

Peace of Mind:

Emotions, the Limbic System, and Equanimity

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Evolutionary Perspectives

Daily life is full of emotions, from the pleasures of happiness and love to the pains of worry, frustration, sorrow, and anger.

While we may take them for granted, our feelings are actually an extraordinary evolutionary achievement, as remarkable in their own way as language and logic.

Animals have emotions, too, as Darwin observed in his book, *The Expression of Emotions in Man and Animals*, in 1872. But consider the apparent emotions in a spectrum of animals, from – say – snakes and lizards, to squirrels, dogs, and monkeys, and then to human beings. There is a direct correlation between the complexity of social life of a species and the range and depth of the emotions of its members. Because our relationships are so layered, nuanced, enduring, and plain messy, humans have the greatest emotional range of any animal.

In our species, emotions serve many functions. They arouse our interest and tell us what to pay attention to. They motivate approach strategies through pleasant feelings and motivate avoidance or attack strategies through unpleasant ones. They enable us to share states of mind with other members of our family, tribe, or nation – and to signal or detect important states of mind such as fear, disgust, anger, or erotic interest. They bond children and parents, lovers and friends.

Emotions join us in common cause with other people, whether it's chatting companionably while gathering nuts and berries on the African savannah 100,000 years ago or it's circling with spears around a woolly mammoth in Siberia 80,000 years later – or it's cheering our football team to victory . . . or it's exulting, alas, while watching our nation's missiles strike an enemy target.

More subtly, emotions make us known to ourselves. Flowing through the field of awareness – perhaps arising, actually, as a modification of awareness – emotions signal the deeper underlying movements of mental activity.

Which reflects, of course, the underlying movements of neurological activity.

Emotion in the Brain

The major brain regions that support emotional processing include the limbic system – particularly the hippocampus, amygdala, and hypothalamus – and the prefrontal cortex, anterior cingulate cortex (ACC), nucleus accumbens, and insula. Technical note: there are two hippocampi, one in each hemisphere of the brain; the same for the two amygdalae, ACCs, and insulae. Following common practice, we'll mainly use the singular form.

By the way, as an interesting evolutionary detail, the limbic system seems to have evolved from the olfactory (scent) neural circuitry in the brain developed by our ancient mammal ancestors, living around 180 million years ago. They seem to have used their advanced sense of smell to hunt at night, while those cold-blooded reptiles were snoozing – and easier prey.

The conscious experience of emotion is just the top story – the penthouse floor – resting on many layers of neurological activity, both the firing of very complex and intertwining neural circuits and the tidal flows of neurotransmitters and hormones such as dopamine, serotonin, and oxytocin. Here's a brief summary of each of these brain regions and its apparent role in emotion:

- Hippocampus – This vaguely sea-horse shaped region helps store the contexts, especially visual-spatial ones, for important experiences, such as the smell of a predator . . . or the look of an angry parent. This region is necessary for forming personal memories of events, and is unfortunately damaged over time by the cortisol released by chronic stress (especially, high or even traumatic levels of stress).
- Amygdala – Connected to the hippocampus by the neural equivalent of a four-lane superhighway, this small, almond-shaped region is particularly involved in the processing of information about threats. The subjective awareness of threat comes from the feeling tone of experience when it is unpleasant (distinct from pleasant or neutral). When it perceives a threat – whether an external stimulus like a car running a red light or an internal one, such as suddenly recalling an impending deadline – the amygdala sends a jolt of alarm to the hypothalamus and other brain regions. It also triggers the ventral tegmentum, in the brain stem, to send dopamine to the nucleus accumbens (and other brain regions) in order to sensitize them all to the “red alert” information now streaming through the brain as a whole.
- Hypothalamus – This is a major switchboard of the brain, involved in the regulation of basic bodily drives such as thirst and hunger. When it gets a “Yikes!” signal from the amygdala, it tells the pituitary gland to tell the adrenals to start release epinephrine and other stress hormones, to get the body ready for immediate fight-or-flight action. But keep in mind that this activation occurs not just when a lion jumps out of the bushes, but chronically, in rush-hour traffic and multi-tasking, and

in response to internal mental events such as pain or anger. (For more on the stress response – and what you can do about it – see the Wise Brain Bulletins, Volume 1, #5 and #6.)

- Prefrontal cortex (PFC) – If you whack your self on the forehead, the mini-shock waves reverberate through the PFC, which is “pre” because it is in front of the frontal cortex. The PFC is centrally involved in anticipating things, making plans, organizing action, monitoring results, changing plans, and settling conflicts between different goals: these are called the “executive functions,” and if the brain is one big village, the PFC is its mayor.

Where emotion is concerned, the PFC helps foresee the emotional rewards (or penalties) of different courses of action. The PFC also inhibits emotional reactions; many more nerve fibers head down from the PFC to the limbic circuitry than in the other direction. The left PFC plays a special role in controlling negative affect and aggression: stroke victims whose left PFC is damaged tend to become more irritable, distraught, and hostile (the same happened for the unfortunate and famous Phineas Gage, the engineer who suffered an iron bar through his forehead in a mining explosion). On the other hand, differential activation of the left PFC is associated with positive emotions – and years of meditation practice!

- Anterior cingulate cortex (ACC) – This sits in the middle of the brain, centrally located for communication with the PFC and the limbic system. It monitors conflicts between different objects of attention – Should I notice the bananas in this tree or that snake slithering toward me? Should I listen to my partner or focus on this TV show? – and flags those for resolution by the frontal lobes. Therefore, it lights up when we attend to emotionally relevant stimuli, or sustain our attention to important feelings – inside ourselves and other people – in the face of competing stimuli (e.g., trying to get a sense for what’s *really* bugging a family member underneath a rambling story and other verbiage).
- Nucleus accumbens – In conditions of emotional arousal – especially fear-related – the accumbens receives a major wake-up call of dopamine from the tegmentum, which sensitizes it to information coming from the amygdala and other regions. Consequently, the accumbens sends more intense signals to the pallidum, a relay station for the motor systems, which results in heightened behavioral activity. This system works for both negative and positive feelings. For example, the accumbens lights up when a person with an addiction sees the object of his or her craving.
- Insula – Deeply involved in interoception – the sensing of the internal state of the body (e.g., gut feelings, internal sensations of breathing, nausea) – the insula lets you

know about the deeper layers of your emotional life. And it is key to sensing the primary emotions in others, such as fear of pain, or disgust.

The Machinery of Upset

(Emotional) life is great when we feel enthusiastic, contented, peaceful, happy, interested, loving, etc. But when we're upset, or aroused to go looking for trouble, life ain't so great.

To address this problem, let's turn to a strategy used widely in science (and Buddhism, interestingly): analyze things into their fundamental elements, such as the quarks and other subatomic particles that form an atom or the Five Aggregates in Buddhism of form, feeling (the "hedonic tone" of experience as pleasant-neutral-unpleasant), perception, volitional formations, and consciousness.

We'll apply that strategy to the machinery of getting upset. Here is a summary of the eight major "gears" of that machine - somewhat based on how they unfold in time, though they actually often happen in circular or simultaneous ways, intertwining with and co-determining each other.

The point of this close analysis, this deconstruction, is not intellectual understanding or theory, but increasing your own mindfulness into your experience, and creating more points of intervention within it to reduce the suffering you cause for yourself - and other people.

This will be more real for you if you first imagine a recent upset or two, and replay it in your mind in slow motion.

Appraisals

- What do we focus on, what do we pick out of the larger mosaic?
- What meaning do we give the event? How do we frame it?
- How significant do we make it? (Is it a 2 on the Ugh scale . . . Or a 10?)
- What intentions do we attribute to others?
- What are the embedded beliefs about other people? The world? The past? The future?
- In sum, what views are we attached to?

-> Mainly frontal lobe and language circuits of left temporal lobe

Self-Referencing

- Upsets arise within the perspective of "I."
- What is the sense of "I" that is running at the time? Strong? Weak? Mistreated?

- Are you taking things personally?
- How does the sense of self change over the course of the upset (often intensifying)?

-> Circuits of “self” are distributed throughout the brain.

Vulnerabilities

- We all have vulnerabilities, which challenges penetrate through and/or get amplified by (moderated by inner and outer resources).
- Physiological: Pain, fatigue, hunger, lack of sleep, biochemical imbalances, illness
- Temperamental: Anxious, rigid, angry, melancholic, spirited/ADHD
- Psychological: Personality, culture, effects of gender, race, sexual orientation, etc.

-> Depending on its nature, a vulnerability can be embodied or represented in many ways

Memory

- Stimuli are interpreted in terms of episodic memories of similar experiences.
- And in terms of implicit, emotional memories or other, unconscious associations. (Especially trauma)
- These shade, distort, and amplify stimuli, packaging them with “spin” and sending them off to the rest of the brain.

-> Hippocampus, with other memory circuits

Aversion

- The feeling tone of “unpleasant” is in full swing at this point, though present in the previous “gears” of survival reactivity.
- In primitive organisms - and thus the primitive circuits of our own brain - the unpleasant/ aversion circuit is more primary than the pleasant/approach circuit since aversion often calls for all the animal’s resources and approaching does not.
- Aversion can also be a temperamental tendency.
- The Buddha paid much attention to aversion - such as to ill will - in his teachings, because it is so fundamental, and such a source of suffering.

-> Involves the limbic system, especially the amygdala

Bodily Activation

- The body energizes to respond; getting upset activates the stress machinery just like getting chased by a lion.
- Sympathetic nervous system (fight-or-flight)

- Hypothalamus-pituitary-adrenal (HPA) axis
- All this triggers blood to the large muscles (hit or run), dilates pupils (see better in darkness), cascades cortisol and adrenaline, increases heart rate, etc.
- These systems activate quickly, but their effects fade away slowly.
- There is much collateral damage in the body and mind from chronically “going to war.”

Negative Emotions

- Emotions are a fantastic evolutionary achievement for promoting grandchildren.
- Both the prosocial bonding emotions of caring, compassion, love, sympathetic joy . . .
- And the fight-or-flight emotions of fear, anger, sorrow, shame
- Emotions organize, mobilize the whole brain.
- They also shade our perceptions and thoughts in self-reinforcing ways.

Loss of Executive Control

- The survival machine is designed to make you identify yourself with your body and your emotional reactions. That identification is highly motivating for keeping yourself alive!
- So, in an upset, there is typically a loss of “observing ego” detachment, and instead a kind of emotional hijacking - all facilitated by neural circuits in which amygdala-shaped information gets fast-tracked throughout the brain, ahead of slower frontal lobe interpretations.
- With maturation (sometimes into the mid-twenties) and with experience, the frontal (especially prefrontal) cortices can comment on and direct emotional reactions more effectively.

Emotional Hijacking

In light of this machinery of survival-based, emotional reactivity, let’s look more narrowly at what Daniel Goleman has called “emotional hijacking.”

The emotional circuits of your brain – which are relatively primitive from an evolutionary standpoint, originally developed when dinosaurs ruled the earth – exert great influence over the more modern layers of the brain in the cerebral cortex. They do this in large part by continually “packaging” incoming sensory information in two hugely influential ways:

- Labeling it with a subjective feeling tone: pleasant, unpleasant, or neutral. This is primarily accomplished by the amygdala, in close concert with the hippocampus; this circuit is probably the specific structure of the brain responsible for the feeling aggregate in Buddhism (and one of the Four Foundations of Mindfulness).
- Ordering a fundamental *behavioral* response: approach, avoid, or ignore.

The amygdala-hippocampus duo keep answering the two questions an organism - you and I - continually faces in its environment: Is it OK or not? And what should I do?

Meanwhile, the frontal lobes have also been receiving and processing sensory information. **But much of it went through the amygdala first**, especially if it was emotionally charged, including linked to past memories of threat or pain or trauma. Studies have shown that differences in amygdala activation probably account for much of the variation, among people, in emotional temperaments and reactions to negative information.

The amygdala sends its *interpretations* of stimuli - with its own "spin" added - throughout the brain, including to the frontal lobes. **In particular, it sends its signals directly to the brain stem without processing by the frontal lobes - to trigger autonomic (fight or flight) and behavioral responses.** And those patterns of activation in turn ripple back up to the frontal lobes, also affecting its interpretations of events and its plans for what to do.

It's like there is a poorly controlled, emotionally reactive, not very bright, paranoid, and trigger-happy lieutenant in the control room of a missile silo watching radar screens and judging what he sees. Headquarters is a hundred miles away, also seeing the same screens -- but (A) it gets its information after the lieutenant does, (B) the lieutenant's judgments affect what shows up on the screens at headquarters, and (C) his instructions to "launch" get to the missiles seconds before headquarters can signal "stand down!"

Suffering and More Suffering

The "spin" or "packaging" added by the amygdala and its partners may be great for survival - "jump first, ask questions later" - and probably why, in the order of the aggregates in Buddhism, the feeling aggregate comes before the perception aggregate: in evolution, it's more important to sense *whether* there's a threat than to know *what* it is.

But this primal circuitry is a major source of the "second dart" of life: the secondary cascade of uncomfortable emotions, action plans, views, etc. that follows the bare sensory data of the first dart of elemental physical or emotional pain.

In other words, we are continually having reactions as result of being alive, and they have an inherent tone of being pleasant, unpleasant, or neutral.

The usual state is one in which we *react* to those reactions – by reaching after what’s pleasant, *grasping* after it . . . or resisting or trying to get away from what’s unpleasant, *averse* to it . . . or wanting what’s neutral to hurry up and turn into something pleasant!

These understandable reactions to our reactions have just one small problem:

They are a key link in the chain of suffering.

You can see for yourself: your reactions to the initial reaction of pleasant, unpleasant, or neutral very, very often make you or others suffer. Pure and simple. No way around it. Like gravity.

And then those reactions to reactions . . . become the basis for more reactions which lead to suffering.

This is, of course, depressing.

Cutting the Chain of Suffering

But it’s also incredibly hopeful.

The link between (A) our initial, primary reaction – of pleasant, unpleasant, or neutral – and (C) suffering and harms to ourselves and others . . . is (B) our secondary reactions of grasping and aversion.

If we just block those reactions, then whoosh, we’ve snipped the chain. Nipped it in the bud! *And equanimity is the scissors.* It stops reactions developing to that initial, primary feeling tone. And that makes all the difference in the world.

In essence, calm is when you aren’t having reactions, while equanimity is when you’re not reacting to your reactions. (Indifference – let alone apathy – are near enemies of equanimity. Often there is anger – i.e., aversion – buried in indifference and apathy.)

In a state of equanimity, we haven’t yet permanently broken the chain of suffering, since there are other factors at work generating suffering that still need to be addressed. And our relief from suffering is contingent, dependent, lasting only as long as our equanimity does, and thus not utterly reliable – in the “heartwood” sense of complete liberation and freedom.

Nonetheless, even a momentary relief from suffering is great. And in the space of clarity and non-disturbance that equanimity provides, we are also able to have more insight into our own minds – into the factors that promote the welfare of ourselves and others, and those that do not – and able to cultivate wholesome qualities, such as patience, investigation, and compassion.

Changing the Machinery of Upset

So let's consider ways to cultivate more peace of mind – and even its consummation in profound equanimity – by working with the eight gears of the machine of suffering we explored above. (There are other methods, too, that are more specifically Buddhist, and you might like to explore the Access to Insight website for more information.)

This list is by no means exclusive: it just points to how many great tools are available these days for managing our emotional reactions.

Methods for Appraisals

- Stay mindful of the whole.
- Be mindful of the meanings, the framings, we give things.
- Challenge the significance the mind gives something. Is it really an 8 on the 10-point Ugh scale? If it's really a 2, why is my anger an 8?
- Challenge the intentions we attribute to others; realize we are usually a bit player in their drama.
- What beliefs are implicit about others, world? Try cognitive therapy methods for challenging inaccurate, negative beliefs.

Methods for Self-Referencing

- Recognize the suffering that comes from selfing.
- Practice mindfulness of the sense of "I"
- What are the implicit representations of self: Strong? Weak? Mistreated? How does this underlying framing affect your experience of situations?
- How much are we taking things personally? ("Negative grandiosity," I'm so important that they're deliberately hassling me.)
- How does getting upset intensify or shade self?
- See the interconnectedness of things in the situation, including yourself.
- Identify legitimate rights and needs, and take care of them.

Methods for Vulnerabilities

- Hold a frame of compassion for yourself and self-acceptance
- Do an honest self-appraisal of physiology/health, temperament, and psychology: Weak spots? Hot buttons?

- Protect vulnerabilities in situations: e.g., eat before talking about what upset you; ask people to slow down if you tend to be rigid; push through possible inhibitions in assertiveness due to culture, gender.
- Shore up vulnerabilities over time: e.g., medical care, vitamins, 5-HTP, antidepressants; build up greater control over your attention; take in positive experiences that slowly fill the hole in your heart.

Methods for Memory

- Be aware of the “pre-amp” turbo-charging of memory and sensitization.
- Increase positive emotional memories by “taking in the good.”
- Shift emotional memories in positive directions over time by recalling old painful experiences while simultaneously bringing positive thoughts and feelings prominently to mind.
- With a therapist, consider other methods for painful experiences or traumas (e.g., EMDR)

Methods for Aversion

- Understand the central place in psychology and in spiritual growth of working with aversion; use that to motivate yourself to not act aversively.
- Meditate on the Second Foundation of Mindfulness (feeling).
- Focus on neutral feeling tones.
- Dwell on the conditioned, compounded, and impermanent nature of the unpleasant.
- Find compassion for people who are aversive to you.
- See “21 Ways to Turn Ill Will into Good Will” in the Articles section of www.WiseBrain.org.

Methods for Bodily Activation

- Understand the mechanical, animal nature of activation.
- Regard stressful activation as an affliction (as the health consequences of chronic stress)
- Use one of the many methods for stimulating the parasympathetic nervous system to down-regulate the SNS.
- Get in the habit of rapidly activating a damping cascade when the body activates.
- Regard bodily activation as just another compounded, “meaningless,” and impermanent phenomenon.

Methods for Negative Emotions

- Practice mindfulness of how thoughts shape emotions . . . and emotions shape thoughts.

- Explore the many practices for letting go of negative emotions (e.g., visualize them leaving the body through valves in the tips of the fingers and the toes).
- Cultivate rapture and joy – and the dopaminergic neurological benefits of those states, including for steadying the mind.

Methods for Loss of Executive Control

- Slow down; buy yourself time.
- Cultivate steadiness of mind.
- Describe your experiences in words (noting).
- Actively enlist internal resources, e.g., the felt sense of others who love you, recollection of what happened the last time you lost your temper.
- Enlist external resources, e.g., call a friend, do therapy, go to a meditation group.
- Stay embodied, which helps dampen runaway emotional-visual reactions.

A Meditation on Equanimity

If you like, you might explore the meditation just below. You could read it slowly, entering a meditative frame of mind . . . or record your own voice reading it and then listen . . . or ask someone else to read it to you.

Here we go:

Starting by getting comfortable, perhaps focusing on your breath for a few minutes.

Forming an intention for this meditation, perhaps in words, perhaps simply a feeling . . . Relaxing . . . Feeling as safe as you can . . . Finding, evoking happiness . . . Sensing that the benefits of this meditation are sinking into you . . .

Being mindful of the changing sense of pleasant, unpleasant, or neutral in your experience.

Perhaps a lot of pleasant and neutral right now.

Whatever is present, be aware of your reactions to it.

See if you can sustain a sense of equanimity toward whatever qualities your experience has.

Impartial, accepting, and at peace with it if it is pleasant.

Impartial, accepting, and at peace with it if it is unpleasant.

Impartial, accepting, and at peace with it if it is neutral.

The mind remaining steady, quiet, and collected . . .

Seeing that any pleasant, unpleasant, or neutral tones come and go, caused by preceding conditions.

They are interdependent with the world and constantly changing.

And thus not fit to be depended on as a basis for happiness.

Feeling tones coming and going . . . without an owner. Without a self needed.

In the pleasant, there is merely the pleasant.

In the unpleasant, there is merely the unpleasant.

In the neutral, there is merely the neutral.

No owner of the pleasant, unpleasant, or neutral. Nothing to identify with.

Just states flowing through awareness. Mingled with breathing and happiness.

Finding a sense of freedom in the non-reactivity.

A joy, perhaps, in the freedom. In this equanimity.

Impartial to whatever arises. A kind of ease with it. A kind of relaxed indifference.

Not preferring anything else. A sense of fullness already, of being alright as it all is. A profound acceptance of whatever arises. Allowing it to come and go without grasping or aversion.

Abiding as equanimity. Breath after breath after breath. At ease. Settling into deeper and deeper layers of equanimity. Whatever is present is alright.

A vast and thoroughgoing equanimity

Where there is no disturbance. No struggle with what is the case. No struggles at all. Even the subtlest ones.

Resting in equanimity.

Like a Buddha.

Pleasant feeling is impermanent, conditioned, dependently arisen, having the nature of wasting, vanishing, fading, and ceasing.

The painful feeling and the neutral feeling, too, are impermanent, conditioned, dependently arisen, having the nature of wasting vanishing, fading and ceasing.

When a well-taught person perceives this, he or she becomes dispassionate toward pleasant feelings, dispassionate toward painful feelings and dispassionate toward neutral feelings.

Being dispassionate, his or her lust fades away, and with the fading away of lust, he or she is liberated.

When liberated, there comes to him or her the knowledge that he or she is liberated. He or she now knows, "Birth is exhausted, the holy life has been lived, done is what was to be done, there is no more of this to come."

The Buddha, Majjhima Nikaya 146