. The patient is driven by something that has long since ceased to be under her control, and which leaves her feeling unbearably guilty, bad and lazy. It is extremely difficult for her to sit down for anything other than the briefest periods; she will be found doing her homework standing up, eating standing up, listening to the radio or watching television standing up – in fact, doing anything standing up that can be done standing up. Even when she does sit down she will often hold her body in a tense position, or will jiggle her legs up and down ceaselessly.

Patients with AN behave as if their homeostatic systems, which normally should be seeking a balance between energy input and output, have become reset, so that any situation in which input equals or exceeds output provokes extreme anxiety. Normally, when output exceeds input, these homeostatic systems should trigger activation of responses that are accompanied by subjective experiences of hunger and the initiation of food-seeking and eating behaviour. In this situation the survival goal is restoration of energy balance, and any activity that moves the organism back towards that goal should produce a positive emotional state, whereas activity that results in moving further away from that goal should produce a negative emotional state.

For the patient with AN, something has happened that has reset the desired goal away from energy balance, so that her emotional state becomes more negative the nearer she moves towards energy balance. And once a severe negative energy balance occurs, neurotransmitter imbalance dramatically complicates the situation (see Chapter 5).
1.6 Non-eating-related concerns

One of the advantages of working in an inpatient unit is that one spends a considerable amount of time in daily contact with patients in a way that is denied to those engaged exclusively in outpatient practice. This allows one to see even more clearly that their concerns are not just centred on food, weight and shape. Although there is no doubt that abnormal attitudes to energy intake and output (i.e. restricted food intake and increased activity) are central, patients with eating disorders invariably have serious difficulties with, amongst other things, perfectionism, rigidity, obsessiosity, submissiveness, low self-esteem, sexuality and quite generalised difficulties with putting feelings into words (alexithymia).

One soon notices that patients not only deny themselves the comfort of food, but also the comfort of warmth, or of sitting on soft chairs. They find it very difficult to make eye contact, or to say ‘hello’ when greeted. Some may ‘fly off the handle’ for apparently obscure reasons. It is difficult for those who have not worked with patients with AN to comprehend their extreme sensitivity to the ways they respond to stimuli from the external world. It is as if the ‘gain’ on the input controls is turned up to maximum. Small changes in the external environment are experienced as ‘catastrophic’ and lead to massive reactions. If someone is only a minute or two late to an appointment it will be experienced as a major disaster and interpreted as evidence that the patient is not worth anything or that they are hated. A voice raised in mild irritation is experienced as a shout and a mild, relatively polite, justifiable criticism will be experienced as ‘character assassination’.

It is frequently noted that people with AN evidence a strong need to feel in control of their environment. They find it difficult to allow others to make decisions and can very easily become upset if someone disagrees with them. Parents may be accused of ‘not listening’ when actually what is meant is that the parents are not obeying their demands. They insist on life being arranged the way they want it and often find it extremely difficult to understand why this might present problems for other people. It is virtually impossible to escape the conclusion that they find it difficult to regulate emotion. Things are always too hot or too cold, too hard or too soft, but never just right. They do not eat because if they do, they are at risk of experiencing ‘unbearable’ feelings, often of a kind related to ‘badness’ or guilt. If they eat they feel guilty (for being greedy); if they sit down they feel guilty (for being lazy); if they keep themselves warm they feel guilty (for being hedonistic). So why do they feel guilty? When asked, the patients do not know. However, it often seems that one answer to the question is that there has developed an internal imperative that is connected with the notion that to give in to such impulses or longings will result in a catastrophic loss of control. Any such submission to impulses is therefore experienced as being very bad. In other words, the rigid overcontrol is a desperate attempt to avoid the terrifying feelings that result from loss of control – the fear that if the patient relaxes her iron grip for even a second, everything will ‘fall apart’.

This, in turn, begs the question of why loss of control should be experienced as so disastrous. One possible answer is that normal complex regulatory mechanisms have not developed, so that any loss of control results in the experience of chaos, with its attendant fear that the self will fall apart or be destroyed. This rather extreme language is used deliberately, for it feels to the patient that it is, absolutely, a matter
of survival. And ironically, from the physical perspective, this desperate attempt to avoid the perceived destruction does indeed threaten survival.

So how can neuroscience add to our understanding of these issues?

1.7 In-the-beginning questions: the problem of aetiology in eating disorders

We still do not fully understand why a 14-year-old girl might become so terrified of eating that she appears to be willing to risk starving to death. There is no doubt that psychology has developed theoretical models of the functioning of the human mind that are profound, useful and far-reaching. In relation to AN there are theories that variously implicate social and cultural attitudes, genetic endowment (although only in as-yet-unknown ways), trauma, and family and social relationships (although these last are more concerned with factors that maintain the condition rather than causing it). However, there remain few convincing aetiological accounts. The fact that AN is deemed to be a ‘complex, multifactorial disorder’, although undoubtedly true, is insufficient.

The interaction of aetiological factors can be considered in two dimensions: a temporal, ‘vertical’ dimension and a spatial, ‘horizontal’ dimension. In fact, these dimensions are not really distinct and they continuously interact, but they are useful in considering the complexity of aetiology (see Figure 1.1).

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<tr>
<th>Aetiological dimensions</th>
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<td>Predisposing</td>
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<td>Perpetuating</td>
<td>Stability of neural networks</td>
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Figure 1.1 Interactions between aetiological dimensions.

I am indebted to Earl Hopper for this phrase.
1.8 The temporal, ‘vertical’ aetiological dimension

One of the inherent problems in any temporal discussion of aetiology is that of apperception, the process by which new experience is always assimilated to, and transformed by, the residuum of past experience to form a new whole. Thus, to list these categories in reverse order, maintaining factors need to be seen in the light of the effect of precipitating factors and precipitating factors in the light of predisposing factors. In reality these categories cannot be separated out. But even today we still get stuck in discussions about ‘Is there a gene for AN?’, ignoring the fact that genes code for proteins and not for complex clusters of behavioural symptoms. Neurogenetics (that branch of genetics dealing with the action of genes in the nervous system) is rapidly developing accounts of how genes require very specific intracellular environments, which themselves contain information derived from the past (in the form of hormones, neurotransmitters and intracellular molecules produced as a result of the previous activity of perceptual systems), before they can be expressed in the production of specific proteins.

One that has received a great deal of attention is the serotonin transporter (5-HTT) gene, which determines the structure of an integral membrane protein that transports the neurotransmitter serotonin from synaptic spaces into presynaptic neurons, and thereby regulates the action of serotonin. Some people have a version of the gene (an allele) that produces a protein of shorter length, whereas others have a version that produces a longer protein, containing a greater number of repeating sequences of constituent amino acids.

Suomi’s classic studies with rhesus monkeys (which have the same gene as humans) showed that those that carried the ‘short’ allele were significantly more affected by maternal deprivation than those that carried the ‘long’ form. In humans a similar picture is found. In one study, people homozygous for the short allele of the 5-HTT gene had a 43% chance of becoming clinically depressed after four or more stressful events experienced between the ages of 21 and 26, whereas only 17% of those homozygous for the long allele became depressed. Those with the short allele were more likely to display abnormal levels of anxiety and to more readily acquire conditioned fear responses. In this case, variation in only a single gene may explain why some people weather stressful events while others are plunged into depression. Kumsta et al. have found a similar picture in Romanian orphans adopted into UK homes.

Importantly, however, the allele only reveals its influence when people experience adverse events, which include factors such as divorce, debt, unemployment or other occasions of ‘threat, loss, humiliation or defeat’, over which they may have little or no control.

To put it more simply, genes need to interact with their environments in order to be expressed and gene–environment interactions are always recursive. Although it is obvious, it still needs to be stressed that the aetiology of any illness in which genes play an important role (and that is probably all illnesses) must be seen as the result of a complex recursive interaction between gene and environment. (For a more detailed discussion of these concepts, see Chapter 5.)

These understandings throw important light on more than a century of psychotherapeutic observation and theory building in relation to such concepts as
transference,\textsuperscript{4} unconscious fantasy and ‘projective identification’,\textsuperscript{5} which are still widely misunderstood outside psychoanalytical discourse (and there continues to be debate about them even within psychoanalysis). However, psychoanalytical authors such as Quinodoz [13, 14] have argued that the above ideas provide a useful explanatory neuroscientific basis for the clinical observations.

Transference can now be understood as the inevitable outcome of the behaviour of a complex recurrent neural net.\textsuperscript{6} That is, in any perception there is always an element of ‘transference’ in that when any ‘input pattern of activation’ arrives for processing, it activates those neural nets that most closely match (or will respond to) it, but their sub-
sequent activity unfolds in a way that has more to do with the pattern of recurrent activity that has developed through training (learning) than with the stimulus itself [15].

Thus neuroanatomical evidence supports the psychoanalytical conclusion, initiated by Freud’s observations, that there is no such thing as an ‘ahistorical’ present [12]: all one’s current experience of the world is always and inevitably mediated through one’s experience of the past. Likewise, projection and projective identification can be seen as phenomena arising from networks that behave in such a way that those encoding representations of the self are activated more easily than those encoding representations of the external world, leading to a perception of the outside world that is significantly distorted.

Neuroscientists would benefit from paying close attention to data derived from psychoanalytical observation, since the insights derived from the meticulous observation of transference phenomena made possible by skilled psychoanalytical technique give access to psychological processes that cannot be observed in any other way.

For example, Williams et al. [16, 17] explore some key themes observed in psychoanalytical work with patients with AN. These are:

1. difficulties in some aspects of early relationships, mostly connected to the idea of ‘lack of fit’,
2. fusion and projective identification (in which there is a lack of optimal differentiation between self and other),
3. attacks on paternal function (the function of the ‘father’ in helping the mother and infant differentiate) and
4. the presence of a destructive superego.

These elements, it is proposed, lead to the transformation of a healthy, nurturing, reciprocal relationship between self and other into a rather more ‘receptacle/foreign body’ type of relationship, and also to the lack of development of the space between two members of a dyad that allows them to become two identities instead of one single fused identity. In turn, these configurations predispose to subsequent difficulties,

\textsuperscript{4} A term introduced by Freud to describe a situation that he observed in his clinical work with patients, in which the patient seemed to relate to him in ways that suggested that they were transferring attitudes, fantasies, thoughts and feelings connected to figures from the past on to their relationship with Freud in the present. Today the term is considered both in a restricted technical sense in relation to the phenomena occurring within the psychoanalytic treatment process and in a more general sense in relation to perception, and apperception, in general.

\textsuperscript{5} A rather loosely and confusingly defined term referring to the attribution of disowned aspects of the self to the other in such a powerful way that the other unconsciously takes on those attributes.

\textsuperscript{6} A neural net in which ‘downstream’ output neurons recurrently connect back on to input neurons.
particular in relation to the negotiation of the boundary around the self, and the regulation of what comes into or goes out of the body/mind.

Although complex, to some clinicians these detailed psychoanalytical observations ring very true. Many, but not all, patients demonstrate some combination of these characteristics, but they are not specific to AN and are therefore not aetiologically satisfying. Minuchin famously described corresponding patterns of enmeshment in the families of AN patients, and distortions of healthy family structure [18], although whether these patterns are pathognomonic of AN was rightly challenged [19] and they were subsequently shown to be features of any family coping with a seriously ill child. Clinical accounts, however apt and illuminating, are not explanations, and although undeniably they have usefulness, they still lack the underlying coherence necessary to give a seriously satisfying aetiological framework. How might one relate these observations and formulations to underlying neurobiological processes?

The idea of ‘lack of fit’ suggests that there might be underlying neuropsychological problems that adversely affect the capacity to develop satisfactory attunement between mother and child. Subsequently, difficulties arise in developing optimal degrees of differentiation, as differentiation implies the development of sufficiently stable, coherent and robust self-representations that allow separation to occur without panic. The fact that this requires repeated consistent interaction implies that tuning of nascent neural networks is likely to be the underlying neurobiological process. It is likely that at least some of the genetic predispositions to the development of AN may act through their influence on, and possible disruption of, the formation of these early attuned networks, resulting in various compensatory strategies affecting subsequent personality formation.

Connan et al. [20] have proposed a complex neurodevelopmental model in which early stressful experience, such as suboptimal parenting, takes a central (but not sufficient) role in adjusting the ‘sensitivity’ of regulating systems. It is very important here to stress that ‘suboptimal’ in this sense does not mean ‘bad’ parenting. Many have correctly pointed out over the years that we must avoid blaming parents, not out of so-called political correctness, but because blame in this context is both unwarranted and unhelpful, and misses the point. However, at the same time we must not throw the baby out with the bath water. We must accept that trauma is ubiquitous in human experience. None of us have reached adulthood without experiencing it to some degree and in some form, and some of us may have needed to work very hard to overcome it. We must also remember that parents do not parent in isolation; they are part of a family and social context that may both help and hinder the extremely difficult task of parenting. A depressed mother may not have been able to provide her infant with optimal responsiveness, but she may be depressed for very good reasons and in circumstances over which she has little or no control.

Fonagy [21] has linked descriptions of analogous processes to neurobiological findings through Arnsten’s [22] description of a ‘biological switch’. Under conditions of stress, there is activation of limbic circuits and inhibition of prefrontal cortical circuits that contribute to a decrease in the capacity for ‘mentalising’ (a prefrontal cortical activity) and subsequent regression to two more primitive modes of functioning, termed either ‘pretend’ or ‘psychic equivalence’. These two modes of functioning can be related to Hopper’s [23] discussion of traumatic experience and to fears of annihilation resulting from experiences of extreme helplessness. These profound
anxieties involve oscillating experiences of fears of falling apart, abandonment and so on (fission and fragmentation), and fears of suffocation, being trapped and so on (fusion and confusion).

Furthermore, they might be seen to link to properties of the two principle classes of anxious attachment strategies, avoidant (A) and ambivalent (C). Within that frame of reference, individuals who utilise type A strategies attempt to deactivate attachment behaviour in order to reduce exposure to the pain and distress caused by frustration of bids for proximity to attachment figures, perceived to be distant or rejecting. They tend to be self-reliant, excessively independent and avoidant of awareness of their own emotional reactions. Conversely, those utilising type C strategies attempt to keep attachment systems in a state of chronic hyperactivation, and tend to escalate emotion intensity in order to maintain proximity to attachment figures. When these strategies are utilised, negative experiences tend to be tightly bound together and, in terms of associative memory networks, ‘one cognitive node with a negative emotional tag can automatically spread its activation to other negatively tinged cognitive nodes, causing all of them to become highly available to working memory’ [24].

While Fonagy, Arnsten and Hopper describe these processes in relation to stress or traumatic experience, it needs to be remembered that any event can only be experienced through a ‘filter’ of tuned sensory neural networks. Some individuals may have more sensitively tuned networks than others, leading them to be more vulnerable to traumatic experience. In other words, some very highly sensitive individuals might have little option but to experience almost any interaction with the outside world as highly anxiety-provoking, in turn leading to consequent patterns of behaviour that have the characteristics described above.

Nelson et al. [25], in a review of social information processing in adolescence, identify three ‘nodes’: (i) a detection node, responsible for the detection of socially salient stimuli; (ii) an affective node, involved in the generation of emotional experience related to the stimulus; and (iii) a cognitive node, which is responsible for regulating the response to the stimulus. They make the point that the development of the affective node during adolescence is very much under the control of glucocorticoid hormones, whereas the cognitive regulatory node is learning-dependent and takes longer to mature. It therefore can be postulated that individuals with insufficiently developed cognitive regulatory capacities, who, until adolescence, have been very dependent on their parents to regulate their affect for them, can have this fragile equilibrium overturned by the hormonally dependent affective node developing more rapidly.

Thus when the hormonal changes of adolescence induce rapid development of the affective node, these early schematic appraisals of the self as being disgustingly greedy, enormous, too much for the carer to bear, and so on, surface through automatic or associative routes in the generation of the emotion of disgust directed towards the self later on in adolescence. Under these circumstances, starvation becomes not only the only option, but a very effective one. An early effect is that the ensuing loss of weight reverses the production of hormones and the brain regresses to its prepubescent state, minimising the dysregulation.

Neuroscience now offers a framework within which to more fully understand the aetiology of these complex behavioural phenotypes. At the same time, neurobiologists might study these detailed clinical observations and their associated
1.9 The Spatial, ‘Horizontal’ Aetiological Dimension

We now turn to the spatial dimension, composed of what are sometimes referred to as ‘systemic’ factors [26], which in turn can be divided into *internal factors* (within the individual), *proximal factors* (involving those close to the individual such as family and peers) and *distal factors* (which are more nebulous and involve culture and societal pressure).

A system can be defined as a set of components in mutual interaction [27]. A system exists if ‘a set of elements within an environment relate to one another in such a way that changes in them can be predicted without reference to that environment’. However, ‘the actual relationships between the elements of a system and between the system and its environment are always problematic’ [12]. In other words, there is no such thing in reality as a fully closed system. Yet systems may be sufficiently closed for us to usefully consider them as systems, without having to always think of the whole universe when considering their behaviour. Because no system is ever truly closed, the relationship between a system and its environment, or between one system and another within an environment, allows us to consider systems as nested within other systems.

We can then conceive of a hierarchy of systems at differing levels of complexity or abstraction. At each level, elements interact with one another in such a way that they become constituted as a new system. This new system in turn interacts with other systems at the same level to form the next level, and so on. One problem that arises is that when any system, or hierarchy of systems, exceeds a particular level of complexity, the consideration of it as a whole becomes exceedingly difficult or even impossible.

Until relatively recently we have not had sufficient understanding of how things work at the cellular or subcellular levels in brains to allow us to understand much about the relationship between brains, persons and societies. However, that has now changed. As an example, let us consider two levels of system which have not normally been seen as connected, and which have often been characterised as being in opposition: *cultural factors* and *neural circuitry* in AN. For many years the cultural factor that has been seen to be relevant to the genesis of AN has been the overvaluation within particular cultures of ‘thinness’. Although this has been related to other causes, particularly the position of women in society and associated beliefs concerning a sense of agency, not much mention has been made of the issue of self-regulation. There would seem to be little doubt that over the last century there has been a crisis in industrialised societies in relation to the topic of regulation. Industrialisation has brought with it mass production, which in turn has brought the need to encourage consumers to consume, to consume more, and to consume still more. The idea that at some point one might feel satisfied with what one has got is not one that sits comfortably with the corporate need to achieve continuous and never-ending growth in profits.

There are also far fewer social constraints on all sorts of behaviour now than there were 50 years ago. For example, when the ‘F word’ was first used on British television in 1965, ripples of shock and horror spread throughout the country. Now it would be hard to get through an evening without hearing it several times. Parents do not have the support of social norms in the way that they did. In relation to the regulation
of desire, they are actively undermined by a culture based on unbridled capitalism, which denies the possibility of having too many pairs of trainers, or that last month’s computer already needs upgrading.

But how does this relate to neurones? In any complex nervous system, there will be circuits dedicated to control and regulation. In complex organisms such as humans, although many of these systems are innate, many need to be learned. This is almost certainly an evolutionary adaptation that allows flexibility and therefore increases survival value in environments where conditions vary. The principal source of learning, at least in the early years of life, is the family, but families are embedded in societies and recursively interact with them. For families embedded in modern post-industrial societies there is now a contradiction, in that parents want on the one hand to help their children learn to regulate themselves and their desires, and on the other to help their children fit in to a culture which demands they never feel satisfied. We need to be very concerned by the possibility that infants and toddlers may spend more time obtaining noncontingent feedback from a television than they do from their parents.

We now know that learning at the neural level involves physical changes in the structure of proteins involved in synapses that determine how easily or not an action potential will be created in the postsynaptic neurone (neuroplasticity). The more a particular neural net is activated, the more easily it becomes activated in future. This neural net may be involved in the recognition of one’s mother’s face, in the control of one’s legs in learning to walk, in the learning of language or juggling or the ability to say ‘no’ to one’s self, and all these actions involve changes in the ease with which a synapse transmits an impulse in any particular neural net. Thus, any particular cultural attribute, mediated by the transmission of culture through families and parents, becomes ‘inscribed’ physically in the neural circuitry of individuals. Living in a culture in which restraint and self-control are not encouraged surely must result in any individual within that culture having greater difficulty in developing functioning neural circuits that promote self-control than someone living in a highly regulated culture.

It follows that control systems that are dependent on learning, such as those involving executive function, might be particularly affected. The point here is that ‘cultural factors’ need to be seen in a sophisticated way, not just as a somewhat ethereal background pressure, but as something real and tangible that becomes incorporated into the neural circuitry of our brains.

It is very easy to forget (or perhaps more accurately, it is easy to remain unaware, as we are rarely conscious of it in the first place) how much our culture becomes internalised. It is thus often easy to abdicate responsibility for it, to shrug our shoulders and say ‘not my problem’. The point here is that we should not really be surprised that, if we allow commercial organisations in our society to spend millions of pounds on persuading children, through the medium of television advertising, that they need more, and that they should not be satisfied with what they have got, disorders of self-regulation became more common. We should not be surprised that if we contribute to, and support, an ethos that proclaims that social structures of authority are undesirable, and that we should be allowed to do more or less what we want, disorders of self-regulation became more common. We cannot and should not be seduced into absolving ourselves from responsibility by telling ourselves that culture and brains have no connection, and that because eating disorders have neurobiological substrates, culture
does not really have a serious influence. Our brains physically develop within a culture that has real physical effects.

Thus, when considering ‘cultural’ factors in the genesis of eating disorders we should look beyond relatively simplistic notions of responses to depictions of thin models in the mass media. We should ask more complex questions such as why ‘thinness’ itself becomes so overvalued that it is a required attribute of those who are elevated to the status of cultural icons. It is at least worthy of serious consideration that thinness is overvalued as a sort of antidote to a constantly increasing underlying fear of dysregulation in postmodern societies. This fear is connected to, and exacerbated by, the fact that over the vast majority of the time in which our brains have been evolving, we have had to find ways of dealing with scarcity and lack in order to survive. Evolution through natural selection has endowed us with powerful behavioural systems whose goal is to maximise energy input. We are highly sensitive to lack, and behaviour that decreases the intensity of hunger is highly rewarding. Indeed, the need to have effective systems aimed at maximising energy input was so important that it is much easier to answer the question of which part of the brain is not concerned with eating and food (answer: almost none of it) than to decide which part is concerned, as these processes are widely distributed over the whole central nervous system [28].

On the other hand, overdoing it and taking in too much has not, from an evolutionary point of view, been much of a problem (although it may well have become one now), so systems for downregulating appetite are weaker than those involved in upregulating it. Thus the evolutionarily endowed, highly rewarding state of acquisitiveness is exploited by modern industrial societies for the purposes of economic growth. It is not that difficult to persuade people to want more: it is built into our behavioural systems. The price we pay for this is the troubling sense that we are not fully in control of ourselves. We do not like to feel that others are manipulating us and we want to maintain the fiction that we can resist if we want to. Thinness becomes a marker of those who are in control of themselves, those who are able to rise above the ‘base’ domination of appetitive desire, who can resist and stand firm against temptation. The ascetic ideal, persisting all the way down from Plato, in which emotions are seen as phenomena that need to be conquered, has been often admired. In the past this may have been a way of managing lack, and attempting to live with it, but now we are facing far greater difficulties from excess and having too much available, too much choice. Perhaps our evolutionarily adapted neurobiological systems are unable to deal with it.

1.10 The importance of a neuroscientific aetiological framework

All these ideas can be viewed as helpful elaborations of a more fundamental problem. This has to do with the disturbances in the formation of the self that result from very fundamental neurobiological abnormalities, related to the notion of sensitivity, that make the development of satisfactory self-regulatory systems very difficult. Self-regulation, or homeostasis, refers to the capacity of an organism to maintain its internal state within limits that are optimal for survival. In any complex organism it inevitably becomes an extremely complex process or set of processes, but one that is essential for survival and thus of central importance in the function of the organism.
The need for any organism to maintain its internal environment is obvious, and systems that have evolved in order to maintain this environment (homoeostatic systems) have been studied since physiology began. Just as there is a need to maintain the physical environment, there is also a need to maintain the psychological. Thus, in order to function well in our relationships and interactions, we need to be able to regulate our responses, to think before acting, to weigh up the costs and benefits of any particular course of action, to modulate what we say and how we say it, and so on. A particularly important regulatory mechanism involves knowing when we have had enough. Just as the initiation of behaviours is an important part of executive function, the decision as to when to stop and move on to something else is equally important.

Craig [29] has proposed that patterns of forebrain lateralisation originate from asymmetries in the peripheral autonomic nervous system. In his proposal, left-forebrain activity is particularly associated with parasympathetic activity and energy enrichment, and right-forebrain activity with sympathetic activity and energy expenditure. Of particular interest is the observation that this lateralisation seems to occur principally in the anterior insula, with the left anterior insula being activated predominantly by homeostatic afferents associated with parasympathetic functions (energy enrichment) and the right anterior insula being activated predominantly by homeostatic afferents associated with sympathetic functions (energy expenditure). Neuroimaging studies have commonly shown there to be significant asymmetries in insular activation in patients with AN [30–33] (see Chapter 3).

Emotions (consciously experienced as ‘feelings’) can now be considered a function of complex, high-level homeostatic systems, and many patients with AN have particular difficulty with emotion and emotion regulation. When considering the topic of emotion regulation, it is always important to remember that it is difficult to draw a distinction between the generation of emotion and the regulation of emotion [10]. ‘Because emotions are multicomponent processes that unfold over time, emotion regulation involves changes in “emotion dynamics”’ [34]. Emotion products (bodily sensations, facial expressions, actions, etc.) can also serve as stimuli for further emotion generation (such as becoming embarrassed about being frightened), which functions as part of the regulatory activity of the initial state.

The construction of a mental representation of one’s own physical body is a complicated business and is vital to the development of a fully functioning self-representation. Longo et al. [35] have distinguished between the relatively well understood somatosensation (the initial sensory processing of somatic information in the primary somatosensory cortex) and two other, less well understood classes of higher-order processing: somatoperception (the process of perceiving the body itself and ensuring somatic perceptual constancy) and somatorepresentation (a combination of essentially cognitive, lexical-semantic knowledge about the body, emotions and attitudes about the body, and the link between the physical body and the psychological self). These correspond to the three levels of processing of any sensation: primary, reception; secondary, perception; and tertiary, interpretation and integration.

The relationship between emotion and the body is especially important and especially complex. Damasio’s somatic marker hypothesis [3–6] is centrally concerned with the contribution to the experience of emotional states (feelings) by information about emotion-derived changes in the body conveyed back to the brain by somatic
afferent pathways. It is likely that both somatoperception and somatorepresentation are significantly influenced by affects in a recursive fashion. If affect regulation is a serious difficulty, it makes sense to assume that the way the body is experienced is likely to be influenced. Clinical experience suggests that language is often used in a way that assigns physical properties to emotional states (‘worrying about you is too much for me to bear’, ‘you are a weight on my mind’, ‘you occupy too much space in my head’) [36–38]. This may reflect an underlying binding of insufficiently regulated (and hence very intense) emotion to lexical-semantic representations of the body as being ‘too big’, ‘too heavy’, ‘too fat’ and so on. It is as if the (somatoperceptive) physical self is not sufficiently distinguished from the (somatorepresentative) emotional self, and dysregulated ‘big’ or ‘fat’ emotions lead to the experience of ‘big’ or ‘fat’ bodies.

An association between alexithymia and AN (as well as many other conditions) has long been postulated [39–42]. Patients with AN appear to find it difficult to ‘know’ what they feel and to distinguish between one emotional state and another. Because of this, they cannot communicate in words about their current emotional state.

Alexithymia as a concept is poorly understood, and there is some question as to what it really means. That being said, there would seem to be reasonably good evidence to suggest that it reflects a valid concern about the way that patients with AN manage to communicate about feelings. In order to be able to put feelings into words (to ascribe lexical constructs to emotional experience) one first has to be able to consistently recognise and distinguish one emotional state from another. If there are serious difficulties in regulating emotions, it might therefore be difficult to find words for them. The attempt to regulate the emotional state itself may interfere with the ability to hold that state in awareness long enough to name it, given that naming it is almost certainly a high-level operation, requiring attention.

Perfectionism, an almost universal concomitant of AN, can be understood as an extreme way of avoiding unbearable feelings of failure and self-criticism, which again make sense if there is extreme sensitivity to negative emotion. Rather than accepting that one may be ‘good enough’, and thus not being too cast down by disappointment, any perceived negative judgement is appraised as catastrophic and therefore to be avoided at all costs.

Another common feature of AN, obsessionality, is still poorly understood, but it would seem to be clear that it is intimately connected with anxiety, and that obsessional mechanisms can function as ways of downregulating anxiety. ‘Obsessional’ mechanisms such as rituals are used under normal circumstances as ways of making the world seem well-ordered and predictable, and ritualised behaviour is a well-observed feature of normal development.

1.11 Conclusion

The key thesis of this chapter is that clinicians have nothing to fear from neuroscience; in fact, they have everything to gain. AN is an extremely complex disorder and to understand it we require complex and sophisticated models. Models developed before current neuroscience knowledge became available have provided useful insights into the phenomenology of AN but have had only very limited aetiological significance. There is no doubt that neuroscience is complex, but it need not be mysterious. It has
provided, is providing and no doubt will continue to provide extraordinarily exciting and useful insights into why some people have the misfortune to develop such a devastating illness and others do not. Neuroscience allows us finally to dispense with the deeply unsatisfying dualism that has bedevilled psychiatry and related disciplines for decades. Mind and brain can now be integrated into a single, albeit complex, identity. Doing so helps us clarify the limits and constraints that apply to concepts such as freedom and self-determination, without which we struggle to know how to respond to the clinical dilemmas presented to us by our patients.

Clinical observation clearly demonstrates that AN is a disorder comprising far more than problems with eating, and that a range of experiential and behavioural symptoms are not easily integrated. It is through the insights that neuroscience is now providing that we are able to edge closer to a satisfactory underlying aetiological model that will inevitably allow us to build more effective treatments. Models are developing that elucidate the fundamental deficits and difficulties in the continuous and constant integration by our brains/minds of vast quantities of information, from both inside and outside our bodies. Such information helps explain how we can maintain our selves in an optimal relationship with our environment, and how we construct and maintain a coherent sense of self, both physical and psychological. While perhaps history teaches us to be wary of overoptimism, we have good reasons to feel that clinical work can now be more firmly grounded on a secure scientific basis.

References


