

The Transformative Power of Deep, Slow Breathing

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Abstract

Slow, deep, lower abdominal breathing – for millennia a mainstay of Asian internal cultivation practices – is a powerful tool for healing and transformation. A wide range of emotional and physical problems can be helped by slow breathing and in the clinic it can be easily taught to patients – both while lying on the couch and as home practice. For practitioners it is a tool to deepen into calm, centred and intuitive states that will enhance our interactions with patients. For all of us, the growing understanding of the physiology behind deep breathing offers a wonderful insight into the interplay of yin and yang in every aspect of our lives. This article examines the traditional Chinese medical and self-cultivation perspective on breathing, describes a simple breathing practice suitable for teaching to patients, delves into some of the burgeoning science behind breath regulation, and gives an overview of research on the use of breathing practice for the treatment of mental and physical disorders.

Introduction

‘As for the vitality of all human beings
It inevitably occurs because of balanced and aligned
breathing.
The reason for its loss
Is inevitably pleasure and anger, worry and anxiety.’
*Original Tao, 4th century BCE*¹

This article stems from my growing curiosity about why practices such as qigong, tai chi and yoga are so good for us. After all, they are barely aerobic, don't follow conventional strength training methods, and in their original and authentic forms at least, may do little for body sculpting or weight loss – all seemingly major preoccupations of modern exercise. Yet those of us who have a regular practice, know the rich physical, mental and emotional rewards they offer.

As so often, traditional Chinese yinyang classification – in this case of exercise – offers useful insight into some of these questions.

Waijia and neijia

The martial arts (more or less synonymous with exercise itself through most of Chinese history) are often divided into two broad categories – external (waijia) and internal (neijia). This distinction dates from the 17th century, and although not hard and fast, can serve as a useful guide to understanding body-mind-breath practices.

External exercise is more yang. It prioritises aerobic fitness, muscular strength, speed and agility. Training

may be hard – often to the point of profuse sweating and exhaustion. Its martial application may involve large and dramatic movements, for example the flying kicks and punches typical of Shaolin styles. Waijia is clearly similar to much modern exercise – running, weight training, gym, high intensity interval training, boxercise, boot camp workouts and even some modern forms of yoga practice.

The advantages of external exercise include high levels of fitness and muscular development, as well as reliable mood-altering effects due to its rapid effect on moving qi and blood. Disadvantages include the risk of acute or chronic injury and other physical damage due to over-training, the often short-term nature of the mood-altering and qi- and blood-moving effects, and the fact that it may become increasingly harder to practise as we age.

Internal exercise is more yin. In the Chinese tradition it includes practices such as qigong, neigong, taijiquan, baguazhang, yiquan and xingyiquan. More widely it can be said to embrace yoga (sometimes called ‘Brahmin qigong’), Pilates, Feldenkreis method and more.

The advantages of internal exercise include healing, development of core strength and soft power, fluid and integrated movement, improved balance and alignment, minimal risk of injury, mental and emotional development, and prolonged mood-altering effects. It can also be practised at any age. Its disadvantages include the fact that some styles are very slow and therefore frustrating for younger practitioners whose bodies and minds need more dynamic challenges.

Indeed, without combining aspects of external exercise, yin neijia can be an incomplete form of cultivation and may sometimes encourage excessive introversion in those prone to it, which means it may need to be practised with caution in cases of depression.

As always we need to flexibly balance yin and yang according to our age, physical condition and health needs. If all our practice is internal, quiet and slow, it may be just as imbalanced as if it was all fast, hard and external. In the taijitu (yinyang symbol - see Image 1), of course, yin and yang each include a portion of their complementary opposites.



Image 1: The Taijitu

What is the essence of neijia?

There are three core components of internal exercise – body, breath and mind - corresponding to the ‘three treasures’ (jing-qi-shen)². While there are countless internal practices in the Asian traditions, they all cultivate these three to varying degrees. However, in my opinion the highest forms – at least as far as health, wellbeing and the development of wisdom are concerned - cultivate all three *equally*. When body, breath and mind are woven up into a seamless whole, we enter an optimum physiological state and can truly flourish.

Body and mind

‘Once set in motion, the whole body is unified and must be light and filled with spirit.’

Tai Chi Ch’uan Classic, 12th – 14th centuries CE³

Before considering breath in more detail, it is worth briefly reflecting on what cultivation of the body and mind may involve. In internal training, body movements and postures are practised slowly and mindfully. They are designed to develop integrated movement and full body awareness, optimum alignment (top/bottom, left/right, forward/backward), balance and rootedness, fluid and relaxed lengthening and releasing, soft power and core strength. Practising faithfully under the guidance of a good teacher will slowly restore fascial/channel elasticity and natural movement, and promote healthy joints and pleasure in the body.

As far as the mind is concerned, the aim is absorption in the present moment. This offers many of the plastic brain benefits of meditation;⁴ indeed it has been argued

that mindful movement may reduce uncontrolled mental wandering more easily than still meditation.^{5,6,7} The fully present mind can explore internally and dwell in the breath, the whole body or its particular parts. Alternatively it can move out to connect with sky, earth, sun and moon, trees, birds, flowing water and so on – especially when we practise outdoors. Some qigong styles also incorporate visualisations, repetition of sounds, healing words and phrases and so on.

Breathing

‘A day and a night of regulated breathing can [reverse] twenty years of chronic illness.’

Yuan Hao, 15th century CE⁸

Breathing is unique among autonomic functions such as the cardiac, digestive and hormonal systems, in that it is both automatic (most of us breathe without conscious awareness or intervention) and at the same time can be consciously controlled. In traditional Asian self-cultivation traditions this ability to consciously control the breath is used as a powerful tool for emotional, mental and physical health and wellbeing.

The Chinese perspective on breathing

‘The perfected breathe all the way to their heels, unlike ordinary folk who breathe only as far as their throats.’

Zhuangzi, 3rd century BCE

Qigong and the internal arts teach long, slow and deep breathing down into the lower abdomen – a method that is widely taught nowadays to help manage anxiety, depression and post-traumatic stress disorder.

I remember one of my teachers in China laughingly saying that the human body has a design fault – it is both vertical and alive. Its lively yang therefore suffers from a tendency to rise excessively, especially as we age, when yin weakens and can no longer hold and counter the predilection of yang to soar upwards. Physically this can give rise to disorders such as dizziness, high blood pressure, headache, migraine and stroke, accompanied by dissociation from the lower body, poor balance, weak legs and increased risk of falling. On a mental and emotional level it can give rise to an unrooted, unstable shen. The result is a tendency to nervousness, anxiety, worry, fear, insomnia, a restless mind and general ungroundedness.

In the upper body, emotional factors or faulty practice can lead to chest breathing, where the upper chest is lifted and thrust out in the military posture on inhalation. Chest breathing increases feelings of stress, raises the centre of gravity, and further lifts qi to the upper body.

These varied physical and emotional manifestations of uprising of yang can be counteracted by sinking and

grounding the lower body and by breathing slowly and deeply into the lower abdominal core, keeping the chest (heart and lungs) empty and quiet. Since inhalation descends qi, this can be a tool to counter rebellious Lung qi, subdue uprising of Liver yang, and help lower uncontrolled Heart fire into the cooling embrace of Kidney water, restoring yinyang harmony.

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The practice of breathing

Lower abdominal breathing can be practised standing, sitting or lying down. The standing position is described first, but this can be easily adapted for sitting and – in the clinic – lying on the couch whilst needles are retained.

Standing

Standing breathing can be taught to patients for home practice. A basic qigong standing position can be used – feet shoulder width apart and parallel, and knees relaxed so the whole pelvic region relaxes and drops (heavy like a hanging basket). At the same time the chin is slightly tucked in and the neck gently lengthened towards the sky. The shoulder blades separate, rounding and opening the upper back, and the arms hang loose – either to the sides or in front of the body – with ample space in the armpits. The chest hangs ‘empty like a bell’ so that the heart and lungs are quiet.

Once this posture is established, we can fold one hand over the other on the navel. Then, inhaling through the nose but imagining we are inhaling directly into the navel, we slowly allow the breath to radiate to the lower back (from Mingmen DU-4 outwards to Zhishi BL-52), the lower sides, and down into the pelvic cavity. We aim to breathe around five times a minute – six seconds for inhalation and six seconds for exhalation (see discussion later in this article). It is normal to feel a little bit ‘air hungry’, but the breath should never be forced and relaxation is key. If people this pace is challenging, it can be speeded up until they get used to it. If they find it difficult to take the breath down low and deep and feel blocked and constricted in the chest, the answer is to relax, to be patient, and above all to practise, for it will become easier with time.

Lying down

If you normally leave your patients lying with needles in, they can significantly enhance the effects of treatment with breathing practice. The patient can lie with their hands folded over the navel or by their sides and breathe in the same way as described above. Note that lower abdominal

breathing is often taught by asking people to rest one hand on their chest and the other on the lower abdomen. The idea is that the lower hand, but not the upper hand, should rise during inhalation. This method may be useful when learning lower abdominal breathing, but expanding the lower belly outwards is unnecessary and not desirable in the long term.

Once slow, deep breathing is well established, it can be adapted to different clinical situations. For example, those who suffer from uprising of qi can be encouraged to ‘breathe’ in and out of the soles of the feet. Or patients can be encouraged to breathe into the site of disease or discomfort, and to relax and dissolve the area as they breathe out. Alternatively, they can be asked to breathe into the region of the point/s being needed, or visualise breath flowing along specific channels.

The science of slow breathing

A growing and relatively recent body of research into the physiology of slow breathing is confirming its extraordinary physical and emotional health benefits. This section discusses three aspects in order of increasing importance: a. nitric oxide and nasal breathing, b. carbon dioxide, and c. the relationship between autonomic yinyang balance, heart rate variability, vagal tone and breathing. Some of the science, especially in section c, may seem a bit daunting, but I believe it is well worth the effort.

a. Nasal breathing and nitric oxide

‘Heaven feeds man with the five qi ... The five qi enter through the nose and are stored in the heart and in the lung.’

*Yellow Emperor's Internal Classic, between
2nd century BCE and 2nd century CE9*

Nitric oxide (not be confused with nitrous oxide) is a colourless gas that acts as a cellular signalling molecule. Nitric oxide (chemical formula NO) is synthesised inside the body in humans and other mammals and is elevated by eating NO-rich foods, especially leafy green vegetables. Medically, it can be taken in the form of nitroglycerin (for angina pectoris and heart failure¹⁰), sildenafil (Viagra) and similar erectile dysfunction medicines, and also in the form of NO-enhancing supplements that are sometimes taken by athletes and body-builders.

The principal link between these varied uses is that NO relaxes smooth muscle fibres, especially in the blood vessels, therefore acting as a vasodilator – for example increasing blood flow to the heart, genitals and muscles. It helps lower blood pressure, reduces blood clotting, functions as a neurotransmitter, increases blood and oxygen flow to the brain, strengthens immune function, reduces inflammation and more.

In Chinese medicine, the nose is considered to be part

of the Lung system, and by implication plays a role in absorbing the qi of air. For this reason, all neijia breathing practices emphasise nasal inhalation. The value of such practice was confirmed in 1995 when it was discovered that NO is produced in the paranasal sinuses and inhaled with every nasal (but not mouth) breath. The effect of local paranasal NO production is to enhance defence against exterior pathogens, due to its antimicrobial action. And when NO is inhaled into the lungs, it vasodilates pulmonary blood vessels and thus increases oxygen uptake.¹¹ Unsurprisingly, nasal NO production is reduced by up to 50 per cent in people with sinus disorders.¹² More surprisingly, NO production was reduced by up to 83 per cent after five minutes of vigorous exercise – attributed to reduction in blood flow to the nasal mucosa.¹³ Slow breathing, by contrast, increases NO absorption.

Finally, studies show that humming (as in yogic OM chanting, for example) can increase NO production in the paranasal sinuses fifteen-fold,¹⁴ as well as helping to cure chronic sinus disorders.¹⁵ As we shall see below, exhaling against resistance – as in chanting, singing etc. – also activates the relaxing and soothing parasympathetic state.

b. Breathing and carbon dioxide

If people are asked to breathe deeply, it is likely their response will be to inhale strongly and rapidly into the upper chest, assuming that this will increase oxygen uptake. In fact the opposite is the case. Hyperventilation – whether deliberate (as above) or as a response to stress – does not increase oxygenation, but does reduce healthy levels of carbon dioxide (CO₂) in the blood. This lack of CO₂ leads to a whole raft of symptoms including anxiety, chest tightness, worsening feelings of stress, vasoconstriction, reduced oxygenation, raised blood pressure, and reduction of blood flow to the brain (affecting attention, concentration and effective functioning). The well-known remedy for anxiety induced by hyperventilation is to inhale and exhale into a paper bag, restoring CO₂ levels.

When we breathe slowly and deeply, we increase beneficial levels of CO₂ (we can feel this as a sensation of air hunger, which should not be allowed to become extreme). As CO₂ is a vasodilator, pulmonary blood vessels expand, increasing their ability to take up oxygen. More blood and oxygen therefore flow to the heart and brain, blood pressure reduces, and the nervous system is calmed. This CO₂-induced vasodilation may also explain the experience of increased warmth in the hands or the whole body during qigong meditation, even when simply standing still.

c. Breathing - the autonomic nervous system, heart rate variability and vagal tone

This part of the article discusses the importance of achieving a health yinyang balance in the autonomic nervous system (ANS). It then explains how heart rate variability (HRV) serves as a window into the state of the

ANS – one which has allowed researchers to observe which practices and behaviours enhance its healthy functioning. Finally, it explains how slow, deep ('coherent') breathing can be used to promote what is known as vagal tone to restore ANS balance, counter stress and negative physical and mental states, and help repair the body and mind.

The yin and yang of the autonomic nervous system

The yang sympathetic branch

Commonly known as the 'fight or flight' branch of the ANS, the sympathetic nervous system (SNS) is rapidly activated in the face of threat and danger. It is also raised in response to various other challenges, for example time pressure, stress, anger, most external exercise, voluntary exposure to thrill and excitement ('excessive joy') and so on. A cascade of physiological responses accompany raised SNS activity, including constriction of blood vessels, raised blood pressure, raised heart rate, faster breathing, and pupil dilation (better able to see danger).

While the SNS response is clearly a vital evolutionary defence adaptation, and in certain circumstances a state of exciting stimulation,¹⁶ many problems arise when it becomes chronically activated. Some of our patients, family, friends and community – even ourselves – may suffer a kind of locked-in SNS activation. The result is varying levels of ongoing stress, anxiety, insomnia, fear, worry, feelings of sustained threat, chronically raised heart rate and blood pressure, defensiveness, depression, inflexibility, poor judgement, poor reasoning, inability to concentrate, PTSD etc. Sometimes compared to the gas/accelerator pedal in a car, SNS activation burns energy in cells. If the SNS is chronically activated, it can lead to inflammation (with consequent cell damage from free radicals), and inability of the parasympathetic nervous system (PSNS) to restore energy to cells and repair them. Prolonged inflammation is increasingly understood to underlie most chronic non-infectious diseases (cancer, cardiovascular disease, dementia etc.) as well as premature ageing and early death.

The yin parasympathetic branch

'The cool eye discerns men's character. The cool ear hears the intent in their speech. Cool emotions plumb others' feelings. The cool mind penetrates everything.

Vegetable Root Discourse, 16th century CE¹⁷

The parasympathetic nervous system (PSNS) has traditionally been called the 'rest and digest' branch of the ANS. In this state, blood vessels relax and dilate, heart rate and blood pressure reduce, and the immune system is enhanced. Cell energy reserves are restored, and anti-inflammatory pathways are activated to counter the

inflammatory effects of SNS predominance.

Beyond this, there is ever-growing interest in the psychological and emotional implications of having a nervous system that defaults to PSNS activity. Along with calming and relaxing of the body comes a host of responses such as increased feelings of trust, safety, closeness and affection.

Polyvagal theory

‘The complete mind cannot stay hidden in the body. Rather, it takes shape and appears on the outside. It can be known from the complexion of the face. When people meet someone whose appearance and mind are full of positive energy, they will feel happier than if they had met their own brother.’

Guanzi, 4th century BCE¹⁸

Stephen Porges, distinguished psychiatry professor at the University of North Carolina, developed his ‘polyvagal theory’ in 1994. One aspect of this is a discussion of evolutionary defence systems associated with the ANS. The most primitive is the reptilian freeze (and play dead) response. This can still immobilise us in the face of threat and danger, as well as physical, emotional and sexual abuse. Long-term consequences include dissociative states, inability to feel and inhabit the body, and digestive disorders such as IBS. When his patients report feelings of shame that - in the face of abuse - they neither fled nor fought back, Porges reassures them that in the circumstances they were responding with the best, or only, defence available to them at the time.

These messages cannot easily be faked, but when genuine and springing from a deeply residing calm, centred and compassionate state, can help shift others from a SNS-dominant condition of stress, tightness and fear, to a PSNS-dominant relaxed and trusting one.

More evolutionarily advanced is the standard SNS ‘fight or flight’ response. Beyond that - the most recent and sophisticated defence system and one unique to mammals - is the PSNS response, a ‘circuit for social interaction’ as Porges calls it. He proposes that fibres from the vagus nerve (primarily associated with the PSNS) link to muscles of facial expression, vocalisation and listening. This means that when we ourselves are in a PSNS dominant state, we are signalling to others (friends, family, strangers and patients) via our facial expressions, tone and pattern of voice and willingness to listen, that we are safe and can be trusted.¹⁹ These messages cannot easily be faked, but when genuine and springing from a deeply residing calm, centred and compassionate state, can help shift others

from a SNS-dominant condition of stress, tightness and fear, to a PSNS-dominant relaxed and trusting one. For those unable to access this state without help, it can come as a blessed relief and is the starting point of healing – even before needles or herbs are applied.

Yinyang balance

‘The yang energy in people is firm; firmness without restraint turns into aggressiveness, like fire rising. Yin energy is flexible; flexibility without support becomes too weak, like water descending.’

Liu I-ming, 18th century²⁰

We no more want to be in a permanent state of blissed-out relaxation than we do in a high energy state of pressure and stress. What we do want is a flexible and appropriate autonomic response. We want to be able to go into a yang SNS-predominant state if there is genuine threat or need, or by choice, and to return to a default PSNS-predominant state at will, or just automatically, like an elastic band the moment it stops being stretched. At the same time, when we enter SNS-dominant states to deal with threat, conflict, challenge, work stress, business decisions, competition etc., we want to be able to hold a calm PSNS centre (yin within yang) that helps us act smartly and skilfully in the most appropriate way. Equally, in our relaxed and calm PSNS state, we want to retain a kind of latent SNS readiness, so we can swiftly and smoothly transition into effective action (yang within yin). This kind of flexible and appropriately responding nervous system builds what is known as ‘stress resilience’ – the ability to respond to, and recover from challenging events.

Heart rate variability – a window into the autonomic nervous system

One of the problems in assessing the ANS is that there are few reliable, non-invasive markers as to how it is functioning, which makes observation of heart rate variability particularly valuable.

The idea that a healthy heart should be metronomic in its rhythm has long been supplanted by the understanding that the beat of a healthy, flexible, responsive heart is constantly speeding up and slowing down. This change in inter-beat interval is known as heart rate variability (HRV). A higher degree of HRV is associated with youth, fitness, a healthy cardiovascular system, and more widely with more adaptive and healthy emotional responses. A low degree of HRV is associated with cardiovascular disease, ageing, lack of fitness and all-cause mortality, and a host of psychological problems including post-traumatic stress disorder (PTSD), attention deficit hyperactivity disorder (ADHD), irritable bowel syndrome, aggressiveness, stress, anxiety and depression.

The principal influence on HRV is fluctuations in the autonomic nervous system. Increased SNS or reduced

PSNS activity speeds up the heart.²¹ Increased PSNS or reduced SNS activity slows it down.

Heart rate variability and breathing

By monitoring HRV in real time, it has been possible to observe how it (and therefore the autonomic nervous system) responds to breathing. When we inhale, the beat of a healthy heart speeds up and when we exhale it slows down. Inhalation is therefore associated with increased SNS/reduced PSNS activity, and exhalation with increased PSNS/reduced SNS activity. This rise and fall in heart rate in harmony with breathing is known as respiratory sinus arrhythmia (RSA) and a healthy (high amplitude) RSA reflects what is known as vagal tone - the level of activity of the vagus nerve and its influence on the PSNS.

Vagal tone

The extraordinary vagus (wandering) nerve is the longest nerve in the autonomic nervous system, principally associated with the parasympathetic branch. From the brain, it wanders through the heart and most other major organs of the body as far as the large intestine. While the vagus nerve carries messages from the brain to the body, 80 per cent of its activity flows the other way – informing the brain of the activity and state of the organs.

Vagal tone describes the influence exerted by the vagus on many body functions, and especially the heart. It exerts a continuous parasympathetic influence (called ‘the brake’), and without it, SNS activity would be uncontrolled. Vagal tone is therefore a term used to describe a healthy autonomic nervous system which defaults to a PSNS state, and the ability to increase vagal tone is a powerful tool to optimise the yinyang balance of the ANS.

Putting it all together – coherent breathing

It should be clear by now that many physical and mental problems arise from an inappropriately responding autonomic nervous system. The big question, therefore, is how do we train vagal tone (i.e. strengthen PSNS dominance) to make it function in a healthier fashion?

Most anti-anxiety medications work by dampening down SNS activity rather than by promoting PSNS activity. This leaves a great need for alternative approaches. Research shows that various practices including meditation, relaxation, rhythmic muscle lengthening/releasing,²² and developing physical fitness all promote vagal tone and HRV. But the simplest, seeming fastest and most reliable way is what is known as coherent breathing, and one of the most intriguing of recent discoveries is that each of us has a breathing frequency that promotes optimum vagal tone and autonomic balance. Although this rate varies between individuals (and is also affected by height and gender²³), the average is around 5.5 breaths a minute. At an individual’s optimal frequency,²⁴ HRV (the external sign of vagal tone) can increase tenfold – from a four beat difference to 35-40 beat

difference.²⁵ This resonant frequency also optimises blood pressure - indeed slow breathing is the only short and long-term non-pharmacological treatment for high blood pressure recommended by the US Food and Drugs Administration.²⁶

Since inhalation promotes the SNS and exhalation the PSNS, when we evenly and equally inhale and exhale for five to six seconds each, we put the autonomic nervous system into yinyang harmony. Yet like all yinyang paradigms this is fluid. If we want to more strongly promote a parasympathetic rest and relax state, we can make the outbreath longer than the in-breath. We can also breathe out against resistance – humming, sighing, whistling, singing, playing a wind instrument, slightly closing the throat etc., all of which stimulate the PSNS.

Equally, while a deep, vigorous in-breath will strongly stimulate the SNS, if we make our inhalation long, slow, quiet and deep (to the lower abdomen) we moderate this with PSNS activation (yin within yang). And while a slow, releasing exhalation will strongly stimulate the PSNS, if we exhale more vigorously and noisily, for example when lifting a weight or making a martial strike, then we increase SNS within PSNS (yang within yin).

Coherent breathing in the clinic

It is hopefully clear by now that our own ability to maintain a genuine PSNS flow state in the clinic will reassure and help shift patients from a sick SNS-dominant state into a healing PSNS state (even before we start treatment). But we cannot be with our patients all the time, and beyond the treatment we give we need to offer patients tools that they can use to enhance and own their own health. It is possible to teach the basic coherent (qigong) breathing described above in just a few minutes, and below I give details of a YouTube video I have made to assist this. There are also numerous free and paid smartphone apps available to guide optimum breathing rate. But like most things, it is regular practice that bears fruit and we need to encourage those patients who would really benefit from this intervention to practise for at least ten minutes at a time, ideally two to three times a day. While they may initially balk at this, we can clearly explain that this will help relieve their physical pain and emotional distress; in fact, the calming results are so rapid and generally reliable that they may need little encouragement.

If patients want to go further, they can be pointed towards sophisticated internal cultivation practices such as qigong, internal martial arts, yoga etc. which expand coherence and harmony throughout the entire body-mind. One of the many traits of these practices is the cultivation of yin calmness, slow breathing and relaxation in the midst of demanding yang bodywork, thus training us to better adapt to all kinds of stress.

Patient compliance, of course, will be greatly helped if we practice coherent breathing in some form ourselves.

There is a story told about Mahatma Gandhi. A woman

brought her young son to him and asked the Mahatma to tell the boy to stop eating so much sugar. Gandhi asked her to bring the boy back in three days, whereupon he duly gave the requested advice. When she asked why she had to wait three days, he said, 'First I had to stop eating so much sugar myself.'

Afterword

I have no science background and this is my best shot at understanding some of the fast-growing research in this field. It is also my impression that in the spirit of true science, much of what is written about these matters represents what is known at this moment in time, and will inevitably develop and grow. In this vein, I welcome comments, corrections or useful additions to anything I have written above.

Resources

- I am much taken by the work of psychiatrists Patricia Gerbarg and her husband Richard Brown. Several YouTube videos featuring Pat Gerbarg make interesting watching, and their joint book *The Healing Power of the Breath: Simple Techniques to Reduce Stress and Anxiety, Enhance Concentration and Balance Your Emotions* is a simple guide to various breathing techniques, and comes with an instructional DVD. Gerbarg and Brown

are co-authors, with Gretchen Wallace, of *Yoga Therapy in Practice: Mass Disasters and Mind-Body Solutions: Evidence and Field Insights*²⁷ as well as several other useful and interesting articles.

- Stephen Porges, author of *The Polyvagal Theory: Neurophysiological Foundations of Emotions, Attachment, Communication, and Self-Regulation* is also an excellent read and YouTube watch.

For those working with adolescent depression, rich material can be found in Blom, E., Duncan, L.G., Ho, T.C. et al. (2014). The development of an RDoC-based treatment program for adolescent depression: "Training for Awareness, Resilience and Action", *Front Hum Neurosci*, 19(8):630

A lengthy video of a lecture with the same name as this article is available on my Peter Deadman YouTube channel. There is also a short video (the practice of coherent qigong breathing) demonstrating the breathing practice described above.

Peter Deadman has practised, written about and taught health-promoting practices for nearly fifty years. He is author of Live Well Live Long: Teachings from the Chinese Nourishment of Life Tradition, teaches regular qigong classes and workshops, and is currently working on a book on the science and practice of internal exercise.

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- It is slower in men and tall people.
- Heart rate variability biofeedback devices can be used to help us identify our optimum breathing rate.
- For example 100 beats per minute on inhalation and 65 beats per minute on exhalation.
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