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Chapter 1

An Evolutionary Perspective on Anxiety and Anxiety Disorders

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1. Introduction

Anxiety and depression are two of the negative emotions described by Levenson (1994). These emotions, along with anger, tend to disrupt the emotional homeostasis of the body, while the positive emotions such as contentment tend to restore homeostasis. The actions of anxiety and depression may be synergistic but they differ in important respects. Anxiety usually has an obvious cause and also a goal (safety, and the avoidance of danger), whereas depression usually has no obvious cause and also has no goal. Depression is thought to be related to social factors in relation to other human beings, whereas anxiety is related partly to social situations but also to non-social dangers. The strategies for dealing with human danger include submission, whereas this is not an appropriate response to non-human danger. Anxiety is classically thought to be concerned with the threat of danger, whereas depression is thought to be the result of danger. I will describe later how the negative emotions can be divided into the escalating emotions such as anger and the de-escalating emotions of anxiety and depression

In a recent monograph, Bruene (2008) says, "Behavioral observation of patients with anxiety disorders suggests that these disorders – as a group – reflect exaggerated responses to internal or external signals of perceived danger or threat. The autonomic part of the anxiety response pattern prepares the organism for one of several response options to terminate the anxiety-eliciting situation, namely, flight, immobility, submission or aggression."

An evolutionary approach to any behaviour (including anxiety and other forms of psychopathology) refers to two separate "causes". One is the question of function. What is the function of this behaviour, if any? Why has it evolved? What adaptive advantage does it give to the individual, or the individual's close kin, or to the individual's social group? This approach relies on behavioural ecology, which is the study of the function of behaviour, and

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the evolution of alternative behavioural strategies (Troisi, 2005). The other question is its phylogenetic origin. How did it evolve in our ancestors, and does it occur in other species? Clearly the fossil record does not record anxiety, and whether it occurs in our immediate-return hunter-gatherer ancestors has not been adequately studied. So the occurrence of anxiety in other species is of interest, bearing in mind that behaviour can be very different in closely related species, such as the absence or presence of paternal behaviour in some rodents (e.g., montane vs. prairie voles).

These two questions, the function of behaviour and its phylogenetic origin, are two of the four questions which Tinbergen famously asked of any behaviour in order to understand it properly (Tinbergen, 1963): What is its function, what is its phylogeny, what is its ontogeny, what is its immediate causation? Of course, statements about the function of a behaviour during evolution are in a different logical category from statements about proximal causation, in that they cannot be verified empirically. This has led to negative comments from some sources (e.g. Dubrovsky, 2002), caricaturing them as "just-so stories", in the same category as Rudyard Kipling's "How the leopard got its spots"; but if we did not ask how the leopard got its spots, we might know a lot less about camouflage, colour vision and predator-prey relations,

I wrote on this topic ten years ago, and since what I said than can be read free on the internet (Price, 2003) I will try not to repeat myself, but rather emphasise certain points and attempt to cover more recent thinking.

2. The adaptive function of anxiety

It is obvious that anxiety is adaptive in protecting the individual from danger. A person who crossed Niagara Falls on a tightrope every day would not last long. In the UK we have had many deaths from "tombstoning", which means jumping off a high cliff into water (and entering it vertically, like a tombstone). Anxious avoidance of snakes and spiders has clearly saved lives, and the fact that there is no in-built anxiety about cars and electric sockets indicates that evolution has not had time to build up anxiety about these dangers. This is because of a "mismatch" between the present and the Era of Evolutionary Adaptation (EEA), which is the evolutionary time in which adaptations evolved.

I will write about the triune brain (McLean, 1990; Ploog, 2003). Although Paul McLean's ideas have been trashed by his successors in neuroanatomy (Wikipedia), and they do not fit well with the neuroanatomy of vocalisation (Newman, 2002), I think that some of his ideas are helpful, especially his idea of the forebrain consisting of three "central processing assemblies", operating somewhat independently, and arranged in a rostro-caudal sequence in the mammalian forebrain. This triune brain may well underlie the triune mind postulated by philosophers such as Plato, Pascal and Gurdjieff. Although I discussed this matter ten years ago, there is more to be said. One important finding is that the genetic tendency to generalised anxiety disorder (GAD) and major depressive disorder is the same (Kendler et al., 1992; Hettema et al., 2005), and so from an evolutionary view the arguments for one apply also to

the other. My own view is that anxiety and depression operate synergistically to manage social change in small groups, but more of that in a later section.

First, I will illustrate how escalation and de-escalation can be hypothesised to occur relatively independently at the three levels of the triune brain. Each level makes its own decision, when confronted by a threat or challenge, either to escalate or de-escalate:

Brain level	Response	to	threat
	Escalate	or	De-escalate
Rational level (isocortex)	Decide to fight (stubbornness or courage)	or	Decide to flee or submit (common sense)
Emotional level (limbic system)	Anger, feel assertive and confident	or	ANXIETY, feel inferior , impotent,
Instinctive level (basal ganglia)	Elevated mood	or	Depressed mood Anxious mood, GAD

Table 1. Escalating and de-escalating strategies at three brain levels: agonistic competition.

Human competition is very different from animal competition, and most of the methods of competition do not involve face-to-face encounters with rivals. Moreover, success is achieved not by intimidating a rival, but by attracting positive responses from other members of the group, resulting in prestige. Remarkably, the choices between escalation and de-escalation have survived the transition from agonistic to prestige competition, and so we can emend Table 1 to express the new type of competition, as laid out in Table 2:

Brain level	Response	to	competition
	Escalate	or	De-escalate
Rational level (isocortex)	Adopt new goals, actively pursue existing goals, assert oneself, speak in public	or	Give up goals, efface oneself, refrain from public speaking
Emotional level (limbic system)	Feel assertive, exhilarated and enthusiastic	or	ANXIETY, feel inferior, ashamed, writer's block
Instinctive level (basal ganglia)	Elevated mood	or	Depressed mood Anxious mood, GAD

Table 2. Escalating and de-escalating strategies at three brain levels: prestige competition.

It should be clear that de-escalation at the rational level can pre-empt or terminate de-escalation at the lower levels. These lower levels have evolved as a safety net in case the rational brain is too ambitious. Therefore we often see patients who are escalating at the

rational level, but, their escalation being unsuccessful, the lower levels are accessed. We also see patients who are escalating at the emotional level, and in spite of de-escalation at the rational level, if the angry emotion does not achieve its aim, we then get de-escalation at the instinctive level. Most of these patients have suffered unjustified misfortune, such as death of a child or being passed over in work by an incompetent member of the family firm; they are denied the principle of retributive justice, as was Job in the Book of Job of the Old Testament.

The idea of separating the negative emotions into escalatory and de-escalatory is not new. Stone (2002) reports that "Maurice de Fleury (1897) divided the emotions into two groups. Doubt, humility, sloth, fearfulness, sadness and pity are symptoms – to varying degrees – of cerebral exhaustion; Pride, foolishness, anger, egoism, courage, heroism, and cruelty are the manifestations of exaltation of the spirit." (p. 9).

2.1. The anxiety-generating effect of bad news

I would like to re-emphasise the importance of "bad news" in the genesis of psychopathology, as this does not seem to be generally recognised. Bad news, of deaths and other disasters, is not available to our primate cousins who are not equipped to exchange gossip, but has been available to our ancestors over the last few million years since language evolved. Since these ancestors lived in groups of about 150 individuals, the amount of bad news they could generate was limited, even if we add in bad news from neighbouring groups. Now, we have available the bad news of many billions of people. Since news of death or other disaster may presage the nearby existence of a predator or of raiding parties from neighbouring tribes, or of disease, it must have been adaptive for bad news to increase anxiety and promote activities to ward off occurrence, such as increased washing, checking of security arrangements, and the advantageous territorial constriction of agoraphobia.

In the EEA bad news was probably discussed and so shared with other group members, whereas modern man tends to watch it or listen to it on his own, or at least without comment. Things are worse when the bad news is close by. An Egyptian psychiatrist (Nagy, 2012) reports on a patient who was glued to her TV set, absorbing the chaos all around her; and the situation was dire: two of the psychiatrist's students were killed while trying to save injured protesters.

When I practiced as a clinician, I advised all my anxious patients to avoid watching TV news, and I found that many of them had learned the lesson for themselves. They realised that each item of bad news raised their background level of anxiety, and, of course, severely depressed patients may believe that they are personally responsible for the disasters which occur daily around the globe.

There is a need for controlled study of the effect of reducing patients' access to bad news, and this is difficult in modern conditions when family television has replaced games and conversation for family interaction. I make a point of advising my anxious patients to restrict their viewing to comedies and nature programmes, although this injunction may cause family arguments, if other members of the family have a different viewing agenda. This is

yet another argument for treating patients in family groups, so that the whole family can be motivated to protect the patient from the horrors of contemporary life. No one, to my knowledge, has done a controlled trial of "news avoidance" as an item of therapy.

2.2. Growing up with anxiety

A lot of variation in neuroticism (the personality equivalent of anxiety-proneness) is due to genetic factors and to non-shared environmental experience, negating the folk psychology view that children are strongly influenced by the behaviour of their parents and the atmosphere of the family home. Some genotypes prosper under negative home circumstances, whereas others suffer under those circumstances, but prosper more than the "tough ones" when the environment is benign (Bruene et al., 2012). This confirms the old observation that some children do better with the stick, and others with the carrot. We need to improve our means of distinguishing these two genotypes early in childhood.

I will say something about the genesis of anxiety in adolescence. Much good work has been done on the establishment of a secure base for the child in infancy (Price, 2000), but less has been done on adolescence, which in my clinical experience is a strong divider into the happy and the miserable. Some young people take to adolescence like a duck to water, and they are accepted by their adolescent peers and given positions of influence and even leadership in their groups. Others do badly at this time, and are bullied unmercifully by both boys and girls, that by boys tending to be physical, that by girls tending towards social exclusion. Normal children entering adolescence may be disadvantaged for many reasons; they may be odd in some way, speak with an unusual accent, have some physical deformity, or maybe they have moved into an area where the adolescent group is already full and does not want new recruits. For those who have suffered anxious or avoidant attachment in infancy, the problems of adolescence are compounded (Wilson, Price & Preti, 2009).

2.3. Social anxiety disorder (SAD)

Social anxiety disorder (SAD) is an exaggeration of the normal submissive or appeasement display which people make to more powerful individuals or to a disapproving group. Kaminer and Stein (2005) point out that SAD is an excessive fear of humiliating or embarrassing oneself while being exposed to public scrutiny or to unfamiliar people, resulting in intense anxiety upon exposure to social performance situations. Feared social situations are either avoided as much as possible or create significant distress. Physical manifestations of anxiety in the feared situations include a shaky voice, clammy hands, tremors and blushing. In the generalized sub-type of SAD, anxiety is associated with most social situations (including both formal performance situations such as giving a speech or speaking at a meeting, and informal social interactions such as initiating conversations, attending parties or dating); in the non-generalized sub-type, anxiety occurs only in specific social situations, such as public speaking, or eating/drinking in public, or writing in public. Prevalence rates for SAD range from 3% to 16%. From an evolutionary point of view, SAD must promote group functioning by reducing social competition, and ensuring that group discussions in the council chamber do not last indefinitely. Most readers will be aware that in question time

after a scientific paper, the people who ask questions are those who have social confidence and like the sound of their own voices, regardless of their knowledge of the subject, whereas many of those with something important to say remain silent because of SAD.

3. Anxiety in other species

Anxiety is the emotion associated with avoidance of danger, and it is obvious that many species encounter more danger than ourselves. Humans are sometimes taken by tigers and other predators, but many species are subject to constant predation, being the basic diet of the predator species. Can we learn from their reactions? One obvious defensive measure is to have a safe haven, especially at night. Some species avoid danger by being enclosed, others by being exposed. An extreme example of being enclosed is the naked mole rat, which does not appear above the surface of the earth. Rabbits avoid danger to their young by visiting them for suckling only once a day, and ferrets are more extreme in suckling only once in 48 hours. In this way they avoid giving predators a clue as to the whereabouts of their burrow, and this advantage clearly outweighs the advantage of constant maternal care. When kept in cages, rabbit and ferret mothers cannot do this, which may account for some of the aggressiveness they show at this time. Some species prefer to be exposed, such as the hamadryas baboon which sleeps on a cliff face, and many birds nest on cliffs for the same reason. Some humans adopt both strategies, and live in caves which open onto the cliff face, and in this case either acrophobia or claustrophobia would be a disadvantage.

A lot of information about animal anxiety is available informally on the internet: just Google "anxiety in horses (or monkeys, or birds, etc.)". Different animals have different sources of anxiety and different reactions to it; for instance, horses suffer from severe separation anxiety, and this no doubt originated in their need to stay with their herd.

Some group-living species delegate the role of anxious individual to one of their members, so that the rest can forage free from anxiety. We have all seen films of meerkats in which the group forages happily while one member stands on a mound and looks anxiously for birds of prey and terrestrial predators. This delegation of responsibility may be important for humans. If a foraging meerkat does not trust the sentry, the freedom from anxiety may be lost. If the obsessional housewife does not trust her cleaning lady, she is likely to repeat the work while nursing pathological grievance against her employee.

3.1. Phylogeny of anxiety

In an intriguing chapter, Hofer (2002) describes the response to danger in organisms of varying complexity. The bacterium swims forward with its flagella working together, absorbing molecules of sucrose and other foodstuffs. However, if receptors on its surface detect a toxin, its flagella then act independently, and the bacterium tumbles about. In half a second, it has forgotten about the toxin and sets off with flagella all pulling together, in whatever direction it happens to be pointing at the time. Hofer comments: "When it stops and tumbles in response to the presence of a negative signal, is it anxious? Certainly, we would not want

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to say so, even though the mental picture of a tumbling creature with flagellar hairs standing on end may be intuitively persuasive…..The presence of these behaviors in so primitive an organism gives us an idea of how basic a state resembling anxiety has been for survival of life forms."

Hofer also discusses the invertebrate sea hare, *Aplysia californicus.* It can be conditioned to respond with avoidance to shrimp juice by associating it with electric shocks (mimicking its predator, the starfish), thus producing a state of anticipatory anxiety, but in the absence of shrimp juice (the conditioned stimulus) its behaviour is normal. However, a series of uncontrollable electric shocks produces a "persistent state (lasting several weeks) in which defensive and escape responses were exaggerated, and responses to positive events were blunted, an abnormal behavioral repertoire had been established that resembled a form of chronic diffuse anxiety."

The development of the limbic system in mammals allowed new and social forms of anxiety to evolve. Rat pups emit high frequency squeaks when separated from their mother and these sounds release searching and retrieval behaviour in the mother. In his own work, Hofer was able to breed strains of rats with high and low tendency to emit squeaks. He speculates that the ability to squeak evolved to keep the rats warm, and only secondarily became a signal to the mother (exaptation). The squeaks are inhibited by benzodiazepines and opioids, and exacerbated by benzodiazepine antagonists. In later work (Brunelli & Hofer, 2007) the high squeak infant rats developed into nervous adults, while the low squeak rats were notable for their aggression, so there had presumably been selection for escalation versus de-escalation in the emotional (limbic) forebrain. Presumably, rabbit and ferret pups do not respond to separation in this way, otherwise they would attract predators to their burrow.

Turning to primates, Hofer describes Suomi's work on free-ranging rhesus macaques on an island in the Caribbean. This population contained a sub-population of very anxious individuals, some of whom suffered from "lasting incapacitating states resulting in substantial mortality". The anxious traits could be increased by selective breeding and prevention of good mothering. He describes the response to "chronically threatening conditions. Persistent anxiety (high levels of arousal, searching for cues for danger, and high levels of avoidance of potentially damaging encounters) confers an adaptive advantage over less anxious individuals." There has been criticism of Suomi's work on humanitarian grounds.

In the case of humans, Hofer describes the speculation of Klein that panic attacks may be a response to imminent suffocation, mediated by high levels of blood carbon dioxide. Hyperventilation (overbreathing) is a common feature of panic attacks, and may aggravate the panic by causing tetany due to low levels of carbon dioxide and thus an excessively alkaline blood.

My own extensive experience of patients with panic attacks resulted from an appointment as medical casualty officer in a hospital near an underground railway station in London. Two or three patients a day were brought by ambulance from the station, having developed panic in the underground, especially when it was crowded and the train stopped between

stations. These patients had very rapid respirations which caused involuntary contraction of muscles and sensations of tingling due to the alkalinity of the blood due to loss of carbonic acid due to overbreathing. Of course, these symptoms aggravated the panic and most of the patients thought they were dying. Their condition was rapidly cured by getting them to breathe into a paper bag, so that they were rebreathing their own carbon dioxide. Talking to these patients when they had recovered, it was clear that most of them were healthy young adults who had no history of excessive anxiety or any other psychiatric disorder.

Hofer concludes by pointing out that patients may benefit by being told that they are suffering from, not madness, but from a mechanism that has enabled their ancestors to survive the dangers of our evolutionary past.

4. Genetics

A lot of excitement has been caused by the discovery of a polymorphism in the serotonin transporter gene (which enables the reuptake of serotonin into the presynaptic neuron),because most of our effective antidepressant drugs inhibit the reuptake of serotonin. Equally exciting is the possibility that there is a gene/environment interaction in its effect (Risch et al., 2009). It has been suggested that the "short" allele of the serotonin transporter coding gene is associated with greater risk for depression if linked with early childhood adversities, yet the same version of the gene is associated with *reduced* risk for depression if carriers grow up in emotionally secure conditions (Belsky & Pluess, 2009). This suggests that selection favoured plasticity or "open programs" that render individuals more susceptible to environmental contingencies – for better *and* worse (Belsky, Jonassaint & Pluess, 2009). Similarly, psychiatrists guided by evolutionary theory have recognized that antagonistic pleiotropy may play a role in psychiatric disorders – genes that convey fitness advantages in one domain, while having potentially maladaptive value in another domain, a concept that was originally put forth with regard to senescence (Bruene et al., 2012). Nowadays, examples for antagonistic pleiotropy can be pinned down to even single genes such as the catecholamine-O-methyltransferase coding gene, of which one particular allele is associated with poorer working memory performance but superior empathy (Heinz & Smolka, 2006)). Taken together, these insights offer an answer to the question of why natural selection designed bodies that are – under specific circumstances – vulnerable to disease (Nesse & Williams, 1994). There have been several hundred studies of the serotonin transporter gene in various psychiatric populations and consistent results are not easy to obtain (Duncan & Keller, 2010).

I mentioned above some findings from the large Virginia twin study carried out by Kendler and his colleagues (Hettema, Prescott, Myers et al., 2005). They found that the genetic predisposition to major depressive disorder was the same as that to generalised anxiety disorder and to panic disorder. There was some overlap with social anxiety disorder and agoraphobia, but the genetic predisposition to specific phobias was separate. This means that if one is predisposed by genetics to major depressive disorder, one is

equally predisposed to general anxiety disorder (GAD), but the same cannot be said for lesser degrees of anxiety.

4.1. The serotonin transporter gene in macaques.

Humans and macaques are the only primates to have the short version of the serotonin transporter gene. 48% of Caucasian populations are heterozygotes, having both short and long alleles. 36% are homozygotes for the long allele, 16% for the short allele. Rhesus monkeys who possess the short allele are notably more anxious than the long homozygotes (Watson et al., 2009). Moreover, when shown pictures of dominant monkeys, their pupils dilate more than those who are homozygous for the long allele, and they have to be bribed (with juice) to see the face of a dominant monkey, whereas the long homozygotes will forego juice in order to see the same pictures. The rearing of these monkeys is not described, so it is difficult to compare with the human data mentioned above.

4.2. Anxiety in different human cultures

I am not an anthropologist, but it is clear from the literature that some cultures have different attitudes to anxiety and maybe different genetic predispositions. Margaret Mead (1935) studied three tribes living in the Sepik River Valley of Papua New Guinea. The Mundugumor were very aggressive and warlike, so that anxiety was not a desirable feature with them (but the actual frequency of anxiety is not known). The Arapesh were extremely peaceful. The Tchambuli were also peaceful and the men spent their time putting on plays. The two latter tribes had been driven out of the fertile areas of the island.

The Tarahumara of Mexico (McDougall, 2010) are reported to be extremely nervous and inhibited, so that any social contact requires large quantities of corn beer to be consumed. They are famous for their utrarunning (running more than marathon distances), and possibly they seek the "runner's high" (thought to be due to the release of endogenous opioids) to counter their natural timidity.

Also very nervous are the Chewong of the Malaysian Peninsular, and in this tribe the admired norm of behaviour is to be timid (Howell, 2012). It is said that the elders are fond of telling stories about the times they have run away. Asiatics may have higher frequencies of the short version of the serotonin transporter gene than Europeans (Watson et al., 2009).

5. Anxiety and its resolution in a sacred text

For reasons of confidentiality, we cannot present case histories from our practice, but fortunately there is a clear account of an anxiety attack and its resolution in the Hindu epic poem, the Mahabharata (Price& Gardner, 2009). The poem describes a long and bitter struggle between two sets of cousins, the Pandavas and Kauravas, for control of ancestral lands. The Bhagavad Gita (a small part of the Mahabharata) begins with the two armies drawn up for battle with warriors blowing conches and beating drums. Arjuna, a younger Pandava broth-

er renowned as an archer, drives his chariot between the armies to assess the opposition. His charioteer is none other than the god Sri Krishna. As Arjuna views the superior Kaurava army, he sees relatives and mentors he knows well. He feels doubts about killing these family members and friends, translated by Mitchell (2002) as follows:

Arjuna saw them standing there: fathers, grandfathers, teachers, uncles, brothers, sons, grandsons, fathers-in-law, and friends, kinsmen on both sides, each arrayed against the other. In despair, overwhelmed with pity, he said: "As I see my own kinsmen, gathered here, eager to fight, my legs weaken, my mouth dries, my body trembles, my hair stands on end, my skin burns, the bow Gandiva drops from my hand. I am beside myself, my mind reels. I see evil omens, Krishna; no good can come from killing my own kinsmen in battle. I have no desire for victory or for the pleasures of kingship" ….. Having spoken these words, Arjuna sank down into the chariot and dropped his arrows and bow, his mind heavy with grief…..

As Arjuna sat there, overwhelmed with pity, desperate, tears streaming from his eyes, Krishna spoke these words to him: "Why this timidity, Arjuna, at a time of crisis? It is unworthy of a noble mind; it is shameful and does not lead to heaven. This cowardice is beneath you, Arjuna; do not give in to it. Shake off your weakness. Stand up now like a man."

Arjuna said: "When the battle begins, how can I shoot arrows through Bhishma and Drona, who deserve my reverence? …… I am weighted down with pity, Krishna; my mind is utterly confused. Tell me where my duty lies, which path I should take. I am your pupil; I beg you for your instruction. For I cannot imagine how any victory – even if I were to gain the kingship of the whole earth or of all the gods in heaven – could drive away this grief that is withering my senses."

Having spoken thus to Krishna, Arjuna said: "I will not fight," and fell silent.

As Arjuna sat there, downcast, between the two armies, Krishna smiled at him, then spoke …

The god Krishna, the eighth avatar of Vishnu, then speaks to Arjuna for 16 more chapters (and the reader is left to wonder what the two armies are doing during this time). In a verbal dominance display of unparalleled beauty (except possibly for the speech of the Lord out of the whirlwind in the book of Job), Krishna explains to Arjuna that he is all-powerful, and then he displays himself to Arjuna in all his divine majesty. Arjuna is overwhelmed and submits to Krishna, saying "I will do as you command". He then recovers from his anxiety attack and fights heroically in the ensuing battle.

In this example we see a distressing situation lead to a severe panic attack, a request for advice which is not followed, a dominance display by the god followed by total submission on the part of Arjuna and then recovery from anxiety. By abrogating responsibility to Krishna at the rational level of his triune mind, Arjuna no longer needs the anxiety which arose from his emotional mind due to the initial failure of the rational mind to deal with the problem (by taking Krishna's advice).

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5.1. Anxiety and art

Although artists can portray frightening scenes, it is less easy for them to depict the anxiety response. Here is a comment by Edvard Munch about his famous (and expensive) painting "The Scream":

"I was walking down the road with two friends when the sun set; suddenly, the sky turned as red as blood. I stopped and leaned against the fence, feeling unspeakably tired. Tongues of fire and blood stretched over the bluish black fjord. My friends went on walking, while I lagged behind, shivering with fear. Then I heard the enormous, infinite scream of nature." He later described the personal anguish behind the painting, "for several years I was almost mad… You know my picture, 'The Scream?' I was stretched to the limit—nature was screaming in my blood… After that I gave up hope ever of being able to love again." (Wikipedia).

5.2. Social presentation of the anxious person

Anxious patients may not appear anxious to others, but may be seen as aloof or even arrogant. Leahy (2010) puts it as follows::

"People with social phobia or social anxiety often give out signals of their own apprehension that inadvertently send the wrong message. For example, many of my patients over the years with social anxiety often don't smile, they avoid eye contact, and they remain silent because they are so anxious that they will either sound foolish or look anxious. Ironically, these attempts to remain "closed" result in the "wrong impression". Many of these people appear to be cold and aloof-and, in some cases, conceited. It's the wrong message and they don't even know they are sending it. Ironically, they fear that they will appear anxious, but they actually appear arrogant. They also fail to "mirror" or "match" the emotions that others are displaying. For example, other people may be smiling, but the anxious person may remain cool and aloof. This sends the wrong message - that you are not interested and you don't care."

One of my first patients was just such a young man, seen as aloof by fellow patients in a neurosis unit (Sainsbury and Price, 1969). Asked to paint "Myself and the group" in art therapy, he drew a circle of red blobs representing the group and a single black blob representing himself. In the group discussion the next day, the other patients said that they had thought he felt himself superior to them, but in the ensuing discussion he disabused them of this idea and was then accepted by the group. This is similar to the misperception of depressed patients, who are seen, not as depressed, but as lazy because they do not perform tasks well, or rude because they do not carry out social obligations such as writing thank-you letters.

The concealment of anxiety is a promising line of study. A chimpanzee in a conflict situation has been seen literally wiping the submissive grin off his face with his hand. Some tribes cut the muscles around the mouth to prevent the manifestation of a trembling lip. The concealment and detection of anxiety is to be found expressed in the novels of Georgette Hayer. Anxious young people may hide their anxiety from their parents, perhaps hiding scars on

their forearms with long sleeves, and this may lead to further parental pressure to succeed academically which, of course, makes the anxiety worse. I described this situation in some detail in my previous paper (Price, 2003), and here I reproduce the figure which illustrates how the ambitious parents mistake the position of their child on the Yerkes-Dodson curve:

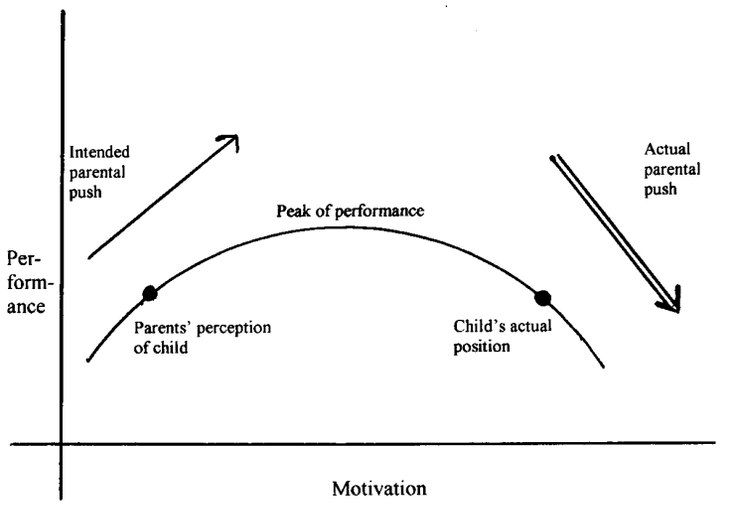


Figure 1. The inverted U-shaped curve of the Yerkes-Dosdon law. The single-shafted arrow represents the parents' attempt to push the child up towards the peak of performance. The double-shafted arrow represents the actual effect of the parental pushing.

6. Conclusion

Since evolutionary speculations are not directly testable, I have tried to show how they may be useful in planning treatment programmes, and in research. One of the main contributions of the evolutionary perspective is to show that anxiety plays a major role not only in protecting people from non-social dangers, but also in maintaining social stability in social groups. Practically all group-living vertebrates have social hierarchies which function to maintain peaceful relations within groups and also to provide a structure for social selection to occur. There is an enormous amount of inhibition in these animal groups, and this is maintained by anxiety and depression. Especially among males, life is one of continual inhibition, in which desires for mating, food and sleeping quarters are supressed. Few individuals achieve the alpha position in their groups, and it is only these alphas who are free to express their personalities and desires without inhibition. The acceptance of relatively low hierarchical position by other group members allows the group to work co-operatively, as in hunting by wolves and cape hunting dogs.

6.1. Rational de-escalation can prevent or terminate sub-rational de-escalation

Aristotle pointed out that if someone hits you, you experience pain; if the pain is caused by a higher ranking individual, you feel sad, if it is caused by a lower-ranking individual, you

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feel angry. You have no choice about these reactions as they are determined by the sub-rational brain. You do have a choice about your voluntary action. You can attack the person who hit you, and this is the fight version of the fight/flight response; or you can shrink away, and this is the flight version of the fight/flight response. If you attack a higher-ranking person, you are likely to incur severe costs; on the other hand, if you win, you stand to gain significant benefit. Since fight involves actions such as recruitment of allies, preparation of armaments and planning of strategy, it has been described as an escalatory response by behavioural ecologists; this contrasts with the de-escalatory response of flight which also includes submission, in which there may be not only an absence of flight, but an actual approach to the rival for the purpose of reconciliation. Therefore in a threat situation we have a choice between escalating and de-escalating strategies at two or more levels. With our rational brain we can choose either to fight or submit, and with our sub-rational brain we can "choose" either to feel angry or to feel sad and anxious. If these two brain levels choose the same strategy, then all is well, there is either angry attack or anxious submission. But if the two levels make opposite choices, there may be trouble. Especially if the rational brain decides on escalation and the subrational brain decides on de-escalation, we are in for trouble (psychopathology).

We do not have to go further than Charles Darwin himself for an example. His theory of evolution by natural selection was an attack not only on the church, but also on his wife (who held religious views). In pursuing his theory he was escalating at the rational level. His escalation was at first muted, since he kept his manuscript in a drawer for many years. But his attachment to the goal of publication was evidenced by his rapid response when a rival appeared in the form of Wallace, and he was quick to summarise his theory for joint presentation with Wallace to the Linnean Society. With encouragement from his friends, his rational response was escalation. But his sub-rational brain made a different analysis of the situation, seeing the church as a formidable rival and not one to be trifled with; therefore it made a decision to de-escalate. As a result Darwin was plagued with anxiety and psychosomatic symptoms for the rest of his life.

I have treated many patients who are escalating at the rational level but de-escalating at the sub-rational level. Reasons for rational escalation can be called courage or stubbornness, depending on your viewpoint. Moral scruples are a common cause for escalation; for instance, patients refuse to take part in stealing by fellow employees and so suffer social exclusion; one patient of mine refused to accept advertisements for call girls for her magazine, which put her in conflict with management. In our monograph, Stevens and I report in some detail the case of a porter who refused to take sick leave when he was not sick. The poet Milton (not a patient of mine!) continued writing poetry and tracts criticising the monarchy, and suffered ill-health as a consequence.

As can be seen from the Tables, the sub-rational brain can be divided into two, an emotional level in which there is partial realisation of the situation and an instinctive level in which there is no such realisation. Here again, escalation in the form of anger may be combined with de-escalation at a lower level in the form of depression and anxiety. If anger is effective in righting the situation, all is well, but often anger is frustrated by authority or by the situa-

tion itself, so that lower level de-escalation becomes chronic. Patients of mine in this situation include parents whose child had been killed by a drunken driver, people unjustly sacked form their jobs, parents whose children have been denied educational opportunity be the school system, and, in one remarkable case, a father whose daughter had precocious puberty and who was accused by social services of sexually interfering with her. Treatment in these cases is difficult. In some cases I have helped the patient to discharge the anger by writing letters to the offending authority. In some cases, joining a group with other people similarly abused can direct the anger into productive channels, as when group of parents whose children have been killed by drunken drivers band together to tighten the laws on drunken driving.

6.2. Delegation and abrogation

One clear suggestion from the evolutionary viewpoint is the desirability of shedding responsibility. This can take the form of delegation of responsibility to other members of the social group, and the model here is the adoption of the role of sentry by foraging meerkats. Also there is abrogation of responsibility to a more powerful person or a higher power. This is part of the programme of AA in which one "step" is to acknowledge that one cannot give up alcohol on one's own, without the help of a higher power, which may be some form of deity or an emergent property of the group. We have seen how Arjuna's panic attack and anxiety about killing his relatives and friends was allayed by submission to his God, Krishna. Many religions offer peace and joy to those who submit. One of my own anxieties is about the loss of rainforest in the world, and this anxiety is assuaged by my knowledge that Prince Charles is not only more worried about it than I am, but is also immensely more powerful.

The mismatch between the environment in which we evolved (the EEA) and the conditions we now live in are not difficult to apprehend. One crucial difference is the transmission of bad news. We now have daily reports of the tragedies and afflictions which affect many billions of people, whereas our ancestors knew only about the reverses suffered by a group of 150 or so people. Therefore it is sensible to encourage anxious people to avoid reading newspapers and watching news broadcasts, and stick to sport, comedy or nature programmes.

An evolutionary approach is also helpful for research, offering a wide variety of animal models of anxiety for the investigation of mechanisms and the testing of anxiolytics. There has been too little work on reptiles, some of whom change colour when defeated. Tail-chasing in dogs is being used as an animal model of obsessive-compulsive disorder (Tira et al., 2012).

6.3. Treating the anxious patient

Here is a check-list for the therapist who is treating an anxious patient:

1. Since from an evolutionary perspective anxiety is an unconscious form of submission, has the patient submitted consciously and voluntarily where necessary?

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2. If the patient is a believer, have they submitted totally to their god, or are there elements of "My will be done", or is there a problem with accepting a god who allows unnecessary suffering? If the patient is not a believer, has he accepted the universe and his place in it: if not, he should join a group of people with similar problems.

3. At work, does she respect her boss, or does she think she could do the job better? Does she have insubordinate subordinates?

4. Has he or she submitted to the reasonable demands of the marriage partner?

5. Has he submitted to the rules of society? E.g., does he avoid paying taxes or fiddle his expenses?

6. Has the patient delegated where possible, and does he or she trust the person delegated to?

7. Has the patient restricted television viewing to comedy and nature programmes?

8. Have you spoken to the patient's marriage partner or someone else close to the patient? Teenage or grown up children often see things that adults miss, and they usually appreciate being involved in their parent's treatment, especially if there have been threats of suicide.

9. Is the anxiety worse after receiving letters or phone calls or visits from anyone?

10. Has the patient got supportive friends? If not, group therapy should be considered (and also for patients who have been abused by the adolescent peer group – fellow group members can provide a re-run of the adolescent experience).

11. Are the patient's goals in life realistic?

12. Is there conflict with anyone such as a neighbour or relative?

13. Is there unresolved grief?

14. Is there a problem with alcohol or anxiolytic medication?

In the behavioural treatment of anxiety, there is an odd situation in which extremes may be more beneficial than anything in between. Thus the choice may be between very gentle deconditioning and flooding, in which the patient is kept in the anxiety-arousing situation for as long as it takes for the anxiety to subside, and then the patient realises they can be in that situation without anxiety. This is similar to the situation with autistic children, with whom success has been achieved either by a very gradual approach or by overwhelming cuddling. The same applies to self-esteem, which may be built up with the help of a therapist, or the self may be abnegated to facilitate total submission to God. Philosophers advise us to take the middle course, but sometimes the middle course is ineffective.

In summary, anxiety evolved to keep us out of danger, to obey the rules of our group, and to treat each other with respect. If we have too much anxiety, we suffer, if we have too little, we may become insufferable.

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