

**TRAIN YOUR BRAIN**  
**AWARENESS OF YOUR BODY**  
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**ARTICLE**

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**Introduction**

This class is about a foundational psychological skill: awareness of your body. And it's interesting that this skill is also fundamental to most contemplative practices.

Awareness of the body has been a fundamental practice within most contemplative traditions. The body as a temple, the body as a source of beauty, the body as repulsive, the body as transitory—all of these concepts have had their place in spiritual practices.

In steadying the mind in concentration, developing mindfulness of moment-by-moment experience, fostering compassion for ourselves and others, and nurturing equanimity in the face of impermanence, old age, sickness, and death, we start with the bodily experiences of right now / right here.

In the Christian tradition, the phrase that comes to mind is “the Kingdom of God is within.” In the Buddhist tradition, the Arahant or Bodhisattva is one who is awake and aware. That is what the practices aim for, the awakened and aware heart/mind, fully present in the Present and Presence.

To that end, tonight we want to talk about some of the underlying neuroanatomy and neurophysiology of the experience of the moment, beginning with some basic, well-known anatomic diagrams, and moving on to basic principles of how the nervous system constructs an electrical representation of the external and internal world.

Fundamentally, the sensory systems differentiate sensations, and the brain then integrates those signals again into what it is set up to “see” as useful percepts and successful behaviors.

What we hope to give you is security in the knowledge that you are a dynamic and ephemeral coalition of neurons—there truly is no There there. Sometimes that knowledge is uncomfortable, because we like security and stability (“I need to trust you will be there for me!”).

But if you stop and think about it, you've operated for most of your life with the illusion of There being there. And maybe that's a major reason for what has been less than happy or successful in your life!

Knowing that There is **not** there could free you up to handle the unsuccessful areas of your life more skillfully, with greater compassion for yourself and others, and hopefully with more joy and peacefulness.

As a final introductory aside, it is important to remember and appreciate the incredible gift we have each inherited: We got here as a species because these nervous systems were so incredibly successful in acting in and on the world, in understanding how to predict consequences from actions, and in achieving deep understandings of the ultimate nature of the energy relationships in this universe.

So that's the frame around tonight's picture. In that frame, we will initially talk about the Buddhist classification of the five aggregates of existence. Then we will look at some neuroanatomy and neurophysiology, and try not to glaze over your eyes too much. We'll also do some meditations related to deepening your awareness of your body and appreciating it more.

As a result, we hope that you will practice increasing steadiness of mind and become more aware of the constructed, *compounded* nature of experience.

That deepening sense of how your brain builds up a virtual reality that seems integrated and just one thing out of an actual diversity of inputs is a road right into lightening up about the endless changes and frustrations in human experience. And, for those who are interested, is a great aid to spiritual practice.

## The Five Aggregates

### Introduction

To help you become more aware of your body, we are going to use a "map" or way of categorizing every aspect of objective reality and subjective your experience, and then apply that map to your own nervous system.

The map is called the Five Aggregates. It comes from the Buddha, and that fact gives it certain associations – perhaps positive or negative depending on who you are. But as the Buddha himself taught, you should never just take anything he or anyone else says on faith alone. Judge it on its merits, and see for yourself if it rings true – and more centrally to the Buddha – if it is *useful* to you. If you like, you could imagine that someone named Jane or Bob came up with this map, and take it from there.

## The Aggregates

The Aggregates are:

- 1) Form - External reality and the raw sensation of it
- 2) Feeling – The tone of experience as pleasant, unpleasant, or neutral
- 3) Perception – The labeling or categorization of something
- 4) Formations – Thoughts, feelings, desires, memories, images, and all other contents of mind besides Form, Feeling, and Perception
- 5) Consciousness – Awareness, “core consciousness,” “autobiographical consciousness”

Although each of these aggregates can be described and analyzed independently, they are all present at each moment of experience.

The original word for the Aggregates – skandhas in Sanskrit and kandhas in Pali - translates as “heaps” or “piles,” and we like the earthy informality of that language. In other words, the “pile” of Form contains all possible material elements as well as the most basic sensation of them, the pile of Formations includes all possible thoughts and feelings, and so on.

And right here, in this instance, we have two of the major themes of the Buddha’s approach:

- Analytically breaking things down to their most essential elements as a way of discovering their truth. Note that this strategy is the same one used in much of science. For example, the study of physics has proceeded largely as the pursuit of smaller and smaller building blocks and the most elemental laws that govern their behavior. Substitute the word “mind” for “physics” in the previous sentence, and you have much of what the Buddha taught in a nutshell.

Interestingly, the relentless *deconstruction* of apparent reality that is so quintessentially Buddhist – from talks given 2500 years ago – is also very post-Modern.

- The second theme embodied in a word like “heap” or “pile” applied to our oh-so-precious personal experience of life is an attitude that is distanced and dispassionate, even disenchanting. There’s no cheerleading here, no flattery of the self at all.

That attitude can seem a little chilly at first, but the test of it is whether it helps you suffer less – even to the point of complete freedom and Awakening.

### **Compounded, Constructed Experiencing**

In this model, all existence and experience consists of one or more of these elements at any moment in time. Put slightly differently, all neurological activity pertaining to conscious experience consists of one or more of these elements.

Now, that's a kind of top-down view. From the bottom up, the point is that our experience – which seems so seamlessly unitary and integrated – is actually *constructed* out of a great diversity of elements. It is *compounded*, and the Five Aggregates are the major classes of elements that are brought together in the mind – much as one might use these five classes of elements to bake a batch of cookies:

- Flour
- Egg
- Sweetener
- Liquid
- Candy

To use a different metaphor, consider one of those pictures that looks like a cathedral from a distance, but when you look closer, it is formed from a thousand tiny photographs of one thing or another that taken together seem to blend into just one image. But the apparent integration is a kind of trick of the mind, an illusion. The truth is that the virtual image is comprised of a thousand parts – and each one of those parts itself is made of a thousand individual pixels.

### **Subject to Clinging**

So – what's the point of seeing that experience is constructed from tiny, ephemeral elements? How does that understanding make your life any better?

Well, it can do so in some very concrete and practical ways.

The actual phrasing used for the Aggregates is always “the Five Aggregates subject to clinging.” The Aggregates are what we pursue or resist – which is clinging, either way – and you can see for yourself that clinging is an immediate engine of suffering:

- Clinging itself feels strained, stressful, tense, and unpleasant
- Pursuing that which is always changing – which is the nature of reality and experience – is inherently frustrating

- Trying to hold onto and keep what is always changing is inherently disappointing
- An attitude of resisting what is feels contentious, angry, aggressive (and this attitude is different from taking a stand for what is just and benign, and naming what is unjust and harmful)

As we will see, understanding the Aggregates helps untie the knots of clinging leading to suffering.

### **Clinging to Self**

One prominent form of clinging is to what we think of as our personal identity. Encountering the endless stream of the Aggregates, we identify with them or appropriate them to form our sense of “I” or “mine.” In plain English, we take things personally.

We’ll be talking more about the construction, the compounding – and the deconstruction – of the apparent self in future Train Your Brain Classes, so we won’t be heading down that rabbit hole tonight!

But it is worth noting in passing that *identification* with or *appropriation* of the elements of the Aggregates are the two main ways that self is formed and keeps regenerating or reconstructing itself. If you like, you could simply observe the activity of identification and appropriation in your mind and see how selfing increases and decreases.

And I will conclude this part about the self by saying that identifying with or appropriating the Aggregates as “self” is a fast track to suffering.

The way that works is this: Since we naturally have a lot of interest in and concerns about and hopes for what we take to be “me, myself, and I,” when the elements that comprise the self (i.e., the Aggregates) change as they always do, or turn out to be less than great – as they often do, alas – then we suffer: we feel a little, or a lot, of stress, anxiety, frustration, sadness, anger, disappointment, etc., etc.

It would be easier, and less fraught with suffering, if we could regard the Aggregates as simply a passing show: with acceptance, detachment, and disidentification, like a movie playing on the screen of bare awareness.

To quote a monk, Bhikkhu Bodhi (the gold standard translator, in our book, of the earliest available record of the Buddha’s discourses):

*When we recognize that the things we identify as our self are impermanent and bound up with suffering, we realize that they lack the essential marks of authentic selfhood and we thereby stop identifying with them. [In the Buddha's Words, p. 309]*

### **Free at Last**

This gets at the stance toward the elements that compound experience – the Aggregates – that is your best odds strategy for having less suffering – and more happiness, love, productivity, and wisdom.

A traditional metaphor for the ordinary, typical relationship of a person toward the Aggregates is that of a dog tied to a post: we keep revolving around them, never breaking free.

It is our ignorance that keeps us caught to the post. It comes in the form of three delusions:

- That the Aggregates are permanent
- That the Aggregates are a source of true happiness
- That the Aggregates comprise a self

The alternative is to understand the nature of the Aggregates – at first intellectually, and over time with a growing experiential grounding – and on the basis of that understanding, increasingly disengage from them. That, just that, snips snips snips at the threads of clinging.

Be amused, be interested, be compassionate. But don't be caught. Know the Aggregates for what they are: a passing stream, elements intertwined with and dependent upon each other, coming and going, endlessly vanishing. In the traditional formulation, you could increasingly regard each Aggregate as: *This is not mine, this I am not, this is not my self.*

That growing insight into the Aggregates as impermanent, prone to suffering, and not-self leads progressively three great stages toward Awakening: disenchantment, dispassion, and liberation.

In sum, we think it is an observable fact – supported by the neurological information discussed below – that all experience, no matter how momentarily pleasurable, is inherently, fundamentally:

- Compounded – It is comprised of an endlessly changing stream of component elements.

- Unsatisfying – Since experiences always change and always have a subtle strain inherent in their construction in the mind, no experience can ever be ultimately satisfying.
- Non-binding – Awareness itself is never sullied or altered by the stream of experience; it is categorically possible to detach from *any* experience and neither identify with it nor appropriate it as “me”; no aggregate, no experience has any more power to control us than we give it. Which is wonderful news.

## The Neurology of the Aggregates

### Introduction

What follows is a summary of the *neurology* that is associated with the *psychology* of the Aggregates. In other words, these are the structures and functions of your brain that enable, underlie, and are in a sense one with the movements of your mind.

You don't really need to learn or remember any of the details that follow (unless you want to). The point is to get a feeling for the incredible compounded complexity that produces the moment to moment unfolding of lived experience. A great way to do this is to pause periodically as you read and imagine the physical processes that are producing your sensing, feeling, perceiving, thinking, and awareness.

### Neuroanatomy of Form and Sensation (1<sup>st</sup> Aggregate)

The term, “sensation,” can refer both to the most elemental experience of the physical world (that's its meaning in the Buddha's system of the Five Aggregates), and to one of the five basic senses, the tactile one. Just keep this in mind when we get tactile sensing below.

#### Vision

- Basic anatomy – Rods and cones to ganglion cells in retina, then optic nerves to lateral geniculate in brainstem, then optic radiations to occipital cortex in back of head. The left visual field goes to the right occipital region, and vice versa; events below the horizon go to the upper occipital areas; in other words, your brain receives a doubly mirrored set of inputs which it unscrambles to let you hit a baseball or drive a car.
- Basic physiology – One hundred million rods detect dim light, five million cones detect daylight vision and color (three types of cones, for short, middle, and long wavelengths of light). Ganglion cells organize the output into receptive fields. The lateral geniculate organizes the visual data into fine grain color vision (red-green, blue-yellow) and a sense of luminosity.

The data input stream consists of about 10 million bits per second of visual information; the cortex processes this data and filters out a lot of it. Even with all that filtering, your brain receives around 5 – 50 “pictures” each second.

From the primary visual cortex, two pathways emerge—a vision-for-action path to parietal and then to frontal lobes, and a vision-for-perception path to temporal and then to frontal lobes. Visual consciousness occurs in the path through the temporal lobes, where memory and identification happen.

- Fun facts –

The central one degree of vision is heavily overrepresented with processing power in the brain – kind of like the zoom center of a movie camera – so we move our eyes around a lot to take advantage of this high-power center of the visual field.

The brain paints in the blind spot by inferring from neighboring inputs.

Vision fades when you focus on one spot.

Vision is suppressed during eye movements – one reason why your video of your kids playing around in the yard is so jerky!

### Hearing

- Basic anatomy and physiology – Hair cells in cochlea increase their firing rate as they are squeezed between the basilar membrane and the tectorial membrane.

The cochlea is tonotopically organized. Some of the localization of sound in space starts in the brainstem, in the superior olivary complex, which establishes the time delay between sound arriving at left or right ear.

Starting at the brainstem, the auditory pathway goes through a series of nuclei—the dorsal and ventral cochlear, the superior olivary, the lateral lemniscus, the inferior colliculus, the medial geniculate. Multiple cross connections occur at each level.

The bulk of neural activity from one ear winds up in the contralateral temporal lobe.

- Fun facts—

Sounds can blend into each other and be misidentified.

Cocktail party phenomenon—you can track one person’s voice in a complex auditory environment.

Speech and prosody (the musical quality of speech) are different neurological functions, and are actually located on different sides of the brain.

### Smell -

- Basic anatomy and physiology—100 million olfactory afferent fibers travel into your olfactory bulbs (you have two of these). These bulbs are organized into glomeruli (25000 receptor inputs), which respond to physicochemical properties of the odorant molecules.

Local circuits and feedback inhibition result in mitral cell outputs that correspond to subjective sensations.

Mitral and tufted cells project to central structures, including the amygdala, the cortex near the hippocampus, and the hypothalamus.

- Fun facts—  
Pheromones cause menstrual cycle synchronization.

Most of taste is odors.

Notice how your olfactory memories are so strongly encoded.

### Taste

- Basic anatomy and physiology—Taste buds detect four sensations—sweet, sour, salt, and bitter. The tip of the tongue detects all four, the anterior sides of the tongue detect sour, and the back of the tongue detects bitter.

The sensory inputs come in on three separate cranial nerves, but integrate in the nucleus of the solitary tract. From there, the information is relayed to a pontine taste area, which projects to the lateral hypothalamic area, the amygdala, and the thalamus.

From the thalamus, the sensory cortex near the face area is informed.

- Fun facts—  
Taste reflex arcs (circuits) in the brainstem cause both salivation and “gustatory sweating.”

Taste is represented bilaterally, so it’s hard to know which side of the tongue is stimulated (try this sometime).

## Tactile

- Overview – There are two types of tactile sensing: somatic and proprioceptive.

- Somatic

Basic anatomy---Cutaneous receptors come in six types:

4 mechano-receptors:

Fast adapting – Pacinian corpuscle

Slow adapting – Merkel's disc

Hair follicle endings – quickly adapting

Meissner's corpuscles – serving sense of touch

2 thermo-receptors

Krause's endbulb – free nerve endings

Pain – free nerve endings

- Proprioceptive (position):

Joints - 4 receptor types giving movement, position, and pain

Muscle – 4 receptors: one for vibration, one for pain, a Golgi tendon organ to detect tension, and a muscle spindle organ to set the length of the muscle

- Incoming sensation from the body and the face is divided into two major systems:

1) a posterior column system carrying discriminative touch or pressure, muscle length and tension, and joint position and vibration, all focused on mediating fine tactile and kinesthetic sensations

2) an anterolateral system carrying information about pain, temperature, coarse touch and pressure.

These systems relay in the thalamus and are passed on to cortex.

There are slight differences in the locations of the pathways in the brainstem and the relay stations in the thalami, but the principles are the same. The incoming sensory pathways are also under continuous dynamic control, both locally and from the cortex-thalamus-brainstem—example is pain suppression.

- Fun facts—

Your brain routinely suppresses pain signals so that you can pay attention to other things; it's only when the pain signals get intense that they break through into awareness.

Note that the sensation from any part of the body is broken up into so many different characteristics that it isn't a unitary experience at all. The cortex makes up that fable for convenience.

### Visceral

This is a kind of sixth sense (not a paranormal one) that is commonly lumped together with the tactile sense.

This class of sensation is largely mediated through the autonomic nervous system, which regulates our internal housekeeping department.

### **Neuroanatomy of Feeling (2<sup>nd</sup> Aggregate)**

Recall that "feeling" here does not mean emotion, but the basic tone of an experience as pleasant, unpleasant, or neutral.

The primary neurological unit in your brain that creates the feeling tone is the amygdala, with a supporting role for the hippocampus and the insula.

The "decision" the amygdala makes for labeling an experience is heavily influenced by "upstream" processing in the nervous system, especially related to pain and pleasure.

Pain—starts locally, the product of a stimulus suggesting actual or impending tissue damage. This activates nociceptive fibers (both myelinated fibers that cause the jerking away response and "electric" sensation, and unmyelinated fibers that are slower and mediate the burning/aching sensation) which travel to the spinal cord or brainstem and are then relayed to thalamus and cortex. This results in the activation of behaviors such as withdrawal, wincing, or changes in facial expression.

As pain signals cascade through neural circuits, the autonomic nervous system is activated, especially the sympathetic systems, which participate in regulating the organism's response to actual or threatened damage. The heart rate and blood circulation alter. Chemical signals from damaged tissues result in white cells migrating to the area, and these chemicals also stimulate pain neurons. All this is at a very fundamental level in your body.

Pain is also a feature of higher cortical functions, such as loss, embarrassment, frustration, and other mismatches between desires and attainments. There is a feed-forward mechanism between pain thresholds and depression such that pain sensations are perceived more intensely by depressed people, and those amplified pains contribute to the maintenance of the depression.

Pleasure—Much more complicated. It's actually not the opposite of pain, but rather a different direction. It has more to do with the relief of a perceived imbalance, such as hunger or thirst or sexual/sensual gratification. A lot of these behaviors are coordinated at the hypothalamic and limbic system level. At a higher cortical level, the forethought of how not to have a problem, the anticipation of reward, is pleasurable. The opening up to the experience leads us to seek and approach and attain.

Neutral (boredom)—Some might argue that no truly neutral experience actually exists, but the sensations coming in are below the threshold of necessary avoidance or the cost of pursuit. The thrust of a living organism moving through time is to seek pleasure and avoid pain: who cares about the neutral?! Subthreshold stimuli probably initiate a search mechanism to find the next great thing.

Therefore, as a meditation practice, these neutral stimuli are useful to help us note why we keep chasing rainbows or running from ghosts. And in the addiction world, the experiences of cocaine, methamphetamine, and crack addicts shows how the modification of the dopamine receptor by stimulant exposure diminishes enjoyment responses to everyday sensations, therefore making them unsatisfying, which increases the search for more intense pleasures (e.g., the next fix).

### **Neuroanatomy of Perception (3<sup>rd</sup> Aggregate)**

Out of the sensory inputs, neural patterns related to the object are constructed in the appropriate cortices, involving many different regions working in concert and synchronized by the 40 Hz gamma oscillation frequency of the cortical columns involved.

The various aspects of the object are mapped. These mappings are simultaneously compared against memories of previous experiences. A perception is born. It is categorized as a concept or language or experience, and stored for later retrieval and comparison. Sometimes you can observe this coding happen.

Examples: Visual of forms, letters—Try not to see the letter “W.” Try not to see the color of your skin. Auditory of sound—On a retreat once, the buzzing of a fly in my (Rick Mendius) ear morphed (as the fly moved away) imperceptibly into the train

horn down in the valley. Smell and memory—Diesel exhaust on a cloudy wet day evokes Vienna for me.

### **Neuroanatomy of Mental Formations (4<sup>th</sup> Aggregate)**

This is where it gets interesting.

The emotional, volitional, and intellectual aspects of any experience can now be seen as a result of the combination of:

- the genetic loading of the organism at conception
- the biological progress of that nervous system and body through embryogenesis and development up until this moment
- the experientially determined behaviors and memories of that organism

All of this biases the organism to perceive and react to stimuli – including internal stimuli – in a particular way, whether it's the banana on the table or the PTSD experience of loud noises imitating Iraqi IEDs.

Each experience has a resonance throughout the entire brain, from multiple sensory systems to memory stores to preferential motor responses. These resonances are mediated by coalitions of cortical columns throughout the brain, coupled with their cortical connections and brainstem-hypothalamic-spinal cord-somatic-autonomic connections.

For example, the neurologic correlate of visual conscious awareness is a 40 Hz oscillation synchrony.

There is a habitual pattern of interaction, which has proven effective in the past, which will predominate the oscillations because “neurons that have fired together have wired together and will fire together again.” Because this is a dynamic and inherently unstable system, there is hope that the organism can correctly perceive this unique moment and act effectively.

Most of the time, that is what happens.

But, we need to work our brains to correct the times that this does not. This is the everyday process of learning from experience; as they say in medicine: “Good judgment comes from experience . . . and experience comes from bad judgment.” And it is also the not-so-common process of serious introspection, deliberate psychological growth, and spiritual practice.

### Neuroanatomy of Consciousness (5<sup>th</sup> Aggregate)

While the term, consciousness, is routinely used, it has many philosophical and religious associations that go far beyond its meaning in a neurological or psychological sense. Probably the word, awareness, is better, since it is simple and clear (relatively speaking!). That's what we mean here, when we speak of "consciousness."

With that preamble out of the way, it's worth noting that most neurological activities never rise to the level of awareness. Nonetheless, these processes within processes within processes usually are – taken as a whole – incredibly intelligent.

For example, I (Rick Hanson) was once rock climbing in Colorado and standing on a tiny belay ledge overlooking a river 500 feet below. As I paid out the rope for my friend climbing above, and reflected on all the high tech gear and training that enabled us to progress safely up territory many would consider insane, I saw a large black ant crawling up the coarse granite in front of my nose. It reached its claws and legs up and over crystals in the rock that, at its scale, amounted to much more difficult ground than my friend and I could handle. That ant was a heck of a climber! Then it occurred to me that with all of modern science and computer technology, humans are still not able to make a robot that could do what that ant could, with a brain smaller than a grain of sand.

And that was simply an ant. Just imagine all of the activities occurring beneath conscious awareness that get assembled in increasingly complex and summary architectures of meaning until they just barely break the waterline of consciousness, the tiniest discernible tip of a vast iceberg below.

To be sure, many of these activities involve relatively simple circuits, sometimes so simple that they're called "reflexive." Perhaps a better term for behaviors that do not require conscious awareness and direction, but which rely upon adaptive and learned patterns of neurological activity, is "automatic." Christof Koch and Francis Crick sometimes refer to these as "zombie" activities, which is evocative, but which might lead one to underestimate the sophisticated information processing they require – even if it's only a "soulless one" lurching down main street in a B movie.

An excellent discussion of the possible neurology of consciousness – a subject that is still in its scientific infancy, and full of controversy – can be found in Antonio D'Amasio's book, *The Feeling of What Happens*. In particular, he makes a crucial distinction between "core consciousness" and "autobiographical consciousness."

Core consciousness, in D'Amasio's terms, is the appearance of an external stimulus or internal state at the point of awareness. It is right after that appearance that we can gain some control over the process, and change our behavior.

When the autobiographical consciousness begins to take hold, we can rewrite the chapter of the book. That is dependent on practicing with the internal witness, whose anatomic correlate is probably the anterior cingulate. That appears to be one of the main points of meditation practice, to use the recursive watcher of the watcher circuitry, which is built into the system, to familiarize ourselves with how we construct this moment. Knowing how something is built up gives us the perspective and the tools to deconstruct it, refurbish it, and improve it.

### **In Sum**

- There are recurring themes in neuropsychology – and contemplative practice – of differentiation and integration.
- There is mindfulness of the body, to be sure. But also a body of mindfulness, or embodied mindfulness.
- In other words, the mechanisms that produce mindfulness of the body are themselves embodied! It is the body being mindful of the body.

*May you be ever more mindful of your body. And bodily mindful!*