

Academic References supporting the Positive Mental Training (as described in the animation).

Alastair Dobbin: Honorary Fellow, Edinburgh University School of Medicine and Veterinary Medicine

Firstly, athletes are well documented to be optimistic and have high levels of positive emotions, they are highly resilient and tend to see a failure as a learning situation; see the positives in their performance (reappraisal). They also display a leftward cerebral dominance (as per left insula in the animation)¹. Our programme is based on instilling an Olympic Sports mindset. For memory and mood see Emily Holmes' work, a good review of the field.²

The Firewall. This is a concept which explains why certain memories cause recurrent bad feelings although they are not *recognised* as the cause.

This is based on the self-memory model as proposed by Conway & Pleydell-Pierce in 2000³ with refinements from 2009⁴ and 2015⁵. This model recognises that one of the principal functions of memory is that of supporting the effective ongoing fulfilment of goals that satisfy the needs of the early adult version of the self. The key format of memory with regard to needs satisfaction is recognised as **episodic memory**, a memory of something that happened in the course of a single day. Such memories are highly visual, thus containing a very large amount of information about the progress of an event and our actions for future reference. Such memories may be retained long term because they contribute to action algorithms (patterns of movement and behaviour) that can help current problem solving. If an event has a good outcome in terms of fulfilling these needs it will tend to be used again and again as a guide to problem solving in different contexts, i.e. a sense of mastery is transferable between different situations. Thus goal attainment drives the structure of the long term *retained* adult episodic memory (so-called **self-defining memories**) to support the ongoing satisfaction of the persons goals. This drive creates a blueprint for action and influences all of a person's interactions with the world, physical and social. Self-defining memories ('find a memory that defines you as a person in a positive (or negative) way') are particularly important to the core goals of a person affecting the way they interact with the world; they support a behavioural algorithm that fulfils the principal goals of the adult self, such memories are used again and again outside conscious awareness.

As episodic memories seek to guide the individual to immediate effective goal directed action in often rapidly changing circumstances, their influence will largely be automated, there is no need for them to enter consciousness, and this was recognised in the 2000 paper by Conway & Pleydell-Pearce.

'A fundamental premise of our approach is that autobiographical memories are transitory dynamic mental constructions generated from an underlying knowledge base. This knowledge base, or regions of it, is minutely sensitive to cues, and patterns of activation constantly arise and dissipate over the indexes of autobiographical memory knowledge structures. Such endogenous patterns of activation may not coalesce into "memories," nor do they necessarily or even usually enter into consciousness' Conway & Pleydell-Pierce (2000) page 261.

This activity of memories outside conscious awareness has been further developed since then, it would be counterproductive to bring the episodic memories into consciousness and would slow down the individuals' responses and interfering with smooth action⁶. If goal progress slows or disappears there needs to be a review of the underlying memory or memories, perhaps to signal a need to change the memories for ones that better serve the individual⁷, these could be personal memories of one's own action, or vicarious memories where the person observed the effective action of others (i.e. parent or friends parents). Such a need for review is signalled by an emotional change, goal progress is measured in term of positive (faster progress) or negative (slower or no progress) emotions, this means that emotional distress can be seen mainly as a thwarting of goal progress, and lasting emotional distress means that the individual is not able to change the episodic memories for more effective ones.

Negative Self-defining (NegSDef) memories are key to understanding the challenging nature of emotional distress, i.e. depression/anxiety/self-harm etc, and can be a particular challenge to deal with. Freud thought that such memories were repressed, which was a pretty good guess for the time, while recent research has found that people

remember the event happened, they just do not recognise the problem, the negative emotional effects that such memories cause. Executive decisions taken by the mind will exclude such memories from consciousness, particularly as the threat they recall can destabilise mood and concentration and hamper effective action in a tricky situation. So although people can recognise how goal fulfilling memories make them feel better, they do not recognise that goal frustrating memories are make them feel bad , for instance they may remember that they were assaulted or neglected or abused but be unable to connect the memory to their current bad feelings, they get the feeling but not the connection to the memory,

'...people may not be aware of the actual effect that their episodic memories may have on their well-being. Indeed people appear to falsely believe that need-satisfying memories exert the most influence on their well-being, but not need-thwarting memories..... it would appear that people are not aware of the actual effect of their memories on their well-being.' P 509 -510 ⁸.

So, for instance, someone might remember that their parents argued when they were small but will not recall specific arguments and the powerful distress they felt at the time, feeling helpless and frightened. They might think they are over it all, but there may be certain ways their current partner or a work colleague has of speaking/behaving may act as an unconscious cue, making them feel helpless and angry without knowing why and lead them to withdraw from contact with that person, and blame them for being aggressive, a negative cognitive bias⁹. (ref ledoux). Adverse Childhood Experiences (ACEs) are recognised now as being endemic¹⁰ and while the data processing and conclusions have been questioned (as many people manage to deal with adversity and move on or even become stronger) there is little doubt that many will have experienced them and may not have successfully dealt with them, they may remember them and yet do not recognise them as the cause of negative emotions.

These findings are reflected in the findings of a group of researchers in Canada, led by Fred Philippe (The ELABORER group), who have formulated a theory of episodic **memory networks**, linked thematic episodic memories that can support or thwart our ability to cope in certain situations. They looked at the influence these networks have on key negative memories ^{11 12} and as already mentioned they found that people do not recognise the effect of negative memories.

Using free association as an investigative tool they found that an event will activate one key memory, the **main memory**, but will also simultaneously trigger other memories the **network memories**, and the nature of the first 3 network memories (in terms of whether they are helpful or not in satisfying the person's psychological needs) is the main factor in terms of the positive or negative effect on situational coping and well-being; the overall effect of the main memory is *entirely dependent on its network memories* together these form a **memory network**. How do you measure the effect of an episodic memory? The key is whether they help to satisfy the most important psychological goal, recognised to be fundamental to all nations and cultures, that is the need for **self-determination**. The 3 basic needs underpinning self-determination are the need for autonomy, competence and relatedness. So each of the 3 network memories is scored for these factors, thus each network memory is ranked as positive (increasing self-determination) or negative (preventing self-determination). In a *self-defining* memory (note the difference from *self-determining*) the overall effect of activating the main memory depends on the sum of the 3 network memories in terms of their positive or negative outcome. As the animation says if 2 out of 3 memories are positively self-determining then the main memory is said to be **integrated**, that is the person has come to terms with the memory and gains strength from recalling it. If however 2 out of 3 are negatively self-determining, then whenever the main memory is activated by a situation it decreases the persons well-being, they feel under threat, and the memory is not **integrated**. As self-defining memories are retained long term and are constantly triggered outside awareness in relevant situations, ELABORER proposed and proved that the effect of the network memories of a self-defining memory are critical to long term well-being. [Our own work with Philippe](#), verified his model of coping, resilience and memory networks and in our joint study we found that we could change one of the 3 core memories from negative to positive¹³. This flipped the students in our study into a 'coping' state with feelings of autonomy, competence and relatedness (self-determination) they were able to visualise a good future outcome in

which they are coping and competent, and this would then be triggered in the relevant situation. This fits well with our previous research which showed a significant increase in quality of life and decrease in depression, particularly severe depression. (Koeser et al 2013)¹⁴ One phenomenon of memory which can be retrospectively explained by these ideas of Conway & Pleydell-Pierce (2000) and Philippe, Dobbin et al (2017) is the early work of Freud as seen in the case of Emma¹⁵.

So basically the challenge to good psychological function is a negatively integrated NegSDef memory. If it is integrated that is fine, it can act as a resource to help the person, if it is non-integrated the person cannot recognise why they feel bad, cannot connect it to a memory, and thus their wellbeing is constantly dragged down by an unidentifiable feeling of threat, and the anxiety can become generalised to situations that actually have nothing to do with the real cause. In fact we have proposed that memory network structures around non-integrated NegSDef memories can supply a unifying model underpinning emotional distress, emotional regulation and recovery we call the NEMESIS model (**Negative MemorieSIIntegrationSystems**) fit into a unifying framework.

The Body Switch. The concept of the parasympathetic 'relax and relate' system switching off the sympathetic 'fight or flight' system, a concept called **opponent inhibition**, is summarised by Arthur Craig. (Craig A (2015) 'How do you feel? An Interoceptive Moment with your Neurobiological Self' Princeton University Press 2015: Chapter 8 and Fig 21 plate 16). He has established over a lifetime of innovative research in functional neuroanatomy, that the pathways he discovered from body to brain show that certain bodily sensations (affiliative touch, oxygen and nutrient levels, circulatory flow, pain and more) in particular those that take the contralateral spinal pathway (up the spinothalamic tract) are in fact **not** sensations in the way medical students have traditionally been taught; they are part of an autonomic afferent system that flow directly to the 2 **insulas**, left and right, which brain centres activate the parasympathetic and the sympathetic systems respectively, with, for instance, affiliative touch and signals of bodily health flowing to the left insula while pain and signals of inflammation and body *dis*-ease flow to the right insula. The left and right insulas are associated with emotional activity, they activate different behavioural strategies through robust connections to their respective anterior cingulates, and the whole emotional system and its feedforward and feedback pathways, connected to the body by the spinothalamic tract and the vagus nerve, is very separate from the somatosensory cortex. As the sympathetic system is associated with withdrawal (fight or flight) behaviour and the parasympathetic system with approach (relax and relate) which promote diametrically opposed behavioural strategies, Craig suggests and demonstrates that there are brain pathways that switch the balance between one and the other, he suggests the pathway of inhibition is probably the anterior commissure (private communication) from rat experiments. To understand more about these ideas see Craig (2009)¹⁶ and a useful video¹⁷.

Stephen Porges came up with a theory of how the parasympathetic system changed our physiology and behaviour, affecting all the cranial nerves to make us more receptive to approach by others switching into an 'automatic' affiliation mode, linking us to a positive upward spiral of affiliation and good feelings¹⁸ Porges' early work established the effect of respiration on the parasympathetic nervous system and mental health (panic)¹⁹ showing that changes in the homeostasis of gas and electrolyte control decreases parasympathetic activity and can cause panic. Others have found that slow breathing increases the end tidal CO₂, and indeed slowing the breathing is a recognised way of controlling panic and anxiety²⁰. CO₂ is the key factor controlling arteriole dilatation and oxygen release from haemoglobin (Bohr Effect), increasing the oxygenation and nutrition of all body tissues, increasing autonomic feedback up the spinothalamic tract (the pathway identified by Bud Craig) increasing activity in the left insula while simultaneously diminishing activity in the right insula. This essentially means we can calm the mind with the body, as Craig says:

*'bodily awareness, or more accurately interoceptive awareness, has a crucial role in emotional awareness, in other words, the neural substrates responsible for subjective awareness of your emotional state are based on the neural representation of your body's physiological state.'*²¹

So slow deep breathing will calm the mind²² and isometric Jacobson relaxation also has an added positive effect. A second useful outcome is that focussing attention on the bodily sensations associated with specific breathing patterns, may cause thalamic blocking of attention to threat cues, reducing distressing and distracting sympathetic arousal from cues that may arise from firewalled memories. The result is an intense parasympathetic state from the physiological exercises which also switches off the sympathetic system by opponent inhibition, along with the removal of attention from negative environmental cues. We regularly demonstrate this in our workshops (we have a video of this) measuring heart rate variability in real time combined with emotional observation of trauma memory and recovery. Additionally, an anatomical pathway of mammalian calming by slow breathing has recently been established; a link between a nucleus that controls breathing rate and the locus coeruleus, the centre that promotes mammalian arousal²³. Although the relationship between breathing science and emotional regulation is complex, there is no doubt that it has been known about since antiquity and now has a validated scientific basis for emotional and physiological control. The upshot is that as humans we are aware of our feelings and *we can choose how we want to feel* in a way that is possibly independent of our genetic and epigenetic experience. So paying attention to our breathing **1)** removes the insidious effect of unconscious negative environmental cues engendered by episodic memories, but **2) also** stops us rejecting more positive and functional explanations of unpleasant events (i.e. that event was 'not your fault it was just a random event') that we might normally reject by paying attention²⁴ because the rise in positive self-regard might challenge our safe level in the social status quo, our social homeostasis. A third useful outcome is that the act of following a visualization of a past event also changes our attentional focus, and puts us into an altered mental state which has been likened to a state of mindfulness²⁵, and this state has been shown to help us positively reappraise past negative events; it also drives the process of attentional distraction and thalamic inhibition still deeper, and Positive Mental Training also drives:

'visualisations of situations displaying traits, mindsets, and actions characteristic of resilience, such as self-control, hardiness, taking on challenges, experiencing growth as result of difficulties, strong personality, high self-esteem, trust in abilities, being energetic, and positive meaning finding.' (Philippe et al 2017 p3)

Finally the cycle of the animation takes us back to Olympic Sports: The students in our study listening to the resilience programme *all* had an average increase in needs satisfying coping memories by 1 out of 3, even those who had good psychological adjustment (i.e. 2 needs satisfying memories) in their network to start with. This may explain how the programme can both increase the performance for those at the top level of sport *and also* act as an aid to recovery from the social defeat of depression and anxiety in depressed and anxious individuals; increasing performance in both the sports *and the social* arena. This brings us back to the origin of Positive Mental Training, as an Olympic sports development programme, created from the study of the mental and physiological skills and mindset of Olympic gold medal winners. (see [video of interview](#) with Lars-Eric Unestahl here)

¹ Hecht, D. (2013) The Neural Basis of Optimism and Pessimism *Exp Neurobiol.* 22(3):173-199 see page 183.

² Holmes, E., Blackwell, S., Burnett Heyes, S., Renner, F., & Raes, F. (2016). Mental imagery in depression: phenomenology, potential mechanisms, and treatment implications. *Annual Review of Clinical Psychology*, 12, 249-280

³ Conway, M., & Pleydell-Pearce, C. (2000). The construction of autobiographical memories in the self-memory system. *Psychological Review*, 107, 261-288. doi:10.1037//0033-295X.107.2.261

⁴ Conway, M. (2009). Episodic Memories. *Neuropsychologia*, 47, 2305-2313. <https://doi.org/10.1016/j.neuropsychologia.2009.02.003>

⁵ Conway, M., Loveday, C. (2015). Remembering, imagining, false memories & personal meanings. *Consciousness and Cognition*, 33, pp. 574-581. doi:10.1016/j.concog.2014.12.002.

⁶ Solms, Mark. (2015). Reconsolidation: Turning consciousness into memory. *The Behavioral and brain sciences*. 38. e24. 10.1017/S0140525X14000296.

⁷ Brewin, C. (2006) Understanding cognitive behaviour therapy: A retrieval competition account. (2006) *Behav Res Ther*, 44 (6) 765 - 784. 10.1016/j.brat.2006.02.005

⁸ Philippe, F., Koestner, R., Beaulieu-Pelletier, G., Lecours, S., & Leles, N. (2012). The role of episodic memories in current and future well-being. *Personality and Social Psychology Bulletin*, 38, 505-519. doi:10.1177/0146167211429805

⁹ LeDoux J (1996). *The Emotional Brain: The Mysterious Underpinnings of Emotional Life*. New York: Simon & Schuster

¹⁰ Centre for Disease Prevention: Injury Prevention and Control: Division of Violence Prevention: Child Maltreatment: ACE Study: Data and Statistics: <https://web.archive.org/web/20151219135025/http://www.cdc.gov/violenceprevention/acestudy/prevalence.html>

¹¹ Philippe, F. L., Koestner, R., Beaulieu-Pelletier, G., Lecours, S., & Leles, N. (2012). The role of episodic memories in current and future well-being. *Personality and Social Psychology Bulletin*, 38, 505-519. doi:10.1177/0146167211429805

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- ¹² Houle, I., & Philippe, F. L. (2017). Need satisfaction in episodic memories impacts mood at retrieval and well-being over time, *Personality and individual differences* 105, 194–199. doi: [10.1016/j.paid.2016.09.059](https://doi.org/10.1016/j.paid.2016.09.059)
- ¹³ [Philippe, F., Dobbin, A., Ross, S., Houle I.](#) (2017) Resilience facilitates positive emotionality and integration of negative memories in need satisfying memory networks: an experimental study. *J Pos Psychol*; DOI: 10.1080/17439760.2017.1365158.
- ¹⁴ [Koeser, L., Dobbin, A., Ross, S., McCrone, P.](#) (2013) Economic evaluation of audio based resilience training for depression in primary care. *J Affect Disord* 149(1–3):307–312, doi:10.1016/j.jad.2013.01.044
- ¹⁵ Freud, S. (1895) Project for a Scientific Psychology p.410
- ¹⁶ Craig, A. (2009) How do you feel--now? The anterior insula and human awareness. *Nat Rev Neurosci.* 2009 Jan;10(1):59-70. doi: 10.1038/nrn2555. Author information: (1)Atkinson Research Laboratory, Barrow Neurological Institute, Phoenix, Arizona 85013, USA. bcraig@chw.edu.
- ¹⁷ Video of Arthur Craig from Lindsjoping University <https://vimeo.com/8170544>
- ¹⁸ Porges, S. (2000) The polyvagal theory: phylogenetic substrates of a social nervous system *International Journal of Psychophysiology* 42 2001 123-146
- ¹⁹ George, D., Nutt, D., Walker, W., Porges, S., Adinoff, B., Linnoila, M. (1989) Lactate and Hyperventilation Substantially Attenuate Vagal Tone in Normal Volunteers A Possible Mechanism of Panic Provocation? *Arch Gen Psychiatry* 1989;46:153-156)
- ²⁰ Gilbert, C. (2005) Better Chemistry Through Breathing: The Story of Carbon Dioxide and How it Can Go Wrong *Biofeedback* Fall 2005 Volume 33 - Number 3
- ²¹ Craig, A. (2018) Handbook of Emotions 4th Edition Chapter 16 Interoception and Emotion Guildford Press
- ²² Zautra, A., Fasman, R., Davis, M., Craig, A. (2010) *Pain* 149 (2010) 12–18
- ²³ Yackle, K. et al (2017) Breathing control center neurons that promote arousal in mice 355, Issue 6332, pp. 1411-1415 DOI: 10.1126/science.aai7984 see related [video here](#)
- ²⁴ Kaiser J, Barker R, [Haenschel C](#), Baldeweg T, Gruzelier JH. (1997) Hypnosis and event-related potential correlates of error processing in a stroop-type paradigm: a test of the frontal hypothesis. *International Journal of Psychophysiology : Official Journal of the International Organization of Psychophysiology.* 27: 215-22. PMID [9451580](https://pubmed.ncbi.nlm.nih.gov/9451580/) DOI: [10.1016/S0167-8760\(97\)00055-X](https://doi.org/10.1016/S0167-8760(97)00055-X) (particularly see fig 3 p 220 showing loss of error evaluation signal from ERP)
- ²⁵ Werner-Seidler, A., Moulds, M. (2012) Mood Repair and Processing Mode in Depression *Emotion* 12:3:470–478