

Presence in Mind – Autonomic Afferents and Well-Being

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¹ The notation in this essay is to use insular cortex interchangeably with insula. [Reference: Insular Cortex: http://en.wikipedia.org/wiki/Insular_cortex]

Preamble:

This paper links forms of mental training [such as Mindfulness Training / Meditation, Positive Mental Training, and Autogenic Training] with Well Being, in the context of the Autonomic Nervous System [ANS]. Emotional Well-Being and Autonomic (nervous system) activity are intimately interlinked, and this article examines these dynamics [Craig 2005] in the context of being present, and mindfulness. Further background information about the ANS is given in the Autogenic Dynamics Section of this website in Sections A7 & A8. Those unfamiliar with some of the basic physiology of the ANS may benefit from first looking over the above two papers².

The first part deals with some background considerations regarding presence and what it means to be present, and itself can really be seen as a preamble to the second part; Part II focuses specifically on the Autonomic dynamics underpinning presence and mindfulness.

Part I: Setting the Scene**1. Introduction**

In everyday life we may feel that our minds are in good shape. This may be the case. Yet for many of us, if we sit down quietly and practise an Autogenic Standard Exercise sequence, or some other form of Mental Training, we may be amazed at the extent to which our minds wander from the mental exercise. We should not be alarmed at this, for this is what our human minds tend to do; yet it reflects that our minds are not well trained in some forms of focused attention – and to this extent at least we may not be mentally fit.

For overall Well-Being, we need to keep physically fit with regular [physical] exercise; in the same way, in order to keep mentally fit, some form of regular mental exercise is required. Regular physical exercise helps to keep our muscles, heart, and lungs in good shape; regular mental exercise helps us to develop focused attention; that is, the ability to give our true presence to what we are attending to. When our mind wanders (say half way through an Autogenic sequence), the practice is to become aware of the wandering and so return to the exercise mindfully – without judging ourselves. Presence is one of the key aspects of Dana Paramita, a Buddhist discipline concerning what we can give. We can give our true presence to others (see this website: D2: Dana Paramita); in mental training we develop our ability to be truly present for others by being present with ourselves during our mental / Autogenic training. Mental training should, I think, be seen as an essential discipline for healthy societies as it helps us to develop mindfulness (D1: Reflections on foundations for mindful living); if we are sometimes confused as to what exactly mindfulness is, we can ponder on the reverse of mindfulness – i.e. mindlessness – as in “that was a mindless response”.

2. The power of words

During a talk that Daniel Siegel gave at a conference in London in May 2013, he suggested that we focus inwardly and become aware of any bodily sensations / feelings / thoughts while he said two series of words. The first series was: “No; no; no; no; no; no; no; no.” This is a helpful exercise to try on ourselves.

The second series was: “Yes; yes; yes; yes; yes; yes; yes; yes”.

He then got feedback from the participants. Now of course we will all tend to respond to such an exercise in different ways, yet there was a common experience that the “no” series produced effects such as: feeling upset; feeling rejected; sensation of tightness in chest; not feeling understood. Now this is very interesting: at a conference for counsellors / psychotherapists, this single word could produce these effects. Such effects are associated with the flight / fight response

² In the meantime, it is helpful to be aware that the ANS can be divided into two main parts: the Sympathetic Nervous System [SNS], primarily to do with dealing with external threats and so with withdrawal behaviours such as flight / FEAR [unless fight / RAGE systems are activated, when attack may be involved], and the Para-Sympathetic Nervous System, primarily to do with rest, repair, recuperation, and approach / Social Engagement behaviours.

and the Sympathetic Nervous System [SNS] – and are themselves associated with avoidance types of behaviour. With such feelings / sensations / thoughts, it is difficult for us to be truly present. SNS activity is generally not compatible with Social Engagement with others (Porges 2009; 2011) or with Self Awareness — i.e. being focused and aware of our own internal state (Siegel 2010A p 23; 2007; Siegel refers to this as Self Engagement).

On the other hand, the feedback from the group relating to the experience of hearing “yes; yes; yes.....” was quite different. Here participants tended to feel: positive, understood, welcomed, ok, out-going and wishing [SEEKING] to engage. Such responses are associated with the myelinated vagal system [part of the PSNS] and Social Engagement (Porges 2011; Porges 2005) and the ability to focus with true presence on what is going on within us³. Whoever we are, whether a teacher, parent, vagabond, waiter or therapist, mindful living includes being in touch with what is going on within ourselves.

3. Automatic, restricted and non-mindful Responses when feeling uneasy

Feelings of internal distress are generally not associated with activation of the myelinated vagal system (PSNS), but rather with states associated with SNS activity (i.e. the Flight [FEAR] and Fight [RAGE] response – Porges 2011; Panksepp & Biven 2012); when these become prolonged / chronic they can be associated with a hyper-vigilant state – which can also be associated with some forms of depression (Dobbin & Ross 2012). In such states, we are as it were already on a plateau of increased probability [Siegel 2010 p 10] – that is, increased probability that we will react automatically to any trigger / comment / statement / negative feeling in a dysfunctional way; this automatic response is an SNS response that was good for survival in our evolutionary past – but is generally entirely inappropriate when, say, we are at work or upset by a remark of our partner. As already indicated, such SNS activity is not normally compatible with meaningful Social Engagement or Mindful awareness of what is going on within us.

4. Being Present: Calm & Connection and the Tend & Befriend Response

During the twentieth century a lot of work and research was done on the Stress Response in animals and humans (Cannon 1929; Selye 1956; 1974; 1976) – and this tended to support a somewhat restricted interpretation of evolution in terms of “the survival of the fittest” within a confrontational – “Nature red in tooth and claw” – paradigm. This research was essentially carried out by men.

Shelley Taylor et al develop a different paradigm with their “Tend and Befriend”⁴ perspective (Taylor 2000), which suggests that just as important a response to external stressors / danger as the fight / flight response, in evolutionary terms, was the more measured tend & befriend response. For example, if a group of women and children were threatened by an external danger, their response would tend to be a collective one of mutual support.

.....females of many social species respond to challenges to homeostasis with affiliate and nurturing behaviours..... and [that] this profile depends on stress-responsiveness hormones generally ignored by the Cannon school, namely, vasopressin and oxytocin.

Sapolsky 2007 p 608, referring to the work of Taylor et al (2000)

³ i.e. Self Engagement in Siegel’s terminology [Siegel 2010A p 23]

⁴ See A1 on this website for further details of the Tend and Befriend Response.

This response resonates with one of the most crucial primary process emotions – that of CARE [Panksepp 1998; Panksepp & Biven 2012; and B3 Part I & II in this series].

Uvnäs-Moberg’s extensive research on the role of oxytocin in both women *and* men throws further light on Being Present, and the neuro-physiological benefits of remaining calm and centred (e.g. Uvnäs-Moberg 2005). In this 2005 article, she has a very moving photo of a Madonna and Child painting by Guido Reni, (1575–1642) captioned with: “The Madonna with child, as an expression of the individual and interactive aspects of eustasis⁵”, and she suggests that this physiological pattern be referred to as Calm & Connection [Uvnäs-Moberg & Magnusson 2005 p 60]. For copyright reasons the Guido Reni is unavailable, but her article is available on line without charge. Figure 1 is a representation of the Madonna theme.

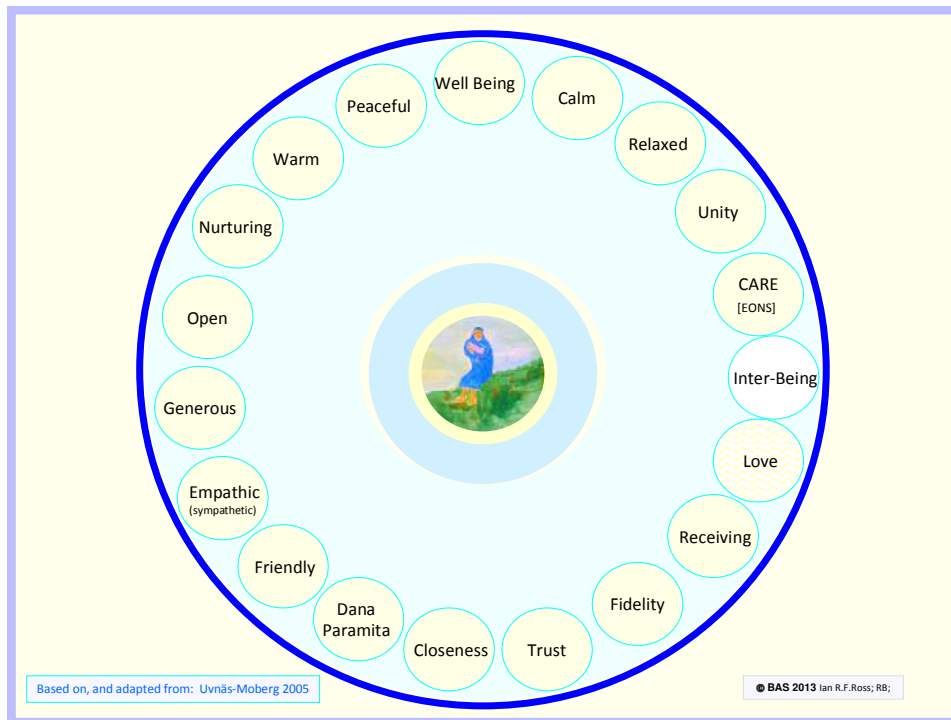


Figure 1
Being Present
Adapted from Uvnäs-Moberg & Magnusson (2005)

Comment on Figure 1

As indicated, this is an adaptation of Figure 1 in the 2005 article by Uvnäs-Moberg & Magnusson. The various related modalities follow the original of Uvnäs-Moberg with some changes: Fidelity replaces Loyalty; Well-Being replaces Happy, and Dana Paramita⁶ replaces Giving. We have added Nurturing, Inter-Being, and CARE to emphasise the centrality of CARE circuits and related oxytocin (Panksepp 1998; Panksepp & Biven 2012; Trevarthen 2009; 2011; 2012).

Central to Uvnäs-Moberg’s thesis is that nurturing type behaviour will be associated with the release of oxytocin, and indeed is underpinned by oxytocin; without oxytocin our CARE circuits become severely compromised. With oxytocin flowing, we become calm and connected⁷ (Uvnäs-Moberg 2005) to ourselves and others.

⁵ Eustasis is the optimal physiological condition – neither too much nor too little (Chrousos 2009).

⁶ Dana Paramita: one of the six Paramitas described by Hanh (Hanh 1998 pp 192 – 213; see also D2 on this website).

⁷ There are a number of stimuli that facilitate the calm and connection modality; these include: warmth; delicate touch; being part of a nurturing social group; massage; breast feeding; suckling; and stroking. These stimuli are also associated with the release of oxytocin [Uvnäs-Moberg & Magnusson 2005].

5. Human distress, paying attention, mindfulness and resilience

Human distress, including depression, loss, and burn out, is often associated with loss of meaning. These conditions may be caused by, or exacerbated by, lack of resilience. For example, some people seem to deal with severe loss / bereavement much better than others. Mindful type practices, which axiomatically include on-going mental training, have been shown to increase resilience, and so reduce the chances of developing, or being overcome by, mental distress (Krasner et al 2009; Dobbin & Ross 2012). Daniel Siegel has this to say about socially engaged occupations:

Whether you are fighting malaria or malnutrition, working to alleviate global warming and ecological destruction, practising surgery, or focusing on intensive psychotherapy⁸, there is always your own inner life that needs attending to in order for you to do your job well. Well means not only bringing presence to your work, but bringing resilience to your life.....

Caring for yourself, bringing support and healing to your own efforts to help others and the larger worlds in which we live, is an essential daily practice – not a luxury, not some form of self-indulgence.

Siegel 2010A pp 2-3

Mindful practice brings about greater self-awareness, which Goleman has shown to be essential for emotional and social intelligence (Goleman 1996; 2007; Siegel 2010A p 3). Such Mindful practice can be developed in many different ways, and it is important that we each find ways that are appropriate – and therefore helpful, for ourselves. This may involve going for a walk in the country, walking meditation, T'ai Chi, Yoga, specific breathing exercises, or some other form of Mind Training – such a Mindfulness Meditation or Autogenic Training. In Autogenic / Meditative types of approach, we focus on various states of the body and / or the mind. This requires us to be present and focused – and this in turn will bring about greater self awareness. Mindful practices embrace two aspects of awareness (Siegel 2010A p 28; also see Siegel 2012: 7-1 to 7-5):

- Awareness of Awareness [e.g. “I am aware that I am breathing in; I am aware that I am breathing out”].
- Awareness (attention) to Intention. For example, we cannot develop mindfulness without mindful practices such as meditation / AT. This means that we have to be not just aware of our intention to practise, but also to attend to [i.e. practise] the intention [see also Siegel 2007 pp 176-178⁹].

Well-Being and wholeness embrace being present for both ourselves and others; by paying attention we build in internal resilience [Siegel 2010A p 29; and see in Section 13.3 below]. Note that Kabat Zinn formulates Mindfulness thus: “Mindfulness means paying attention, in a particular way, on purpose, in the present moment, and non-judgementally” [Kabat-Zinn 1994 p 4].

The research suggests that we can increase our resilience by such practice. This will facilitate our approach type and Social Engagement modalities, and our CARE system [Panksepp 1998]. This is associated with increased EEG activity in the Left Frontal Lobe [Davidson 2003; 2003B]. Why should

⁸ This quote is from a book written primarily for therapists and clinicians; but the essence is for all of us, whether we are, for example: parents, retired, seeking a job, out of work or in work.

⁹ Siegel also puts this in a wider context of being open to others: “This intention to be open, not the receptivity alone but the intention to be receptive, is itself something which can be perceived by the mind. This is the perception of intention” [Siegel 2007 p 177]. If we attend to such perceptions with mindfulness, we will go on to carry out appropriate intentions.

this be in this left side of the brain, when popular neurology often equates the left side of the brain with “problematic” modalities¹⁰? We will return to this theme in due course [Section 12].

Part II: Autonomic Afferents and Well Being

6. Porges, the myelinated vagal system, and Social Engagement

Such mindful practice as we can develop in, for example, T'ai Chi, Positive Mental Training, Yoga, Meditation and Autogenic Training, is associated with increased Para-Sympathetic Nervous System activity (PSNS) [Benson & Klipper 1975]; specifically, with increased myelinated vagal activity [Porges 2005].

In general terms, external and internal threats are modulated by the SNS with associated withdrawal behaviours. Life threatening events may, however, activate the *unmyelinated vagal* [PSNS] and cause fainting / collapse; *this* is associated with profound slowing of the heart rate and reduced breathing. While this was (and is) a good protective adaptation in evolutionary terms for reptiles, for mammals and humans it is highly problematic: for it can seriously compromise the oxygen supplies to the brain¹¹. Note that this means that part of the fight / flight response, in extremis, is modulated by this unmyelinated PSNS and not by the SNS.

Over aeons, mammals, and in particular primates and humans, developed very sophisticated Social Engagement behaviours which are modulated by the myelinated vagal system¹² [Porges 2011]. Such behaviours develop when the environment is perceived to be safe. Social Engagement behaviours have been essential to the wholesome development of human societies, and include: “enhanced neural control of the face [via the facial muscles – IR], larynx, and pharynx that enables facial gestures and vocalisations associated with social communication” [Porges 2005 p 39].

If we are feeling threatened in any way, this implies that our SNS is in active mode – for example, the heart rate may be increased. We become aware, consciously or unconsciously, of this aroused bodily state through the SNS afferent fibres (from the body and organs) to the brain; this alerts the brain that all is not well in the periphery: and so we feel agitated, not at ease, and / or in the hypervigilant state described by Dobbin & Ross [Dobbin & Ross 2012].

On the other hand, as the body settles, so do the distressed feelings. Mindfulness type practices facilitate settling of the body and organs, and this settling then results in a reduction in the SNS afferent impulses to the brain, while increasing the PSNS afferents to the brain: as a result, the brain interprets this as:

“Everything in the periphery is quiet.”

Wallnöfer 2000

Thus we feel safe.

These brain dynamics then increase vagal [PSNS] myelinated efferent – from the brain to the body – impulses: for example, to the heart, allowing the heart rate to remain calm and slowish [i.e. not fast]; and this myelinated vagal system at the same time enhances Social Engagement and therefore approach type behaviours [Porges 2005; 2012].

We return to the question: why is this associated with increased Left Frontal Lobe activity on EEG?

¹⁰ For example: analytical, linear, and reductionist perspectives attributed to the left brain. The relationship between the two hemispheres is complex and complementary. See also: ‘The Master and his Emissary’ [McGilchrist 2009]; and Craig [Craig 2005; 2008].

¹¹ This is not the case for reptiles whose brains are far less sensitive to hypoxia [reduced oxygen levels].

¹² A fuller discussion of the implications of Porges Polyvagal theory can be found on this website – Section A7 & A8.

7. Sympathetic and Parasympathetic Afferent nerve fibres to the brain

7.1 Preamble:

The Autonomic Nervous System deals essentially with both monitoring and enabling optimal functioning of various parts of the body – including the viscera and organs; this is mainly at an unconscious level [i.e. the body just gets on with these essential tasks while we get on with our lives or reflect on butterflies]. These essential tasks are enabled by the autonomic efferent fibres from the brain to the body. However, for balance and homeostasis to be maintained, we need an excellent feedback system from the body to the brain, and this is supplied by the autonomic afferent fibres. The vagal system, part of the PSNS, has both efferent and afferent fibres; what may be less well known is that some 80% of these fibres are afferent: this means that the brain is very well informed about what is going on in the body in physiological terms; some of this information becomes conscious, and this overlaps with Damasio's concept of "Background Feeling" [Damasio 1999]; such background feelings are in addition to our primary process emotions and primary process [affective] consciousness [Panksepp 1998; Panksepp & Biven 2002 p 13].

7.2 Autonomic Afferents and the Insular Cortex¹³:

It is well known that we have both a motor and a sensory cortex in the brain (near the surface of the neo-cortex). The sensory cortex gives us information of sensations – especially on the surface of the body, that we become conscious of; the motor cortex is the brain area from which messages are relayed to move various parts of the body for activating appropriate (voluntary) muscles¹⁴.

The insular cortex [deep within the cerebral cortex] has many functions, including receiving afferent messages from the Autonomic Nervous System. Thus both afferent SNS and afferent PSNS fibres relay the state of the body (including the viscera / organs / striated muscles) to the anterior insular cortex. These pathways play a fundamental part in maintaining homeostasis by carrying (intero-ceptive) messages that represent "the physiological condition of the body" [Craig 2008 p 275 – Figure 16.1; and Craig 2004¹⁵].

These afferent ANS fibres include modalities such as "temperature, pain, itch, hunger & thirst" and "feelings from the body such as muscle ache, visceral urgency and so called 'air hunger' " [Craig 2008 pp 273-274].

Research during the last decade or so has shown that SNS afferents from both sides of the body [i.e. both the left and the right side of the body] terminate in the *Right* Anterior Insular cortex; however, the PSNS afferents – again from both sides of the body – terminate in the *Left* Anterior Insular cortex [Craig 2008 pp 272-288; Craig 2005; Craig 2004]. These ANS afferent pathways are represented in simplified format in Figure 2 on the next page.

¹³ The notation in this essay is to use insular cortex interchangeably with insula. [Reference: Insular Cortex: http://en.wikipedia.org/wiki/Insular_cortex]

¹⁴ These messages are relayed from the motor cortex (of the cerebral cortex) via upper and lower motor neurones to the neuronal end plates that terminate in the muscles; this includes voluntary [consciously purposeful] movements.

¹⁵ In this article, Craig [Craig 2004] refers to the James-Lange theory of emotions and Damasio's more recent somatic marker hypothesis. I have found the following quote from Wikipedia to be instructive: "The insular cortex, in particular its most anterior portion, is considered a [limbic](#)-related cortex. The insula has increasingly become the focus of attention for its role in body representation and subjective emotional experience. In particular, [Antonio Damasio](#) has proposed that this region plays a role in mapping visceral states that are associated with emotional experience, giving rise to conscious feelings. This is in essence a neurobiological formulation of the ideas of [William James](#), who first proposed that subjective emotional experience (i.e. feelings) arise from our brain's interpretation of bodily states that are elicited by emotional events. This is an example of [embodied cognition](#)" [http://en.wikipedia.org/wiki/Insular_cortex – accessed on 09-06-2013 - IR].

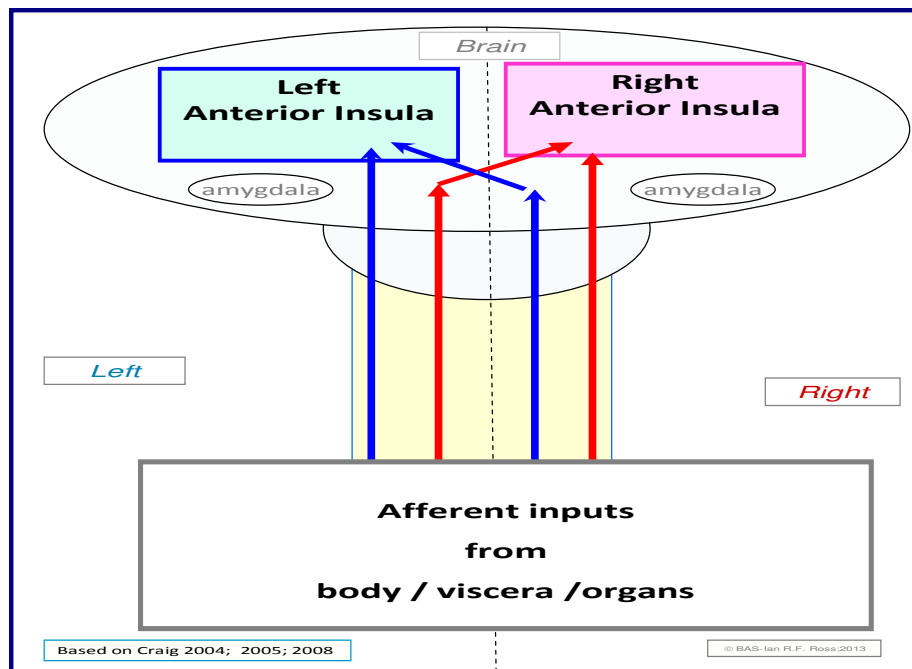
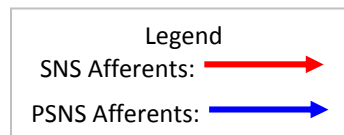


Figure 2

Lateralisation of Autonomic Afferent Fibres from the body to the brain



Comments on Figure 2

- This diagram is highly simplified for the sake of clarity.
- Red arrows represent SNS afferents.
- Blue arrows represent PSNS afferents.
- It will be noted that SNS afferents from the left side of the body cross over to the right insula [insular cortex]; those from the right side do not cross, and so also terminate in the right insula.
- In a mirror fashion, the PSNS afferents from the right side of the body cross over to the left insula, while those from the left side do not cross.
- This means that the right insula deals with only SNS afferents, while the left insular deals only with PSNS afferents.
- The amygdalae are shown. Increased SNS afferent activity will be associated with increased amygdala activity in terms of, for example, the flight and fight response [FEAR and RAGE circuits of our primary process emotions – Panksepp 1998].
- On the other hand, increased PSNS afferent inputs to the left insular cortex will be associated with changed dynamics in the pre-frontal cortex, with the ability to down regulate FEAR and RAGE circuits.
- In addition, increased PSNS afferents will be associated with Social Engagement [Porges 2012].
- The lateralisation of these afferent autonomic fibres may be associated with the observed lateralisation of EEG activity in the frontal lobe – see below.

8. Further reflections on the Insular cortex

The Insular cortex monitors what is going on within our body – so, for example, it alerts us to our heart pounding or other states within the body, such as pleasant or unpleasant states of our tummy. However, some people are not able to be self-aware of these internal states because the insula is malfunctioning. Research by Richard J. Davidson in Madison, Wisconsin, showed that there

are a group of people who, when stressed in experimental conditions, “deny experiencing much anxiety or stress, yet their bodies tell a very different story [Davidson & Begley 2012: pp 78-79]. This group Davidson described, at the time, as suffering from ‘repressive defensiveness’. They do not subjectively experience stressors as stressful, yet measurement of, for example, their heart rate and skin conductance revealed that physiologically they were having a normal-type Stress Response [Benson 1975]. Below is a more extensive quote from Davidson and Begley:

Back in graduate school, I began to study a personality type characterised by what was then called repressive defensiveness. People with this personality deny experiencing much anxiety or stress, yet their bodies tell a very different story; as we saw in one particular experiment. We had participants do what’s called an emotional-phrase task, in which they would say the first words that came into their minds when they read a phrase. The phrases were neutral (“The lamp is on the bedside table”), sexual (“The prostitute slept with the student”), or aggressive (“His roommate kicked him in the stomach”). The subject who had high levels of repressive defensiveness rated the emotional phrases as not perturbing them at all – yet their heart rate and skin conductance (which measures sweating and hence anxiety) were off the chart. Clearly, they were not the most self aware people¹⁶. Subsequent research showed that people with marked repressive defensiveness do not consciously suppress their reactions, or lie about their feelings. Rather, they are honestly oblivious to what is happening inside them. As a result of the failure to accurately perceive their internal states, what they say about how they feel diverges widely from objective measures of those states.

Davidson & Begley 2012: pp 78-79

This demonstrates how unwise it can be to make judgements regarding, for example, the insensitivity of some people to what is going on inside themselves; such judgements may well be made out of a fundamental ignorance regarding aspects of affective neuro-science. At the time Davidson et al found this piece of research of interest, but were unable to explain it in neuro-physiological terms. Since the introduction of neuro-imaging over the last couple of decades or so, this has changed. To understand this more fully, it is helpful to look somewhat more deeply into the neuro-physiology of the insular cortex – and in particular the Anterior Insular Cortex (AIC) [Craig 2004 – and footnote¹⁵ on page 8 above]. This area produces a representation of the state of the internal organs (e.g. liver, heart, stomach etc), much in the same way that the sensory cortex of both hemispheres produces representations of the surface of the body and incoming signals – from the toes to the top of the head – some of which we become consciously aware of [Davidson & Begley 2012 – p80]. Figure 3 gives a simplified overview of the state of affairs relating to the insula.

¹⁶ The inference is that normal subjects were highly aware of their altered states – e.g. increased heart rates. For the original research, see Weinberber, Schwartz & Davidson 1979 – available free from internet.

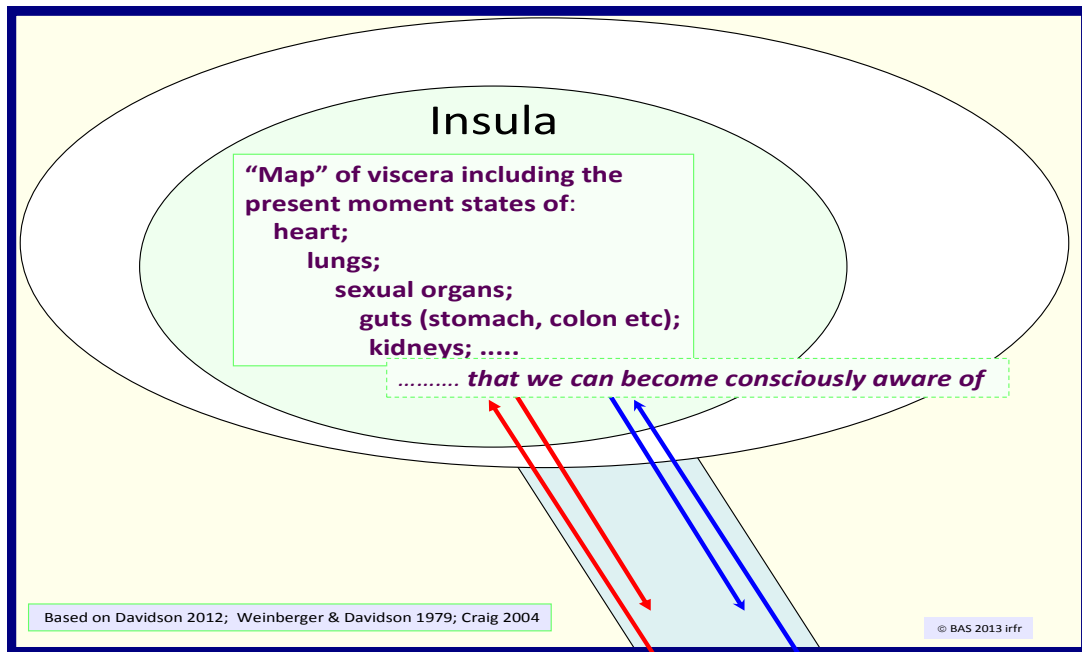


Figure 3

Schematic & highly simplified representation of the role of the insula [insular cortex] in our self-awareness of what is going on in the body

[Based on Davidson 2012; Weinberger & Davidson 1979; Craig 2004]

Legend: red arrows SNS; blue arrows PSNS; both efferents and afferents shown [efferents actually leave from the Anterior Cingulate Cortex]

Comments on Figure 3:

1. Signals from the body come up to the insula [in the autonomic afferents already described], where they are re-presented and this can give rise to conscious awareness of bodily states [unless we suffer from “repressive defensiveness”, which research shows is an unconscious defensiveness related to lack of conscious awareness of the true state of the body – see main text].
2. The insula responds [unconsciously at least initially] with outputs back to the body – e.g. perhaps to speed up the heart.
3. This scheme overlaps with Antonio Damasio’s Somatic Marker Hypothesis and his comment:

It is probably true to say that background feelings are a faithful index of momentary parameters of inner organism state. The core ingredients of that index are (1) the temporal and spatial shape of the operations of the smooth musculature in blood vessels and varied organs, and of the striated muscle of heart and chest; (2) the chemical profile of the milieu close to all those muscle fibres; and (3) the presence or absence of a chemical profile signifying either a threat to the integrity of living tissues or conditions of optimum homeostasis.

Damasio 1999, pp 286-287

Notice that this implies that messages to and from the insula / brain are transmitted both by neuronal (Autonomic Nervous System) and informational substances such as hormones.

4. The red arrows signify autonomic SNS inputs to and from the brain; while the blue arrows signify the PSNS afferents and efferents.
 - The afferent input will be mainly SNS when we are perceiving threat [consciously and unconsciously] as in this situation the Stress Response will be manifesting itself in the body and viscera. So we become aware subjectively that all is not well [from the body]; and this in turn will re-activate the Stress Response via the SNS efferents from the insula [actually via the Right Anterior Cingulate cortex] to the body.
 - On the other hand, when the afferent inputs are mainly PSNS, this will have the reverse effect: we will feel all in the body is well, and in turn this will [consciously and unconsciously] activate PSNS efferents – with the effect of maintaining this state and associated Social Engagement dynamics [Porges 2012].

Insular activity can now be identified by advances in neuro-imaging. Increased insula activity is associated with both greater self awareness of what is going on in the body [i.e., the self-awareness that is “translated” from the incoming autonomic afferents] and emotional awareness [Davidson & Begley 2012 – p80]. However, in some people there is very little insula activity [whatever the input from the autonomic afferents], and they are the group that Davidson had identified in the group with the diagnosis of “repressive defensiveness”. At the other end of the scale, some people’s insula activity has been found to be excessively high, and this may be associated with panic disorders and hypochondrias [Davidson & Begley 2012 – p81].

Leaving aside such atypical insula activity, Mental Training such as Meditation, PoMT, and Autogenic Training all seem to enhance basic bodily awareness; and this can facilitate greatly our ability to develop empathy¹⁷ [see for example, Siegel 2010B; and C2 on this website]. Such mind training practices will, axiomatically, tend to reduce SNS afferent inputs and increase PSNS afferent inputs. Also note, and not unrelated, that the words “no, no, no” may be associated with increased SNS efferent outputs to the body, and hence increased SNS afferent inputs to the insular cortex; on the other hand, “yes, yes, yes” may be associated with increased PSNS efferents to the body, and thus Social Engagement, both of which will then tend to increase PSNS afferent activity back to the brain [ex Siegel 2010A pp 24-31].

9. Lateralisations of ANS Afferent inputs [Craig 2005; 2008]

The following section gives a more detailed – and therefore accurate – description of autonomic afferent pathways described in parts 7 & 8 above. Some readers may prefer to go directly on to section 10.

As previously implied, recent research suggests that the actual inputs to the brain / anterior insula from the SNS and PSNS become lateralised, and this may have therapeutic implications (see below). SNS afferents to the brain from both the right and the left side of the body end up in the Right Anterior Insular cortex, whereas PSNS afferents end up in the Left Anterior Insula¹⁸ (Craig 2005). Craig’s extensive work in this area indicates that there are connections from the left and right anterior insular cortex to the:

- Anterior cingulate
- Dorsolateral PFC¹⁹ [DLPFC]
- Orbitofrontal PFC [OFC]

Figure 4 includes these pathways – and is therefore technically more accurate than the highly simplified Figure 2; Figure 5 roughly locates the anatomical sites of the DLPFC and the OFC within the brain – for those of us not so familiar with these brain areas.

¹⁷ As indicated in other articles on this website, the word empathy is somewhat problematic as it appears that the original translation of the term from the Greek into English was incorrect; our European colleagues can be confused by our use of the term [empathy]; they see it in terms of understanding deeply what is going on in another person – with the ulterior motive of then having some power over them. Sympathy may therefore actually be a better word, in its origins, for what we mean. The matter has been discussed in depth by, for example, Trevarthen [Trevarthen 2009; 2011]; for example: “As is clear in the original Greek, em-pathy is a one-sided projection into (or taking in of) an emotion “about” an object by the self, whereas sym-pathy is a creative sharing of feelings, of whatever kind, “with” an other or others – seeking immediate mutual sensibility between friends or opponents (Smith 1777/1982). The difference is that in sympathy, there is a motivation for cooperation and the social negotiation of role (Reddy & Trevarthen 2004), even between infants in groups (Bradley 2008)” [Trevarthen 2009, pp 56-57. For a brief overview of Trevarthen on this, see this website C6B pp 15-16: Appendix: *Some reflections on sympathy and empathy*].

¹⁸ As implied in Figures 2 & 3, SNS efferents from the Right Anterior Insula then return to the visceral organs (via quite involved pathways), as do the PSNS efferents from the Left Anterior Insula.

¹⁹ PFC: Pre-Frontal Cortex

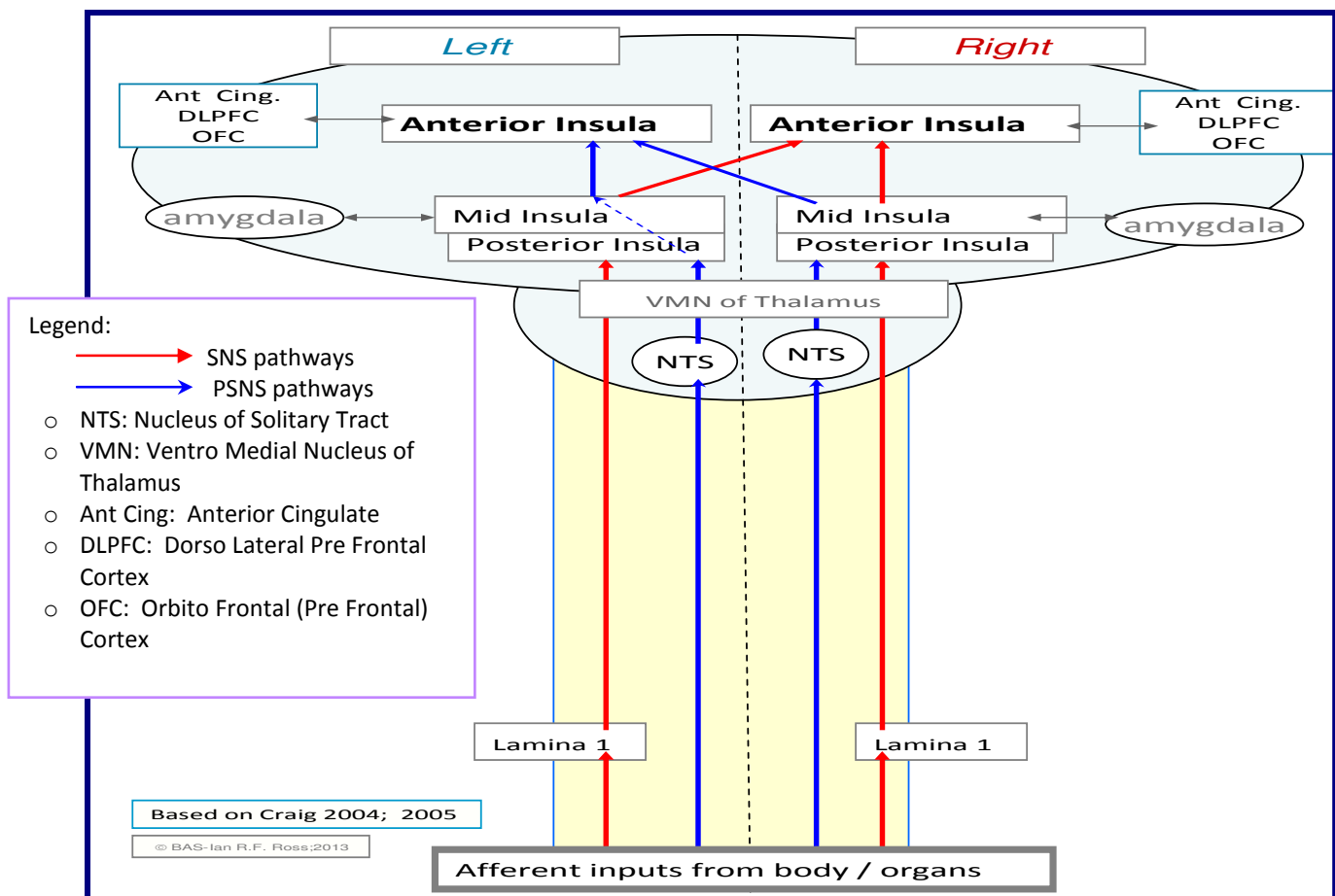


Figure 4
Autonomic Nervous System paths from body / organs to the brain
Based on Craig 2005

Comments on Figure

1. SNS afferents

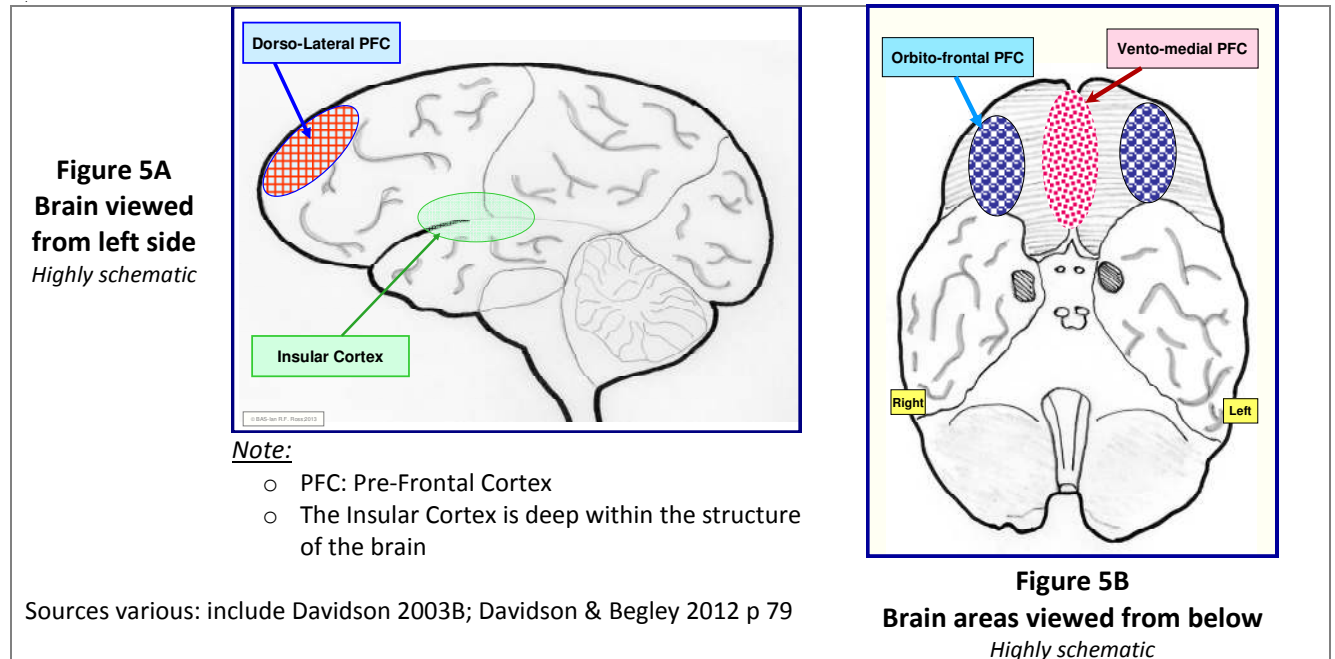
- SNS afferents from the body / organs enter the spinal cord and synapse in Lamina 1 [in the dorsal horns of the spinal cord²⁰] before ascending through the Posterior part of the Ventr Medial Nucleus of the Thalamus and then ascend through the posterior and mid insula;
- Afferents (SNS) from the right side of the body then go directly up from the right Mid Insula to the Right Anterior Insula.
- However, SNS afferents from the left side of the body enter the left mid insula and then *cross over* to the right Anterior insular.

2. PSNS afferents

- An analogous opposite type of arrangement is found for the PSNS afferents:
- PSNS afferents from the body / organs enter the spinal cord and go direct up to the Solitary Tract Nucleus [NTS] in the brain stem, from where they are relayed....
- up through the basal VMN of the Thalamus and on to the mid Insula;
- PSNS Afferents from the left side of the body are then relayed direct up to the Left Anterior Insula, whereas....
- the PSNS afferents from the right side of the body *cross over* from the right mid insula to enter the left anterior insula.

Some of the actual anatomical sites referred to in figure 4 are shown schematically in Figure 5A & 5B.

²⁰ The dorsal horns contain lamina I, II; III; and IV.



10. Potential significance of ANS afferent pathway in terms of our Well Being

10.1 General reflections

If our SNS afferent pathways are active, we will essentially be in the domain of energy expenditure which is usually linked with withdrawal²¹ or defensive type modalities [Craig 2008 pp 284-284]. The type of afferent inputs in this case will be, for example: coolness, pain, and sensual

touch – and note that “these include both pleasant and unpleasant feelings” [Craig 2005 p 569]. Unpleasant type feelings will tend to increase defensive and withdrawal type behaviour – and “physical and mental energy expenditure”.

On the other hand, if our PSNS afferents are active, this will tend to be associated with approach and affiliative type behaviour – including nurturing, CARE, and feelings “during romantic love and maternal attachment”. These are associated with “physical and mental energy ‘enrichment’ ”. [All quotes in this section from Craig 2005 p 569.]

Functional Imaging studies compared to Primary Process Emotions

Primary process emotions have their origins in deep sub-cortical mid brain structures, and involve the seven Emotional Operating Neuro Circuits or Systems²² [EONS] described by Panksepp [See also related web-pages B3 Part I & II].

Functional imaging studies reveal activity in the Anterior Insula and the Anterior Cingulate Cortex during almost all emotions [Craig 2005 p 569]; and these are associated with two aspects:

- Feelings (associated with the Anterior Insula or the limbic sensory cortex); and
- A motivation (associated with the Anterior Cingulate Cortex / the limbic motor cortex) [again Craig 2005 p 569].

This implies that all feelings have an associated motivational component; these motivational circuits will I think overlap with Panksepp’s SEEKING EONS.

²¹ Accepting that activation of the RAGE circuits may result in attack, rather than withdrawal, type behaviours.

²² The seven Emotional Operating Neuro Circuits described by Panksepp are: FEAR; RAGE; Separation Distress [PANIC / GRIEF]; CARE; PLAY; SEEKING (our explorative urge) and LUST [Panksepp 1998; Panksepp & Biven 2012]; to these it is helpful to add Social Bonding [see Sunderland 1996 p 19; & Porges 2011^(Social Engagement)].

In other words, increased activation of PSNS afferent is intimately linked to our Social Engagement [Porges 2011] pathways; and Well-Being flourishes with positive interactions with others.

One of the underlying themes of this paper is that background feelings [Damasio 1999] are modulated by our ANS afferents; if, at any particular time, these are predominantly SNS – then it is probably true to say that we will not be feeling comfortable or settled – but see box below with quote from Benson & Stark. On the other hand, if most of the time the predominant afferent stimulation is parasympathetic, then we will tend to feel settled, be approachable [in Social Engagement terms]; engage with others appropriately, and have the potential to develop equanimity.

10.2 SNS activity, Stress, Exercise and the Relaxation Response

If we decide to take some exercise – say go for a swim, a walk or a jog, then the SNS activity of this will increase sympathetic afferent activity: and the exercise itself may be associated with the release of endorphins. Chronic mental distress, on the other hand, comes about when persistently “everything in the periphery is not calm”, resulting in persistent sympathetic afferent activity, which in turn can result in hypervigilant states [Dobbin & Ross 2012] and Allostatic Load [McEwen 1998; 2003; 2004].

Benson has suggested that we can actually be activating the Relaxation Response when exercising – so this implies a sympathetic relationship, at times, between the SNS & PSNS. For example, he states:

You can [also] jog and elicit the relaxation response, paying attention to the cadence of your feet on the pavement – “left, right, left, right” – and when other thoughts come into your head, say, “Oh well,” and return to “left, right, left, right.” We have found that by using this approach, the runner will achieve in the first mile the “runner’s high” that usually occurs in the third or fourth mile.

Benson & Stark 1996 pp 136

This is similar to walking meditation – and mental training disciplines in general – in that we are training our mind to not become hooked onto wandering thoughts; the “oh well” implies non-judgement. We simply run on with acceptance – as Benson & Stark suggest; without any gaining idea [Suzuki 1970] of achieving anything.

10.3 Judgement and ANS Afferents

There is a form of meditation called “Choiceless Awareness” [e.g. Kabat-Zinn 1990 p 71]. In this, we simply focus on what is at that moment in our mind / or what we are aware of. For example, we become aware of a clock ticking; then our attention settles on a bird singing outside – and we simply focus on that²³. A moment later, we may hear the sound of phone ringing: we accept each of these sensations as they arise.

The other evening at our weekly meditation group, it came to me that any judgement we make at any moment will change our body state; so, for example, judgement regarding the phone ringing – or someone coughing – will tend to be associated with increased SNS afferent inputs from the body; these, as already described, will be picked up by the insular cortex, and this will then tend to fuel any irritation²⁴ we may already be feeling.

On the other hand, if we accept the sound of the phone, or a cough, as part of what is, without judgement, then no such SNS afferent activity will be induced: rather, the background PSNS afferent activity associated with meditative type states. Such background PSNS afferent activity is associated with increased Left Frontal Lobe activity on EEG [see Section 12 below].

²³ During recent meditations it came to me that such “Choiceless Awareness” is itself imbued with impermanence – see also C11 in this series: Impermanence and Uncertainty.

²⁴ Note that irritation can easily become linked in with RAGE circuits.

11. Returning to Presence

11.1 Presence in the presence of increased SNS afferent activity

This may sound a bit of contradiction, physiologically speaking; if SNS afferents are very active, it is very difficult for us to be truly present as we will essentially be in a defensive type mode of fight / flight / freeze [or faint]²⁵; and / or in an associated hypervigilant state (Dobbin & Ross 2012). As the saying goes, “If you are trying to drain a swamp and you are up to your midriff in alligators, it is difficult to focus on the task in hand.”

In less extreme situations, however, despite increased SNS activity, with practice we can reduce the SNS afferent inputs with mental exercises such as one of the Partial Exercises – e.g. “Neck & shoulders are heavy”; or the “Three Minute Exercise” [Segal et al 2013 p 208; and Segal et al 2002]; and / or a breathing exercise [see below]. These practices will tend to increase PSNS activity [afferent & efferent] while reducing SNS activity.

11.2 Presence: and the gap between the stimulus and the response

It is reasonably easy to be mindful and present when our PSNS afferents are giving us positive/ good background feelings from the body. True presence also means modulating increased SNS afferent activity in a mindful way; this is axiomatically more difficult, yet it is possible. A (negative) stimulus or event triggers a set of unconscious responses within us through our SNS system, and it takes a little time for us to become aware of what is happening at a conscious level; the gap between the stimulus, and us becoming conscious of what is happening, has been termed the Refractory Period²⁶ (Ekman 2003 / 2007; Dalai Lama & Ekman 2008; and see B4 in this series). A prolonged refractory period may set in motion a response that we subsequently regret: for example, if the stimulus sets in motion RAGE dynamics.

The refractory period can be reduced by Mindfulness practices – for example Meditation / Autogenic Training; such practices are associated with the development of meta-attention [Dalai Lama (Dalai Lama & Ekman) 2008 pp 23-24]. The Dalai Lama & Ekman conversations focus on the role of Self Awareness in well being: “The role of self-awareness, this meta-attention, is to train the practitioner to the point where the person is able to detect, even before the actual emotion has arisen, a proneness to this emotion. So the more advanced you are²⁷, the earlier you will be able to detect the potential for the arising of that emotion” [Dalai Lama & Ekman op cit pp 23-24].

Prior to the work of Ekman, but long after Buddhist psychology was formulated, Victor Frankl said:

Between the stimulus and the response there is a space.
In that space is our power to choose our response.
In our response lies our growth and our freedom.

Frankl [? 1946]

“In that space is our power to choose our response....” In mindless responses, we do not so much choose as go onto “automatic pilot” [e.g. Segal et al 2002 p 47] which is driven by our autonomic unconscious processes; such automatic responses will often be driven by underlying SNS afferent inputs. Developing mindful presence and being in the moment facilitates PSNS afferent activity – and so our potential for growth and freedom [see also on website: B18 – The Space to Choose].

²⁵ These are associated with “physical and mental energy expenditure” [Porges 2005].

²⁶ This overlaps with what Davidson calls the Recovery Function – the time to return to normal baseline after a distressing emotion / experience [Davidson 2003 p197].

²⁷ In 2001 Davidson suggested a similar concept – that some of us recover more quickly from a stressful event – and return to base line much more quickly than others. This ability may be partly genetic and partly epigenetic – in the sense of influences from early childhood [e.g. Sunderland 2009; Burghy et al 2013]; evidence suggests that mindfulness practice can also improve [shorten] such recovery time.

11.3 Presence and increased PSNS afferent activity

True presence and mindfulness is neuro-physiologically underpinned when the major afferent activity is PSNS: Mental Training in this context is associated with both increased afferent & efferent PSNS activity. For example, following the breath gently in a non-striving mindful way²⁸ – especially if this is associated with a prolongation of the out-breath (see Figure 6).

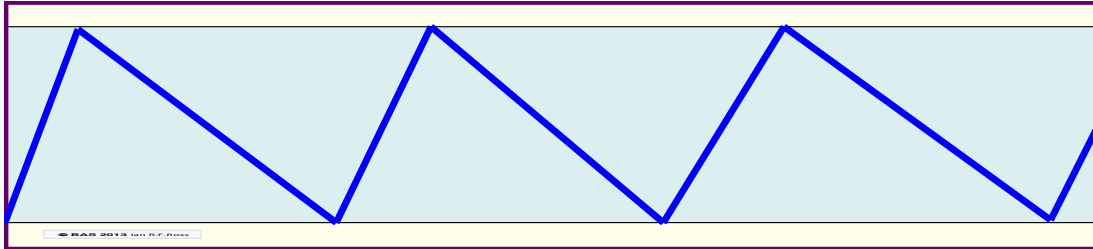


Figure 6

Schematic illustration of breathing with a prolonged out-breath
[time axis from left to right; in-breath signified by steep upward slopes,
out-breath by longer downward slopes to the right]

Such breathing is associated with increased PSNS activity,
and so with an increased ability to be both Present and Mindful.

For many of us, such breathing will develop naturally during
mindful practices such as Autogenic Training.

Such breathing is associated with increased HRV [Heart Rate Variability], which is an indirect measure of increased PSNS activity [and reduced SNS activity]; and is associated with an overall reduced heart rate. [This, axiomatically, leads to reduced SNS afferent activity and increased PSNS afferent activity²⁹.] This enables us to become more and more present; more and more in the present moment [Hanh 1993].

12. Possible association / overlap between Anterior Insular lateralisation of afferents and Pre-Frontal Cortex EEG activity in relation to emotions and Well Being

As implied in Figures 2, 3 & 4, SNS efferents are stimulated [as a result of SNS afferent impulses to the Right Anterior Insula] – and these efferents then modulate the physiology of the visceral organs and the body; as do the PSNS efferents from the Left Anterior Insula. The above lateralisation is of particular interest as it overlaps with previous research [Davidson 2003A; 2005] suggesting that there is lateralisation of Frontal Lobe EEG activity in relation to negative / destructive emotions compared with positive emotions. Specifically, there is increased EEG activity in the Right Frontal Lobe associated with negative / destructive emotions such as FEAR and RAGE, whereas there is increased EEG activity in the Left Frontal Lobe associated with positive and nurturing emotions – such as the CARE system [Panksepp 1998]. The Figures 7A & 7B illustrate these activations.

²⁸ Note that prolongation of the out-breath is per se associated with increased Heart Rate Variability, an indirect measure of increased PSNS activity – the increased vagal myelinated efferent activity being quickly followed by increased PSNS afferent activity.

²⁹ Note that there is now evidence that mental training / meditation / mindfulness can induce myelin formation around neurones, which has the result of increasing neuronal conduction-times many times; this can then facilitate many mental activities [e.g. Siegel 2010A pp 218-227].

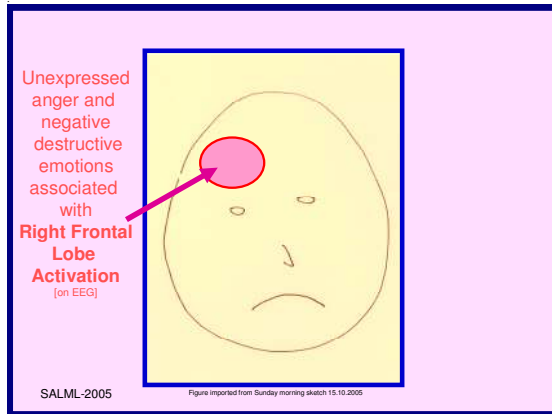


Figure 7A

Right Frontal Lobe EEG activity associated with negative and destructive feelings

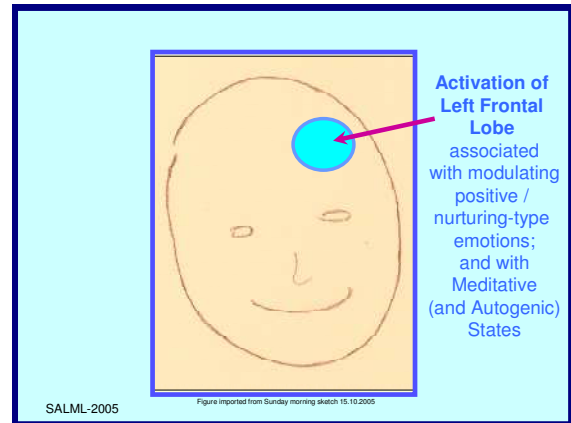


Figure 7B

Left Frontal Lobe EEG activity associated with positive / nurturing type emotions

Figure adapted from Ross 2005X p 25

Much of this original research was carried out by Richard J. Davidson, Professor of psychology and psychiatry at the University of Wisconsin – Madison. He comments, in the context of research in this area: “When we present negative images, designed to evoke emotions like fear, we see an area of activation in the right frontal cortex, reflecting increased metabolism in this region. When we present positive pictures like the mother loving the baby, we see a very different pattern: activation of the left side in areas of the orbital as well as the upper part of the frontal lobe, and some motor areas as well. But these areas are all on the left side, with none on the right side – it’s a very different pattern from negative emotions” [Davidson 2003b p 194].

The EEG pattern shown in Figure 7A is also likely to occur in situations of unexpressed anger. “When a person reports that he or she is angry but doesn’t express it, research has found that the person shows the pattern of right-sided activation [EEG] of the frontal lobe that is associated with other kinds of negative emotions. The person also shows activation of the amygdala.....” [Davidson 2003B p 199]. The amygdala is associated, amongst other things, with fear [FEAR] and anger [RAGE].

Further research has shown that positive emotions such as “zeal, vigour, enthusiasm, and buoyancy” are associated with increased activation of the left frontal cortex [Davidson 2003b p 338]. In addition, further research by Davidson and his team has shown that meditative practices are associated with positive emotions and increased left frontal lobe activity, which in turn acts as an anti-dote to negative and destructive emotions / feelings. This is shown schematically in Figure 7C.

Supportive research for Davidson’s findings:

- “Negative” emotions such as fear and anger will be associated with FEAR and RAGE circuits [Panksepp 1998].
- Panksepp’s research has indicated that positive emotions such as CARE and PLAY act as anti-dotes to these negative emotions and neuro-circuits [Panksepp 1998; and B3 Part II on this website].
- This is partly mediated through informational substances such as oxytocin and progesterone and
- gentle touch [Panksepp 1998; Panksepp & Biven 2012].

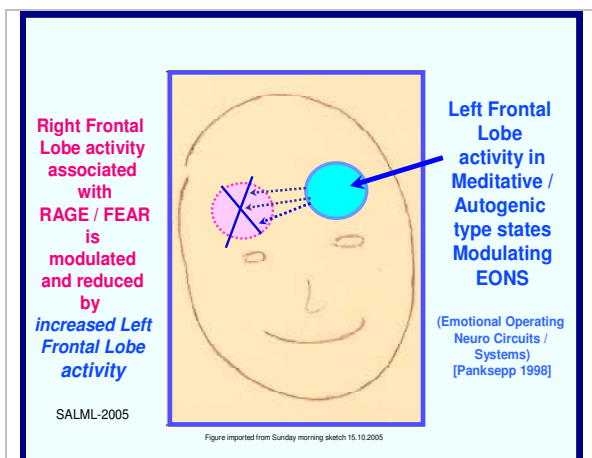


Figure 7C

Effect of Meditative type states on negative / distressing emotions / feeling

Figures 7A, 7B, & C adapted from Ross 2005X; & 2010 p147-149

Touch is of particular significance in childhood. Children are not able to regulate their emotions because their immature brains do not have a sufficiently developed frontal cortex (Sunderland 2006 e.g. pp 15-12). As parents will know, their distressed child needs close physical support for the upset to settle. This in turn will help to develop the child's pre frontal cortex so that, in time, they will be able to modulate and regulate their own disturbing affects.

As previously indicated, fears and distress are associated with increased SNS efferent activity, which will change the physiological state of the viscera, organs, and body – and this in turn will be picked up by SNS afferent receptors and manifest itself in increased SNS afferent signals to the Right Insular cortex, shown schematically in Figure 8A; it is suggested that this increased Right Insula activity is associated with the increased EEG activity in the Right Frontal Lobes already described.

On the other hand, feelings / emotions of nurturing, CARE & PLAY – and feelings of being- at-one – will also change the physiological state of the body; this in turn will be picked up by the PSNS afferent receptors and in due course result in increased PSNS afferent signals to the Left Insular Cortex³⁰, shown schematically in Figure 8B. Furthermore, meditative type states facilitate, for example, settled breathing, which increases heart rate variability, an indirect measure of PSNS activity. So Wallnöfer's words, in this context, that "Everything in the periphery is quiet" can now be seen to be correct, not just experientially, but also neuro-physiologically [Wallnöfer 2000].

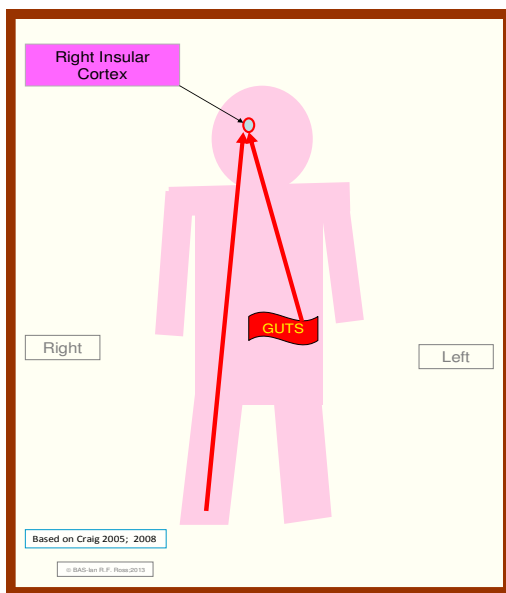


Figure 8A
SNS afferents active indicated by red
arrows from body and viscera
[guts only shown]

Message to Brain: "Things in the periphery
are not settled; stay vigilant."

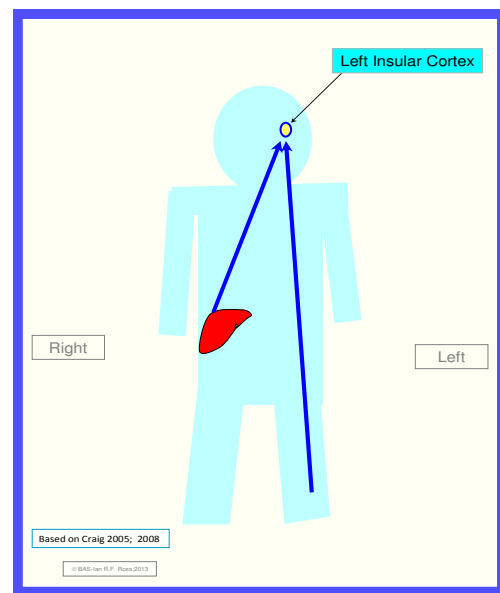


Figure 8B
PSNS afferents active indicated by blue
arrows from body and viscera
[liver only shown]

Message to Brain: " 'Everything in the
periphery is quiet'³¹; it is safe for
relaxing.....Social Engagement.... Intimacy."

Comment on Figures 8A & 8B:

- i. Both figures are highly simplified and schematic.
- ii. Figure 8A depicts SNS afferents active; afferents from the right side of the body travel up to the right insular cortex; those from the left side of the body cross over and so also end in the right insular cortex. This includes all the organs of the body, such as the liver, heart, lungs and guts (only the guts are shown for simplicity).
- iii. Figure 8B depicts PSNS afferents active. Note that those from the right side of the body cross over to the left insular cortex; those from the left side of the body do go straight up to the left insular cortex.

³⁰ As with the SNS (i.e. in an analogous way), it is suggested that this increased Left Insula activity is associated with increased EEG activity in the Left Frontal Lobes.

³¹ i.e. Wallnöfer's phrase 2000.

The implications of Figures 8A and 8B are that we cannot have emotional well being without Autonomic well-being – that is, without on-going activation of the PSNS afferents from the body, which in itself is a marker of a settled body, physiologically speaking. A settled body implies safety, and these are just the conditions that facilitate Social Engagement [Porges 2011]. Recent research indicates that emotions and homeostasis are intimately linked³² [Craig 2015 p 570]; this means that emotions are intimately linked to the state of the Autonomic Nervous System, which in turn means that emotions are intimately linked to what is going on in Autonomic Afferents, moment by moment.

In mindfulness / meditative type practices, we can gradually tune in to the state of the body; for example [in Autogenic Training], the heartbeat, the pulse in our fingers or tongue, sensations deep within the tummy [Solar Plexus Warm; or “Inner Solar System Warm”]. By doing this, we are becoming more focused on the body and the dynamics going on within the insular cortex; each time we do an exercise, we reinforce these neuro-circuits and embed them in our neuro-physiology. This is similar in principle to walking through a forest regularly on an old dis-used path; initially it is easy to lose our way; as we establish the pattern of regular walks, the path becomes well established and much easier to follow [metaphor given by Christopher Johnstone, London, 30.XI.2013³³]. Kabat Zinn has described yoga as a form of meditation [e.g. Kabat-Zinn 1990 pp 94-105]; this is the case when we practise yoga mindfully; by attending to the body and the feelings in the body in the various exercises, we are effectively tuning in to the incoming autonomic afferents to the insular cortex. So, with practice, we become more and more aware of the inner state of our body – including when the autonomic afferents that are active are predominantly SNS. We do not judge these sensations / feelings; rather we accept whatever is there, as Rumi does in his poem: “This being human is a Guest House” [Rumi trans. 1995].

13. Reflections on further research relating to being and presence

13.1 Preamble

True presence is often³⁴ associated with increased PSNS afferent inputs to the brain from the body – and in particular to the left anterior insular cortex. This is associated with increased myelinated vagal [PSNS] efferent activity which is also associated with increased social engagement (Porges 2009; 2011; and A7 & A8 in this web series) and approach and affiliative type behaviour. This implies that our overall well being will be facilitated by regular mental training type practices. Some further therapeutic implications are outlined below.

13.2 Increased EEG activation in Left PFC associated with faster recovery times and increased resilience following meditation

Richard Davidson comments in his 2003 paper on brain and immune function in response to Meditation thus:

It is of interest that we observed reliable increases in left-sided activation with training in the meditation group in response to both the positive and negative affect induction. We have suggested on the basis of a growing literature on the neural bases of emotion regulation that left-sided anterior activation is associated with more adaptive responding to negative and/or stressful events. Specifically, individuals with greater left-sided anterior activation have been found to show faster recovery after a negative provocation (Davidson 2000A & 2000B).

Davidson 2003 p 569

³² And, neuro-anatomically, this link manifests itself especially in the human forebrain [Craig 2015 p 570].

³³ Resilience Training: one day seminar with Dr Christopher Johnstone, London, 30.XII.2013 Confer Conference [The Grange Fitzrovia Hotel, 20-28 Bolsover Street, London]

³⁴ Often or usually; yet with mindful practice, we can also become present in a situation of danger when there will be increased SNS activity – if our Pre-Frontal Cortex is sufficiently developed.

Such faster recovery time suggests that mindful type practices can increase our resilience. In this context, Siegel has this to say:

Studies reveal that with mindful awareness practice, we come to approach rather than withdraw from challenges. This subjective finding is correlated with the physical changes of a “left shift,” in which the electrical activity of the left frontal area of the cortex increases after mindful meditation training (see Urry et al 2004). This left shift is thought to reflect a shift toward the approach state of the left hemisphere – in contrast to the tendency of the right frontal activation to be associated with withdrawal from novelty or challenge. For this reason alone, formal mindful training is thought to promote resilience, the ability to approach rather than withdraw from difficult situations.

Siegel 2010A pp 28-29

13.3 Increased social engagement associated with reduced stress response [Craig 2005³⁵]

Increased PSNS activity of the myelinated vagal nerve is associated with increased HRV [Heart Rate Variability], social engagement, and positive affect. Social engagement / positive affect are often associated with increased CARE circuit activity and the release of oxytocin (Panksepp 1998; Panksepp & Biven 2012; Porges 2011). Social engagement and oxytocin have been shown to:

- Suppress arousal [in sense of fight / flight; RAGE / FEAR]. This means a reduction in the Stress Response.
- Reduce Depression: “A key finding is that, in clinically depressed patients, stimulation of the left vagus nerve³⁶, which activates the left insula and often elicits subjective mood enhancement, produced de-activation of the right Anterior Insular (Devous et al 2002)” [Craig 2005].
- Reduce cortisol levels [increased levels of cortisol are themselves associated with depression – see Ross 2010 pp 50 – 56 for an overview of the prolonged / chronic Stress Response].

13.4 Brain plasticity and structural change

Contrary to previous assumptions about the adult brain being fixed with little ability to change, this is now known not to be true: the brain remains malleable and “plastic” into old age³⁷; this ability to change and develop new neural pathways very much depends on the use we put our brains to. If we exercise our brain, then new pathways will develop; if we are mentally inactive, the pathways will stay static and / or wither³⁸.

Appropriate mental work can change the structure of our brains in at least three ways [Siegel 2010A pp 217-232; 2007 pp 209-227; see also Kempermann 1997; 1999; Rossi 2002]: by creating new and strengthening existing synapses; by the growth of new neurones; and by increasing the thickness of the myelin sheaths surrounding neurones. Myelination around neurones increases

³⁵ Sources for this section also include: Uvnäs-Moberg et al 2005; Zautra 2003; Heinrichs et al 2003; Devous, M.D. et al. (2002); Park et al 2007.

³⁶ This [i.e. vagal nerve stimulation] has now been tried in clinical trials with patients with “Treatment-resistant depression” [Park et al 2007]; such electrode procedures may not always be appropriate or holistic; it is possible that vagus nerve stimulation results naturally from certain forms of Mental Training. Mental training has been shown to be of value with some people suffering from depression, and it is possible that this is mediated at least in part by increased vagal activity. Examples of such efficacious mental training include: Positive Mental Training [Dobbin et al 2009]; Meditation (Mindfulness Based CBT for depression – Segal, Williams, & Teasdale 2013;), and Autogenic Training [Krampen 1999; also see A5 in this web-series].

³⁷ Assuming no degenerative type brain process occurs – such as dementia / Alzheimer’s disease.

³⁸ Much in the same (analogous) way that our muscles atrophy if we do not use them.

conduction speeds, and is one of the crucial aspects of Porges’s poly-vagal theory, in terms of the myelinated vagus [PSNS] nerve [Porges 2011].

Evidence is accumulating that mental training / meditation / mindfulness can bring about such structural changes; for example, by inducing myelin formation around neurones, which has the result of increasing neuronal-conduction-times significantly; this can then facilitate mental activities and creativity [see Siegel 2010A pp 217-232; 2007 pp 209-227]. These processes are modulated by various types of genes and gene expression – i.e. the environmental factors that can switch our genes on or off (epigenetics) [see also Rossi 2001; and Ross 2010 pp 97-136].

As already discussed, the myelinated vagal nerve in humans plays a crucial part in down regulating heart rate – and in facilitating social engagement; it is suggested [e.g. by Siegel 2010A] that mental training induces such myelination and the resultant physiological changes.

Figure 9 highlights the three types of structural change described above.

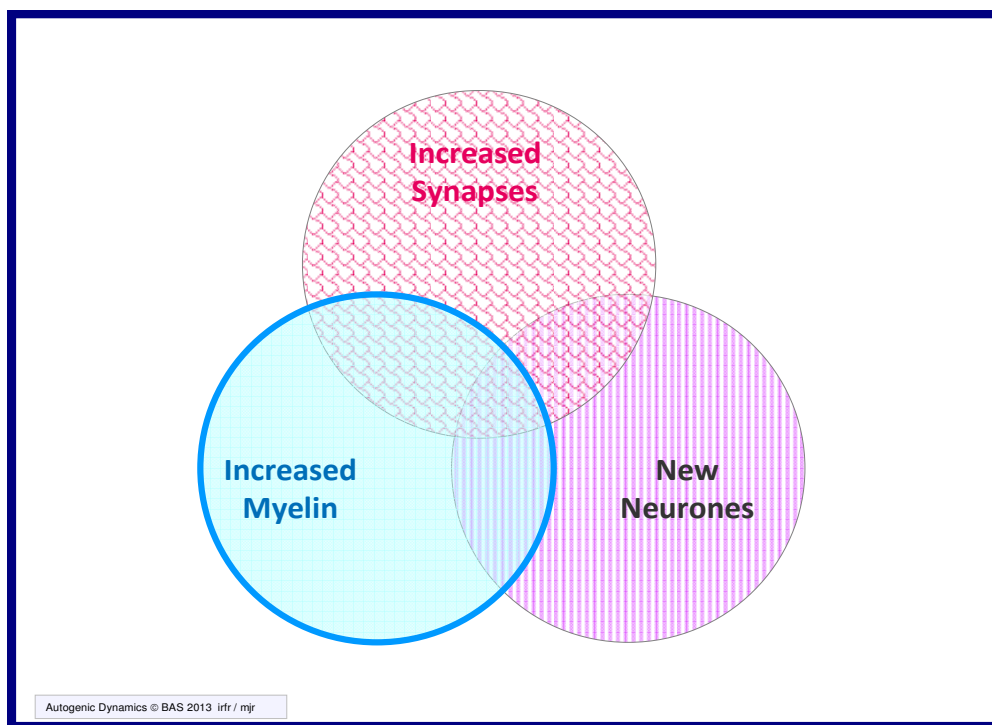


Figure 9

Structural type brain changes that can occur throughout adult life; and can be brought about by Mental Training

[after Siegel 2010A; Kempermann 1997; 1999; Rossi 2002]

As implied above, these concepts are not exactly new. In the early 1990s, Ernest Rossi³⁹ wrote a remarkable book called “The Psycho-biology of Gene Expression”; remarkable because at a very early date he realised that, at a physiological level, changes come about as a result not simply of our genes, but as a result of the way these same genes express themselves. That is, our genes can be switched on or off as a result of environmental influences – the domain of epigenetics.

In the preface of his book, he says something that has changed the way I think about health and healing:

³⁹ Who early on in his career worked closely with Milton H. Erickson.

Three fundamental discoveries of current neuroscience will forever change the way we understand human nature.

- ❖ The first is that novelty, enriching life experience, and physical exercise⁴⁰ can activate neurogenesis – new growth in the brain⁴¹ – throughout our entire lifetime.
- ❖ The second is that such experiences can turn on gene expression within minutes throughout the brain and body to guide growth, development, and healing in ways that could only be described as miraculous in the past.....
- ❖ The third discovery follows as a natural implication of the first two. We now really know that "every recall is a reframe." That is, whenever we recall an important memory, nature opens up the possibility for us to reconstruct it on a molecular-genomic level within our brain. That is, we are constantly engaged in a process of creating and reconstructing the structure of our brain and body on all levels, from mind to gene.

Rossi 2002 p XV

Original format slightly altered; - irfr- from Ross 2010 p 112

Rossi goes on to discuss these concepts in detail in his wonderful book. A summary of some of Rossi's work can be found in Ross 2010B pp 97-136.

14. Presence, PSNS afferents, and Well Being – some concluding reflections

If our bodies are constantly in an aroused [SNS] state, as depicted in Figure 8A, it becomes, generally speaking, impossible for us to feel settled / have a sense of equanimity. Being present – actually a form of meditation in itself – is intimately linked with a settled state of the body – in which we will be receiving PSNS afferent inputs from the body, as indicated in Figure 8B. Such parasympathetic afferent activity⁴² will, axiomatically, be associated with the calm and connection modality [Uvnäs-Moberg & Magnusson 2005], and being present. In this sense, being present and PSNS activity inter-are; it is not so much that one causes the other, as that both mutually bring about the state of the other; and so, potentially, equanimity.

Mindfulness embraces being present. One of the things we can give as human beings to others is our true presence. Thich Nhat Hanh recounts the story of a business man who was always flying from one meeting to another – so he was seldom in one country for more than a few days. One day, he asked his seven year old son what he would like for his birthday; his son pondered, and then replied: "Daddy, I want you." [Hanh 1998 p 194; also see D2 "Dana Paramita" on website]. We can only give our true presence right now – not sometime in the future; the future is too late – it is never present.

At the end of an Autogenic (Standard Exercise) sequence, or during a meditation, we can adopt the practice of Choiceless Awareness. I find this a lovely practice in which we tune in to what ever is going on in that moment, in a mindful, non-judging, accepting sort of way. So, for example, we might become aware of our feet on the floor – we simply focus on this sensation, this awareness; we then might find our attention has moved to our breathing, so we focus mindfully on this; then a thought may come in about family matters or work: again we simply focus on whatever is going on in the present moment – in an accepting, non-judging sense. At other times, we may become aware of sounds from the environment around us, and we focus and attune to these sounds [see Kabat-Zinn

⁴⁰ Physical exercise has now been extended to embrace mental exercise as well; this is clearly of crucial importance from the perspective of both healing and creativity (Rossi 2009 p 290).

⁴¹ During the 1960s, and probably long after, medical students were taught that new nerve cells could not develop in the adult brain; this is now known not to be the case – in primates and humans [see, for example, Gould et al 1999a; Gould et al 1999b; Kempermann et al 1997; 1999.] [This footnote adapted from Ross 2010 p 112]

⁴² Which tends to increase as our breathing slows down, as in mind training disciplines.

1990; e.g. pp 73-74; also see Hanh 2001 pp 145-147]. In some respects, we can see the poem “The Guest House” [Rumi] in terms of Choiceless Awareness.

Each Standard Exercise in an Autogenic sequence can actually be seen from the perspective of being present; for example, in the “It Breathes Me” sequence, we focus on the breath in and the breath out, moment by moment. Breathing can also be conceptualised in terms of each in breath being an in-breath of love from the cosmos; and with each out-breath we return love and compassion to the world⁴³; with these reflections may come a sense of wonder at the cosmos for the breath of life.

Without the air in the atmosphere, without the cosmos, we would not be; so each breath in can be a breath of gratitude to air and space beyond. Giving our True Presence embraces giving our True Presence to, for example, a meditative sequence; to Life; to a grasshopper. Mary Oliver [1992], in her poem: “A Summer Day”⁴⁴ moves usinto the world of wonder.

Linked themes in this Autogenic Dynamics Section:

A1	The Stress Response, the Relaxation Response, and the Tend-and-Befriend Response
A5	Autogenic Training, Psychotherapy / CBT, and Depression based on research by Krampen 1997 / 1999
A7	Porges and the Polyvagal Theory – <i>reflections on clinical and therapeutic significance</i>
A8	The Polyvagal Theory <i>and a more sympathetic awareness of the ANS</i>
C2	Mindsight – <i>our seventh sense and associated pre-frontal cortex functions</i>
C6A	Integration and Well Being – <i>original version</i>
C6B	Integration and Well Being – <i>Dancing in the Flow of Integration</i>
C11	Impermanence and Uncertainty – <i>Towards Timely Integration</i>
B1	Bears, Imagination, and Well Being
B3	Part I: The Origins of Affect and Affective Neuroscience – <i>and the misplacing of Affect in the Neo-cortex</i>
B3	Part II: Emotional Operating Neuro Circuits – <i>a brief introduction to Panksepp’s model</i>
B4	Emotional Triggers and the Refractory Period
B18	The Space to Choose – <i>reflections on the gap between the stimulus and the response [After Frankl]</i>
D1	Reflections on foundations for mindful living (after Kabat-Zinn)
D2	Dana Paramita

References /

⁴³ I came across this conceptualisation in a book called: “Active Hope – How to Face the Mess We’re in without Going Crazy”. It is actually a lovely and profound book on the environment – and on what it means to be human – written with compassion and non-judgement [Macy & Johnstone 2012].

⁴⁴ <http://www.loc.gov/poetry/180/133.html>

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⁴⁵ No relation to Ian Ross

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