Chapter 4

The Sensory System

A quick journey through the senses · VKA preference statements

I am not afraid as I descend,
step by step, leaving behind the salt wind
blowing up the corrugated river,
the damp city streets, their sodium glare
of rush-hour headlights pitted with pearls of rain;
for my eyes still reflect the half remembered moon.
Already your face recedes beneath the station clock,
a damp smudge among the shadows
mirrored in the train's wet glass,
will you forget me? Steel tracks lead you out
past cranes and crematoria,
boat yards and bike sheds, ruby shards
of Roman glass and wolf-bone mummified in mud,
the rows of curtained windows like eyelids
heavy with sleep, to the city's green edge.
Now I stop my ears with wax, hold fast
the memory of the song you once whispered in my ear.
Its echoes tangle like briars in my thick hair.
You turned to look.
Second fly past like birds.
My hands grow cold. I am ice and cloud.
This path unravels.
Deep in hidden rooms filled with dust
and sour night-breath the lost city is sleeping.
Above the hurt sky is weeping,
soaked nightingales have ceased to sing.
Dusk has come early. I am drowning in blue.
I dream of a green garden
where the sun feathers my face
like your once eager kiss.
Soon, soon I will climb
from this blackened earth
into the diffident light.

Eurydice by Sue Hubbard
Ghost Station (2004)[1]

A quick journey through the senses

... experience is always new...
– Goethe

The purpose of this Chapter is overtly to discuss the various kinds of sensory information available and how the senses work. But most importantly I hope to stir some curiosity about sensory experience. That curiosity, once directed in particular directions that are "useful" is an extremely powerful force for health.

There is something of great importance about the constant renewal of sensory experience and our connection to the world through the senses. This capacity to re-engage with the world and refresh our experience through curiosity has, for various reasons, been supplanted in Western cultures by an attempt to seek greater and greater stimulation. Some of this is through a fashion for travel. I can remember my own travelling experiences 30 years ago with some unusual clarity. One thing I realised about travel to other countries – is that we are forced into a greater sensory awareness. The fact of being thrust into an unfamiliar culture and language automatically places us in a survival situation, where we *have* to be more alert and we *have* to engage with our senses, and we *have* to recognise that life is going to include a steep learning curve. When that heightened awareness, interest and engagement in the world meets beauty, the experience that arises is exhilarating, and can be almost ecstatic.

Sensory curiosity is one way that we connect to Life. Animals do this all the time – to the point that it is strange that many humans do not... My partner adopted a dog from the local rescue home – or more to the point, Rocky quite clearly adopted her – and while he was alive, I learned a lot from that dog. One thing that impressed me deeply was his perpetual and unwavering curiosity and optimism about the world, and what it might have to offer.

It is common to talk about "the five senses"; although most people realise that five is something of an underestimate. It is extraordinary that very little attention is usually paid to the somatic sensory range. In fact the "*five senses*" – sight, hearing, touch, smell, taste – only include the most obvious of the *external* senses and completely ignore all those *internal* sensations that also give us contextual and qualitative information about ourselves. Almost everyone knows when they need to go to the toilet, but maybe don;t consciously log that this is an internal sense that is telling them – in fact, a communication from the deeper more physiological and biological parts of the human organism that reaches all the way up into to the conscious mind.

There are several different ways to categorise and enumerate the senses. One common classification is to divide the senses into Interoceptive (internal) and Exteroceptive (External) – but as you will see, there is often no clear distinction. Rudolf Steiner identified twelve different senses (some of which include multiple sub-senses) : namely Touch, Life, Self-Movement, Balance, Smell, Taste, Sight, Temperature/ warmth, Hearing, Language, Concept and Ego[2,3]. A New Scientist special issue[4] on the senses listed about 10 clearly defined senses and another 11 "other" senses available to conscious perception. A very common medical classification found in physiology textbooks is based on a comparison with technical man-made sensors[5] and transducers such as might be used in an industrial process:

i. Chemoreceptors
ii. Nocioceptors
iii. Thermoreceptors
iv. Mechanoreceptors
v. Photoreceptors

What is particularly confusing is the tendency in the English language towards disembodied ways of expressing interoception. For instance, it is common to say "*I am thinking about my body*" when what is actually meant is "*I am placing my awareness on my body so that I can feel something*". "Thinking about" any sensory experience removes the observer to a distance and seriously blurs the distinction between imaginary and the imaginal. Because whereas the senses are information about the real here-and-now – the mind untethered by immediate sensory awareness in the present moment (particularly *somatic* awareness) may flit between the past, the future and never-never-land without even touching anything at all to do with here-and-now.

In reality(!), there is a seamless relationship in everyday and experience between detection of sensory stimulus, interpolation and integration of different sensory "systems", and interpretation of meaning. It is *normal* for information from many different types of "sensor" to be integrated in complex ways as part of this process of interpretation. So although a transducer-like classification may be one useful reductionist way of describing afferent nerve endings; it can result in a very mechanical, simplistic, and inherently deceptive view of what is a very complex, holistic and fundamentally *organic* sensory system – that is (in ways that are essentially indefinable) enmeshed within the process of consciousness. Therefore one must be careful not to be deceived by the various categorisations of nerves into thinking that "sensing" is purely the assimilation of information via sens-ors.

I have put together below a rough (and necessarily incomplete) list of both internal and external senses that we *potentially* have conscious access to. When viewing this list, there are a few caveats to bear in mind. I have talked to people about their sensory experiences for about 20 years; and frankly, for a time I wondered how on earth we even communicate – so wide is the range of personal experience of embodiment, the embodied connection to the sense of identity and to the external senses (and therefore to the external environment). We do *not* all access our senses in the same way, or use them in the same way, or interpret them in the same way. Which can make meaningful and accurate *verbal or written* communication about anything of an experiential nature extremely difficult, and potentially deceptive. Most languages and language-users assume that information is adequately conveyed by use of that language. But this is not the case with regard to internal and necessarily subjective experiences. Perhaps Sanskrit or Pali might offer an exhaustive categorisation of possible experiences, but even then – there is a difference between an intellectual knowledge of a word, and the experiential basis underpinning it. One can think one understand something, and actually not understand it at all until some internal switch flips to an unacustomed "ON!" position and *something* is experienced. I am always particularly impressed by the way "*Good*", "*Fine*" or "OK" in English can mean anything from vibrant health and happiness through to being suicidal or on the verge of death – though this is more related to the use of language and sarcasm than the details of experience. The tricky interactions between linguistics and sensory experience will keep returning in future chapters like weeds in an old untended garden.

Very few people indeed have immediate and full access to all of the senses listed below. Some people can consciously access them all. Some people only have access to a few, and even those are somewhat muted – but nevertheless, often have non-conscious or subliminal access to the same information. Some people happen to be able to integrate some of their senses in a synaesthetic way that may massively increase the qualitative experience of living. Many people have access to inner senses – but may have been told that these senses are unreliable (or that body sensations are unimportant) – so they ignore and mistrust them ... and so through lack of use have temporarily mislaid them. The senses are not strictly "lost" in the way that word is usually applied in this context – gone forever. Rather, they are "lost" in the way that a screwdriver might have fallen down the back of a workbench. Finding it again requires that either we accidentally come across it in a period when everything is reinspected and turned upside down – or we realise that there is something missing, and initiate a more systematic search through old memories and experiences.

One critical aspect of accessing any sense is that *we believe that we can*. If there is no

belief that the sense even exists (or that it is not possible to sense a particular thing or quality or in a particular way), then effectively that sense cannot exist for that person. So at the very least it is important to be *open to the possibility of the capacity for awareness*. This non-sceptical approach to the senses opens a far bigger world than the one commonly acknowledged in popular culture, which has increasingly tended towards a sceptical, restrictive and in my opinion pseudo-scientific view of human capacity (the position often taken is "*if science hasn't proved it, it must not exist*"). A secondary aspect of this necessary belief is ***trust*** that the sense has some kind of *meaning*, and that it is – for the purposes we are using it – *reliable*. So immediately there is one important rule that arises directly from a paradigm of Wellness (Chapter 3). That is that ***the senses are fundamentally reliable***. Even if you don't understand the information being offered by them, it is still meaningful, and something is causing your sensory system to give you this information.

I have heard all the sceptical nay-saying that has entered Western culture, increasingly over the past couple of decades, and seen most of the optical illusions supposed to convince us that the senses are unreliable. Let me put it this way... just four arguments out of many possible ones...

- Something deliberately designed to fool the senses is not an indication of their general reliability. Just because there are a few con artists in the world does imply your grandmother is also a con artist. The presence of a few optical illusions does not invalidate all the sensory system – it doesn't even bring the sense of vision into question in most situations.

- If senses are really unreliable, and we have relied on them for survival for hundreds of millions of years – how come we are alive as a species?

- And if you don't trust your senses, whose do you trust? Because all the information that we have about the external world (and internal world) comes one way or another through somebody's sensory system.

- List times when you do rely heavily on your senses all the time – catching a ball, feeling complex emotions, knowing where your arms and legs are ... So why single out specific senses as being unreliable (or unreliable in certain situations) when you implicitly trust your senses on these other occasions?

All of this debate on the capacity of the senses is in may ways based on a way of thinking that puts the cart before the horse. Consider a creature in the Cambrian explosion, swimming or crawling in those fertile seas, surrounded by potential food and potential

predators. Every fiber of its being must be attuned to its senses so that it can eat and not be eaten. David Bohm[6] considered that Sensitiv-ity precedes and is primary to all of the senses. It is the will – the intentional capacity to be sensitive that leads any organism to access the greatest richness of information and then to filter that information (through Gestalt and Meaning – see next chapter) so that the most important, immediately relevant, and survival-critical is foremost in its awareness. There would be no formation of sensory organs without the will to sensitivity, and that will must be expressed at the very beginnings of Life – both from an evolutionary point of view, and in the first microsecond after cell fertilisation or division. As the will to sensitivity, so Sensitivity (the maximisation of receptiveness) pushes towards a more hard-wired adaptation (such as the evolution of an eye) and towards the capacity to e selective in what is being sensed.

If somatic/internal sensory experience is included in the category "touch" (both being body/ somatic sensations that reflect or arise in physical processes), then the "five senses" are in fact a list of the means by which we gain awareness of anything and *everything*. So there may be crossover or displacement of one sensory channel by another by habit or conscious/unconscious preference, and many of the more subtle and less well recognised senses are experienced through the medium of the main senses... *Somehow* the information must be conveyed from the peripheral nervous system (and internal pre-processing and synthesis that takes place automatically) into the conscious mind.

I have also attempted to categorise the sensory list below – so far as is possible – into External **(X)**, Contact **(S)** and Internal **(I)**. What rapidly becomes apparent with some of them is that there is not such a clear distinction between what is sensed/perceived internally or externally. The somatic senses (internal sensations coming from the physical body) are particularly important for the purposes of dealing with trauma – since one aspect of trauma is dissociation, which often involves a loss (or distortion) of internal/somatic senses. In fact, a loss of somatic awareness is one aspect of dissociation.

We don't see things as they are ...
We see them as we are.
- Anais Nin

Sight (X) : The visible electromagnetic spectrum is detected mainly through the eyes, via Cranial Nerve (CN) II. Eyesight consists of two quite distinct senses. Foveal vision, mediated by colour-sensitive cone cells, gives us detail. It takes place the zone of central focus of the eye – an area less than two millimetres across at the back of the eyeball, containing less than 1% of the optical nerves. However, most of the optical nerves are non-foveal ("peripheral") rod cells. Peripheral vision sees the world in black and white, works far better than foveal vision in low light conditions[7], and detects peripheral motion. The full colour images of the world that we "see" in normal experience are not strictly

detected by the eyes... The foveal information – a small central spot of colourful clarity – is added to other previously viewed foveal dots (the eye dances around at a rate of about three random jumps per second – "*saccades*") and to black-and-white peripheral images ... And what we "see" is actually a constructed composite that is the brain's best guess from those saccades and peripheral images of what the big picture might look like, pieced together from less than 10% of the actual picture.

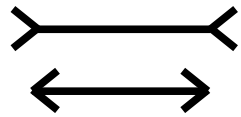
> *The world rests in the night. Trees, mountains, fields, and faces are released from the prison of shape and the burden of exposure. Each thing creeps back into its own nature within the shelter of the dark. Darkness is the ancient womb. Nighttime is womb-time. Our souls come out to play. The darkness absolves everything; the struggle for identity and impression falls away. We rest in the night.*
>
> *John O'Donohue*[8]

With such a high degree of post-processing, interpretative layers, expectation (anticipation) and interpolation in the sense of sight – vision is the easiest sense to trick; and so most sensory illusions are visual "optical illusions". We definitely have a tendency to see what we expect to see[9] because that is the very nature of vision[10]. It is inherently impossible to see all of anything, and therefore much of interpretative vision (seeing "something" instead of an abstract set of light, dark, lines, colours) requires that the dots have to be joined in a way that does not distract from the *practical application and use* of sight. If you look at a house, the walls and roof facing you can be seen, but nothing else. It is only familiarity with houses and perspective that makes you assume that this is a solid 3-D object of a certain size, that the flat slightly reflective surfaces are transparent, that[11] it indeed does have more than just a frontal aspect and is not a Hollywood prop, and that its roof is angled relative to the walls. The subject of visual gestalt is given a more attention in Chapter 5 (Meaning).

The post-processing of vision also enhances certain aspects that are considered to be particularly important, so what is seen by the eyes is rarely what is seen by any kind of optical capture device such as a digital camera or roll of light sensitive film. Anyone who has attempted flower photography can testify that the sense of vision automatically enhances and increases the saturation of colours[12]. A wood full of bluebells may appear to the eye as a glorious display of purple and mauve, because the brain enhances the parts of what you are seeing/sensing that you are attributing particular importance to. But the camera is neutral and hardly shows this glory at all unless the lighting conditions are absolutely perfect.

Culturally, people living in the Western world are surrounded by straight lines and

rectangular corners in their normal environment. This in turn creates a sensory *expectation* of straight lines. This *expectation* of linearityis one basis for the sense of perspective. Thus, many optical illusions are based on fooling the interpretative part of the visual cortex which is programmed by our everyday environment to expect straight lines. Presenting curvy lines in certain ways, or messing with lines of convergence and divergence fools the visual expectation of normality. Both the Ames Room illusion[13] and the Müller-Lyer illusion (see figure below : the horizontal lines are of equal length) have the strongest effect on people from western cultures, and tend not to fool people who have grown up in a more natural, less rectangular and perspective-dominated environment.



The difficulty in judging length in the Müller-Lyer illusion is related to the fact that all information is naturally contextual, and the eyes are always looking for comparative points of reference - for difference. And some things in the natural environment are more contextual than others – in which case the senses tend to be more interested in the context. Length is one of those – if only because apparent length (and size) are affected by perspective and distance. And by expectation. A half-ton ox standing 6 feet high at the shoulder is large but not unexpectedly so – whereas a three-foot long rat is really big![14] So one could fairly easily estimate the distance that the ox was standing at, but would have to cross-check the rat against other familiar objects and linear relationships – there is a word for that internal exclamation mark – a "double-take", because of the internal sense of disorientation that the ab-normal can create. On the other hand, angles and proportions are hardly affected at all by context, and so the capacity to visually discriminate angle and proportion is sensitive to extraordinarily detail. Aircraft cockpit instrumentation is therefore based on the use of dials – because a small change in angle can be noticed far more easily than a small change in length. In a similar manner, verticality and horizontality can – with practice – be estimated almost as accurately as being measured by a bubble level. Proportion is extraordinarily sensitive, and is partly visual but also somewhat visceral in nature. Le Corbusier's brutalist architecture was softened by his use of golden section proportions, and the hanging of a picture on a wall.

One important thing to remember about all optical illusions is that they present geometric combinations to the eye that are not found in the natural world. So there is no good reason why the optical sense should have developed a capacity to discriminate in these situations. Simply put, Ames Rooms and Müller-Lyer figures do not usually exist in the

normal world, and even if they do, their presence and an ability to "see" them is not survival-critical.

> *Runeson[15] explains how, for the specific case of the Ames Room, that even though it was technically possible to build this equivalent configuration, it wasn't ecologically likely enough to have influenced the development of a smart perceptual mechanism attuned to the ecological constraints of its environment; in fact equivalent configurations are so ecologically implausible that it's not even clear how a perceptual system could begin to acquire the necessary assumptions the cognitive approach claims it requires to cope[16] ...*

There have been a lot of attempts to model brain function mathematically. Although this has not really revealed how the brain works in any major way, it has revealed some interesting glimpses. For instance, it is necessary for the connections in the brain dealing with visual information to have some regular structure. The reason we know this is that random connections tend create or amplify Turing patterns[17]; and if this were happening we would hallucinate every time we looked at a tigers stripes or a leopards spots (or even if were were to look at our own fingerprints).

Part of mammalian evolution appears to have been as small rats scurrying round at night to hide away from dinosaurs. With only night vision being necessary, there was a loss of colour receptors in laterally placed eyes (as is found in birds) - in favour of a binocular (forward-placed) pair of eyes equipped with peripheral vision highly sensitive to motion and only two different colour receptors. Most mammals are therefore colour blind to some extent, primarily sensing blue (and possibly ultraviolet). However, about 30 million years ago primates re-evolved red-green discrimination, leading to modern-day trichromatic human macular (cone) vision[18]. Birds, on the other hand, have an evolutionarily more mature and rich pentachromatic (green, blue, red, violet and black/white) cones which in many birds have an optimised random spacial distribution[19] on the retina allowing them to have intensely detailed vision. Thus, an eagle is able to identify a mouse at about one mile distance.

The visual bandwidth employed by living creatures appears to occupy an extremely narrow range of the electromagnetic spectrum. Of all the possible frequencies we *could* detect, the visible spectrum occupies a tiny range[20]. Insects and some animals (such as birds) detect ultraviolet (UV) frequencies, but anything higher than near-UV is unlikely to be emitted by living organisms. One might think that infrared (IR) would be a useful sense, and indeed it is at night or during winter, so some nocturnal animals do possess IR vision. However, on a sunny summer day the IR detectors would be blinded by all the

emitted and reflected heat, so sensitivity beyond near-IR is a potential liability and not usually a visual sense. Radio frequencies (far-IR) are not emitted by living organisms, and the lower radio frequencies pass through living tissue, so again these very low frequencies are less useful. It may be that some people are sensitive to near-IR and/or near UV. The photodetectors in the eye – particularly the black-and-white peripheral vision rods - are sensitive to single photons; and so extremely low levels of light can (potentially) be processed visually provided that one is open to very ephemeral and indistinct perceptual impressions.

Sight (X & I) : There is also an internal awareness of light other than that found in the eyeballs. The pineal gland senses light penetrating the eyes and skull, deep inside the brain. Most biological structures – even thin bones – are translucent. And all cells of the body – including the skin – exhibit a potential directional awareness of some parts of the near-visual (Infra-red) electromagnetic spectrum[21] (which seems to go so far as visible light and colour sensitivity in some people)[22]. The skin is an accurate IR sensor (see Temperature sense below).

Sight (I) : We also possess an internal capacity for "visualisation" or a "mind's eye". There is a lot of confusion around this point, centred on the difference between imagination (making something up), and the imaginal realm (using the minds eye to access subtle sensory information in a visual manner). The capacity to visualise and to have visual memories[23] is so common and generally important that its absence – *in*ability to visualise is a recognised condition[24] – "*aphantasia*". As in all cases, the brain and mind are adaptive and creative, and where there is a loss of one sense (be that external or internal), other ways are found to function. It is suspected that aphantasia may have (sometimes?) have some relationship to dissociation due to trauma, because it reduces the emotional impact of memories.

12 Not wanting

the five colours
blind our eyes.
The five notes
deafen our ears.
The five flavours
dull our taste.
Racing, chasing, hunting
drives people crazy.
Trying to get rich
ties people in knots.
So the wise soul
watches with the inner
not the outward eye,
letting go,
keeping this

~Tao Te Ching (Lao Tzu, ed. Ursula K Le Guin)

The Inner vision is a portal to many forms of sensory information that cannot be easily classified. For, although I have argued against the idea of "five senses", in fact the five senses are the means by which ALL the senses are conveyed to consciousness. The inner senses in particular are the way in which we access this "extra-sensory" information. The information provided by inner vision is not truly extra-sensory (i.e. some strange sense that only a few people have and which may or may not exist), but the inner eye (and the idea of vision and the visu-al) is a powerful means by which we can be aware of things that are not within the scope of the plain vanilla five senses to detect. It is a form of communication between *some level(s) of our being that we only have indirect access to*, and our waking conscious awareness. The inner vision and the other inner senses (such as inner somatic movement) can be subtle, and are only of use if they are trusted. Although the external senses may appear to be be distinguishable in a nominal fashion from these inner senses, when there is some level of fluency in using the inner sense, there is something of a seamless transition between inner and outer. There is a sense-ing. Asking "how do I know that?" in a way that is curious about the process of sensing and the small details of how it came into awareness – can expand these senses. Asking "how do I know that?" out of incredulity engenders disbelief and they are no longer available or accessible in that form, though people may still have access to some less definable "gut instinct". But reliable gut instinct is actually access to the body's sensory system. Again, if that is not trusted and used, it becomes less available and less reliable.

> *"Let thy imagination be guided wholly by nature" advises the Rosarium. "And observe according to nature, through whom the substances regenerate themselves in the bowels of the earth. And imagine this with true and not fantastic imagination."*
>
> *So, first of all let it be clear that our Philosophy disdains what commonly passes for imagination: mere fantasy which is no more than the fleeting passage of dim involuntary images through the mind. True imagination belongs to the Spirit. That small portion of our totality which we have ignorantly come to think of as ourselves can only passively look on as the Spirit creates its images for our delectation or terror.*[25]

Sound (X,I) We can hear frequency (pitch) & quality (e.g. Timbre, Loudness, Intonation) through the ears. The middle ear (CN VII) picks up external sounds direct through the auditory canal, and indirectly through bone conduction in the head. There are also lateral line pressure sensors[26] at the sides of the body, which detect deeper sounds, pressure changes, and rhythm. The viscera are also attuned to very deep low frequency vibrations. What we call sound covers the entire range from the high pitched whistling of a shrew or bat and the hissing of grass in the wind (about 30,000 Hz), down to low double bass notes that can be felt in the body (about 20 Hz) down to even lower frequency pulses that we detect somatically and viscerally as physical throbbing, vibration and rhythm... The sense of hearing is similar to the eyes in that what we "hear" is is a synthesis of all these different sources (middle ear through the external auditory canal, middle ear through bone conduction, lateral line pressure sensors, visceral/somatic vibration and presssure changes), without us realising this is happening. The habituated impression is usually that it comes through the ears, because we "think" of the ears as being the organ of hearing, and tend to believe that so strongly that all hearing is attributed to the ears.

Sound (I) Like inner vision, there is an internal "self-talk", which also has the potential to act as a synaesthetic way of accessing "other" senses. It can be less easy to use reliably than inner visualisation, because it is more easily confused with generated thoughts.

As humans, we are one of the animals that uses modulated sound to communicate, and so meaning (see Chapter 5) is particularly strongly bound to the auditory sense. It used to be thought that sounds were processed and then afterwards words were extracted from them – but it now appears that language and raw sound (pitch, intonation, etc) are processed in parallel[27]. Perhaps this should have been obvious, since it is possible to be thinking "words" whilst listening to music or even to conversations, but almost(?) impossible to be internally going through a tune whilst listening to other music. This separation of internal and external can be taken to extremes, in that it is possible to be far more aware of internal sounds/words/images/ideas than external stimuli. Showing that there is a bandwidth limit for conscious attention, in which internal and external information streams are selected according to what we place attention on. This is a

particularly important principle that will be returned to later.

Make everything in you an ear,
each atom of your being,
and you will hear at every moment
what the Source is whispering to you...
you are -we all are-the beloved of the beloved,
and in every moment, in every event of your life ,
the Beloved is whispering to you
exactly what you need to hear and know.
Who can ever explain this miracle? It simply is.

~Rumi

Direction and Echolocation (X) is also part of the sense of human hearing – hence the existence of blind football teams[28]. The directional sense compares arrival times of sounds to the left and right ears, being able to detect variations of as little as a millisecond. Clearly this is not processed consciously – because the conscious mind is only able to run at about 10 Hz, not 1000 Hz. But nevertheless, the directional sense is accessible consciously by deliberately placing our attention in that internal place where it resides. We can *choose to be more aware of direction*... Which again reveals something more of the general state of relationship between cognition and the senses. There is a participation and cooperation. The conscious mind requests information for a particular purpose – and the sensory system responds. Therefore there is no real knowledge of what the senses *can* provide unless there is an active and ongoing exploration of their capacity. Animals do push their senses to the limit all the time. My suspicion is that the reason "*animals senses are more acute than humans*" (which way of thinking almost explicitly categorises hunter gatherers more as animals) is that most humans no longer rely on their senses in the same way for survival, so they are not constantly actively using them. We do still use our senses a lot – but for most people it is more unconsciously – in socialisation, body language etc.

The human capacity for echolocation in particular gives a clear indication of the degree to which post-processing is integral to the senses. It is not the ears that echolocate – but rather the *visual* part of the brain[29,30] that compares what is coming into left and right ears. i.e. the echolocation sense is inherently *synaesthetic*. Complex non-cognitive post-processing of this kind is dependent on a conscious sense of meaning being used to train the brain to attach significance to certain subtle differences, and then to pass that information back to the conscious mind "when requested". The feedback process of training the senses is more potent at an early age, but is there throughout life, and the

echolocation sense is a fantastic example of its working. There is conscious attention to an abstract principle of "direction", which is conveyed to the brain by (i) a heightened interest and curiosity or urgency, (ii) movements of the head and neck consistent with a need to know direction, and (iii) heightened attention to a specific sense. The more detail that is considered in this process, the more improbable it appears to be – without some layers of adaptive intelligence in the neural circuits themselves *that is aware of the conscious mind's intention*. Suggesting that consciousness is a holographic phenomenon, and not just constrained to cognition. This can be recognised in all the other senses – the interest in the beauty of the colour of bluebells causes that patch of colour shine out more than would be captured by a camera. There is a subtle and sensitive feedback loop that listens to the conscious mind's "this is what I want" and then says "here it is".

Taste (S) is usually considered to be another external sense. But actually the tongue is only semi-internal to the body, and provides a chemical sense of contact in that space between inside or outside (think of licking a lollipop). The tongue (via CN V3, VII, IX, X) can detect a handful of basic flavours : salty, sweet, sour/acid, bitter, pungent and Umami[31]. Even 6 month old foetuses appear to have a sense of taste. An experiment on humans in the early 20th century showed that there was a deliberate ingestion of amniotic fluid if a sweetener was added to it.

It is not possible to consider taste without also stepping into the no-mans land between the real and imaginary, and between the body and the mind, because ...

Smell (X,S) is often confused for taste. Strawberries taste sweet, tangy and acid, but that classic strawberry taste reminiscent of rose-apples is taken in by the sense of smell. "Loss of taste" is in most cases a loss of smell. It has been recently realised that quantum effects[32] in the olfactory nerve (CN I) give us access to tens of millions of different odours. The main application of smell is in identifying things that are familiar. So smell/taste is only as useful as we have bothered to take the time (and interest) to have curiosity about what this sense is bringing to our attention. Most of the nerves for the sense of smell lie at the cribriform plate at the very top of the nasal turbinates. It is interesting that we have the ability to deliberately direct air up towards the upper nasal passages, so that we can better smell something. If you're not sure about this, try smelling a rose! Richard Feynman, the famous 20th Century physicist, had a party trick where he tracked his guests route through the house by using his sense of small, with his nose to the floor like a bloodhound[33].

There is also a Vomeronasal organ located halfway up the nose, which detects hormones (related to social/sexual signals and emotions in other people), whose sensitivity varies

with diurnal cycle. If one considers taste and smell as being chemoreceptors rather than something that gives immediate qualitative information), they extend right through the oesophagus, stomach and most of the digestive tract. Here we are able to detect fats and proteins that are a strong source of energy – and rapidly learn to associate certain combinations of smell and taste with a high likelihood of ingesting high calorie foods. As such, the sense of smell seems to extend through a remarkably wide range of biological levels. On the one hand we can *recognise* complex and nuanced odours, and in order to do this we must have encountered them before and stored that sensory experience as a recallable memory. On the other hand, smell connects directly through to digestive processes, peristalsis, salivation, activity of the gut microbiota, appetite, and from there (only slightly less directly) to energy metabolism and fat storage.

Overall, the sense of smell is considered the least explicable of the senses. In Latin, "Sagacious", meant not only a keen sense of smell, but also clever[34], and "*olfactory imagery was employed in Classical Greek and Roman literature in order to describe beauty, ugliness, moral worth and virtue*"[35]. Taste and smell also figure strongly in modern common phrases that describe the best and the worst – "*she's so sweet*", or "*it stinks*", or perhaps even "*the essence...*" The smell of a person or an experience can be the most lingering of memories. I have a particular love of the smell of dust that has been dry for many weeks, and which, on being wetted by the first rainstorm, releases a heavy earthy fug; that seems to also bring with it a complex emotion tinged with of hope and plenty.

> *...whereto agreeth the doctrine of Theophrastus. Arise O North-wind, and blow thou South upon my garden, that the spices thereof may flow out; For the North-wind closing the pores, and shutting up the effluviums, when the South doth after open and relax them; the Aromatical gums do drop, and sweet odours fly actively from them*[36].
>
> *18. A transcendent Perfume made of the richest Odorates of both the Indies, kept in a Box made of the Muschie Stone of Niarienburg, with this Inscription -*
>
> **Deos rogato Totum ut te faciant, Fabulle, Nasum**
>
> *Just one sniff, Fabullus, and you'd wish you were one huge nose!*[37]

Touch/skin contact (S) is a hugely adaptive sense. There are particular parts of the body that are particularly sensitive to touch – the face, the hands, the lips and mouth. Fingertips possess about 25,000 sensory nerve endings per square centimetre! The range of information that can be obtained from touch alone is vast, as Helen Keller[38] could tell you. Touch may be anything from superficial to deep, and includes sensitivity to pressure, texture (rough, sharp, smooth, slippery, soft, hard, etc.), vibration and moisture. So I can have a pocket full of small items and use my fingers to detect the difference between a plastic button and a small coin. I have seen this discriminatory sense of touch being used

in Sri Lanka by people who mine alluvial gravel deposits for semiprecious stones. An experienced gem miner can run his fingers briefly over a handful of pebbles, and the tiny variations in glassy-soapy-waxy-plastic (and similar) textures allow him to know what kind of gems he is holding. Tourmaline feels different from sapphire, and so on. In a modern western culture, slightly different senses are usually applied for different purposes. The ability to find the gap between two sheets of paper, or to hold a sledgehammer or an eggshell. The complex integration of senses necessary to drive a car on a foggy night on an unfamiliar road.

Once we begin to think about general skin and body contact, it is clear that (much as sound has a continuity of experience across the frequency spectrum that ends up as viscerally-sensed vibration and rhythm) there is a continuity of experience from very light superficial skin contact through to deep sensations of tissue being compressed deeper in the body.

One of the most sensitive parts of the touch sense is in the mouth. I usually know that a pot of fresh nettle tea has brewed because the tea feels to be slightly more viscous. Babies orient to the world firstly through their mouth, and will place everything they find there. It is only later at maybe a year old that the hands start to become more dominant tools for physical investigation. Even now I still find some fascination (since I first started getting interested in the capacity of the senses some 20 years ago) in the process of finding and isolating a small bone in a mouthful of fish and miscellaneous vegetables ... and (considering that the movements of the tongue[39] are largely non-conscious) how intelligent is the interplay between the muscles of the mouth/tongue[40] and the sensory system. Purely from a survival point of view the nervous system is particularly attuned to whatever goes on in the mouth and nose. We rely on them for air food, water, and social communication; and as openings they are particularly vulnerable parts of the body.

The variations in texture that we can perceive with our fingers (but also with many other parts of our skin) is truly astonishing. We can feel moist and dry, and can even tell if the moisture is slightly slimy or gloopy or sticky. A single quick thumb movement over a blade edge will tell its degree of sharpness. Cats fur feels different from that of a dog, or human hair because of variation in its surface texture on the micron level. Even different types of metal have different “feels” to them.

The sense of touch gets even more interesting. Many people can tell the difference between an invasive or needy touch, and a loving or supportive touch – even when the physical pressure is the same. This capacity to intuit emotional content in touch may come from subtle tells of muscle tone, or there may be another sense that is so far

unidentified. Whichever is the case, emotion or mental state or intention result in different qualitative experiences. The sense of touch itself has so much depth and range of perception that it would not be unreasonable to devote an entire book just to this topic.

Skin hairs are a sensory extension of the skin. They work in a similar way to a cats whiskers, are an extension of skin-touch – and can indicate proximity. They can also detect air motion and static electricity.

Temperature (X,S,I) is detected by several different sensory faculties. Hot and cold skin sensations are detected by two quite different sets of nerves[41,42], which at very high or low temperatures also cross over into nocioceptive senses (pain resulting from tissue damage). The mediator of the temperature sense is located in the midbrain, which is also the main brain area dealing with emotions.

A *different* temperature sense is the external/non-contact sense of radiant infra red, (which may be more related to the capacity I mentioned earlier for skin to be a light-detecting sensory organ). Jean-Pierre Barral runs courses that teach how to achieve a sensitivity down to a difference of about 0.1 to 0.2°C radiant infra red[43] – almost as accurate as a hospital infra red camera – by simply using the palm of the hand to "scan", moving about four inches away from the body. Note that the temperature detected is *relative* rather than absolute[44]. Radiant infrared occurs across a wide spectral range[45], and whilst the skin does not appear distinguish between these different frequencies, we tend to detect far infrared simply because that is the frequency band emitted by warm blooded animals.

There is also a deep body sense of warmth/coldness, and a special visceral sense that warns us when the CSF is overheating in the head. Qualitatively, most of the senses of warm/cold are also related to senses of moisture and dryness, so it is possible to distinguish a warm moistness from a dry heat, and dry penetrating cold from a more damp clammy or icy cold.

Pain, tissue damage & inflammation nocioceptors (I,S) Itching is the first level of sensation that indicates an inflammatory response in the skin. There are various depths of nocioceptor (a nerve that detects tissue damage) – cutaneous, internal (muscle/nerves) and deep visceral. The nocioceptive system is innervated via the Autonomic Nervous System, and therefore is strongly associated with minor blood vessels. Pain is a modern epidemic, with about 10% of the UK population having been prescribed opioids (the strongest available painkillers) at some time between 2015 and 2017! The perception of

of pain is strongly linked to emotional and mental states, and to belief systems about how the body works. The use of attention in certain ways is capable of escalating or de-escalating acute and chronic pain.

Proprioception[46] (I?) The ability to tell where your body parts are, relative to other body parts is vital for movement. Proprioception includes sensations of muscle movement and joint position, including posture, verticality, movement, and facial expression. Neurologically it is mainly dependent on stretch receptors in muscles and joints. But like hearing and vision this sense is is also integrated through several senses[47] – such as balance. Vision is integral to the sense of proprioception – though not absolutely necessary. If you ask most people what position their left arm is in, they will first look at it, in preference to feeling its location by using interoception. Of course, both of these are being used simultaneously, but the personal and cultural preference tends to be biased towards vision[48], and culturally we have been taught to believe our vision and have less trust in our somatic senses[49]. Proprioception is also dependent on an internal self-representative map, which (thinking of e.g. anorexia) is *also* connected to the more abstract sense of self-identity ("self-image" – another nod towards the visual sense).

A sense of **Midline (I)** is an extension of (or maybe a precursor to?) more general proprioceptive senses[50]. Steiner's sensory category of "self-movement" includes proprioception. If anyone has ever had extensive light bodywork or body psychotherapy treatment, they will know that there are *at least* three very distinct forms of movement that each have very distinct qualitative experiences. One is normal voluntary movement. Another is normal involuntary reflex movement, usually associated with rapid turning the head (orientation reflex) or other reflexes (e.g. hand near a flame). The third is a strange, sometimes viscous and slow, non-voluntary movement that is essentially self-corrective and primitive that can be allowed to happen (and access to it is something of a skill that can be cultivated) – and can also be overriden. It might typically unravel congested tissue or maybe expresses some incomplete gestural movement from as far back as embryological gestation.

Direction (X, I?) is a very interesting sense. A very few people in modern culture consciously retain a strong dependable sense of direction. This is usually based strongly on memory of familiar landmarks, but may also include use of other visual clues or even (e.g.) a sense of smell (how close am I to the sea?). But people who live in wilder places tend to have a stronger sense of direction. Sometimes that sense of direction is relative, based on familiar landmarks, and and fairly easy to confuse once these landmarks are no longer available. The sun, moon and stars are always useful points of reference[51].

However, there are "Geographic Languages" in a few parts of the world (e.g. Northern Australian Aborigines) in which people do not say "that ant is to the left of your foot", but rather "there is an ant Northwest of your foot". Speakers of geographic languages can be driven blindfolded in tortuous routes, taken into a building with no windows and still be able to immediately use their directional language with accuracy. This suggests that the geographic sense may be a magnetic[52] sense[53], and maybe the handful of visual receptors adapted in Robins[54] to detect[55] magnetic fields using cryptochrome[56] are also present in humans.

It is clear that the geographic directional sense is available in these cultures because it is embedded in the language. In a language that does not rely on geographic direction, the user has no need to direct his/her awareness to this directional sense, and does not learn to use it from childhood. Streets are named, there are many visual landmarks and clues – to the point that a geographic sense of direction is more or less superfluous to anyone in a "developed" country who is not faced daily by impenetrable forest or miles of featureless grassland. Maybe we all possess a magnetic sense, just as homing pigeons[57], turtles and bees and hundreds of other species (including protists – primitive bacteria) appear to do? As humans, we certainly *all* appear to posses an abundance of proteins in our eyes (cryptochrome or CRY2) that can detect magnetism[58]. It has been known for some time that cells can construct magnetite[59] (i.e. ferromagnetic) crystals. A recent experiment[60] has shown that human brain activity responds to shifts in magnetic field direction. Furthermore, it appears to calibrate itself to the normal background magnetic field (strength, angle of dip), so it can tell if there is a sudden change in orientation or dip, and will filter that out. This ability to discriminate between natural "normal" and abnormal magnetic fields (and to deliberately screen out signals that are abnormal, including ones that are far too large) has also been observed in experiments looking at the biological effects of anthropogenic electromagnetic "smog" from radio transmissions and electronic devices (see below).

As an interesting twist, a geographic language fixes the sense of identity inside a broad and timeless landscape. Whereas a non-geographic language is far more egocentric, immediate and ephemeral, with everything being relative to the individual's personal orientation at any one moment. I was recently surprised to find during a conversation that my sister in law – who struggles to tell left from right – has always oriented herself based on the landscape (external references) rather than having an internal frame of reference. So it could be that "difficulty telling left from right" is sometimes an issue of the person identifying themselves as part of the environment – as opposed to the environment rotating around their identity.

When attempting to duplicate this, I find that I automatically drop into something more like de-focussed vision – a state in which external and internal senses are equally available – but I tend to be more aware of where the Pole Star is located rather than a straight "geographic direction". Perhaps "*5/10 for effort, more practice needed*", but this raises all kinds of interesting questions as to when we can potentially perceive through our senses that is beyond our capacity to imagine given the materialist tendency to require a sensory organ of known ability to do the job. It has recently been reported (2023) that research shows that human hairs are tactile[61] but I can remember knowing that fact when I was at primary school. The difference now is that we appear to have found "the" mechanism – a release of serotonin and histamine from the follicle. So what is the mechanism for hearing the sound of stars, as reported by Laurens van der Post in his book *Heart of the Hunter* (1961)?[62]

> *So the traffic of meaning between the Bushman and the stars has gone on from the beginning right into the lives of his descendants in the desert of today, like that traffic of angels which Jacob saw in a dreamduring his own desert dlight, ascending and descending a ladder pitched between him and the sky. Nor was the traffic visual only. I have already mentioned the sounds wherein the stars speak to the Kalahari Bushman today: nearly a hundred years ago a Bushman told Bleek about their voices; and he said too – a thing I had not heard in the Kalahari – that the sun had a great voice of its own. It made a ringing sound in the sky. When I read that, I thought instantly of the great chord with which Goethe begins the music of Faust : "Die Sonne – tönt nach alter Weise."*

Time (I) There are several internal (biological) clocks, some of which we may be available[63] to be used consciously. Humans have a structure of about 20,000 neurons in the hypothalamus called the suprachiasmatic nucleus (SCN), which is also present in all vertebrates – and receives light directly from the eyes. The job of the SCN is to synchronise the biological clocks of the body with the solar day, into a coherent diurnal cycle. Biological clocks are present in almost every organ and cell type in various forms, (with e.g. one time-keeping molecule flipping over every 24 minutes[64]) and are fundamental aspects of metabolic regulation for every kind of cellular life[65],[66]. The sense of diurnal (24-hour) time in humans was thoroughly investigated by the American and Russian space programmes in the 1950's-70's. They showed that the synchronisation of this internal clock with the solar day was crucial for all aspects of physical and mental wellbeing[67,68] – since it controls critical aspects of the metabolism such as cerebrospinal fluid production, activity of the pineal gland, sugar, cortisol, and adrenaline – in addition to mood and cognitive performance. Although particularly sensitive to light, the diurnal clock is also affected by exercise and sensory stimulation. One can think of the entry of light into the brain (or into the cell) as a means to calibrate the "internal" clock with the "external" environment.

The experience of the moment as a meaningful event is not only about "now". It requires that we also have awareness of a short preceding timeframe so that the present moment exists within some form of recognisable context. This function in a human being appears to be performed by the Insula; though the fact that single cells can decide to retrace their previous movements would suggest that the Insula is merely a more sophisticated version of something that is present in most lifeforms. The Insula is a kind of first-in/first-out (FIFO) rolling memory.

Electrical/Electromagnetic senses (X,S,I) The earth has an electrical environment[69] with substantial voltages moving through the ground, electrical potentials in the air (about 200 Volts/metre vertically), and a range of natural electromagnetic frequencies caused by resonance of light waves around the Earths atmosphere[70], and activity in the ionosphere in response to the solar wind. We have evolved inside this electrical environment since Life first began, and it is inevitable one way or another than its presence has influenced our cells, and that they are responsive to it. I'm not sure that this is specifically a sense in the normally accepted meaning of the word (though some fish and eels use it as one of their primary senses). To quote Stephen Harrod Buhner :

> *To gain an idea of just how sensitive to weak electrical signals these fish are, if you connected wires to each end of a 1.5 volt flashlight battery and placed the other ends of the wires two thousand miles apart in the ocean, sharks and rays would be able to detect the electric field that it produced ... Some fish have been found to be sensitive to fields as tiny as 2.5 billionths of a volt.. This sensitivity is nearly refined enough for the fish to count individual electrons as they touch the surface of its skin ... Paddlefish (and sharks and rays) can not only detect the weak signals themselves, but can also tell from them just what kind of fish they are sensing and whether or not it is their preferred food. They can tell how many fish there are, their size, age, and level of health; they can also pinpoint the location of the fish so accurately that they can find them in the extremely large ocean in which they are swimming (p. 60)*
>
> *Oscillating external electromagnetic fields can entrain or phase-lock heart cells so that the organism that we know as ourself moves into synchronicity with those electric fields. We are, in fact, supremely able to perceive and be affected by extremely weak electromagnetic fields form the environment (p. 112)*[71].
>
> *"There is no fundamental lower limit with respect to the magnitude of the perturbation that is still capable fo influencing a nonlinear oscillator" (Paul Gailey)*

To what extent we humans also possess electromagnetic sensitivity is debated, but it is likely that we use it all the time and simply don't notice because we don't think we have that sense. Some people definitely suffer from a capacity to be sensitive to (conscious of)

the invasiveness of radio-frequency electromagnetic (EM) noise. Most people who are this sensitive are aware of their nervous system being jangled – so this may just be that some part of their CNS is more easily entrained by this EM noise. And most of them are unable to switch this sensitivity off, as EM sensitivity often comes hand in hand with distortions of the proxemic sense ...

Proxemic sense (X,I) : Body and social (proxemic) space is the distance from our body that we unconsciously consider to be our zone of safety. I think everyone must know the discomfort that is felt when someone (who is not in an intimate relationship with you) comes just a little bit too close. On one level the proxemic sense is an acute awareness of the balance point between safety (is this possible danger far enough away that I feel safe?) vs support (is this possible source of support close enough so that I feel supported?) The topic of Proxemics will be covered in a lot more detail in Chapter 7. The effect of external space is sensed by most people through an internal (interoceptive) awareness of comfort vs discomfort/unease.

Equilibrioception (X,I,S) is the ability to keep your balance and sense body movement in terms of acceleration and directional changes. It is yet another integrated sense, relying a combination of the labyrinth of the inner ear (the "balance organ") via CN VIII, stretch receptors in muscles and joints, vision, the Kinaesthetic sense (acceleration), and pressure on the soles of the feet. A circus gymnast would use all of these senses to orient – and indeed, if they could not they would probably not have the coordination to do the job. However, this access to senses does not have to be fully conscious once the skill has been learned – it merely needs to be integrated and available for coordination of movement. I only realised this when I was talking to a patient who was a gymnast. I said how wonderful it must be to have such a wonderful awareness of where her body was as it was performing a somersault – to which she replied "*Oh – it doesn't work like that at all – I just decide to do a particular movement, and then it happens!*" Maybe there was a time when she was learning to fly through the air that this had to be conscious. After a certain point all movements become semi-automatic and there is no need to be conscious of them at all.

Chemoreceptors (I) of various kinds in the body send trigger and area of the hindbrain (medulla) involved in detecting blood-borne hormones and drugs. The gag/vomiting reflex is a particularly strong signal that often follows feelings of disgust (see section on emotions below). The Carotid Body is a particularly important chemoreceptor. Situated in the side of the neck, it inspects the arterial blood entering the brain to determine oxygen (O_2) content. Carbon dioxide (CO_2) and blood acidity (pH) are sensed mainly in

the Medulla Oblongata (brainstem). If the blood Oxygen content and/or O_2/CO_2 ratio goes out of normal range this usually induces faster breathing, along with a feeling of panic. We are also capable of being aware of cerebrospinal fluid acidity[72]. These are all included in the broad category of sensory experiences that Steiner called an awareness of "Life".

Visceral Stretch Receptors: e.g. lungs (lung inflation), bladder (urination), stomach (fullness), blood vessels (blood pressure), and the gastrointestinal tract (bolus/ defecation). Even if someone feels numb, it is relatively unusual to have lost sense of the body so much that they do not know when to go to the toilet or that their lungs are full and they need to breathe out, or they have no sense of how full their stomach is.

Thirst (I) is mediated in the Left Cingulate Cortex (midbrain) and the Hypothalamus. There may also be a conscious access to the chemoreceptors that sense plasma osmotic pressure, so thirst may also be caused by an insufficiency of salt.

Hunger (I) pangs are not just mental – there is a very distinctive sensation that is felt in the sub-diaphragmatic viscera. They are brought about by the contractions of an empty stomach, associated with a local release of the hormone ghrelin. The quasi-emotional feeling of hunger is just one of a series of urgent signals (rather like an internal fire alarm) that the body can give us in certain circumstances. The brain processes hunger through the Hypothalamus, which is also the "seat of emotion".

General Interoceptive senses (I) : Usually ignored in list of senses, the internal bodily sensations of being alive and having physical presence are a whole world in their own right. Many people in western cultures ignore the body most of the time and only place attention on it when it is in pain, or there is some other strong stimulation. In fact there is a constant ebb and flow of sensation that may be local to a small patch of skin or part of a limb – or global (whole-body). These sensations may arise in the skin, the muscle, the connective tissue, the lymphatic system, the viscera/internal organs, the vascular system (etc.) – and are something like the background noises in a busy city. A few words that might describe the vast range of sensory textures include

> Frozen, icy, cold, chilly, cool, wet, sweaty, moist, damp, boiling, warm, dry (dry-mouthed), hot, burning, parched, dehydrated, thirsty • Hungry, ravenous, full, bloated, satiated, satisfied, stuffed • Comfortable, uncomfortable • Dizzy, swirly, woozy, spacey, faint, floaty, giddy, disconnected, ungrounded, floating, light-headed Numb, blank, absent, empty, hollow • Queasy, nauseous, sick • Energetic, wired, buzzing, tingly, bubbly, energised, fizzy, electric • Pulsing, pounding, vibrating, throbbing, pressure Trembly, nervy, twitching, butterflies, fluttery, quivering, shaky,

shivery, shuddering • Calm, peaceful, spacious Expanded, expansive, airy, open, floating, relaxed, released, light, soft, cotton-wooly • Solid, grounded, strong • Flexible, fluid • Stiff, rigid, locked, taut, tight, tense, jammed • Exhausted, limp, floppy, damp rag, tired, drained, flat • Squirmy, jittery, jumpy, wobbly • Cloudy, dark, dull • Spongy, congested, heavy, saggy, squishy, squashed, stretchy, Bloated • Clenched, closed, contracted, blocked, knotted, constricted, small, short • Bursting, radiating, stabbing, jabbing, stinging, tight, raw, sore, achy, bruised, hurting, sensitive, itchy, prickly, tickly, jagged • Breathless, suffocated, short of breath, easy-to-breathe, headachey, thick-headed Teary, tearful • Urgency, twitchiness, agitation, anxiety.

To these can be added many other descriptive words. Some somatic sensations feel like they have the quality of very specific materials (such as metallic, woody, plastic, glassy, leathery...), often in combination with associated textural sensations – sharp, rough, smooth, etc. This list does not include a full list of emotions – which are also complex combinations of sensations (in specific parts of the body) that we have labelled – see later. But quite a few of the above words may be used to describe qualities of emotion and/or mental-emotional state, and it is impossible to list somatic sensual experiences without straying into the territory that is usually labelled "emotional". For instance, the slightly anxious urgency that indicates a very full bladder. The somatic sensations are also related to every single internal (I) and contact (S) sense listed previously, and often add important information to the external senses (X).

Inner motion / urge to move (I) : Whilst the inner interoceptive senses are states of being, and may of themselves lead to an inexplicable desire for particular kinds of movement, there is also an inner sense of movement that arises of itself, and is so intimately tied into the sensory system that movement is inextricable from sensing – the two are a unified action. The body simply moves itself - if it is allowed to do so. There are many possible ways to organise the relationship between the mind and body, but the main axis that these fall on is one of forcefulness (mind over matter) vs cooperation and mutuality (and trust). The body is somewhat animal in nature, and (if allowed to do so) is capable of exercising that more animal somatic intelligence through movement without the need for the conscious will to do anything other than ride – pretty well exactly like a horse-rider can let the horse have its head. Martial arts training (and method acting, and improvised dance e.g.) is designed to train that relationship so that the mind remains capable of exercising control, but does so sparingly and lightly *"like cooking a very small fish"*, usually giving only general direction, and and letting the body decide the how-ness of that. Within that very light control the body's innate intelligence decides what movements it should make and does the moving. There are two extremes of inner movement. One is heavily trained – such as military training – and is a fallback habitual

reflex, a Gestalt movement that takes over when the mind fails due to overwhelm. These emergency Gestalts are extremely useful for survival, but often deliberately rely on dissociation to take effect. The other extreme is accessing movements that reside within the cellular and tissue intelligence in the body, as might happen in an Authentic Movement class. In between these two extremes are trained movement patterns that are deliberately cultivated to have a particular effect whilst still being very conscious. Martial arts training constantly repeats a high quality of certain kinds of motion, so that particular motion is embedded in the body, and the body then re-expresses it far faster than the mind can instruct it to do so. Traditional (e.g. hunter-gatherer) dance might be another example, in which there is a cultural pattern of motion that forms the foundation, but then as the dance becomes more ecstatic the body moves itself within that structure. As can be seen from these examples, there is also an axis of degree of ability to re-exert conscious control. The subjects of Pierre Janet's studies in the Pitié-Salpêtrière Hospital in Paris had lost all conscious control (and even awareness) of this inner self-motion.

Counter-Transference[73], other more ephemeral and "Extra-sensory" senses (X,I) do not have any obvious set of nerves like the stretch receptors in joints. They are integrative, they are deeply somatic, they are related to consciousness and emotion, and they tend to be imaginal. The Craniosacral practice I have engaged in over the past 20 years has required that I continuously have to open more and more to the possibility of new forms of sensory awareness. As has been noted previously, the conscious awareness of some qualitative aspect of the world is dependent on a lack of disbelief. One must be consciously open to the *possibility* that something may be sensed, and when starting to use senses that are new and unfamiliar, the information is always initially very subtle, and so easy to miss or mistrust. Conscious awareness is almost wholly dependent on the sensory system, which (amongst other things) provides a background "sense" (or maybe an ab-sense!) of "*presence*" – and other qualitative aspects of feeling alive, energised, embodied, and "here". The slightly tingly fizzy sensation that is part of an awareness of being energised and alive *may* be related to lymphatic activity. And/Or may be "something else"... An excitation of cells as they receive just the right amount of oxygen and blood sugar? Or the movement of the capillary bed as it becomes more responsive to the surrounding tissue? Or some kind of bioelectrical activity? I believe that it is important to not disbelieve an impression or experience just because there is (up to now) no simple scientifically recognised way to account for it. There are many senses and experiences that are called "extra-sensory", as if they are outside of the "normal" senses (and therefore non-sense) – when actually – they are just senses like all the others, just not quite so well used or familiar. Who better than Jim Corbett to have the last word on this?

I had forgotten all about the tigress until I suddenly felt that I was in great danger. Hurriedly grounding the butt of the rifle I put two fingers on the triggers, raising my head as I did so, and saw a little earth from the fifteen-foot bank in front of me, come rolling down the steep side and plop into the pool. I was new to this game of maneater hunting or I should not have exposed myself to an attack in the way I had done. My prompt action in pointing the rifle upwards had possibly saved my life, and in stopping her spring, or in turning to get away, the tigress had dislodged the earth from the top of the bank. The bank was too steep for scrambling, and the only way of getting up was to take it at a run. Going up the watercourse a short distance I sprinted down, took the pool in my stride, and got far enough up the other side to grasp a bush and pull myself on to the bank. A bed of Strobilanthes, the bent stalks of which were slowly regaining their upright position, showed where, and how recently, the tigress had passed, and a little further on under an overhanging rock I found where she had left her kill when she came to have a look at me.

I have made mention elsewhere of the sense that warns us of impending danger, and will not labour the subject further beyond stating that this sense is a very real one and that I do not know, and therefore cannot explain, what brings it into operation. On this occasion I had neither heard nor seen the tigress, nor had I received any indication from bird or beast of her presence, and yet I knew, without any shadow of doubt, that she was lying up for me among the rocks. I had been out for many hours that day and had covered many miles of jungle with unflagging caution, but without one moment's unease, and then, on cresting the ridge, and coming in sight of the rocks, I knew they held danger for me, and this knowledge was confirmed a few minutes later by the kakar's warning call to the jungle folk, and by my finding the man-eater's pug marks superimposed on my footprints.

– from "*Man Eaters of the Kumaon*" by Jim Corbett

I hope by now that you have realised that the senses are themselves extraordinary, and consist of a vast ocean that is not usually explored. In the 16th century the known world was only sketched out in very superficial detail, and in between sometimes exotic and imagined continents – there were sea monsters.

Andy Harkin[74] describes how Wellness and embodied-ness are interoceptive senses in their own right – or at least qualities and states of being that we can perceive through the somatic senses. Rest is a qualitative physical-mental-emotional state that is known via a feeling of rested-ness – and is not simply "doing nothing". He also notes that in Western cultures there are two quite different streams of information about the world. One is based on external instrumentation – a tape measure can gauge how many centimetres tall you are; or a clock measures seconds, minutes, hours; or a set of scales measures your

weight in kilograms. This is a linear sequential and very left-brain-hemispheric world of abstractions. But we also have a more right-brain measure that comes to us through the somatic senses – which provide a far more subjective assessment of these properties. So whilst remaining the same height you may feel crushed or elevated, or be "standing tall". With no measurable change in weight you might feel light and buoyant or leaden. Time can stand still or race quickly, the day disappearing faster than we can grasp it. The cultural norm is that we are told to trust measurement and deny experience. However, experience tells us both about out internal state and about out relationship to the world. And if the relationship with the world is one of compassion and empathy, our internal state is inevitably attuned to the external world - and so that supposedly subjective layer of information is able to provide a second channel of information, a rich depth of qualitative experience that conveys something very real about the world beyond our skin.

> *Inasmuch as we can test the validity of intuition by seeing whether or not the possibilities do occur actually, and since millions of these possibilities arrived at by intuition have been realized, it is legitimate for the intuitive type to value his function as a means of understanding one phase of reality, that is, dynamic reality.*
>
> *~Carl Jung, 1925 Seminar, Page 132*

Steiner's additional senses[75,76] of ***Language***, ***Concept*** and ***Ego*** deserve some attention, if only because they raise interesting questions as to the scope of our sensory world and how much it interfaces and interlaces seamlessly with other fields of conscious experience. We are actually all familiar with a sense of **Ego**, and may talk of feeling affronted or embarrassed, or belittled, or encouraged or nurtured (etc. etc.) So to take just one of many possible examples, somebody may possess a "sense of dignity" – which they will experience (interoceptively) as an increased capacity for the thoracic torso to self-support, and for the identity and personal boundaries to be respectfully expansive. An external observer may well notice this change in physical posture and in the usage of facial muscles; so it is not uncommon to remark how a particular person has a "dignified bearing" or "dignified countenance". The baseline feeling of *presence* that is changed when these qualitative quasi-emotional states are sensed – is the sense of ego. It's quite difficult to define, but some sustained mindful observation of it results in an identifiable sense of "*this is how I experience myself*", and to external observers "*this is how I qualitatively perceive this person*". This ego-awareness is often referred to as a "*sense of identity*". Most people equate their body with their self, and therefore equate at least some of what they feel in their body as being part of their identity. Having a good qualitative sense of healthy physical presence tends to result in a strong and resilient sense of identity. Being in constant high level pain doesn't only result in stress in the way we usually think of it, but may also fracture the relationship between the mind and body in a way that creates an equally painful disruption to the sense of identity.

Personally, I am not so sure about **Language** as a definable sense. This is because in my definition of "sense", I conceptually separate the capacity to perceive *qualia*[77] from the capacity to interpret and derive meaning. Although I have consistently argued that it is impossible to truly separate the sensing of raw data from the derivation of meaning, the problem arises in that derivation of meaning is a capacity in its own right that extends right up into the cognitive levels of consciousness. So to constrain the fundamental sensory world to non-cognitive levels one must insist that sensing of information requires a certain proportion of qualia – and language goes beyond that level of simplicity. However, I have to agree with Steiner, in that there is in principle no difference between the understanding of language compared to the reading of sounds, shapes, colours when walking through a forest or savannah. The interplay between the human conscious mind/brain and the lower level processes again takes this slightly beyond the zone I would like to constrain senses, simply because I believe senses should be viewed not only from a human perspective, but also from a biological perspective. So a dragonfly would not go through the same cognitive (or even Right brain) processing of sensory information as a human being, but would still be capable of sensing – and a necessary part of that sensing is still enmeshed in some means by which *meaning* is derived. To "see" a fly moving must include a "knowing" that this is food – so meaning (i.e. cognition) is inherent in the sense of sight without the need for cognitive capacity in the complex way that we humans experience cognition. Possibly the main argument for not considering language to be one of the senses is that we use language to label and apply meaning, so language inherently contains meaning. Thus, language is a higher and more universal order of meaning (a ***Meta***-meaning).

For the same reasons I would place **Concept** as recognition or experience of *meaning*[78], placing it in a meta-position in the same manner as Language. As has been noted previously ("sense-meaning-response"), senses are of themselves useless unless they are also connected to some means of deriving meaning and then to some mechanism by which we can respond meaning-fully. We use the word "sense" in many interesting and varied ways. There is a "*sense of beauty*", which, although drawing heavily on more interpretative aspects of consciousness, and on the *sense of meaning*, is also often an expression of the *sense of proportion* – an often unconscious awareness of how the golden section[79] is contained in what is being observed. We have evolved in parallel with other life forms, and it is impossible to not be affected by their presence in the field of sensory awareness... The hum of bees and other insects in a garden... The particularly identifiable pattern of sunlight passing through ash leaves... The sound of a lark or song thrush or crow or seagulls, or of wind passing through tall grass.

And men go abroad to admire the heights of mountains, the mighty waves of the sea, the broad tides of rivers, the compass of the ocean, the circuits of the stars; yet pass over the mystery of themselves without a thought

- Augustine of Hippo

		Visual	Auditory	Kinaesthetic/physical
1	when operating new equipment for the first time I prefer to	read the instructions	listen to or ask for an explanation	have a go and learn by 'trial and error'
2	when seeking travel directions I..	look at a map	ask for spoken directions	follow my nose or maybe use a compass
3	when cooking a new dish I..	follow a recipe	call a friend for explanation	follow my instinct, tasting as I cook
4	to teach someone something I..	write instructions or draw a diagram	explain verbally	demonstrate and let them have a go
5	I tend to say..	"I see what you mean"	"I hear what you are saying"	"I know how you feel"
6	I tend to say..	"show me"	"tell me"	"let me try"
7	I tend to say..	"watch how I do it"	"listen to me explain"	"you have a go"
8	complaining about faulty goods I tend to..	write a letter	phone	go back to the store, or send the faulty item to the head office
9	I prefer these leisure activities	museums or galleries	music or conversation	physical activities or making things
10	when shopping generally I tend to..	look and decide	discuss with shop staff	try on, handle or test
11	choosing a holiday I..	read the brochures	listen to recommendations	imagine the experience
12	choosing a new car I..	read the reviews	discuss with friends	test-drive what you fancy
13	learning a new skill	I watch what the teacher is doing	I talk through with the teacher exactly what I am supposed to do	I like to give it a try and work it out as I go along by doing it
14	choosing from a restaurant menu..	I imagine what the food will look like	I talk through the options in my head	I imagine what the food will taste like
15	when listening to a band	I sing along to the lyrics (in my head or out loud!)	I listen to the lyrics and the beats	I move in time with the music
16	when concentrating I..	focus on the words or pictures in front of me	discuss the problem and possible solutions in my head	move around a lot, fiddle with pens and pencils and touch unrelated things
17	I remember things best by..	writing notes or keeping printed details	saying them aloud or repeating words and key points in my head	doing and practising the activity, or imagining it being done
18	my first memory is of	looking at something	being spoken to	doing something
19	when anxious, I..	visualise the worst-case scenarios	talk over in my head what worries me most	can't sit still, fiddle and move around constantly
20	I feel especially connected to others because of	how they look	what they say to me	how they make me feel
21	when I revise for an exam, I..	write lots of revision notes (using lots of colours!)	I talk over my notes, to myself or to other people	imagine making the movement or creating the formula
22	when explaining something to someone, I tend to..	show them what I mean	explain to them in different ways until they understand	encourage them to try and talk them through the idea as they try
23	my main interests are	photography or watching films or people-watching	listening to music or listening to the radio or talking to friends	physical/sports activities or fine wines, fine foods or dancing
24	most of my free time is spent..	watching television	talking to friends	doing physical activity or making things
25	when I first contact a new person..	I arrange a face to face meeting	I talk to them on the telephone	I try to get together to share an activity
26	I first notice how people..	look and dress	sound and speak	stand and move
27	if I am very angry..	I keep replaying in my mind what it is that has upset me	I shout lots and tell people how I feel	I stomp about, slam doors and throw things
28	I find it easiest to remember	faces	names	things I have done
29	I think I can tell someone is lying because..	they avoid looking at you	their voice changes	the vibes I get from them
30	When I'm meeting with an old friend..	I say "it's great to see you!"	I say "it's great to hear your voice!"	I give them a hug or a handshake

Table 3.1 : VKA preference statements

A list (probably incomplete) of potentially conscious senses

X :: Sight : mainly eyes CN II :

- external (foveal) : colour, central focus
- external (peripheral) : B&W, low light conditions, peripheral motion, motion tracking
- Pineal gland (light/dark)
- skin and other cells (?)
- internal “visualisation” or “mind's eye”

X :: Sound : Frequency & Quality (Timbre, Loudness, Intonation & Direction

- middle ear CN VII: direct through auditory canal and indirect through bone conduction
- lateral line pressure sensors : deep sounds, pressure changes, rhythm
- Viscera (?) : deep sounds
- internal “self-talk”, thinking, etc

X :: Echolocation

C :: Taste : tongue CN V3, VII, IX, X (Salty, sweet, sour, bitter, Umami)

X,C :: Smell (often confused for taste) :

- CN I (at least 1 trillion different odours?)
- Vomeronasal organ (hormones, emotional states)

C :: Touch/skin contact

- Pressure
- texture
- vibration
- moisture

X :: Air motion & static electricity (skin hairs)

X,C,I :: Temperature :

- external (radiant infra red)
- contact/skin & internal (Heat, Cold)
- internal head temperature

C,I :: Pain, tissue damage & inflammation (nocioceptors):

- Itch
- external/skin
- internal (muscle)
- internal (visceral)

I :: Proprioception (the ability to tell where your body parts are, relative to other body parts : sensations of muscle movement and joint position including posture, movement, and facial expression), includes

- stretch receptors (inc Muscle tension)
- interoception (somatic sensations)
- internal map
- visual clues

X(I?) :: Direction

- Relative direction
- Geographic sense (magnetic?)

I :: Time : internal clocks

I,C,X :: Equilibrioception (the ability to keep your balance and sense body movement in terms of acceleration and directional changes) : combination of

- inner ear/labyrinth
- stretch receptors in joints
- Kinaesthetic sense : acceleration
- pressure (soles of feet)
- Visceral Stretch Receptors: e.g. lungs (lung inflation), bladder (urination), stomach (fullness), blood vessels (blood pressure), and the gastrointestinal tract (bolus/defecation).
- visual clues.

I :: Thirst

- Left Cingulate Cortex (midbrain) & hypothalamus
- maybe also plasma osmotic pressure

I :: Hunger

- Brain : Hypothalamus (also related to emotion)
- Hunger pangs in subdiaphragmatic viscera
- Blood glucose?

I :: Chemoreceptors : These trigger an area of the medulla in the brain that is involved in detecting blood-borne hormones and drugs. It also is involved in the vomiting reflex. e.g.

- CSF pH
- Blood Oxygen content & O2/CO2 ratio
- Blood pressure : arterial, maybe also venous

I :: Other Interoceptive senses :

- Lymphatic activity
- Moisture
- etc etc

I :: Sense of “presence” & other qualitative experiential aspects of being alive

I :: Somatic aspects of Mental-Emotional states

I,X,C :: Electrical/Electromagnetic senses

X :: Proxemic sense : body space (inc. Sheldrake’s awareness of being looked at)

X,I :: Counter-Transference & Empathy (!)

? :: ESP (etc) and all that stuff

NOTE : Synaesthesia!

NOTE : Multisensory integration (e.g. colour/taste, balance/movement)

(A) Resourced Interoceptive qualities

General Questions...

- What am I feeling/what am I aware of in my body right Now?
- What is the specific texture/quality of this sensation?
- How would I describe it to someone else so they they would understand exactly what I am aware of?
- Where is the sensation/ what is its "geography"? (Skin, muscle, viscera / surface, shallow, deep / front, back / left, right : e.g. do my L and R sides feel exactly the same, and if not, what is the difference?)
- How local is this sensation vs general/ whole-body?
- If it appears to be all over, where is it NOT?

Contact & movement

Pressure, skin sensations (texture, warmth/cold, solidity, moisture, air/space, tightness, softness), support & being held, movement of breathing (ribs front/back/sides, belly, filling/emptying), air flow & temperature of air during breathing (nose/upper respiratory tract), inside of mouth (teeth, tongue, gums, etc), sense of clothing, shape of eyeballs in their sockets, presence of genitalia. Contact texture : bony, soft, etc → shape

Proprioceptive (when lying or sitting still)

Position & shape of body & limbs (Q. are these the same as what you would expect from how you know you have placed your body or can see it?), texture of muscle (mainly limbs, face, belly), muscle tightness & softness, shape & position of bony joints, facial expression

Inner vision, inner movement, inner urge to movement

Temperature

Burning / Hot / warm / cold / icy, and these may have a normal or dry or moist/damp quality

Vibration in the body due to external noise

Subtle & vibratory somatic etc

Pulsing (heart or other), beats, vibration, aliveness, potential for movement, tingling, fizzing, effervescent, bubbling, electrical, flow, cotton-wool, airy, expansive/full (inflated), full of blood (muscles), soft, energised lightness, solidity, weight/heaviness, density, substantial

Somatic component of mental-emotional states

(these will have a somatic texture and specific locations in the body, and in many cases the somatic texture + location is directly interpreted into meaning)

Safety, happiness, contentment, appreciation, love, gratitude, peace, stillness, now-presence, awake, alert, curious (yes! This also has a somatic component!)

(B) Hyper-aroused Interoceptive qualities

Pain (Itch, burning, dull, ache, "toothache", sharp, piercing, cutting, throbbing, electric, crushing, "nervy", tingling.) Tightness, tension, rigidity, excessive vibratory stillness of muscles, "waiting", external senses hyper-aroused/ hyper-alert, restless legs, twitching body.

Peripheral cold

Mental-emotional states : normal non-peaceful emotions : anxiety, fear, anger, sadness, etc; time distortions (time experienced faster or slower), agitation, restlessness

Time distortions (speeded up, slowed down)

(C) Hypo-aroused Interoceptive qualities

Numb, blank, absent, empty, dizzy, disoriented, disjointed, disconnected, clumsy, uncoordinated, low energy, exhaustion, sleepiness, deep cold, very heavy, very solid, dullness

Alien world, world through thick glass or cardboard, or as if seen on TV (depersonalisation).

Mental-emotional states : overwhelm, despair, hopelessness

Time distortions (drifty timelessness), OOB

Notes : Chapter 4

1 Sue Hubbard (2004) Ghost Station. Paperback: 112 pp Publ. Salt Publishing. ISBN-13: 978-1844710355

2 Jeff Green (2011) Sensing the world and ourselves. http://taruna.ac.nz/articles/12_senses_jeff_green.html

3 Tom van Gelder : Phenomenology. http://tomvangelder.antrovista.com/welcome-to-my-phenomenology-site-99m10.html

4 New Scientist (2005) Special issue : Why you have (at least) 21 senses. 26th Jan issue #2484. *"It used to be so simple. There were five senses and they created a picture of the world inside your head. But new ways of probing the brain are transforming this view of sensory perception. For starters, we have far more than five senses: the consensus is that there are at least 21 (page 34). And the boundaries between them are being blurred. Maybe you don't need eyes in order to "see" – other senses may take over in ways that so far defy explanation (page 37). In fact the whole idea that our sensations depend on which sensory organ picks up the information is being challenged. Deep down, it is what we do that counts (page 40)."*

5 Dr. Ali Ebneshahidi The General and Special Senses : online PDF http://www.lamission.edu/lifesciences/AliAnat1/Chap%2011-%20The%20General%20and%20Special%20Senses.pdf

6 The Bohm–Krishnamurti Project: Exploring the Legacy of the David Bohm and Jiddu Krishnamurti Relationship. A series of 10 seminars at Oak Grove School, Ojai, California. http://bohmkrishnamurti.com/bohm-consciousness-seminars/

7 Jonathan Amos (18 June 2018) Animals with "night vision goggles". BBC News online (Science) https://www.bbc.co.uk/news/science-environment-44501058 : a review of "**Life in the Dark**", an exhibition by the Natural History Museum, London, 13 July 2018 until 6 January 2019 http://www.nhm.ac.uk/visit/exhibitions/life-in-the-dark.html

8 Night-time. Excerpt from John O'Donohue (1999) Anam Cara: Spiritual Wisdom from the Celtic World. Publ. Bantam ISBN-13: 978-0553505924 https://johnodonohue.com/

9 There is a story that the great wooden ships that the Spaniards arrived in were so outlandishly foreign and unfamiliar to South American people – that they were unable to see the ships at all for some days. How true this is I do not know. Inability to see the unfamiliar is usually a bit more subtle. There's an old Jungle tale of a man who went fishing, riding a chestnut horse to a lonely spot in the forest on the banks of a river. He tied the horse to a tree behind him. After a short time, the horse started making a noise – whinnying, snorting, stamping in panic and trying to move from where it was tied. He went to the horse, and calmed it down, returned to his fishing, but yet again the horse became agitated. After a while, having tried to quiet and calm the horse many times, he just ignored it, and sat fishing. He positioned himself with his back against a tree, so that he was comfortable, and had the chestnut horse just visible from the corner of his eye. To his relief, the horse eventually did go quiet. When the man finally stopped fishing two hours later and looked behind himself, a tiger got up from eating the horse and melted back into the jungle.

10 Elena Yu. Zueva & Konstantin B. Zuev (2015) Dominance Concept by AA Ukhtomsky and Anticipation. Researchgate DOI:10.1007/978-3-319-19446-2_2

11 Robert A Heinlein (2007) Stranger in a Strange Land. Hodder Paperbacks ISBN-13: 978-0340938348 First publ. 1961, - see the character Ann, who is trained as a "Fair Witness" to not assume any un-sensed information – such as whatever might be behind the front wall of a building (including whether there might be a rear wall!)

12 Amelia Settembre (27.Feb.2020) Magenta: The Color That Doesn't Exist And Why https://medium.com/swlh/magenta-the-color-

that-doesnt-exist-and-why-ec40a6348256

13 The Ames Room illusion explained by Ingrid Wicklegren for Scientific American. https://www.youtube.com/watch?v=gJhyu6nlGt8

14 See the tale of the Rat and the Ox, from Vikram Seth (1991) Beastly Tales from Here and There. Publ. Viking ISBN 978-0-7538-1034-7

15 Runeson, S. (1988). The distorted room illusion, equivalent configurations, and the specificity of static optic arrays. Journal of Experimental Psychology: Human Perception and Performance, 14 (2), 295-304 DOI: 10.1037//0096-1523.14.2.295

16 Notes from two scientific psychologists (Wednesday, 6 October 2010) Runeson, the Ames Room and the Irrelevance of Equivalent Configurations http://psychsciencenotes.blogspot.com/2010/10/runeson-ames-room-and-irrelevance-of.html

17 Turing patterns are technically called diffusive reaction patterns, and arise when there is at least one driving "reaction" and one inhibiting response that interact in space. The resulting patterns can be seen in the distributions of stars in galaxies, or in high altitude cloud formations and sand dunes, the patterning on the skin of a whale shark, trigger fish and many sea shells, the intergrowth of competing bacteria or plants; and in many other areas of nature.

18 Natalie Wolchover (July 12, 2016) A Bird's-Eye View of Nature's Hidden Order. Scientists are exploring a mysterious pattern, found in birds' eyes, boxes of marbles and other surprising places, that is neither regular nor random. Quanta Magazine. https://www.quantamagazine.org/hyperuniformity-found-in-birds-math-and-physics-20160712/

19 Yoseph A. Kram, Stephanie Mantey & Joseph C. Corbo (2010) Avian Cone Photoreceptors Tile the Retina as Five Independent, Self-Organizing Mosaics. Plos One https://doi.org/10.1371/journal.pone.0008992

20 https://en.wikiversity.org/wiki/Radiation_astronomy/Electromagnetics

21 The investigation into cell intelligence by Albrecht Buehler has identified the orthogonal pair of Centriole organelles as a simple directional EM sensor present in every cell. He has not tested their range of EM sensitivity, but has confirmed that they are sensitive to near IR (the EM range just below the visible red wavelengths). Buehler has published over 20 academic papers on the subject of cell intelligence. The website http://www.basic.northwestern.edu/g-buehler/cellint0.htm contains video clips of single cells which are fascinating to watch – as they display clear signs of consciously making decisions. Probably a good place to start with academic papers would be Albrecht-Buehler, G. (1995) Changes of cell behaviour by near-infrared signals. Cell Motility and the Cytoskeleton 32:299-304

22 "Colour-sensitive fingers" : a scientific conundrum. Notes and Comments in New Scientist, 16th Jan 1964, p. 130.

23 Adam Zeman, Matthew MacKisack & John Onians (eds.) (2018) The Eye's Mind - visual imagination, neuroscience and the humanities Cortex | Special Edition 105, pp1-188 (Aug) https://www.sciencedirect.com/journal/cortex/vol/105/suppl/C

24 Future Minds Lab, University of New South Wales. Aphantasia and the Mind's Eye. https://www.futuremindslab.com/aphantasia

25 *From* Patrick Harpur (2008) Mercurius: The Marriage of Heaven and Earth. Publ. The Squeeze Press ISBN-13 : 978-1906069056 | *Congelation, p.349*

Notes : Chapter 4

26 The Lateral Line Pressure Sensors (LLPSs) in humans are remnants of the LLPSs in our ancestral fish. The ear is an adaptation of the most cephalad of these – part of the way that primitive gill arch structures have adapted to form the neck and face. A fish uses the LLPSs to detect changes in water pressure – mainly to detect large predators. The remnant versions in humans are also particularly attuned to low frequencies. They are located – as for a fish – on the place where the costal nerves exit from between each rib, on the line of the body that divides front from back.

27 Liberty S. Hamilton, Yulia Oganian, Jeffery Hall & Edward F. Chang (2021) Parallel and distributed encoding of speech across human auditory cortex. Cell August 18 https://doi.org/10.1016/j.cell.2021.07.019

28 https://www.youtube.com/watch?v=MD7UI2i9-xkw (Blind football team GB in action)

29 Science Blogs (Neurophilosophy) Human echolocation activates visual parts of the brain. Posted by Mo on May 25, 2011. http://scienceblogs.com/neurophilosophy/2011/05/25/human-echolocation-activates-visual-parts-of-the-brain/

30 Thaler L, Arnott SR, Goodale MA (2011) Neural Correlates of Natural Human Echolocation in Early and Late Blind Echolocation Experts. PLoS ONE 6(5): e20162. https://doi.org/10.1371/journal.pone.0020162 *(Conclusions : These findings suggest that processing of click-echoes recruits brain regions typically devoted to vision rather than audition in both early and late blind echolocation experts.)*

31 Pungent is the strong dense almost oily taste typical of herbs. Umami is a savoury flavour recognisable in soy sauce, gravy and foods that have been slow-cooked or slightly caramelised in a frying pan or oven (e.g. roast parsnips).

32 Jim al-Khalili & Johnjoe McFadden (2014) Life on the Edge : The coming of age of quantum biology. Publ. Bantam Press 368pp ISBN-13: 978-0593069325

33 Richard P. Feynman (2018) Surely You're Joking, Mr. Feynman!: Adventures of a Curious Character. Paperback, 400 pp Publ. W. W. Norton & Company; Reissue edition (first published 1985) ISBN-13: 978-0393355628

34 I never realised fully what "having a good nose for the job" meant – until I once gave a leaflet to a couple of policemen. I was working with an aromatherapist who was aware of the way subliminal smells can affect people's choices – so, for instance, some shops use very small quantities of aromatherapy oils to attract customers into the premises. She had placed one drop of bergamot essential oil on her finger and run it along the edge of a stack of 500 leaflets – the ones I was handing out. Anyhow, the younger of the two policemen took the leaflet from my hand, and then he suddenly became very alert and started to sniff the paper, stating that it had "an interesting smell". This was even more extraordinary in that the oils had been on there for several hours on a hot sunny day, and we were standing on a busy road with acrid smells of traffic exhaust all around us.

35 Kevin Falconer 30th June 2018 "Dr Brown's Nose" – from Aquarium of Vulcan blog, https://aquariumofvulcan.blogspot.com/2018/06/dr-brownes-nose.html

36 Sir Thomas Browne (1658) *Garden of Cyrus* (Chapter 4), quoted in Falconer 2018, ibid.

37 Sir Thomas Browne (1686) *Museum Clausum*, quoted in Falconer 2018, ibid.

38 Helen Keller became blind and deaf as a result of an illness at 19 months old. She later learned to read, write and speak through the persistence of her teacher, Anne Sullivan; becoming (despite her deafness and blindness) one of the great peace activists and

authors of early 20th century America. This is a description of her first experience of discovering the meaning of a word … *"As the cool stream gushed over one hand* [Anne] *spelled into the other the word water, first slowly, then rapidly. I stood still, my whole attention fixed upon the motions of her fingers. Suddenly I felt a misty consciousness as of something forgotten—a thrill of returning thought; and somehow the mystery of language was revealed to me. I knew then that 'w-a-t-e-r' meant the wonderful cool something that was flowing over my hand. That living word awakened my soul, gave it light, hope, joy, set it free! There were barriers still, it is true, but barriers that could in time be swept away."*

39 We still possess a primitive reflex between the oculomotor muscles (that control eye movement) and the tongue muscles. If you consider a cow or other grazing animal, it has to check with its eyes what is in the direction that it projects its tongue (or vice versa). So anyone able to observe their tongue motion and eye motion without consciously getting snarled up with the movements – will notice that the eyes tend to go where the tongue goes when it is pushed out of the mouth and in a left or right direction. Uncoupling voluntary override of this reflex is not easy. If you can observe your breath without taking it over and changing it – then you might be on the way to being able to achieve the tongue-eye trick. I have found this reflex useful sometimes when treating trauma. If the eyes are locked in one position because there is a fear to look in one direction, then one way that the brain can be taught that direction is safe is to *symbolically* inspect it by exploring it using *physical* tongue movements (so the tongue teaches the eyes that looking in this direction is OK).

40 Not to forget the teeth! As an ex-geologist, I know that the teeth are capable of distinguishing textures down to about 10 microns (1/100 of a millimetre), which is useful for distinguishing the difference between a silt and a clay without the need for a microscope. It was something of a joke that old field geologists all had worn-down teeth.

41 Eric S. McCoy, Bonnie Taylor-Blake, Sarah E. Street, Alaine L. Pribisko, Jihong Zheng, Mark J. Zylka. (2013) Peptidergic CGRPα Primary Sensory Neurons Encode Heat and Itch and Tonically Suppress Sensitivity to Cold. Neuron; DOI: 10.1016/j.neuron.2013.01.030 and a simplified description at University of North Carolina School of Medicine. "*Hot and cold senses interact: Cold perception is enhanced when nerve circuitry for heat is inactivated.*" ScienceDaily. ScienceDaily, 8 April 2013. www.sciencedaily.com/releases/2013/04/130408172243.htm

42 https://www.thenakedscientists.com/get-naked/experiments/how-we-sense-temperature describes a simple experiment in which the hot and cold nerves are desensitised on different hands – to demonstrate that there are two sets of nerves!

43 Jean-Pierre Barral (2005) Manual Thermal Evaluation. Hardcover: 128 pp Publ.: Eastland Press ISBN-13: 978-0939616480

44 Infra red is an odd sense, and having observed it during treatments for 20 years I have come to the conclusion that I really do not understand its behaviour. Sometimes it is possible to feel cool on the front of the hand pointed towards a patient and simultaneously warm on the back of the hand. Note that we are not a calibrated instrument detecting absolute temperature (or absolute anything else for that matter). The human sensory system detects differences rather than absolutes. So a small 0.1ºC difference in radiant temperature between one place on the body and somewhere 5 or 10 centimetres away is detectable, but radiant heat from a general body temperature of 38 degrees might not feel appreciably different to one of 37 degrees. However, it would probably feel unusually warm to *touch*, because the hand touching is (presumably) at normal body temperature (and so again it is difference that is being detected, not absolute temperature).

Notes : Chapter 4

45 Near infrared to far infrared covers about twice the order of magnitude of frequency and the visible spectrum. Animals tend to have a black body radiation centred around 12 microns (far-infrared).

46 Fabrice Sarlegna, Chris Miall, Jonathan Cole & Robert Sainburg (February 16, 2021) Proprioception, our imperceptible 6th sense. The Conversation https://theconversation.com/proprioception-our-imperceptible-6th-sense-150775

47 In my experience of bodywork for over 20 years, I have observed that the body map against which the proprioceptive senses are calibrated is related to some deep acupuncture channels that more or less follow the bony skeleton. These channels are not necessarily hard-linked to body structure, and changes in energetic balance can have a profound effect on proprioception. See notes on body vectors in John E. Upledger (1987) Craniosacral Therapy II : beyond the Dura. Publ. Eastland Press Inc 259pp ISBN-13: 978-0939616053

48 This cultural bias runs deep, is embedded in every corner of thought in Western cultures (to the degree that it is so familiar it is essentially invisible), and has come about through a sleight of hand by medieval theologian-scientists. (Until the late 18th century in Europe, science and theology were essentially the same thing, and science was considered to be one way to reveal God). The "really real" was considered to be non-physical. So therefore, in investigating the really real world, it was necessary to see through the mirage of the apparently real physical world. Therefore, whatever could be sensed by the body was not considered to be of any substantial (!) importance. This topic is discussed in more depth in later chapters, because it is a very powerful cultural engine that increases the tendency towards dissociation and disembodiment.

49 Which is itself somewhat paradoxical and debilitating – given the modern fashion of using optical illusions to "demonstrate" the unreliability of the sense of sight!

50 Sean Gibons Smarter Rehab Blog : The Body Image Project. http://smarterehab.blogspot.com/2016/12/the-body-image-project-part-1-overview.html

51 It was thought for a long time that the pieces of Iceland Spa crystal (very pure, transparent calcite) found in Viking burials were just ornamental. However, it was realised fairly recently that the birefractive properties of calcite can be used to locate the position of the sun on a completely overcast day. See this video on how to use a "Sun Stone" https://www.youtube.com/watch?v=bkBVxGZNIV0

52 Noboru Ikeya & Jonathan R. Woodward (2021) Cellular autofluorescence is magnetic field sensitive. Proceedings of the National Academy of Sciences Jan, 118 (3) e2018043118; DOI: 10.1073/pnas.2018043118 https://newatlas.com/biology/live-cells-respond-magnetic-fields/

53 I have experimented with the geographic sense for some years. I found that I often got confused by 180 degrees when attempting to think of a magnetic sense. However, when I started to think "where is Polaris (the north pole star)?" I began to be able to locate that direction and elevation quite accurately most of the time. There is a different feel inside my body when I place my attention in that direction. Which is interesting.

54 Robins start with a magnetic compass in both eyes, and end up with just one *in* National Geographic : Not Exactly Rocket Science : A Blog by Ed Yong. 28/Aug/2012 http://phenomena.nationalgeographic.com/2012/08/28/robins-start-with-a-magnetic-

compass-in-both-eyes-and-end-up-with-just-one/

55 Thorsten Ritz, Roswitha Wiltschko, P. J. Hore, Christopher T. Rodgers, Katrin Stapput, Peter Thalau, Christiane R. Timmel, and Wolfgang Wiltschko (2009) Magnetic Compass of Birds Is Based on a Molecule with Optimal Directional Sensitivity. Biophysical Journal Volume 96 April pp3451–3457 doi: 10.1016/j.bpj.2008.11.072

56 Cryptochrome and Magnetic Sensing. NIH Center for Macromolecular Modeling & Bioinformatics | University of Illinois at Urbana-Champaign. http://www.ks.uiuc.edu/Research/cryptochrome/

57 C Walcott, JL Gould & JL Kirschvink (1979) Pigeons have magnets. Science 07 Sep 205 (4410) pp1027-1029 DOI: 10.1126/science.472725

58 Foley, Lauren E., Gegear, Robert J. & Reppert, Steven M. (2011) Human cryptochrome exhibits light-dependent magnetosensitivity. Nature Communications 2011/06/21/online 2 (356) http://dx.doi.org/10.1038/ncomms1364

59 Heinz A Lowenstam (1962) Magnetite in Denticle Capping in Recent Chitons (Polyplacophora). GSA Bulletin (1962) 73 (4): 435-438. https://doi.org/10.1130/0016-7606(1962)73[435:MIDCIR]2.0.CO;2

60 Shinsuke Shimojo, Daw-An Wu & Joseph Kirschvink (2019) New evidence for a human magnetic sense that lets your brain detect the Earth's magnetic field. The Conversation March 18, 2019 5.01pm GMT https://theconversation.com/new-evidence-for-a-human-magnetic-sense-that-lets-your-brain-detect-the-earths-magnetic-field-113536

61 Julià Agramunt, Sergio Mena, Victor Ubels, Francisco Jimenez, Greg Williams, Anna DY Rhodes, Summik Limbu, Melissa Hexter & Claire A. Higgins (2023) Mechanical stimulation of human hair follicle outer root sheath cultures activates adjacent sensory neurons. Science Advances 9(43) Oct DOI: 10.1126/sciadv.adh3273 with a non-technical summary at : Caroline Brogan (October 27, 2023) Hair Follicles' Hidden Role in Touch Sensation. Neuroscience https://neurosciencenews.com/hair-follicles-tactile-perception-25110/

62 Die Sonne – tönt nach alter Weise translates roughly as "The Sun – sings its ancient [story through its] song".

63 I know a few people who wake up at exactly the time the decide they wish to wake up, by making the decision just before going to sleep. And a game I have played with my girlfriend on and off is to guess the time. When we were doing this daily we were getting down to an accuracy of a few minutes over an interval of several hours. Definitely a "use it or lose it" sense.

64 24 minutes is an interesting number. One 60th of a day. In Chinese medicine there are 12 meridians that go through a cycle each day, and each is more active for a period of 2 hours. There are also 5 elements in the Chinese cycle of natural processes, and 2 hours divided by 5 = 24 minutes. Just a coincidence.

65 Norio Ishida, Maki Kaneko, & Ravi Allada (1999) Biological clocks. PNAS August 3. 96 (16) 8819-8820; https://doi.org/10.1073/pnas.96.16.8819

66 Tina Hesman Saey (2015) The origin of biological clocks : The evolutionary story of circadian rhythms is under scrutiny. Science News 188 (2), July 25, p. 14 https://www.sciencenews.org/article/origin-biological-clocks

67 Jagannath A, Taylor L, Wakaf Z, Vasudevan SR & Foster RG (2017) The genetics of circadian rhythms, sleep and health. Human

Molecular Genetics, Volume 26, Issue R2, 1 October, Pages R128–R138, https://doi.org/10.1093/hmg/ddx240

68 Chandrashekhar V. Apte (2012) Biological clocks: The coming of age. Int J Appl Basic Med Res. Jan-Jun; 2(1): 1–2. doi: 10.4103/2229-516X.96788

69 National Research Council of America (1986) The Earth's Electrical Environment. Publ. The National Academies Press, Washington, DC. 263pp ISBN-13 978-0-309-03680-1 doi:10.17226/898. Also available free online as a PDF https://www.nap.edu/catalog/898/the-earths-electrical-environment

70 The electrical environment that we live in is no longer a natural one. George Starr White noted even in the early 20th century that his chickens preferred direction of sleep (and their egg laying) that he had observed for over a decade was permanently disrupted when the first radio transmitter started broadcasting near his home. That effect would be almost impossible to quantify now, given that artificial EM fields are almost universal. It's not only a matter of screening the artificial EM, because there is a geomagnetic EM (Earth Cavity Resonance) and electrical field (the atmospheric electrical potential) that we have evolved in for a couple of billion years. Earth cavity (Schumann) resonances have a fundamental frequency of 7.83 Hz (i.e. light travels round the Earths equator 7.83 times per second), but exist in a broad spectrum of frequencies from about 3Hz up to over 100Hz. They are transmitted particularly strongly in the more conductive Ozone layer, along with the electrical potentials of hundreds of thousands of volts generated by atmospheric lighting discharges. Since life is incredibly adaptive and creative I would be surprised if these natural EM fields did not have some effect on our metabolism. Having a physiological effect may or may not be the same as being sense-able – the senses would have to be interoceptive in some way or another. I am aware that some places on Earth feel more energising and uplifting than others, and one possibility is that this is an electromagnetic effect.

71 Stephen Harrod Buhner (2004) The Secret Teachings of Plants: The Intelligence of the Heart in the Direct Perception of Nature. Publ. Bear & Company ISBN-13: 978-1591430353

72 New Scientist (2005) op. Cit.

73 Counter-Transference is the awareness in ones own body-emotions-mind of something that is simultaneously happening in another person's body-emotions-mind. This is a resonance between two people, most usually when they are in the same room together, but sometimes it happens because they are very strongly connected emotionally (e.g. parent and child). It is not easy to know that a feeling is Counter-Transference unless (a) the circumstances are fairly simple, and (b) the recipient is very clear about their own internal state and what is going on around them, and how they normally respond in these circumstances. If an unexpected emotion or feeling arises and it cannot be directly attributed to internal processes, then it may be a resonance with somebody else's experience. It usually takes substantial self-awareness and experience in to be able to know that what is being experienced truly is Counter-Transference, and that this is not Projection. Exactly "How" Counter-Transference arises is a very interesting question – and this is one of several fairly common experiences that point to consciousness not being located purely in the brain.

74 Mind the Gap: Moving From Brain to Body | Dr. Andy Harkin | TEDxBunbury https://www.youtube.com/watch?v=yfcnRzcpTd4

75 Jeff Green (2011) op. cit.

Notes : Chapter 4

76 Tom van Gelder op. cit.

77 *In philosophy and certain models of psychology, qualia (/ˈkwaːliə/ or /ˈkweɪliə/; singular form: quale) are defined to be individual instances of subjective, conscious experience. The term qualia derives from the Latin neuter plural form (qualia) of the Latin adjective quālis (Latin pronunciation: [ˈkʷaːlɪs]) meaning "of what sort" or "of what kind" in a specific instance like "what it is like to taste a specific orange, this particular orange now". Examples of qualia include the perceived sensation of pain of a headache, the taste of wine, as well as the redness of an evening sky. As qualitative characters of sensation, qualia stand in contrast to "propositional attitudes",[1] where the focus is on beliefs about experience rather than what it is directly like to be experiencing.* (https://en.wikipedia.org/wiki/Qualia 19/Jun/2018)

78 ... and as *meaning*, "Concept" is more in line with Douglas Hofstadter's view of conscious/linguistic processes as being applications of *analogy*. See the slightly dry 2016 lecture by Douglas Hofstadter – *Analogies are the core of thinking* https://www.youtube.com/watch?v=vORB92BUI7zk or the slightly less dry 2009 lecture *Analogy as the Core of Cognition* https://www.youtube.com/watch?v=n8m7lFQ3njk

79 Scott Olsen (2006) The Golden Section: Nature's Greatest Secret. Publ. Wooden Books, Hardcover, 64pp ISBN-13: 978-0802715395