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# Opening the heart: exploring the interpersonal neurobiology of spiritual practices suitable for public education

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## ABSTRACT



Modern education has prioritised the intellectual dimension, while giving insufficient attention to children's emotional and spiritual development. This article offers an interdisciplinary understanding of how public education can nurture spirituality and the human capacities for compassion and love, also called the 'qualities of the heart'. The paper explores the interpersonal neurobiology that underlies 'heart opening' spiritual practices, conceptualised as both spiritual and neurobiological phenomena. I discuss the scientific foundations for spiritual practices that can be suitable for education in secular public schools. Starting with my own empirical research in transpersonal psychology, the paper brings together research in interpersonal neurobiology with perspectives from spiritual traditions of yoga and meditation. The aim is to contribute to developing a framework for pedagogical practices that helps children develop their spirituality and loving and compassionate relationships, and feel more connected to themselves, others and the world, suitable for promoting children's spiritual development through religious education, moral education, and life skills education in secular public schools.

## KEYWORDS

Education; love and compassion; interpersonal neurobiology; transpersonal psychology; spiritual practices

## Introduction

Educators have advocated for the inclusion of spirituality in education through various pedagogical practices that can nurture young people's compassion, love and connection (Erricker and Erricker 2000; Hay and Nye 2006; Miller 2018; Narvaez 2016; Rodriguez and Stokke 2019) and scholars in various fields have discussed the problems associated with modern education's overemphasis on the intellectual dimension at the expense of emotional and spiritual development (McGilchrist 2009; 2021; Narvaez 2014; 2016; Park 2020; Schore 2019; Wade 1996). This has been conceptualised as 'left-brain dominance' and these authors suggest that public education needs to develop 'right-brain thinking'. While left and right hemispheres usually work together and brain tissue is flexible, certain ways of thinking are specialised in one hemisphere (Greyson 2000).

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The left-brain has been associated with logical, rational, goal-oriented and conformist thinking, facts, and detail. The right hemisphere focuses on the present moment, emotional connection, social pleasure, and self-transcendence (Schore 2019) and intuitive, holistic, and nonconformist thinking. Transpersonal psychologist, Wade (1996) writes that individuals with a dominant left-brain or 'achievement consciousness' tend to be emotionally detached and only take in what can be empirically proven, as in modern rationalist thought. Individuals with a dominant right-brain or affiliative consciousness look for patterns, subjective feelings, intimacy, and community.

McGilchrist (2009) emphasises that the distinction between hemispheres is not primarily between reason and emotion, but rather that the left-brain perceives the world as separate units in an atomistic way, while the right-brain perceives relations and big pictures. The right-brain perceives bodily emotions and intuitions, which the left-brain rationalises these into thoughts and beliefs. Narvaez (2014; 2016) writes that a left-brain dominant culture promotes an atomistic worldview of separation and isolation, creating dysregulated, stressed, and traumatised children whose needs for connectedness and attachment are not met. This suggests that children develop a tendency to disconnect from their intuition, their bodies, other people, and their environment.

In the field of moral education, Narvaez (2016) suggests that rather than focusing only on a mental approach to ethics and philosophy, we should focus on emotions and the body and develop young people's right-brain characteristics. In the field of religious education, DeGroat (2016) explores the neurobiology of wholeness by placing spiritual traditions in dialogue with contemporary psychology and proposes that contemplative practices enhance health. Furthermore in neurotheology, Newberg (2018) explores the neurological effects of religious and spiritual practices, while Porter (2021) argues for a shift away from cognitive belief towards embodied practices in theological formation. Along these lines, and similar to British religious educators Erricker and Erricker (2000), and Hay and Nye (2006), I have proposed in previous research (Stokke and Rodriguez 2021) that religious education should focus more on spiritual experiences and development, and not only on religious text and discourse.

## Aims and scope

This essay goes beyond particular school subjects like religious education or moral education, and instead discusses how spiritual practices can be suitable for interdisciplinary pedagogical aims to support the development of the whole human. While this aim is explicitly expressed in approaches like John Miller's (2018) holistic education, which centres on love and compassion, increasingly, educators and policymakers do recognise that schools need to include relational and emotional dimensions of human development, as indicated, for example, by the current focus on life skills education in Scandinavian countries, and on yoga and mindfulness interventions in the UK and North America. The UK curriculum mentions moral and spiritual development for religious and nonreligious children as an interdisciplinary aim, but religious education has assumed a special responsibility for it (Wintersgill 2017). In Norway where my research is based, spirituality is not mentioned, but the interdisciplinary themes of life skills education and developing the whole human cover similar aims as in the UK, such as searching for the meaning of life, awe and wonder, and exploring existential questions

(Rodriguez and Stokke 2019). However, in public schools, these ‘spiritual’ themes tend to be approached intellectually rather than through embodied, emotional and experiential practices such as mindfulness, yoga, and meditation, which could facilitate connection and awareness to their intuition and emotions, their bodies, other people and their environment; otherwise known as ‘tuning into the heart’ (Narvaez 2014; 2016).

The essay presupposes that for such ‘spiritual’ practices to be acceptable in secular public schools, they need to be based on solid scientific foundations rather than perceived as ‘religious’ practices; particularly in highly secularised European countries like Norway, where ‘spirituality’ tends to be associated with either Christianity, Islam, or New Age beliefs, rather than understood as a universal human dimension beyond any particular faith. There is little doubt that the contemporary world needs more love, compassion, and human connection, thus we need further research of the neurobiological basis of these qualities, and which pedagogical practices are suitable to enhance young people’s psychological health and potential for love, peace, compassion, and connectedness in public education.

The divided brain model has been criticised for having insufficient basis in neurological evidence.

While there is an emerging field of research connecting spirituality and neurobiology (DeGroat 2016; Drubach 2008; McNamara 2009; Mohandas 2008; Newberg 2018; Porter 2021), this paper aims to bring together my own research in transpersonal psychology with a review of selected research in interpersonal neurobiology. This essay does not intend to do a systematic review, it discusses a selection of the most relevant academic and popular literature in transpersonal psychology and interpersonal neurobiology. As an interdisciplinary essay that aims to address public and policy discussions about spirituality in education, it highlights some authors with a media presence, such as Frederickson (2013); McCraty et al. 2009; 2014; 2015), Porges (2022) and Siegel (2018). My exploration starts with my previous transpersonal psychology research on heart opening as empirical spiritual phenomenon that occurs spontaneously or as a result of intentional practice among Norwegian and English participants (Stokke and Rodriguez 2021). Then, I review and discuss interpersonal neurobiology, focusing on the biochemistry of positive emotions (Frederickson 2013; Newberg 2018), polyvagal theory and the autonomic nervous system (Porges 2011), heart–brain interaction and heart rate variability (McCraty et al. 2009; McCraty and Schaffer 2015; McCraty and Zayas 2014). Next, I discuss how neuroscience connects with a perspective from the yoga tradition on the ‘biology of kundalini’ (Dixon 2008; Greyson 2000; Park 2020). The final section discusses pedagogical practices suitable in public education (Narvaez 2016; Siegel 2018), including spiritual practices such as meditation, mindfulness, breathing exercises and yoga, and practices for social connection and compassion are particularly suitable in educational settings.

### **Heart opening as empirical phenomenon**

The heart is both a common metaphor for the emotional and spiritual dimension, and a physical organ that interacts with the brain and nervous system to play a central role in emotion regulation. Narvaez (2014; 2016) sees right-brain characteristics as corresponding to ‘qualities of the heart’ such as listening to the heart and leading a

heart-centered life. In yoga, heart opening refers to expanding the heart chakra (or heart centre). Heart opening can occur spontaneously, or as a result of designated intentional practices.

In a previously published empirical study (Stokke and Rodriguez 2021), I found that participants in Norway and the UK describe the experiential phenomenon of heart opening as a key aspect of psychological and spiritual transformation. That study was based on qualitative interviews with four individuals who had experienced spiritual awakening. In transpersonal psychology, it is well-known that while many different spiritual practices exist to facilitate such experiences, they most often occur 'spontaneously'. In my research, participant 1 describes the phenomenon of heart opening as 'feelings appearing in the chest', a 'tingling, happiness, openness' where 'the heart becomes big and open' which they experienced in brief moments when overwhelmed by grief and pain in bereavement. Participant 2 says that 'It felt like my heart physically opened and expanded into my arms' during a session of receiving shamanic healing. Participant 3 describes an 'amazing' experience where 'fear completely dissolved' and they felt 'subtle energy in my arms' during a session of past-life regression therapy. Participant 4 says that 'I just cried, and cried, and cried. I felt like my heart opened completely. I felt safe, and I had a strong feeling of love', which happened during an activation of kundalini energy. For several participants, heart-opening was an overwhelming experience triggered by intense energetic healing practices. I do not suggest that such intense practices are suitable in a school context. However, intense spontaneous experiences of heart opening are useful case studies to explore the neurobiology that underlies these spiritual phenomena.

Transpersonal psychology suggests that chakras or energy centres in the subtle body open because of kundalini activation (Grof and Grof 1990), which can also be spontaneous or result from practice. In yoga philosophy, the degree to which chakras are open or obstructed, determines the way one experiences and relates to the world. Lower chakras represent forces of the body, survival, sex, aggression, and competitiveness, while upper chakras represent spiritual potentials. The heart chakra lies at the centre and connects body and spirit (Dixon 2008; Greenwell 2018). In modern society where many 'live in their heads', individuals often have open upper chakras, while lower ones are blocked due to childhood trauma, which causes us to dissociate and detach from our body. Transpersonal psychologist, Greenwell (2018), describes heart opening as an intense physical and emotional experience where armouring around the heart breaks down, leading to shifts in energy and worldview, blockages fall away, and people feel spontaneous unconditional love. The phenomenological descriptions by participants in my study correspond closely to the transpersonal psychology literature. Greenwell (2018) writes that heart opening produces feelings of unconditional love, allows individuals to develop genuine compassion, and increases their creativity and energy in life. Jung (1975) says that individuation begins with heart opening, and we can then observe our emotions without identifying with them. My own research shows that heart opening leads to an embodiment of spirituality, where spirituality is no longer about mental beliefs, but felt as physical phenomena in the body. This suggests a shift towards what McGilchrist (2009) and Narvaez (2014) call 'right-brain thinking'.

Psychological anthropologist, Fiske's (2019) cross-cultural research on the experience of heartwarming emotions in moments of connection, suggests that heart-opening is a universal phenomenon beyond spiritual experience or practice. He named the

phenomenon ‘kama muta’ – a Sanskrit term that means ‘moved by love’. Across cultures and religions, people describe this universal emotion with physical characteristics such as warm feelings in the heart, tears and goosebumps, which Fiske (2019) encountered in participant observation in Sufi and Pentecostal practices where worshippers felt divine love. This is a smooth and subtle form of the phenomenon experienced by participants in my research. Fiske defines ‘kama muta’ as momentary emotions of love. He found that many practices evoke this emotion, ranging from spiritual practice, religious devotion, and everyday activities such as being touched when seeing a picture of kittens on social media. He notes the psychological benefits of kama muta, which leads to healing, bonding, and a sense of belonging. He suggests that kama muta can reconnect people who feel isolated and vulnerable, and this is what I suggest heart opening practices can do in moral education. Fiske suggests that we need further research about the underlying biochemistry and neural processes involved in these moments of love. In the following, I explore some of these underlying biochemistry and neural processes, drawing on selected research on biochemistry, the nervous system, and heart coherence.

### The biochemistry of positive emotions

A growing field of research connects spirituality and neurobiology (McNamara 2009; Mohandas 2008; Newberg 2018). Neuroimaging studies show how meditative practices contribute to change in all the major neurotransmitter systems, reducing anxiety and increasing feelings of safety, relaxation, love and bliss. A range of neurotransmitters and hormones are involved in the biochemistry of positive emotions, including the reward chemical dopamine; endorphins released with laughter, music and exercise; serotonin produces happiness; the love hormone oxytocin; and the hormone anandamide, named after the Sanskrit term for ‘bliss’ that acts as a heart opener, creating euphoria and enabling feelings of love. Based on neuroimaging studies, Beauregard et al. (2009) propose that particularly oxytocin and dopamine are involved in feelings of unconditional love. Mohandas (2008) discusses an increase in serotonin levels during meditation, which reduces anxiety and depression, and interacts with dopamine to enhance feelings of euphoria.

Additionally, positive psychology researcher Frederickson (2013), shows through brain scans how positive emotions change the way the brain takes in information. In moments of feeling positive emotions, individuals have an expanded view, become more creative, open, and self-transcendent, and see more interconnectedness with others and their surrounding environment. These momentary feelings can produce lasting change and improve social connections, friendships, and learning new things. Positive emotions such as joy, love and gratitude are natural ways to grow and become more resourceful, and the strongest impact on health, happiness and well-being occurs when positive emotions are experienced together with others. Frederickson (2013) defines love as a physical, embodied phenomenon – a physical need experienced by the body. The capacity for experiencing love is measurable and can be enhanced through connection with nature or loving-kindness meditation, both of which change the nervous system and affect the heart. Through experimental tests, Frederickson (2013) shows how biochemistry can be changed by self-generating positive emotions from the inside, specifically through the practice of loving-kindness meditation.

Neurobiologically, feeling love corresponds to neural synchronisation and release of oxytocin, which plays a role in social bonding, love, and spirituality. In experiments with mice, Wei et al. (2015) measured that oxytocin increases the pleasure of social interaction and relationality by producing anandamide, which increases feelings of happiness. Hagerty et al. (2013) studied the brain activity of participants in Buddhist ecstatic meditation, focusing on neural mechanisms that generate happiness without external rewards. While studies usually focus on downregulating stress and negative emotion, this study instead looked at how to up-regulate dopamine, which causes pleasure and positive reinforcement. They found that dopamine can be activated without external stimuli, through purely mental processes that do not invoke happy memories. In contrast to external rewards which heighten tolerance, facilitate addiction, and create withdrawal symptoms, meditators achieve bliss more quickly with less effort over time. They experience short-term neurotransmitter depletion, but no withdrawal symptoms.

### **Polyvagal theory and the autonomic nervous system**

Newberg (2018) explores the neurological effects that religious and spiritual practices have on the autonomous nervous system, and McNamara (2009) discusses the more complex effects of such practices on the limbic system. To begin with, Porges (2011) polyvagal theory connects the autonomic nervous system to social engagement and explores co-regulation of the nervous system through social relationships. Studying how the nervous system perceives threat or safety, he emphasises the transformative power of feeling safe and relaxed in interpersonal relations, which is necessary for human survival. The autonomic nervous system changes in the evolution from asocial reptiles to social mammals. Reptiles only respond to threat, but mammals can perceive safety, calm down and engage in social relations, which requires downregulating the threat system. Porges (2022) explains that the body unconsciously detects threats, and then the mind tries to make sense of it, but often misinterprets and blames other people for what goes on inside the body. In traumatised individuals, prolonged stress has destabilised the nervous system, which becomes locked in threat detection even when there is no threat. Traumatized persons may thus misinterpret cues of safety as triggers of threat. For example, the body withdraws when someone offers a hug.

The triune brain model (MacLean 1985) distinguishes between reptilian, limbic, and cortical brain sections. First, the reptilian brain is a survival system conditioned by early experiences that perceives threats, activates aggression and fear, and turns on fight or flight responses. Second, the mammalian limbic brain regulates care and play, social pleasure, relational attunement, and compassion. Third, the neocortex and prefrontal cortex hosts abstract thinking. In traumatised individuals, the reptilian brain dominates and impairs social engagement and thinking. In individuals that receive care and love and feel safe, the neocortex and limbic brain produce relational attunement and enable what Narvaez (2016) calls heart-centeredness.

Porges (2011) distinguishes between three autonomic nervous system responses: fight/flight, freeze, and social engagement. When individuals feel threatened, the sympathetic nervous system accelerates the heart rate, and activates aggression or withdrawal. If fight or flight fails to provide safety, the nervous system shifts to freeze, an immobilised dorsal response. In survival mode, it is difficult to engage socially with others. Feeling safe

switches on the parasympathetic system, which slows down the heart rate, relaxes the body, and enables social engagement. Porges (2011) also speaks about the bidirectional connection between brain and heart via the vagus nerve. When people feel safe, the nervous system physiologically communicates with the heart to slow down heart rate, relax breathing and muscle tension, and connect face and voice, enabling attuned and connected relating. Via the same process, the heart communicates to the brain, affecting emotional and cognitive processes. This synergetic relationship is one of the main points for Porges' theory.

Polyvagal theory further emphasises that individual patterns of threat detection, conditioned by experience, are the key to understanding heart–brain relations. Whether we feel safe or threatened shapes our emotions, behaviours and how we perceive our surroundings. Individuals who spend much time in fight response, begin to identify with that aggressive personality, while someone who spends much time in flight response, identifies with an anxious personality. When feeling safe, the heart regulates the body allowing individuals to connect fully with themselves and others. When we feel safe and let ourselves be vulnerable in a heartfelt conversation with a friend, we enter a state of coherence (a state of physiological optimal functioning) and the heart opens or expands, we identify with being acknowledged and having a sense of belonging. If we get interrupted, attention shifts to threat detection – and the heart contracts or closes. Porges (2011) concludes that we can only live to the fullest when we open our hearts, and opening the heart is only possible if we feel safe and relaxed in the body. Let us further explore the connections between heart and brain.

### Heart coherence

McCraty et al. (2009; McCraty and Schaffer 2015; McCraty and Zayas 2014) at the HeartMath Institute, studies and measures connections and coherence between heart and brain, and interpersonal heart-to-heart connections. 'Heart coherence' means that the heart beats in a consistent, rhythmic manner. In a state of coherence, heart and brain work together, the nervous system increases the brain's energy, creativity, and intuition, and the individual feels more connected and content. A popular teacher of spiritual practices, Dispenza (2017) writes that heart coherence corresponds to being heart-centered and having an 'opened heart chakra.'

Every emotion influences the heart rhythm. The sympathetic nervous system accelerates the heart rate, while the parasympathetic system slows the heart rate. Both relay communication between heart and brain to maintain an equilibrium, enabling individuals to feel relaxed and safe. Research at the HeartMath Institute (McCraty et al. 2009; McCraty and Schaffer 2015; McCraty and Zayas 2014) shows that positive emotions like gratitude, compassion, love, and joy, produce coherent patterns in heart rhythm, while stressful emotions produce incoherent and irregular rhythms. The heart, limbic brain, and autonomic nervous system are closely connected, and experiments predict a person's feelings with 75 percent accuracy from monitoring heart rate variability (the variation in beat-to-beat intervals). Heart rhythm changes with every beat, and both acceleration and slowing down can occur in smooth or jagged patterns, like accelerating or slowing the speed of a car in a smooth or abrupt way. Heart rate (beats per minute) and heart rhythm are two separate phenomena; a person can have a high heart rate while still be in a coherent state.



A coherent pattern of heart rate variability synchronises the sympathetic and parasympathetic nervous systems, and the individual feels harmonious. In short, positive emotions (such as gratitude, compassion, love and joy) create a coherent and harmonious heart rate variability pattern, which promotes overall well-being. Furthermore, this relationship is one that can consciously be influenced.

Contrary to long-held beliefs in western medicine, we can control functions of the autonomic nervous system like heart rate and blood pressure. Newberg (2018; see also Mohandas 2008; Porter 2021) shows how ritual chanting, silent meditation and yoga, affect the parasympathetic nervous system to calm down an individual and even cause feelings of bliss, while practices like drumming or dancing arouse the sympathetic nervous system and increase heart rate. Thus, research confirms what yoga traditions have long known, that breathing techniques and meditation practices can influence heart rate. Heart coherence can be produced by cultivating positive emotions, which cause the brain to release corresponding chemicals, like Frederickson (2013) describes. When feeling negative emotions like stress, anger, neglect or frustration, the signal from heart to brain becomes incoherent, triggering a release of corresponding chemicals for up to two minutes. Momentary stress is not harmful, but when prolonged, the whole body enters a state of incoherence which negatively affects the immune system and other functions. Shifting feelings continuously influence the heart, and positive emotions are the key to activating and ‘opening’ the heart.

In a state of coherence, brain and heart synchronise. Heart coherence leads to brain waves entraining with heart rhythm and activates the parasympathetic nervous system. This increases intuition, and sidelines the analytical mind, indicating that heart coherence takes a person out of left-brain dominance. Here, Dispenza (2017) adds that an opened heart chakra keeps the reptilian brain in check, making it less likely to get stressed and enter survival mode. The principles of polyvagal theory, heart coherence, and mind-heart connections have many shared concepts to yoga theory, which provides practical tools and ancient wisdom that align with modern understandings of holistic well-being and the integration of various aspects of the self.

### Connecting it all with yoga theory

Yoga theory connects the aspects of neurobiology, biochemistry, the nervous system, heart–brain connections; with chakra theory and the concept of kundalini – a life force energy that impacts biochemistry, the nervous system, connections between brain, heart and body, and brain hemispheres. Transpersonal psychologist Greyson (2000) explains that in the yoga tradition, kundalini is understood as a biological mechanism for individual enlightenment and evolution of the human species towards higher consciousness. Other spiritual traditions describe similar mechanisms, indicating that it is universal.

Dixon (2008) proposes several yet-to-be-tested neurobiological hypotheses that aim to explain the functions of kundalini energy. She writes that kundalini hyperactivates both the sympathetic and parasympathetic nervous systems, producing fear and excitement, as well as relaxation and bliss. In the limbic brain, kundalini energy produces endorphins and cannabinoids that amplify emotions, producing an emotional rollercoaster ride which eventually stabilises. Gradually, the mentioned bliss chemicals (endorphins,

serotonin, oxytocin and dopamine) wipe clean emotional memory, enabling kundalini to cleanse trauma from the autonomic nervous system and limbic brain. Kundalini temporarily reduces left-brain capacities such as math, rationality, memory, and socially conditioned thinking, and dissolves ego functions focused on practical survival skills in the cerebral cortex, which may temporarily lead to depression and feelings of meaninglessness. Kundalini also expands the heart, making people vulnerable. Dixon (2008) writes that kundalini temporarily redirects energy to the right hemisphere, but eventually improves rationality, because it unites heart and brain.

Greyson (2000) studies correlations between active kundalini and self-reported neuropsychology. Interestingly, he found no correlation between kundalini and right-brain dominance, which could indicate that kundalini balances the hemispheres rather than producing a shift to right-brain dominance. However, kundalini correlates with hyper-connection between cortex and limbic brain, producing links between thoughts and emotions. McGilchrist (2009) and Wade (1996) note that the limbic brain is neurologically closely connected to the right hemisphere.

According to yoga philosophy, kundalini rises through different channels along the spine. The active right channel ('pingala') is linked to the left-brain hemisphere and sympathetic nervous system, which accelerates the heart using adrenaline. The passive left channel ('ida') is linked to the right hemisphere and parasympathetic nervous system, which slows the heart using acetylcholine (Mathie 2021). Park (2020) writes that some individuals operate primarily from pingala, others from ida, and some are balanced, along a continuum where individuals can shift between left- and right-brain dominance, corresponding to what Wade (1996) calls 'achievement consciousness' and 'affiliative consciousness' respectively. Further, Wade (1996) describes 'authentic consciousness' as whole brain thinking, where both hemispheres have measurably similar EEG patterns. Authentic consciousness parallels heart-centeredness, where individuals show compassion towards self and others, and embrace both negative and positive sides of being human, while being able to detach more easily from the negative (Park 2020). Integrating yoga philosophy into this discussion of scientific theories related to the relationship between mind, the body, heart, and emotions provides a more comprehensive understanding of well-being and human potential. With this in mind, I look at what practices can be explored.

### Practices suitable for secular public schools

While the modern school system privileges intellectual learning, children and adolescents also need emotional and spiritual nurturing in school, which is to varying extent, recognised in the curricula of different countries, as discussed in the introduction. Narvaez (2014; 2016) points out that education should help young people to develop a natural, embodied morality, nurture compassion and relational functions associated with the right-brain hemisphere and help children to think with their heart. When caregivers do not provide love and nurture, children's hearts close, and they become dysregulated and stuck in the survival system, either withdrawing or trying to dominate others. However, with the guidance of responsive and loving adults, children develop what Narvaez calls a heart-centeredness where they feel safe. With a calm nervous system, individuals can think beyond survival needs and develop right-brain capacities throughout life.

Mindfulness and meditation are pedagogical practices commonly used in schools that help open the heart. Park (2020) writes that opening the heart centre is the most important aspect for psychological development, leading to greater creativity and fulfilment, and enabling compassionate ‘witnessing’ of self and others that should be nurtured in an ideal education system. Witnessing or observing the self, works with the inhibitory functions of the prefrontal cortex and can be taught through mindfulness and meditation practices. Interpersonal neurobiologist Siegel (2018) created the Wheel of Awareness practice, letting practitioners tap into their inner source and realise coherence, connectedness, and love. The practice includes elements from spiritual practices like mindfulness, yoga, and meditation that help people integrate consciousness, which research shows produce well-being. Siegel (2018) asks practitioners to focus on observing the five senses, then observing sensations inside the body, mental activities, interconnectedness with the environment, and eventually turning attention to awareness itself – the observer that observes the other aspects. Siegel has tried this practice in workshops with thousands of people. Within 25 min, participants reach the centre which they describe as joy, love, eternity, or God. Siegel (2018) concludes that the knowing awareness is subjectively experienced as love. Awareness and love appear to be neurologically identical and cause integration and coherence in the brain. Siegel’s neurobiological explanation of awareness practices may be supported by the Theory of Mind, a cognitive process which allows individuals to empathise with others through ‘mirror neurons’. Drubach (2008) suggests that this mechanism is particularly important in spiritual experiences, relationships between healers and their clients, and in individuals’ perceptions of God. It may provide a neurobiological explanation of how the brain creates coherence and integration.

While mindfulness is a good practice for many, it can be triggering for traumatised individuals. Porges (2022) points out that traumatised individuals often are conditioned to associate immobilisation with fear, and they would need to learn that stillness can be safe, before benefiting from mindfulness practice. These individuals need to learn very gently to become aware of what goes on inside the body, and relearn trust, openness, and vulnerability. Porges (2022) suggests embodied trauma therapies such as breathing exercises, yoga, singing and chanting to learn to feel safe again, rewire the nervous system, and activate the social engagement system. He also emphasises that the education system should be reframed as a shared journey of learning rather than focusing on constant evaluation that stresses students.

Additionally, Dispenza (2017) suggests a meditation practice focused on breathing. Practitioners focus on the heart centre, breath slowly and deeply in and out, while bringing up heartfelt positive emotions, and sending this energy to the surroundings. Drawing on McCraty et al. (2009; McCraty and Schaffer 2015; McCraty and Zayas 2014) and Frederickson (2013), Dispenza (2017) writes that this practice, where participants intentionally choose to feel positive emotions rather than wait for external stimuli, opens the heart. Meditation regulates heart rhythm to sustain positive emotions and generate coherence, enabling states of bliss, love, and compassion. Regular practice rewires brain and body, making positive emotions and love an embodied habit that replaces conditioned patterns of worry, fear, and anxiety. With breathing practices, individuals can learn to calm down, and observe their thoughts and how the mindset shifts away from the survival mode of feeling threatened, inferior, or superior.

Calming down and relaxing is a first step, but individuals also need to learn interpersonal bonding and feeling pleasure being with others (Narvaez 2016). Since modern education tends to promote detachment from feelings and relations, overemphasising the importance of competition and individualism, we need practices to cultivate emotional presence, enhance interpersonal connectedness, and engage in playful socialisation. Practices that can develop relational pleasure include caring, positive playfulness with others, such as self-directed learning and physical play, humour, dancing and singing with others. Frederickson (2022) emphasises social connectedness, building a community where we feel safe and have positive experiences together. She suggests cultivating a habit of paying attention to positive feelings and experiences, which occur more frequently than the negative experience we tend to focus on. Further, she distinguishes between learning to value naturally occurring positive emotions – and learning to cultivate these through practices that turn positive emotions into a habit, by prioritising hobbies we enjoy, being in nature, spending time with good friends and connecting with people. It is important to note that these practises can easily be modified with specific engagement strategies employed that are suitable for the relevant age groups.

Positive psychology practices have been criticised for failing to deal with negative emotions. Frederickson (2022) emphasises that cultivating positive emotions does not mean ‘toxic positivity’ where we repress negative emotions and try to ‘think positive’. Emotions are embodied physiology, which means that positivity must be based on authentic experience. Merely thinking positive mental thoughts without the embodied physiology, is inadequate. Trauma experts Mate and Neufeld (2019) emphasise how important it is to feel all feelings to develop emotional maturity. Caregivers and educators need to first have a firm understanding about the meaning of emotions, and the psychological development of children, ultimately teaching children that it is safe to feel all their feelings, without dividing them into acceptable and unacceptable, and without trying to manage feelings prematurely before they even feel them. Mate and Neufeld (2019) point out that negative emotions carry important messages. For example, anger is self-validating, it means one has been treated badly; sadness can help realise it was not one’s fault, and one cannot control other people’s decisions. They emphasise that threatening children with separation, as in ‘time-out’ as a disciplinary measure, has serious negative effects as it denies children the continuous connected relationships with caregivers that they need.

Social connection practices, such as heart-to-heart sharing of feelings to create emotional intimacy, respond to the human need for friendship, social relations, and love. When talking about feelings in the classroom, creating positive relationships, practicing compassion, or working with other pedagogical practices for social connection, interpersonal neurobiology teaches that children’s nervous systems need to be calm first. Creating a safe environment and building trust in the classroom requires an atmosphere of dialogue without judgement, competition and domination. Students should not be forced to share feelings or open their hearts in an unsafe environment, which can further traumatise. Teachers ought to meet their students with love and respect rather than treating them as objects of evaluation and control (Mate and Neufeld 2019; Miller 2018; Porges 2011). In a trauma-sensitive and heart-opening school system, teachers act as caregivers who guide students in a loving, non-authoritarian way. This also requires structural changes, moving

towards more loving and egalitarian relationships and respect for children's rights and freedom of choice.

## Conclusion

As many educators have proposed, education should nurture young people's love and embodied compassion, and not only focus on left-brained abstract knowledge (Erricker and Erricker 2000; Hay and Nye 2006; Miller 2018; Narvaez 2014; 2016; Rodriguez and Stokke 2019). This is recognised in public school curricula in a number of countries, and conceptualised variously in terms of interdisciplinary pedagogical aims of developing the whole child, life skills education, or as moral and spiritual development. Neurobiology (Frederickson 2013; McCraty et al. 2009; McNamara 2009; Mohandas 2008; Newberg 2018) shows that cultivating positive emotions leads to heart opening, which is a universal spiritual phenomenon (Dixon 2008; Fiske 2019; Greenwell 1990; 2018; Stokke and Rodriguez 2021). Common practices to open the heart are derived from mindfulness and meditation (Dispenza 2017; Park 2020; Siegel 2018). Nevertheless embodied practices such as breathing and yoga may be more suitable to calm down the nervous system and prepare individuals for social connection practices such as playing, singing and dancing, which are highly effective for interpersonal bonding (Frederickson 2013; Mohandas 2008; Narvaez 2014; 2016; Newberg 2018; Porter 2021). Cultivating positive emotions does not imply 'toxic positivity' (Frederickson 2013) that denies negative emotions, but allows individuals to feel all feelings in a safe and loving environment (Mate and Neufeld 2019). By drawing together research from transpersonal psychology and interpersonal neurobiology, I have presented a scientific framework that explains the neurobiology that underlies yoga, meditation and breathing practices that can help individuals realise 'qualities of the heart' and 'right-brain thinking' (Narvaez 2014; 2016) and more loving, compassionate and connected interpersonal relationships. This may help refocus education towards an inclusion of embodied emotional and spiritual practices.

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No potential conflict of interest was reported by the author(s).

## Notes on contributor

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