

Osteopathy, psychological trauma and the road of resilience



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“Although the world is full of suffering, it is also full of the overcoming of it.”
(Helen Keller, 1903)

Abstract (English)

The motivation for this qualitative literature review came from a desire to increase awareness of psychological trauma and its physiological effects, and the possible role that osteopathy could play as a complementary therapy in trauma treatment. This was done by researching the physiology of the trauma response, which provided valuable direction to the study. Inspiration was taken from the polyvagal approach to trauma, and the concept of trauma being about the response, and not the event.

The benefits and disadvantages of various therapies are discussed, including both top-down and bottom-up approaches, and what their contributions to trauma recovery are. Additionally, this review explores past and present collaborations between osteopathy and psychology and suggests what possible benefits there are in further joint efforts between the two in relation to trauma therapy outcome and research.

Consideration of more objective forms of measurement in trauma therapy and research, such as heart rate variability, takes into account not only the subjective feedback, but also the physiological components of the trauma response and autonomic activity, and its value as a possible marker of resilience. The question is posed of whether enhancing resilience may assist in trauma recovery, and in reducing susceptibility to future adversities, and what role osteopathy may play in the facilitation of resilience. This article also examines the state of available resources and training concerning trauma within osteopathy, and whether or not osteopaths are sufficiently equipped to treat people with a history of trauma, and deal with their responses.

The findings of this literature review revealed that osteopathy may be a valuable form of complementary therapy in recovering from trauma, and play a role in preventing the development of trauma disorders, due to its whole-person approach, and through the facilitation of the parasympathetic activity and interoceptive awareness, optimising the self-regulation capacity. Due to this, osteopathy may help in enhancing resilience and thereby decrease susceptibility to future adversity. More research is needed in this area, however.

Increasing awareness of psychological trauma within the osteopathic field through trauma-informed care and training in undergraduate and postgraduate osteopathic education would benefit both therapist and patient. The collaboration between osteopathy and psychotherapy proves potentially beneficial for therapy outcome, addressing both top-down and bottom-up processing of trauma, and focusing on the health and resilience of the person rather than the pathology or diagnostic term.

Abstract (Nederlands)

De motivatie voor dit kwalitatieve literatuuronderzoek kwam voort uit de wens om het bewustzijn van psychologisch trauma en de fysiologische effecten ervan te vergroten, en de mogelijke rol die osteopathie zou kunnen spelen als aanvullende therapie bij traumabehandeling. Dit was gedaan door de fysiologie van de traumareactie te onderzoeken, wat een waardevolle richting gaf aan het onderzoek. Inspiratie werd gehaald uit de polyvagaal benadering van trauma, en het concept dat trauma meer over de reactie gaat in plaats van de gebeurtenis.

De voor- en nadelen van verschillende therapieën, zowel top-down als bottom-up benaderingen, worden besproken, en wat hun bijdragen aan traumaherstel zijn. Bovendien onderzoekt deze review vroegere en huidige samenwerkingen tussen osteopathie en psychologie, en suggereert welke mogelijke voordelen er zijn in verdere gezamenlijke inspanningen tussen de twee met betrekking tot de resultaten van traumatherapie en onderzoek.

Bij het overwegen van meer objectieve vormen van meten in traumatherapie en onderzoek, zoals heart rate variability, wordt niet alleen rekening gehouden met de subjectieve feedback, maar ook met de fysiologische componenten van de traumarespons en autonome activiteit, en de waarde ervan als mogelijke marker van 'resilience'. De vraag is of het versterken van resilience kan helpen bij traumaherstel, en bij het verminderen van vatbaarheid voor toekomstige tegenslagen, en welke rol osteopathie kan spelen bij het faciliteren van resilience. Dit artikel gaat ook in op de beschikbare middelen en training met betrekking tot trauma binnen de osteopathie, en of osteopaten voldoende toegerust zijn om mensen met een traumageschiedenis te behandelen, en om om te gaan met hun reacties.

De bevindingen van dit literatuuronderzoek toonden aan dat osteopathie een waardevolle vorm van complementaire therapie kan zijn bij het herstellen van trauma en een rol kan spelen bij het voorkomen van de ontwikkeling van traumastatoornissen, vanwege de benadering van de hele persoon en door het faciliteren van de parasymphatische activiteit en interoceptief bewustzijn, waardoor het zelfregulerend vermogen wordt geoptimaliseerd. Hierdoor kan osteopathie helpen bij het vergroten van de resilience en daardoor de gevoeligheid voor toekomstige tegenslagen verminderen. Op dit gebied is echter meer onderzoek nodig.

Het vergroten van het bewustzijn van psychologisch trauma binnen het osteopathische veld door middel van traumagerichte zorg en training in niet-gegradueerde en postdoctorale osteopathische opleidingen zou zowel de therapeut als de patiënt ten goede komen. De samenwerking tussen osteopathie en psychotherapie blijkt potentieel gunstig voor het therapieresultaat, waarbij zowel de top-down als de bottom-up verwerking van trauma's wordt aangepakt en waarbij de nadruk ligt op de gezondheid en resilience van de persoon in plaats van op de pathologie of diagnostische term.

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Abbreviations

ACTH	Adrenocorticotrophic hormone
ANS	Autonomic Nervous System
CBT	Cognitive Behavioural Therapy
CRI	Cranio Rhythmic Impulse
CN.II	Cranial Nerve Opticus
CN.III	Cranial Nerve Oculomotorius
CN.IV	Cranial Nerve Trochlearis
CN.V	Cranial Nerve Trigeminus
CN.VI	Cranial Nerve Abducens
CN.VII	Cranial Nerve Facialis
CN.VIII	Cranial Nerve Vestbulocochlearis
CN.IX	Cranial Nerve Glossopharyngeus
CN.X	Cranial Nerve Vagus
CN.XI	Cranial Nerve Accessorius
DMNX	Dorsal Motor Nucleus Vagus
DSM-V	Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition
EMDR	Eye Movement Desensitisation and Reprocessing
NA	Nucleus Ambiguus
OMT	Osteopathic Manipulative Therapy/Treatment
PAG	Periaqueductal Gray
PTSD	Post traumatic stress disorder

Introduction

Trauma is more common than we think. At least 70% of the population will experience trauma in one form or another at some point in their life (Kessler et al, 2017). What defines trauma, though, and more importantly, what determines our susceptibility to psychological distress following a traumatic event?

Trauma is about the response to the event, not the event itself. Can resilience play a role in determining our susceptibility to and recovery from trauma? One hypothesis is that osteopathic therapy can enhance our self-regulatory and self-healing capacity, improving resilience, and thereby assist in recovering from trauma, and building a stronger foundation from which to adapt to future adversities.

Our response to trauma is instinctive and autonomic. When our neuroception senses danger, our body reacts before our cognitive brains have time to think. The autonomic nervous system responds with either sympathetic hyperarousal of fight or flight, or immobilisation stimulated by the dorsal vagal complex. The physiological effects of trauma can be extensive and have considerable impact on the neurobiological, neuroendocrine and immune systems, derailing the HPA axis, increasing the subcortical activation and decreasing the activity of the cognitive processes, and social engagement system of the ventral vagus. If the restorative process is hindered, trauma can overwhelm the adaptive capabilities (p.38, Levine, 1997). Due to the unavailability of top-down processing, a more bottom-up approach to therapy, addressing the autonomic nervous system and faulty neuroception as osteopathy does, may prove beneficial.

Osteopathic therapy studies have shown to positively influence the outcome of individuals with post-traumatic stress disorder, anxiety and stress. Research also shows that osteopathic therapy has the potential to positively influence the HRV in healthy individuals, a commonly used marker of autonomic function, mental and physical health, and resilience. It has been proposed that the mechanisms of these effects are most likely due to manual stimulation of specific receptors in the fascia that promote parasympathetic activity and enhance interoceptive awareness, as well as the effects of the therapist-patient relationship, and the osteopathic philosophy of treating the whole being or triune. All of these factors may have a significant influence on trauma therapy outcomes.

The higher an individual's resilience, the less possible risk there is of developing post-traumatic disorders, or the more the individual can cope and adapt to a previous trauma. What are the factors involved in resilience and how can we best enhance the capacity of the organism to resiliently adapt to adversity? HRV may be able to measure the activity of the autonomic nervous system, and in turn, be a factor in determining mental health and risk and/or resilience factors in relation to trauma. Subjective self-reports have long been used in trauma studies, however the use of an objective, non-invasive biomarker

such as HRV may prove useful in determining the physiological measurements as well as the subjective components.

There has been much research done on the effects of psychotherapy on trauma-related disorders such as PTSD. Body-oriented forms of psychotherapy are now beginning to receive more attention, as advances in neurobiological research reveal the effects of trauma on the brain and hormonal regulation, suggesting that a subcortical approach may prove beneficial.

Studies have shown that the combination of both psychotherapy and osteopathy has an optimised therapy outcome compared to just psychotherapy alone. This shows promise for future collaboration between these two fields in the recovery from trauma, however, research up until now has been limited.

There is strong evidence to suggest that osteopathy may be a valuable form of complementary trauma therapy, however this also raises the question of whether osteopaths are sufficiently equipped to treat individuals with post-traumatic disorders. One answer to this could be more preparatory training, both pre and postgraduate, to create more awareness, and a safer, more trauma-informed practice, providing the necessary tools needed to deal with the trauma response and patient's response to therapy.

Helen Keller (1903) said, "Although the world is full of suffering, it is also full of the overcoming of it." Ultimately, there is a need for a more person-centred, holistic approach to treating trauma, one that looks at the health and resilience of the person rather than the pathology or diagnostic term.

Methodology

This thesis took the form of a qualitative literature review. The main question posed was whether osteopathy could play a role as a complementary therapy in the treatment of psychological trauma, by enhancing resilience, facilitating the self-regulatory, self-healing capacity and autonomy of the individual, to better deal with the effects of trauma, either from the past or as a foundation for future adversities. The question was also raised over the potential benefits of HRV as a biomarker of autonomic activity, health and resilience, concerning both trauma research and therapy outcome, and whether this may promote further collaboration between osteopathy and psychotherapy. Additionally, the question was raised over whether osteopaths are sufficiently equipped to treat individuals with traumatic disorders and to deal with patient's response to therapy.

There is a wealth of information regarding the topic of trauma and resilience, and in relation to psychology, however, in relation to osteopathy, scientific evidence is limited. In identifying sources for this qualitative literature review, several databases were used: *Pubmed, Google Scholar, researchgate, and Cochrane Library.*

Other search methods and resources included:

Osteopathic educational institutions (College Sutherland, European school of osteopathy, Scuola di osteopatia EDUCAM), other institutions (Upledger Institute), podcasts related to trauma and resilience, and recommendations of trauma literature from osteopaths and psychologists.

The keywords used in this search were:

Trauma, psychological trauma, psycho-emotional trauma, emotional trauma, trauma and stressor related disorders, PTSD, psychological distress, chronic stress, neurobiology, physiology, neuroendocrinology, autonomic nervous system, autonomic function, resilience, psychological resilience, emotional resilience, physiological resilience, physical resilience, osteopathy, osteopathic therapy, osteopathic treatment, osteopathic manipulative treatment, craniosacral therapy, heart rate variability, cardiac vagal tone, respiratory sinus arrhythmia, interoception, interoceptive awareness, fascia, homeostatic capability, allostasis, allostatic overload, psychotherapy, cognitive behavioural therapy, body oriented psychotherapy, body oriented therapy, somatic therapy interventions, trauma therapy

These keywords were then combined, which presented an overabundance of literature. The inclusion and exclusion criteria then minimalised and gave focus and definition to the search.

Inclusion criteria:

Languages: English, Italian, Dutch, German, human trials, both published and unpublished studies (osteopathy)

Exclusion factors:

Other languages apart from idem, pharmacological interventions, physical trauma, prenatal, perinatal, postnatal trauma studies, animal trials.

However, exceptions to these exclusion criteria were included when articles of interest were presented within other literature, and that could offer information to support the thesis.

When a search gave excessive results, the specificity of the terms was enhanced, and preference went out to limiting the data to more recent literature studies and meta-analysis studies. The sources were then analysed for quality, and specificity to the thesis topic, and a selection of literature was made on basis of this.

Examination of the data created space for more questions and therefore more researching. The search methods used in this part of the process were a combination of database research and collecting articles of interest within the already chosen literature.

The author made a choice to take a broad perspective on the topic of trauma instead of a more specific approach. This gave an overall sense of the literature available and what research has been done and not done, and which specific areas need improvement and advancement. The form taken of a broader qualitative literature review has created the opportunity for the inspiration and direction of future studies on this topic.

Chapter One: What is trauma?

“Trauma does not define an individual. Nor does it have to be a life sentence. It is, however, a part of life”
(p.2, Levine, 1997)

1.1. Definition

Trauma can be defined as a deeply distressing and emotionally overpowering event or series of events that overwhelms the individuals coping mechanisms. It can be a threat to life, physical integrity or sanity (Pearlman & Saakvitne, 1995, p. 60 as cited in Spring, C, 2012).

At least 70% of people will experience at least one traumatic experience in their life (Kessler et al., 2017). How the individual reacts to this trauma and why some individuals are more susceptible to psychological distress than others suggests that trauma is not about the event, but about the response of the individual. In particular, it is about the physical, psychological, and emotional resilience of the individual (Mutinga, 2017). This then raises the question: what determines our individual response to trauma and what makes some people more resilient than others?

The etymology of the word trauma dates back to the late 17th century from the Greek noun meaning ‘wound’. It stems from the root ‘tere’ signifying “to rub, turn” (Online Etymology Dictionary, 2020). In 1894, trauma was described as a “psychic wound, unpleasant experience which causes abnormal stress” (ibid). However, it wasn’t until 1980 that the Diagnostic and statistical manual of mental disorders (DSM) included psychological trauma and PTSD in its third edition (Ringel & Brandell, 2012). Nowadays, the definition of trauma is still up for debate and the question still remains: is it psychological or physical or both?

When considering this question, we can perhaps draw from Einstein's words to Werner Heisenberg from his 1926 Berlin lecture regarding quantum mechanics (Salam, 1990, cited from Fullbrook, 2012), “whether you can observe a thing or not depends on the theory which you use. It is the theory which decides what can be observed.” Borrowing from this idea, how we see and treat trauma depends on whether one follows the ideology of allopathic or holistic therapy.

Allopathic medicine often follows the concept of mind/body dualism, the unity of being is split in two parts: the soma (or physical body) and psyche(mind). There can be a greater psychological or somatic reaction to any type of traumatic experience, but often, the therapy given relates to the event itself. However, there can also be psychological damage

presented after a seemingly physical injury from an accident, just as being emotionally abused can present itself in physical issues and disease.

The holistic approach sees the individual as a whole being, much like the osteopathic philosophy of the triune; the unity of body, mind and spirit. We live our lives holistically, our perception of the environment is taken in with all five senses, not just one. We cannot separate these senses because they exist as one. It makes sense therefore that trauma affecting the whole being be treated holistically.

Peter Levine (1997), a somatic bodyworker and the author of the renowned trauma book 'Waking the Tiger' said "People don't need a definition of trauma. We need an experiential sense of how it feels." (p.38) It is often the feeling, or interoception, and the unconscious detection of safety and danger that is disturbed in victims of trauma. Interoception, or the sense of the internal state of the body is of great importance in preventing the accumulative effect of post-traumatic stress (Haase et al., 2016). It is sometimes called the sixth sense. An altered sense of interoception has been linked to post-traumatic stress disorders (Wald and Taylor, 2008), somatoform disorders (Mirams et al., 2012; Schafer et al., 2012, cited in Edwards et al., 2018), depression and anxiety (Paulus & Stein, 2010), and dissociative disorders (Hankin, 2012; Michal et al., 2014; Sedeno et al., 2014, cited from D'Alessandro, Cerritelli & Cortelli, 2016) and chronic pain (Schmidt et al., 1989, cited from idid).

In order to bring back awareness and interoception, we must first create a feeling of safety. Our evaluation of safety and danger in the environment is an unconscious process. Scientist Stephen Porges, renowned for his Polyvagal theory, termed this process 'neuroception' (Porges, 2003; 2004; 2017, p.243). When we sense imminent threat or danger, the reptilian (brainstem) and mammalian brain (emotional brain or limbic system), which are phylogenetically older than the neocortex, instinctually react. Normally, after the danger has passed, the body is brought back to balance. However, if the restorative process is challenged, the inherent self-regulating capacity becomes derailed (p.38, Levine, 1997).

1.2. Associated symptoms

The four core reactions of trauma are hyperarousal, dissociation, constriction and feelings of helplessness (p.147, Levine, 1997). The stress response activates the sympathetic nervous system, and the HPA axis, causing a massive wave of energy to course through the body, creating a state of hyperarousal and enabling 'fight or flight' reaction. The body works efficiently by constricting blood to areas that are less needed in a life-threatening situation, such as the gastrointestinal tract and skin, and allows more circulation to enter the lungs, heart, and muscles of defence and action, in order to further enable the fight and flight capabilities. If the situation does not allow an escape or fight, then the dorsal vagal complex of the parasympathetic system is activated and causes the body to freeze

or immobilise, as a survival mechanism. These feelings of helplessness and dissociation occur when we believe that we cannot escape the threat (p.127-144, Levine, 1997).

An animal's reaction after a traumatic, life-threatening event or situation is to move, or physically shake, ridding themselves of the traumatic energy that has built up. Trauma occurs when biology turns into pathology, and the built-up energy cannot be resolved (Levine, 1997). Certain symptoms may occur immediately or may show up weeks or months, even years after the actual traumatic event or series of events (Mutinga, 2020). The first to appear are usually the four core symptoms, however, other symptoms may include emotional dysregulation, anxiety and panic attacks, somatisation, avoidance of stimuli that trigger a reminder of the event, amnesia, numbing, alexithymia, abrupt mood swings, aggressive outbursts, sleep problems, difficulty with cognitive processes, and triggers and flashbacks.

Trauma often presents itself in somatisation, as pain or dis-ease in the physical body. It may present itself as a 'difficult' body in therapy. This is widely termed psychosomatic, however this term is contradictory because the psyche and soma are always connected (Calsius, 2020).

Somatoform symptoms can include dizziness, tinnitus, hypersensitivity to certain sound frequencies and light, gastro-intestinal disturbances, headaches, chronic fatigue, neck and back pain, heavy premenstrual symptoms, and certain immune system problems. (Centre for substance abuse treatment, 2014, p.147-149, Levine, 1997). Many of these somatic complaints have no obvious explanation and are therefore often cast aside as purely mental.

There is evidence that chronic pain may stem from early childhood influences. Leisner and colleagues (2014) linked maltreatment and childhood abuse to chronic back pain. Migraine (Tietjan et al., 2010), altered pain processing (Tesarz et al., 2016) and stress related disorders (Van Houdenhove, 2007) have also been related to childhood trauma (cited in Calsius, 2020).

Studies from Bevans et al. (2008), McEwen (2002) and Sinha (2008) showed that exposure to lifetime trauma has a considerably large impact on physical and psychological well-being, with a greater risk of developing stress related disorders and negative health conditions (Seo et al., 2018). Of all the psychiatric disorders, post-traumatic stress disorder (PTSD) has the most medically unexplained symptoms (Andreski et al., 1998, cited from McFarlane 2010), and higher risk and occurrence of a large variety of medical conditions (Sareen et al. 2007; Seng et al., 2005; Anderson et al., 2010; Pietrzak et al., 2011; Stam, 2007; Weisberg et al., 2002) including gastrointestinal, cardiovascular, respiratory, musculoskeletal, neurological and immune-mediated disorders, chronic pain, diabetes, and sleep disorders (cited from McFarlane, 2010). Another study done by the US department of Veteran's Affairs and published in 2007 (Kubzansky LD, Koenen KC, Spiro, cited in McFarlane, 2010) showed that the level of post-traumatic symptoms increased risk of cardiovascular disease, and not the PTSD diagnosis itself.

Statistics show that one in three women and one in six men have experienced contact sexual violence, and one in five or 19.1% of women and 1.5% of men have been raped (The national intimate partner and sexual violence survey, 2017). 52% of women and 17% of men who have been sexually assaulted will develop PTSD symptoms, with roughly the same percentage worried for their safety.

Somatic disorders that can arise from sexual assault may include chronic pain, asthma, chronic headaches, sleep problems, difficulty in daily tasks, and irritable bowel syndrome (Luce et al., 2010), as well as genital and reproductive system disorders, cardiopulmonary disorders, neurologic symptoms, depression and PTSD (Jina & Thomas, 2012, cited in Cuevas et al., 2018). Over 50% of women with a history of childhood abuse had experienced a state of tonic immobility, or a freezing reaction during an abusive episode (Fuse et al., 2007).

The Diagnostic and Statistical Manual of Mental Disorders, Edition five's (DSM-V) chapter for "Trauma and stressor related disorders" includes the following disorders: reactive attachment disorder, disinhibited social engagement disorder, post-traumatic stress disorder (PTSD), acute stress disorder, and adjustment disorders (APA, 2013). Dissociative disorders, anxiety disorders, obsessive-compulsive and related disorders are not included in the "Trauma and stressor related disorders" chapter of the DSM-V, but all have a close relation to and can stem from trauma. However, the many mental and physical disorders and complaints that stem from trauma do not always fit into the typical response and exact criteria of the DSM-V clinical diagnosis. There is also a high rate of comorbidity (Gupta, 2013).

In a review by Gupta (2013) of studies researching somatic symptoms in PTSD, the risk of developing PTSD was shown as dependent on genetics (Afifi et al., 2010, Skelton et al., 2012), epigenetics (Toyokawa et al., 2012, Zoykic & Sweatt, 2012), behaviour (Afifi et al., 2010), and environmental factors including early life stress (Skelton et al., 2012, Perroud et al., 2011, Affifi et al., 2010). Another review from Kessler and colleagues (2017) studying the WHO World Mental Health Surveys also included the female gender, age (childhood-adolescence and 65+) (Olf, Langeland, Draijer, & Gersons, 2007; Tolin & Foa, 2006) and prior trauma exposure (Breslau, Peterson, & Shultz, 2008; Caramanica et al., 2015) to the list of increasing susceptibility.

1.3. Types of trauma

A traumatic event or situation can range from small to big, often termed as little 't' or big 'T', and can include such traumas as a motor accident, sexual violence, death of family member or friend, witnessing a traumatic event, emotional abuse, neglect, violence, natural disaster, being bullied, or medical procedure trauma.

Types of trauma are categorized into:

- Acute trauma: Exposure to a single overwhelming traumatic experience or event

- Complex trauma: Chronic, multiple and prolonged overwhelming traumatic experience or event, often involves interpersonal relationship
- Developmental trauma: Traumatic experiences either ongoing or repetitive in nature, and experienced as an infant, child or in the youth, such as neglect, physical abuse, assault, sexual abuse or assault, abandonment, emotional abuse, witnessing violence or death, coercion or betrayal. This can cause problems of attachment and development
- Intergenerational trauma: Coping and adaptation patterns can be passed from generation to generation
- Vicarious trauma: Empathetic engagement of a therapist with a patient's traumatic experiences, which can then alter the therapist's functioning

1.4. A brief history of trauma therapy

It has been a battle to define trauma throughout history. Many differing terms over the years such as dissociation, hysteria and somatisation are all pointing to the same thing: the somatic response to psychological trauma and PTSD (Gupta, 2013). It wasn't until 1980 that psychological trauma and PTSD were included in the DSM (p.5, Ringel & Brandell, 2012).

Trauma is a part of life and has been a fact of life all throughout history. We see it in works of art, read it in literature, poetry, Shakespeare and Greek mythology, hear it in the songs of our ancestors, and feel it in our bodies, whether experienced in our lifetime or passed on through generations.

The concept of building resilience to successfully adapt to stressors and traumatic events is not new. The ancient Greeks were already employing resilience tactics to young warriors in preparation for the traumatic experiences of war (Nash et al. 2011, cited from p.85, Friedberg & Malefakis, 2018). This preventative therapy continues today for pre-, present, and post trauma in various forms ranging from meditation, cultural and religious rituals, to stress inoculation therapy and resilience training.

In the 1820's, the concept of body-mind interaction was already being expressed. Anatomist Herbert Mayo thought in 1835 that chorea could be caused by fright, affecting the peripheral muscles and nerves via the cerebrospinal nervous system (p.170, Mayo, *Outlines of Human Pathology* (London, 1835), cited from p.215-216, Harrington, 2003). In the mid to late 19th century, 'railway spine', a term given to victims of railroad accidents, was believed by John Eric Erichsen, a well-known surgeon, to be of organic origin (Harrington 2003). It was described as an 'inflammation of the spinal cord in the absence of spinal fracture, with potential psychological overlay' (Cited in Gasquoine 2020). However, many cases of 'railway spine' had no obvious organic injury despite the various somatic disorders and complaints that arose (Harrington 2003).

Herbert William Page, another prominent surgeon, believed that the psychological shock and emotions of such a traumatic accident could cause 'universal nervous shock',

exhaustion of the nervous system caused by fright (Gasquoine 2020). Page believed this shock also to be of organic origin. The symptoms of 'railway spine' were very much similar to the symptoms of psychological distress and PTSD today. Interestingly enough, the likelihood of receiving compensation from a railway injury was considerably higher when of organic origin, which also influenced the conceptualisation of trauma in the twentieth century.

'Hysteria' was also believed to be of organic origin, originating from the uterus, and hysterectomies were often performed as a cure, most likely causing more trauma than healing. However, in the 1880's, Freud, Breuer, Charcot and Janet concluded that hysteria was more psychological in nature than physiological. Freud and Breuer stated that a hysterical attack was "the recurrence of a physical state which the patient has experience earlier." (Van der Kolk, Weisaeth, et al., 1996, p.30, cited from Ringel & Brandell, 2012, p.2). The symptoms of hysteria were dissociative problems and were treated with catharsis, hypnosis and re-exposure techniques (van der Kolk, Weisaeth, et al., 1996, p.50, cited from Ringel & Brandell, 2012, p.1).

The late 19th century gave birth to the prequel of the psychoanalytic era, where touch was not yet controversial. Pierre Janet studied the relationship between neurotic structures and muscle tension, and endorsed the use of touch and massage therapy (p.5, Calsius, 2020). Even Freud used pressure and massage within treatments. However, from the beginning of the twentieth century, Freud's psychoanalytic era, talk therapy was the new norm and touch was taboo.

World War I came and brought with it the term 'shell shock' syndrome, a 'traumatic neurosis' experienced by soldier's post conflict, which can be equated to PTSD nowadays (Van der Kolk, 2014). Psychiatrist Abram Kardiner, believed that traumatic neurosis was physiological (p.11, Van der Kolk, 2014). He questioned the efficiency of re-enactment therapy, seeing stabilisation therapy as perhaps more fitting than reliving the trauma (Ringel & Brandell, 2012).

World War II then brought with it the diagnosis of 'alexithymia', introduced by psychoanalyst Henry Krystal after his study of prolonged traumatising on concentration camp survivors. Many could not 'experience, interpret or verbalise feelings' and symptoms of post-traumatic stress were often somatised (p.60, Van der Kolk, Weisaeth et al., 1996, cited from Ringel & Brandell, 2012).

Following on from this, the 1970's brought a new revolution of biological reductionism (McFarlane, 2010) and the Vietnam war. The official diagnosis of PTSD was accepted into the DSM-III in 1980, which motivated researchers to find more efficient therapy for soldiers and their immediate families (p.19, Van der Kolk, 2014). However, the inclusion of PTSD in the DSM did not encompass complex or developmental trauma. In 1992, Herman brought the idea of complex trauma forward, and later in 2005, Van der Kolk pushed for a developmental trauma diagnosis (p.7, Ringel & Brandell, 2012).

The women's movement then brought awareness to the reality of psychological trauma in women. In a 1980's survey (Russell, 1984, cited in p.5-6, Ringel & Brandell, 2012) it showed that one in four women had been raped, and one in three women had been sexually abused in childhood. Women's therapy groups were founded, and the first rape crisis centre in America opened in 1971 (Ringel & Brandell, 2012).

During the 1990's and early 2000, there was a growing recognition of complex and developmental trauma. The field of psychology has rapidly expanded in the last few decades, and body oriented psychotherapies have been gaining in popularity and are now being acknowledged for their success in trauma therapy recovery (Ringel & Brandell, 2012).

1.4.1. Somatisation of trauma and body psychotherapy:

Somatisation has always been a part of psychological trauma; it has just been given different names or concepts. The idea of somatic psychology already began with Janet and his inclusion of the body and its relations in therapy, and continued with Wilhelm Reich (1897-1957), one of the second-generation psychoanalysts after Freud, and a pioneer of body psychotherapy.

Reich linked tensions and patterns within the body to an individual's character structure. His term 'muscle armour' was the "experience-dependant development of a protective shell of muscle tension grown over time in response to a history of threat, anxiety and trauma" (in Fogel, 2009, p.196, cited from p.71-74, Calsius, 2020). He used the body as an entrance, releasing the tissue, and the built-up emotions, to allow the self-healing capacity of the individual to occur. Reich was inspired by Fenichel (1897-1946), the founder of the forerunner to body awareness therapy, Gindler (1885-1961) and her somato-educational work with remedial gymnastics, and Lindenberg, student and dancer of Rudolph Laban, a famous dance choreographer. This would form the basis for his vegetotherapy and character analysis.

Gerda Boyesen (1922-2005) took Reich's idea of congested emotional energy within the muscles further and included the viscera (psychoperistalsis) and connective tissue in therapeutic treatment (p.71-74, Calsius, 2020). Other methods within the body psychotherapy include the Gendlin focusing method by Eugene Gendlin (1926-2017), the holotropic breath work by Stanislav Grof (1931) and Gestalt therapy by Fritz Perls(1893-1970)(Heller, 2012, cited in p.7. Calsius, 2020).

Although these methods all come under the same body psychotherapy term, they utilise different methods. For instance, the Gendlin focusing method uses verbal communication but no touch, whereas Reichian therapy uses touch. What does correspond in the body psychotherapy concept is that it combines and integrates the physical and psychological aspects in therapy and uses body-orientated interventions within a psychological-psychotherapeutic framework. The aim of the therapy is not the somatic structures and processes themselves but in utilising them as a 'means' (p.7-8, Calsius, 2020).

Osteopathic philosophy follows the same principles that the body has an innate self-healing, self-regulating capacity. In 1914, Still opened the Still-Hildreth Sanatorium (SHS) in Missouri, a centre for osteopathic treatment of mental and nervous diseases, where osteopathy formed the base therapy. The approach was holistic and included complementary relaxation, recreational activities and family therapy, integrating the social and family network into the process of treatment. In 1917, Still noted the great success rate of the Sanatorium compared to the Colorado Psychopathic Hospital, with a total recovery rate of 35% compared to 3%.

From the reports of treated patients, five out of eight patients with trauma-induced disorders experiences a full recovery, one patient saw improvement and two patients saw short-term improvement.

J.R. Lewis wrote in his book about AT Still in 2013, that some of Still's most profoundly mentionable results were from treating traumatically induced mental disorders. Still himself noted in 1917 that the "majority of the insane patients could be treated successfully by osteopathy."

Certain psychiatric disorders were distinct from others via certain somatic traits, for example, hysteria was more often related to hypotonicity than hypertonicity (Ching, 2015). Of course, treatment depended always on the individual. Dunn, co-founder of the SHS, said that OMT or Osteopathic Manipulative treatment was used to "normalise the structural integrity of the body, providing a foundation from which psychotherapy and other therapies could be more effectively employed." (Fitzgerald, 1988, cited from Ching, 2015).

1.5. Awareness and treatment of trauma

"In order to change, people need to become aware of their sensations and the way that their bodies interact with the world around them. Physical self-awareness is the first step in releasing the tyranny of the past." (p.101, Van der Kolk, 2014)

How do we move through trauma? The emphasis is on the word 'move', because the process of healing and building resilience is a dynamic one. Indeed, the word 'emotion' stems from the Latin root 'e-movere' meaning to 'move' or 'move out'.

Darwin (1809-1882) believed the function of emotions were for survival purposes, something to set us in physical motion in order to restore us to safety and balance (p.75, Van der Kolk, 2014). As emotions move us, so too does trauma, both physically and mentally. The force may not always be of a physical nature, however, as the law of physics says, if the force is unopposed, it will change the motion of an object.

Osteopath Edward Mutinga (p.46-59, 2019), sees shock, caused by trauma, much like a shock wave that moves through the body, its direction and outcome dependent on the

force received. While this physical phenomenon is usually only applied to mechanical trauma, we can also relate it to psychological and emotional trauma.

There are many forms of trauma therapy. The goal of this thesis is not to include and define all trauma therapies but to give a brief summary of certain therapies, with the focus on the efficiency of somatic based therapy, specifically osteopathy, and the importance of interoception and the autonomic nervous system in the role of treating trauma.

Psychological trauma can be treated with 'top-down' or 'bottom-up' therapy. 'Top-down' uses the cognitive processes as an entrance, and 'bottom-up' therapy refers to the subcortical approach, and the relation to the sensations in the body. However, both bottom-up and top-down approaches can affect one another.

1.5.1. The 'top-down' approach

Traditionally, psychotherapy uses the 'top-down' approach, engaging the intentional and conscious processes of the cerebral cortex (Taylor et al., 2009, cited in Liem, 2020). Understanding and insight are the most important factors in 'top-down' therapy, enhancing the communication between the cerebral cortex and limbic and brainstem structures involved in neuroendocrine, autonomic and emotional behaviours (Craig, 2002; Critchley et al., 2001; Saper, 2002 cited from Liem, 2020).

Forms of psychotherapy stem from the psychoanalytical, psychodynamic, behavioural, and humanistic approach, with many sub-branches forming from these concepts. EMDR is a form of exposure-based psychotherapy which emerged in the 1990's, showing that there were other beneficial options available apart from the traditional talk therapies known in psychotherapy. EMDR uses the 'top-down' approach, a sort of cognitive re-training technique that utilises the repetition of bilateral eye movement, or the rhythmic tapping of bilateral body parts whilst thinking of their traumatic experience, demanding the focus of dual attention (Ehnholt, 2006, cited in Tait, 2012). However, EMDR also uses the body to have effect on the cognition, so we could argue that it also combines aspects of the 'bottom-up' approach. There is no chronological narrative, so the patient is free to move through time, and fragment the memory. Verbal communication is allowed but is not compulsory. The mechanisms of this approach are not completely known, however Van der Kolk (2011) hypothesises that it may calm down the thalamus. Tait (2012) suggests that osteopathically, we can see EMDR as a catalyst, allowing the individual to temporarily adapt to their lesion (the original lesion state from the trauma).

In a study by Van der Kolk and colleagues (2007), the use of EMDR in PTSD proved more effective than pharmaceutical treatment (fluoxetine) alone and pill placebo. Post therapy, the majority of the participants were asymptomatic, and 88% lost their PTSD diagnosis. Although the fluoxetine and placebo both had an effect, though somewhat milder, the follow-up at six months showed that 57% of the participants that completed EMDR were asymptomatic, compared to none of the pharmaceutical group. The adult-onset trauma participants benefited more from the EMDR compared to child-onset trauma participants.

The majority of the child-onset group did not have complete remission in response to either treatment approach, backing neuroscientific research that there is a definite physiological difference to the trauma response between children and adults (Van der Kolk et al., 2007). Van Etten and Taylor (1998, cited in Van der Kolk et al, 2007) showed that EMDR and CBT were the most successful forms of psychotherapy for PTSD.

Clinical hypnosis and to some extent, mindfulness, can be also grouped under the 'top-down' approach, although this is arguable because of the somatic awareness and focus involved in mindfulness, such as paying attention to breathing and heart rate. The most well-known 'top-down' therapies are cognitive behavioural therapy and psychodynamic therapy. They are widely used and continue to be taught in schools. Thanks to financial support and backing, CBT especially has extensively contributed to evidence-based medicine research on psychological trauma and proved to be successful in their results (Bradley et al., 2005).

Prolonged exposure (PE) is a form of cognitive behavioural therapy and consists of repeatedly recounting and confronting the traumatic event, until the emotional response reduces, and it becomes safe to recall the memory of the fear-evoking trauma. It has become a first line treatment in PTSD due to its positive results in treating PTSD in civilians (Eisenman et al., 2006; Bisson et al., 2007; Harvey et al., 2003; Foa, 2006; Rothbaum & Schwartz, 2002, cited in Yehuda et al., 2010) and in women with a background of interpersonal violence (Foa et al., 1999; Rothbaum et al., 2005, cited in Yehuda et al., 2010).

These studies show a decrease in symptoms, and in PTSD diagnosis for 65-95% of the individuals who completed prolonged exposure treatment. However, studies from Schnurr and colleagues (2007) and Monson and colleagues (2006, cited in Yehuda et al., 2010) give evidence that contradict the success of CBT for PTSD. Schnurr and colleagues (2007) studied the effects of prolonged exposure therapy on female veterans. This prolonged exposure therapy group was compared to a control intervention, present-centered therapy. Improvement was measured immediately after the treatment period for both groups, however the prolonged exposure therapy symptoms returned after six months.

This study shows the possible immediate and short-term effectiveness of prolonged exposure therapy, however long-term benefits in this particular study are lacking as seen by 59% that remained with PTSD diagnosis after three months of treatment, and 78% with remaining symptoms at a six-month checkup. There was also a large dropout rate from prolonged exposure, with only 87 female veterans left from 141. Furthermore, as exposure therapy is based on desensitization, it not only desensitizes the trigger to traumatic memory but also has effect on all emotions and engagement, and therefore numbs the individual's sense of happiness, pleasure and other feelings (Van der Kolk, 2017).

The outcome is much less significant when compared to previous male-only veteran studies, and the beneficial effects of various forms of CBT on PTSD (Glynn et al., 1999; Keane et al., 1989; Monson et al., 2006; Ehlers et al., 2005; Marks et al., 1998; Bryant et al., 2003, cited in Schnurr et al., 2007). However, how trauma is processed remains very individual and there may be differences considering gender, as well as the fact that sexual trauma accounted for 70% of traumatic experiences in this women only study. It would be interesting to further explore the differences here and see how this can relate to and improve the treatment of women and trauma in the osteopathy.

Despite the practice guidelines for PTSD noting the benefits of CBT and prolonged exposure (APA, 2004; VA/DoD, 2003, cited in Schnurr et al., 2007), and the meta-analytic findings that proclaim these therapies to have the greatest effect (Van Etten & Taylor, 1998; Bradley et al., 2005, cited in Schnurr et al., 2007), they are not often used in practice. Why is this? Despite the evidence showing that psychosocial interventions have a great effect on treating PTSD, Bradley and colleagues (2005) also indicated in their meta-analysis that less than 50% of patients receiving CBT had clinically significant improvements, and many symptoms remained. Therapies that were reviewed were grouped into exposure therapy, CBT, CBT and exposure therapy, EMDR, supportive control and waitlist control. A majority of the studies looked at short-term outcomes and failed to present follow-up data. Only two of the 26 studies showed outcomes beyond the six-month mark. Looking at long-term outcomes is necessary with long-standing, chronic disorders such as PTSD. Most inclusion criteria were overly strict, and often excluded comorbidity, which makes up a great deal of the PTSD patients. 30% of patients referred for treatment were excluded from clinical trials on PTSD, but this is probably an understatement. Therefore, many of these studies cannot be fairly applied to the general PTSD population.

In combat veterans, the results are less effective (Yehuda et al., 2010; Bradley et al., 2005). This may be due to the complexity of war trauma, the hesitance to disclose, and the duration and multitude of the stressor/stressors. They may feel trapped between the role of victim and perpetrator, knowing that they had indeed consciously and willingly signed up for their job, and trained and prepared for situations, being fully aware of what the consequences may be. PTSD in combat veterans has a greater comorbidity, including anxiety and other psychological disorders. In comparison, a civilian is often unprepared and unaware of the traumatic experience that awaits them (Yehuda et al., 2010), although it is worth noting that interpersonal violence and other types of trauma may and do often entail multiple exposure.

In a 2008 research assessment of PTSD treatments by the Institute of Medicine, the scientific findings were qualitatively insufficient for such a serious and frequent disorder (Institute of Medicine, 2008). Often, the drop-out rate of participants in CBT studies is high, such as is seen in the study by Schnurr and colleagues (2007) with a drop-out rate as high as 38%. The inclusion criteria is often very strict, leaving out many cases of complex and developmental trauma (McDonagh, 2005; Zayfert, 2005, cited from Corrigan & Hull, 2014). There is an 80% rate of co-morbidity in PTSD, and most of these cases do not fit

into the inclusion criteria. As a result, the most common and severe cases are overlooked (Spinazzola, Blaustein, van der Kolk, 2005 cited from Joyce, 2011; Corrigan & Hull, 2014).

'Top-down' therapy may be useful for understanding and providing insight into trauma. Cognition is necessary as a way of coping, adjusting, and to help define one's experience after a traumatic event (Boals, 2017), and training cognition in combination with other therapies can be helpful to retrain the right neo-cortex to re-story (Dana, 2019, 00:35:10). However, top-down processing can also inhibit or interrupt the subcortical activity and choose to ignore sensory awareness. The heavy emotions and subcortical reactions from trauma can also hinder the cognitive processing. Due to the nature of trauma, if the prefrontal cortex (the brain's default system) is stimulated too soon, this creates a reliving of the trauma experience which can cause more damage (Panksepp, p.336, 2004, cited in Tait, 2012). There is also a decrease in activation of the neocortex and Broca's area in particular, an area responsible for verbal communication, and a heightened activation of the emotional brain (limbic system), so that many cannot find the words to verbally explain their emotions and experiences (Rauch et al., 1996; Hull, 2002; Lanius et al., 2004; Shin et al., 2004, 2005, cited from Coubard, 2016).

Psychological trauma is pre-verbal. The body speaks when words cannot and talk therapy only provides us with half the story. When traumatised, the body's faulty neuroception can no longer understand the difference between danger and safety, present and past, and the individual may remain on high alert. The automatic responses of the body must be changed in order to live in the present (p.21, Van der Kolk, 2014). This neurobiological phenomenon highlights and emphasises the need to include interoception, experience and action patterns in therapy. However, traditional forms of psychotherapy have not yet caught up with the recent wave of neuroscientific discovery, and thus these changes are not yet completely integrated into these therapies (Ogden et al., 2020, 00:26:23).

1.5.2. The 'Bottom-up' approach

'Bottom-up' therapies work from the bottom up, or from the periphery via ascending pathways to the cerebral cortex. Cytokine expression is decreased and heart rate variability is increased, due to the stimulation of chemosensory, visceral or somatic receptors, and their influence on cognitive processes and central neural processing (Craig, 2002; Berthoud & Neuhuber, 2000; Verberne et al., 2003; Duncan & Moynihan, 1994, cited from Liem, 2020).

However, 'bottom-up' therapies are only now starting to receive the appreciation and recognition that they deserve, as research has been largely dominated by more traditional therapy forms. Van der Kolk (2006) highlighted that the closest amalgamation of body-orientated therapies with mainstream science was in 1973 when Nico Tinbergen received the Nobel Prize and devoted his speech to the Alexander technique.

However, times are changing, and evolving, with more experience, knowledge and neurobiological research in the field of trauma therapy. Research indicates that due to the significant role of the older brain systems relating to trauma, verbal and cognitive

treatments may not be sufficient (Ogden, 2006; Van der Kolk, 2015, cited in Van de Kamp, 2019). A systematic review and meta-analysis of body and movement orientated therapy studies in the treatment of PTSD (Van de Kamp et al., 2019) shows evidence that these somatic orientated therapies may significantly reduce symptoms of PTSD and comorbid depression, as an alternative treatment, or as a complementary therapy to CBT and/or pharmaceutical interventions.

There are many forms of 'bottom-up' therapies, too many to mention and research in detail within the context of this thesis. However, some of the more well-known include osteopathy, somatic experiencing, body psychotherapy, sensorimotor psychotherapy, focusing, Feldenkrais and yoga (Ogden et al, 2020, 00:27:59). 'Bottom-up' therapies are body orientated, and may make use of breath, movement, awareness patterns, interoception and proprioception as tools in the treatment of trauma. Dance and music have also been used as a form of therapy throughout history and across various cultures, in the recovery of trauma. Art moves us in many ways. The Dutch word for art is 'kunst', originally meaning 'kennis', 'wijsheid' or 'kracht': knowledge, wisdom and strength: three beautifully fitting words to move us through the healing process towards a greater resilience (Philippa et al., 2003-2009).

Somatic psychotherapy is a branch of psychotherapy focusing on body awareness, and the embodied self. Wilhelm Reich was a pioneer in body psychotherapy, a form of somatic psychotherapy which has influenced many other somatic therapy forms such as the Hakomi method, and biosynthesis. Body psychotherapy has been credited for its beneficial effects on psychological trauma processing, alexithymia and psychosomatic disorders (Payne, 2015; Van der Kolk, 2014; Fogel, 2009; Ogden et al, 2006; Totton, 2005; Schore, 2003, cited in p.10, Calsius, 2020) and has evolved with the newfound knowledge that we have gained through research. Calsius (2020) uses the term experiential bodywork as a more flexible framework that includes body psychotherapy but is not limited to it. Peter Levine, author of 'Waking the tiger', sees the memory of trauma as held in the body, not in the event itself. He created somatic experiencing based on freeing the 'unresolved traumatic residue' in the body.

In two pilot studies done by Van der Kolk (2006) looking at the effects of yoga on HRV and PTSD symptomatology, there was a remarkable increase in interoception and subjective body awareness in the PTSD group, as well as significant decrease in symptoms. The HRV (SDNN) in the control yoga group improved. Unfortunately, due to accompanying vascular and muscular issues of the PTSD yoga group, their HRV readings could not be included accurately. However, it does highlight the need for more research in this area.

Yoga uses breath, meditation and physical postures to bring balance within the body, mind and spirit. Many studies have shown that yoga positively affects the autonomic function, blood pressure, heart rate, breathing patterns, plasma cortisol levels, urinary catecholamines, muscle strength and regulation of arousal (Van der Kolk et al., 2014). It has been proven to have a positive influence on acute stress reactions (Gerberg & Brown, 2005; Telles et al., 2010; Descilo et al., 2010, cited in Van der Kolk et al., 2014), and

depression and anxiety (Smith et al., 2007; Michalsen et al., 2005; Kirkwood et al., 2005; Pilkington et al., 2005, cited in Van der Kolk et al., 2014).

Mindfulness meditation, which is considered 'top-down' therapy, is beneficial in that it allows one to acknowledge fear instead of ignoring it. It has been shown to enhance affect regulation (Wilamowska et al., 2010; Linehan et al., 1991; Davidson et al., 2003, cited in Van der Kolk, 2014). The mindfulness involved in yoga may be beneficial for individuals with PTSD who may have difficulty in focusing and leading themselves, therefore a more guided approach, with constant referral to the internal sensations, can be an aid (Miller et al., 1995, cited in Van der Kolk et al., 2014), connecting the world of 'bottom-up' with 'top-down' approach.

In a further yoga study done by Van der Kolk and team (2014), they evaluated the effects of yoga as an adjunctive treatment for women with PTSD. Treatment was spread over a period of ten weeks, and the women were required to continue their own personal supportive therapy and medication during the period. The study was composed of two groups, with one group receiving supportive women's health education, and the other group receiving trauma-informed yoga.

Both the yoga and supportive therapy groups improved on the Clinician Administered PTSD scale (CAPS), however there was a significant long-term improvement in the yoga group compared to the control which relapsed around the 5 week mark (Van der Kolk et al., 2014). Yoga, with its mind, body and spirit connection allows the individual to be in the moment without judgement, heightening the awareness of sensation through proprioception and interoception. It utilizes both 'bottom up' and 'top-down' approaches, through physical movement, breath, mindfulness and meditation, and is a valid and helpful form of adjunctive therapy for sufferers of PTSD.

Mind-body therapies mix both elements of the top-down and bottom-up approach, with emphasis on the integration of the body and the mind. Combining interoception, proprioception and mindfulness with supported guidance creates greater body awareness, allowing optimisation of the vagal function, to self-regulate and enhancing resilience of the autonomic nervous system (Porges & Carter, 2017; Schmaltz et al., 2015; Streeter et al., 2012; Muehsam et al., 2016, cited in Liem, 2020).

According to neuroscientific research/evidence, enhancing somatic awareness can optimise resilience (Haase et al. 2015; Haase et al., 2016), and in turn, improve overall health and well-being, leading to a decreased risk of developing post traumatic disorders (Hesketh et al., 2015, cited from Samska, 2018). However, there are two ends of the spectrum with regards to feeling in trauma. Either we feel too little or too much. There may be a heightened sense of somatic awareness, and hypersensitivity to external stimuli, or a numbing or absence of feeling. The goal of therapy is to address this state, whether it be over or under-active, bringing balance back into the system, the yin and yang, parasympathetic and sympathetic.

1.6. The importance of timing, sequence and choice

Timing, choice and order of therapy is also of great importance. A project in Denmark studied the order of various trauma therapies on victims of the Afghanistan and Iraq war. Therapists ranged from traditional psychologists to craniosacral and body therapists. Patients received the same amount of sessions with a different sequence, some beginning with body-oriented therapy, and others with verbal talk therapy. The results showed that participants felt more at ease when the body was initially addressed via craniosacral therapy, enabling a sense of safety which allowed them more room to verbally share their experiences and emotions (Rosenberg, 2020, 06:39:12).

If therapy happens too soon and too forcefully, it can be intrusive; too late and it can be more challenging to treat. The average time between a traumatic event and patient disclosure is fifteen months (Fraterolli, 2006). However, it is very individual. Survivors of the 9/11 disaster were treated based on the critical incident stress debriefing procedures, where expressing emotions and recalling of the event was encouraged (p.7-8, Ringel & Brandel, 2012). A study by Sherman, Zanotti and Jones (2005) showed that those who preferred not to talk about their traumatic experiences immediately after the disaster fared better in mental health in the respective two years after 9/11 than those who chose to immediately discuss their feelings and personal experiences (p.7-8, Ringel & Brandell, 2012).

Recalling and reliving an already traumatic event can in fact be counteractive to the healing process (p.10, Levine, 1997). Mayou and colleagues (2000, cited in Kearns et al., 2012) showed that traumatised survivors of motor vehicle accidents who had received psychological debriefing immediately after the event fared worse in terms of physical ailments, anxiety, and PTSD symptoms compared to those that received no intervention. It was indicated that debriefing may in fact cause more harm, and that timing is a delicate factor in trauma therapy.

However, there have also been positive effects shown in early intervention such as the study by Rothbaum et al. (2008), which showed that immediate intervention in the emergency department following trauma may reduce depression and distress. The intervention was based on brief exposure, a more subtle method than psychological debriefing, with added breathing techniques, self-care and attention to cognition (cited in Kearns et al., 2012). Early exposure therapy in the emergency department can also lower the severity of depression one month following trauma, as well as PTSD symptoms four to twelve weeks post event (Rothbaum et al., 2012, cited in Kearns et al., 2012). This suggests that some form of immediate therapy following a traumatic event may be helpful, however more research is needed to determine what these factors may be, and what a long-term outcome may be.

A following study from Price and colleagues (2014) showed that early exposure treatment had a positive influence, however it had less effect on individuals that had suffered a dissociation response to trauma. Dissociation response, lower levels of cortisol and a

history of childhood trauma were all factors associated with more severe PTSD symptoms in those that received no treatment. As far as choice of treatment goes, Van der Kolk stated “There is no treatment of choice. There’s a body and mind that does well with certain approaches and doesn’t do well with other approaches.” (Van der Kolk, 2011). Physiology shows us that the autonomic activity and internal sensations must be addressed first in order to be able to understand what we are feeling. However, most importantly, therapy needs to be person-centred rather than patient or protocol-centred and cater to the individual’s specific needs rather than following a ‘one size fits all’ method.

1.7. Culture of trauma

The very nature of trauma is interwoven with culture, politics, context and identity. Each individual culture has its own understanding of what trauma is, and how and who can treat trauma. From shamans enticing the spirit back into the body, to priests ridding the body of spiritual entities, every culture has their own set of beliefs.

In eastern philosophy, the body, mind and spirit are often seen as a whole, without division. Kokoro, a Japanese word that encompasses the three worlds of heart (body), mind and soul, sees no separation within the unity of being. The three aren’t inherently linked as one, “they are one” (Livni, 2017). In western philosophy, the concept is more of dualism, or a splitting of the soma and psyche. However, our emotions unite us. Nummenmaa and colleagues (2014, cited in Grabbe & Miller-Karas, 2017) showed that no matter what the culture, emotions are registered in the body in exactly the same way. This highlights the global suitability for body -based therapies.

The Maori culture uses dance and voice as a form of connection to self and community. The Haka, a ceremonial dance that celebrates life, was used traditionally as a psychological motivator prior to war. It brought the warriors together and attempted to scare off the opponents. We could see this perhaps as a pre-traumatic ritual, enhancing the resilience of the group and the individual before battle, therefore reducing the risk of post-traumatic distress. Nowadays, the Haka is performed at weddings, funerals, as a welcoming dance, at rugby games, and at cultural events. After the mass shooting in Christchurch in 2019, men and women from all over New Zealand came together and performed the Haka in honour of the dead, and as a way of coping both individually and as a community. When words were not enough, movement served as collective healing.

Shamanism sees the weighted burden of trauma and illness carried not only by the individual but by the whole community. Community support is of great importance in the healing process of trauma, and rituals of dance, drumming, chanting, shaking and psychedelic medicine are enacted to bring the spirit back to the body (p.57-61, Levine, 1997). The splitting of the spirit from the body can be seen as a form of dissociation.

Social support, whether in the form of community, friends, family or workplace are of great importance. A study by Brooks et al. (2015, 2016) showed how social support, especially in the workplace, can benefit first responders during a disaster, and that it reduces the risks of developing behavioural health problems (cited from Samsha, 2018). In the aftermath of the LA earthquake in 1994, the families that showed the most resilience were the ones who shared their camps, food, experiences, and time together. Many were from third world countries, with a different cultural background. The question of what leads to greater resilience also asks us to consider the effects of community, different life experiences and expectations, or socioeconomic status. Higher risk of chronic PTSD has been associated a lower socioeconomic status (King et al., 1999; Koenen et al., 2003, cited in McLaughlin et al., 2011). However, here and in the case of survivors of Hurricane Katrina, it was the middle-class families that showed less resilience than those of a lower socio-economic background (McLaughlin et al., 2011).

Many modern cultures tend to put the focus on being strong, soldiering on, and not letting life's adversities get them down. However, that often means that emotions and trauma are ignored or pushed away only to rear their ugly head at a later stage. Acknowledging emotions and trauma and asking for assistance actually requires copious amounts of strength, something that is slowly gaining awareness.

1.8. Diagnosing trauma

In the great words of Andrew Taylor Still, "to find health **should** be the object of the doctor. Anyone can find disease" (p.28, Still, 1899). Within the world of osteopathy, 'should' has gradually become 'is', moving away from the conditional clause and becoming an accepted fact (Stark, 2012). Where allopathic medicine sees the disease first, and then works to rid the body of disease to find and reveal health, an osteopath's goal 'should' be to find health, rather than disease. Van der Kolk recalls asking his teacher Elvin Semrad if he would call one of their patient's schizophrenic or schizoaffective. Semrad took a moment of thought before answering, "I think I'd call him Michael McIntyre" (p.26, Van der Kolk, 2014). Just as Van der Kolk's teacher saw the whole individual before him instead of a diagnostic term, osteopathy follows the same line of thinking. Trauma does not define an individual and an osteopath does not treat disorder or disease. Instead, they look at the whole and find the freedom in mobility and motility.

What constitutes a traumatic event? The DSM-V criteria for a traumatic event in the diagnosis of PTSD is "exposure to actual threatened death, serious injury, or sexual violence" including either directly experiencing it, being witness to, sudden (violent or accidental) death of a family member or friend, or repeated or extreme exposure to aversive details of a traumatic event(s) (p.271, APA, 2013). As a result, an individual who has been subjectively traumatized by being bullied, something that does not meet the threshold of traumatic event criteria, may not be eligible for a PTSD diagnosis, even though it may elicit symptoms similar to those of PTSD (Boals & Schuettler, 2009; Gold, Marx, Soler-Baillo, & Sloan, 2005, cited in Boals, 2017). On the other hand, an individual

that has objectively experienced a traumatic event following the DSM-V criteria, will not necessarily be subjectively traumatized. It is important to recognize that although not all traumatic events will reach the threshold of being defined as objectively traumatic, they can still present with a significant rate of PTSD symptoms and depression. It is therefore crucial to include these factors in trauma research (Boals, 2017).

A higher rate of PTSD symptoms does not always relate to a greater objective traumatic severity (Rubin & Feeling, 2013, cited in Boals, 2017), just as objective traumatic events cannot explain who will and will not experience PTSD. In a study by Boals (2017), of those who had experienced an objective traumatic event according to the DSM-IV criteria, only 37% subjectively experienced it as a high level of event centrality. That compared to events subjectively rated as high centrality by participants, of which 73% were also classified as objective traumatic events. Objective trauma is related to higher PTSD symptoms. However, the highest rating of PTSD symptoms came from those whose trauma was also subjectively experienced as having higher event centrality. Thus, the subjective experience plays a great role in determining risk, and Boals (2017) suggested to include the concept of event centrality in the classification of PTSD.

The DSM-V has been under constant scrutiny, being initially too inclusive, and now, too exclusive (Pai et al., 2017). For example, a meta-analysis from Bradley and colleagues (2005) that looked at the benefits of psychotherapy for PTSD, noted that 67% of the participants lost their PTSD diagnosis after treatment, however, despite losing one or two symptoms, they remained largely symptomatic. Subclinical PTSD may not be accepted into many clinical studies, or fit into the DSM-diagnosis criteria, however, the symptoms and disturbances that present themselves are valid, and are associated with great impairment to work and social interactions, as well as suicide attempts (Marshall et al., 2002; Zlotnick et al., 2002, cited in Bradley et al., 2005). It is clear that the official DSM-V diagnosis leaves much unsaid, unclear and unfair.

It may be more beneficial to look at the individual and their present autonomic state of response to determine therapy. A diagnostic term makes research much easier, and the DSM-V can serve as a common language between collaboration with psychiatrists, and psychologists, however many modernised trauma therapies that also include body awareness rely more on the physiological state than on the official DSM diagnosis. If we look through the lens of a diagnostic term, we often only see that term. If we take off our glasses to see the whole, the patterns and the influences become obvious. We can use the polyvagal theory as an approach to diagnosis, to look at the autonomic state of the person, and take into consideration how they act, body language, and how they respond to stress (Dana, 2020, 00:47:20).

A more sympathetic hyperaroused state will be evident in that the person cannot sit still, and scans the environment with their eyes, on constant alert. There may be fidgeting, a rigid stance, hypertonicity, the heart rate and breath are accelerated. The person may react with fight or flight, so either with aggression or hypervigilance, or with the sudden desire to flee. They may have the tendency to read a neutral face as danger. A more dorsal

vagal state may present with a flat and unresponsive face, glazed eyes, dissociation, a sunken posture, lack of speech, chronically tired, depressed, and have digestive and immune function issues. There seems to be a lack of presence in the person. Often, acute traumas present as hyperarousal of the sympathetic state, and developmental and complex trauma more as dissociation of the dorsal vagal state (Van der Kolk, 2006) however, everyone responds differently to trauma, and states can be combined, as our autonomic state fluctuates.

Chapter Two: The Physiology of trauma

“Trauma results in a fundamental reorganisation of the way the mind and brain manage perceptions. It changes not only how we think and what we think about, but also our very capacity to think.”

(p.21, Van der Kolk, 2014)

We all experience stress in our lives. Stress is a natural response to internal and external stimuli. Mild stress is a healthy and necessary factor in enhancing our ability to adapt, building physical, physiological and psychological resilience. A moderate level of stress or stress inoculation early in life might in fact be beneficial to resilience (Meichenbaum and Cameron, 1989). As one of Blechsmidt’s three principles of embryology states, there is no performance without resistance. We need resistance or moderate stress in order to build neuroplasticity.

Hans Selye, a well-known endocrinologist who formally introduced and defined the term ‘stress’ in 1936 as “a nonspecific response of the body to any demand” (Tan & Yip, 2018), noted that stress is not what happens to the individual, but how they react to it (Selye, 1974, 1977 cited from Bienertova-Vasku et al., 2020). Selye realised that not all stress reactions are the same and are dependent on the individual's perception, intensity of stressor and physiological responses (Bienertova-Vasku et al., 2020). Similarly, Levine notes in ‘Waking the Tiger’ (1997) that trauma is not about the event, but about the response to the event. This response to threat or danger is biological, primitive, instinctual and physiological, or subcortical (Levine, 2003).

The physiological effects of trauma can be extensive and have considerable impact on the neurobiological, neuroendocrine and immune systems. This thesis concentrates more on neurobiological responses and the HPA axis. In a normal stress reaction, our body goes through a cascade of physiological changes. Depending on the individual resilience and stress vulnerability, allostasis works towards homeostasis through processes of adaptation. If the stress remains constant or chronic, the adaptation mechanisms such as the Hypothalamic-Pituitary-Adrenal (HPA) axis may become unregulated (McEwen, 2002, Sinha, 2008, cited in Seo et al., 2018)

In the case of trauma, it can overwhelm the individuals coping mechanisms, hindering the restoration process, and resulting in traumatisation. When the body senses danger, the autonomic nervous system reacts before the cognitive brain can fathom what is going on. Psychologist William James and physiologist Carl Lange saw emotions as the result of the physiological reactions: “You are not trembling because you feel frightened. You feel frightened because you are trembling” (James, 1884). The first response is innately physiological, not cognitive: we are trembling therefore we are afraid.

2.1 The 'normal' stress response

Let us consider what the normal physiological responses to stress are, where 'normal' refers to responses without chronicity or traumatisation. The body has an innate physiological reaction to stress and can be divided into two parts. The first is a fast-acting, short-lived physiological adaptation via the SAM axis (Sympathetic-Adrenal-Medullary axis), and the second is a slower, longer lasting response via the HPA axis (Hypothalamic-Pituitary-Adrenal axis) (Joëls and Baram, 2009; Tank and Lee Wong, 2015, cited from Godoy et al., 2018). There are also other factors that can influence the stress response such as the state of the individual at that time, stress vulnerability, resilience, the duration and intensity of a stressor, and prior trauma exposure.

The first stress response activates the SAM (Sympathetic adrenal medulla). The five senses scan the environment, bringing back afferent information to the thalamus (with the exception of olfaction, which goes directly to the primary olfactory cortex). The thalamus then passes this information on to the amygdala, the site of emotional processing and danger recognition. Feedback between the amygdala and the hippocampus relates the information to past experiences. If the amygdala senses imminent threat or danger, it will automatically react and send a distress signal to the hypothalamus, the control centre linking the nervous and endocrine systems, and regulating allostasis (Kovanur Sampath et al., 2019). This unconscious process is extremely fast.

The path of conscious awareness is much slower and passes from the thalamus via the hippocampus and anterior cingulate to the prefrontal lobes, the centre of emotion control, planning and moderating behaviour, language, and a great deal of our personality. Hormones relating to homeostasis are regulated in the hypothalamus, via incoming signals and negative feedback. The hypothalamus activates the sympathetic nervous system, and sends the signal via synaptic pathways to the adrenal glands, to release adrenaline and noradrenaline (Cannon, 1914; de Kloet et al., 2005a; Joëls and Baram, 2009; Kvetnansky et al., 2009; Tank and Lee Wong, 2015, cited in Godoy et al., 2018), and to the sympathetic nerves to release adrenaline (Euler, 1946; Kvetnansky et al., 2009; Tank and Lee Wong, 2015, cited in Godoy et al., 2018).

The locus coeruleus is the main site of production of noradrenaline in the brain, and is situated in the pons, close to the floor of the fourth ventricle. It regulates arousal, attention and defensive reactions and is of great importance in the acute stress response (Myers et al., 2017, cited in Godoy et al., 2018). However, activation of a longer duration may lead to certain stress related disorder behaviour (Southwick et al., 1999; Ziegler et al., 1999; Valentino et al., 2012; George et al., 2013; Reyes et al., 2015). The release of adrenaline and noradrenaline starts a cascade of reactions, equipping the body with the necessary physiological state to combat the stress. Blood rushes to areas such as larger muscle groups, heart and lungs, allowing the act of fight or flight. Blood pressure, blood sugar levels, perspiration, heart and breathing rate increase, pupils dilate, and glucagon and fat release are stimulated. Both sympathetic and parasympathetic systems are

reciprocally activated, whereby the latter is dampened for energy reservation, enhancing the relationship with the external environment (p.226, Porges, 1995). Due to this, the internal needs of the body cannot be fully met, and the body experiences this as stress.

Shortly after this first response, the second response is initiated via the HPA axis pathway. The HPA axis is regulated by the amygdala via the hypothalamus (Price et al., 1997, cited in Seo et al., 2018). The neurons of the paraventricular nucleus in the hypothalamus produce Corticotropin releasing hormone which stimulates the anterior pituitary gland to release ACTH (Adrenocorticotrophic hormone), in turn stimulating the release of cortisol, a glucocorticoid, from the cortex of the adrenal glands (Miller et al., 2007).

Cortisol is responsible for mediating the stress response. It decreases the immune response, and the release of serotonin, increases blood sugar levels and attention, and helps to metabolise fats, carbohydrates and proteins. It prepares the body for the longer haul fight or flight response, supplying sufficient energy resources for physical action. Once the threat or stressor has ceased, negative feedback is given to the hypothalamus to halt the cycle. If the parasympathetic system does not intervene, the cycle will keep repeating itself, as is often the case with traumatised individuals. The dissipation of stress hormones takes more time and they become overly sensitive to new responses to mild stress. The dysfunctional hormonal response system can lead to problems with memory and attention, difficulty sleeping, irritability, and chronic health disorders (p.46, Van der Kolk, 2014).

2.2 The physiology of trauma

So, what determines whether one will become traumatised or not? As mentioned in the first chapter, this depends on a complex myriad of factors such as prior trauma exposure, genetics, epigenetics, environmental factors, gender, age, and behaviour. These factors determine one's resilience and stress vulnerability.

The realisation that a situation is physically inescapable or even unsurvivable is one of the greatest factors defining a traumatic experience. This sense of helplessness, and unsuccessful behavioural response to threat or danger, on a physiological and hormonal level, can lead to immobilisation or freezing which can develop into a conditioned behavioural response (Van der Kolk, 2006). The freezing response or dissociation is most often associated with repetitive trauma exposure such as developmental and complex trauma, when the only way to escape the repetitive traumatic experience is to switch off. Acute or one-time traumas often set off the sympathetic system in fight or flight, which can lead to a chronic pattern of hyperarousal. This is not always the case but there is a definite pattern.

One way of understanding this is to think of a stress response as if you were driving a car. Much like keeping a car idling in park, chronic stress can often pass almost unnoticed, like an engine running on minimum petrol until it can't run anymore. By the same token, the

hyperarousal of trauma, or the sympathetic state of arousal, would be like fully engaging the accelerator and driving 250km per hour through a 50km zone, with forceful, spontaneous bursts of braking and acceleration, risking damage to the car and others around, with the high likelihood of a blow out or burn out. The immobilisation of trauma, on the other hand, is like pressing the brake and accelerator at the same time. The car is immobilised and cannot move, however the tension increases. This is what is termed 'tonic immobility' (Van der Kolk, 2014).

Immobilisation can also lead to complete collapse. In this case, the car's engine explodes. The car must be put into gear and manually pushed; it cannot harness the energy itself anymore.

Stress increases the level of cortisol in our system as a way of adapting to the demands of the body and environment. We can also see this in the car analogy, with cortisol representing the petrol. So the more demand there is for petrol, the more we fill up our tank at the tank station (HPA axis). The more we use, the more we need. However, if this continues, and the stress becomes chronic, the car and the tank station eventually run out of petrol. This results in a decrease in basal cortisol levels, due to overcompensation, and an increasingly sensitised HPA axis system (Edwards et al., 2011 cited in Seo et al., 2018).

Hypocortisolism is associated with acute trauma (Yehuda et al., 2005), and stress related disorders (Fries et al., 2005). Low levels of cortisol are also found in individuals with repeated life trauma, which may be due to a compromised HPA axis function, as a response to overly sensitised limbic-medial temporal lobe circuits, and their associated networks, such as the hypothalamus (Seo et al., 2018). A dysfunctional HPA axis can be seen in PTSD, as well as disorders such as whiplash, irritable bowel syndrome, fibromyalgia and chronic fatigue (Pillemer et al., 1997; Yehuda, 2002 cited in McFarlane, 2010).

Many of these syndromes have 'somatic medically unexplained' symptoms, which are experienced by a large number of the typical osteopathic patient group. These are often the patients that allopathic therapy turns away because their problems are viewed through the dualistic lens of physical or psychological analysis. Osteopathic philosophy, however, differs from the allopathic approach, as it looks for the freedom and mobility of the tissue in all its forms, finding health instead of disease, and respecting the triune, the whole being. In this way, the individual feels seen and heard, rather than feeling like a patient boxed into an unexplainable syndrome.

It is worth considering the etymology of the word "syndrome". The word refers to the occurrence of a number of symptoms together, however it also stems from the Greek word "syndromos" meaning "place where several roads meet" (Online etymology dictionary). A crossing, or an intersection, offers many possibilities of the road by which to travel. It is not a dead-end street. The traveller may, however, need guidance, perhaps in the form of a road map to help their self-regulating, self-healing ability on its way.

Traumatic stress not only derails the glucocorticoid system but also affects hormones and peptides such as CRF, neuropeptide Y, beta endorphin, catecholamines (McEwen, 2003 in McFarlane, 2010), serotonin, dopamine and oxytocin. The stress response activates the immune system via the glucocorticoid receptors, affecting the HPA axis. Cytokines are produced which activate inflammatory processes, preparing to defend the body in case of possible injury (Takahashi et al., 2018, cited in Godoy et al., 2018). This inflammation is appropriate for short term action, however chronic stress, or trauma, and this increased level of cytokines can have a detrimental effect on health. Childhood trauma decreases the basal level of cytokines, yet the immunological response to stress has an exaggerated response, suddenly producing large amounts of cytokines (Carlsson et al., 2014, cited in Morey et al., 2015).

The gut brain axis is a bidirectional form of communication between the central and enteric nervous system. The vagus nerve is 80% afferent. Stress can also damage the gut barrier. Permeability of the intestine increases, creating a 'leaky gut', allowing bio-macromolecules and microorganisms to pass through (Leclercq et al., 2012; Slyepchenko et al., 2017, cited in Liang et al., 2018). Psychological stress and trauma may also disturb the gut microbiota (Gur et al., 2015; Liang et al., 2015; Bharwani et al., 2016, cited in Liang et al., 2018) which in turn effects stress vulnerability and resilience factors, increasing the risk of stress related disorders (Moloney et al., 2014; Parashar & Udayabanu, 2016; Cowan et al., 2017, Vuong et al., 2017, cited in Liang et al., 2018). The amygdala is also highly sensitive to changes in gut microbiota (Cowan et al., 2017; Hoban et al., 2017, cited in Liang et al., 2018).

PTSD and anxiety disorders have been associated with a disturbed gut microbiota. Therapies focusing on rebalancing the microbiota have been shown to have positive effects (Kantak et al., 2014; Leclercq et al., 2016; Schnorr and Bachner, 2016; Turna et al., 2016, cited in Liang et al., 2018). Osteopathy is one of the few manual therapies working with the intestinal mobility and motility. Both Puterman and colleagues (2016) and Shalev and colleagues (2013) found that trauma, specifically childhood trauma, can affect telomeres, which protect and encapsulate the end of chromosomes, causing early disease and cell ageing (cited in Grabbe & Miller-Karas, 2017). Szyf and colleagues (2016) revealed that chronic stress may also change the activity of DNA segments of genes in the brain and periphery, leading to disadvantageous gene expression, and health problems. However, these results may be reversible and preventable (cited in Grabbe & Miller-Karas, 2017).

It is beyond the scope of this thesis to cover all of these effects in detail and focus on each and every physiological response to trauma. Instead, this thesis offers a broad overview of physiology with a focus on the relation of the autonomic nervous system and aspects of the polyvagal theory in response to trauma.

2.3 The brain and trauma

“The brain is an organ of and for movement: the brain is the organ that moves the muscles. It does many other things, but all of them are secondary to making our bodies move.”

(Roger Sperry, 1952, in Van der Kolk, 2006).

The brain’s purpose is to support survival. We, as mammals, have evolved, and so have our needs, such as a greater oxygen consumption for the growing neocortex (Porges, 2011). The triune brain is a concept developed by Paul D. MacLean and follows the phylogenetic development of the brain through evolution. The phylogenetically older brain, often called the reptilian brain, is responsible for fundamental survival, fear responses and homeostasis, and consists of the brain stem. It is the first part to develop in utero. The next phylogenetically in line is the mammalian brain, or the limbic system. This includes the amygdala, hypothalamus, hippocampal complex and cingulate cortex, and is responsible for emotions and the perception of danger and safety. Factors influencing the development of the limbic system are experience, genetics and inborn temperament. The majority of this system develops during the first six years of life.

Van der Kolk (2014) termed the sum of the reptilian and mammalian brains the ‘emotional brain’. This system works instinctually and automatically. The newest portion of our brain is the neocortex, the cognitive or human/primate brain. It is more complex and is in charge of conscious processes such as reasoning, planning, rationalising, reflecting, communicating, empathy and decision making. It is concerned with the external world and can help us to overcome small stresses using understanding and rational thinking. It is also the last to develop (pp.55-59, Van der Kolk, 2014).

Trauma tends to overstimulate the instinctive reptilian and mammalian brain and shut down the cognitive brain. According to Damasio, activation increases in subcortical brain regions and decreases in frontal lobes during extreme emotional states (Van der Kolk, 2006), therefore the entire ‘emotional’ brain is overly fired up and the ‘cognitive’ brain cannot fathom what is happening. Williams and colleagues (2006) noted that accurate risk predicting may be altered by a dysfunctional amygdala as a result of traumatisation and/or chronic stress (cited in Seo et al., 2018). What was safe is perhaps no longer considered safe, and what was perceived as danger may not alarm us anymore. This can lead to unperceptive behaviour and decision making.

After World War I, Janet and Kardiner, both noted that traumatised individuals tend to act as if the traumatic event were still happening, a kind of re-enactment, using certain physical actions and protective measures that may have been appropriate then, but are out of context in the present (Van der Kolk, 2006, Ringel & Brandell, 2012). The symptoms stemming from trauma such as flashbacks, altered sense of safety and interoception, alexithymia, hypersensitivity to noise and/or light, inability to explain traumatic experiences in words, hyperarousal and dissociation all have a physiological explanation.

PTSD patients exposed to traumatic reminders have an increased activation of the right amygdala, and visual areas associated with reliving trauma, and decreased activation in Broca's area (Rauch et al., 1996; Hull, 2002; Lanius et al., 2004; Shin et al., 2004, 2005 cited in Coubard, 2016). Similar findings came from Van der Kolk's research (2006) during traumatic memory provocation with increased cerebral outflow in the amygdala, insula, right medial orbitofrontal cortex, anterior temporal pole with a decrease in the left anterior prefrontal cortex, specifically Broca's area. The brain does not realise that this traumatic event has passed and is in fact reliving the experience as if it were happening now. The loss of words and understanding is associated with the deactivation of Broca's area, responsible for language production and comprehension. It is no wonder that verbal talk therapy is not always possible or appropriate at this stage. The autonomic state must first be addressed.

Recounting a traumatic story can actually aggravate the situation by reactivating implicit memories, reliving the physical and physiological reactions with their coinciding emotions that were experienced during the traumatic event or situation. Instead of creating a safe haven, it can create dependency on the therapist due to the lack of feeling safe, and inability to deal with it on one's own (Van der Kolk, 2006). The hyperaroused state that can occur as a result of reliving one's experiences can also become addictive, and what appears to be helping merely initiates a vicious circle. A sense of safety is needed to balance the physiological arousal state before continuing therapy.

There is a tendency to fall into the same patterns. Due to the dysfunctional neuroception and altered belief of what is normal in victims of abuse, there is often a repetition of traumatisation throughout life, either through becoming abusers themselves, or of being the victim of abuse once more. Therefore, the faulty neuroception needs to be addressed first before we can begin with the top-down process of re-story and re-pattern.

The cognitive brain, at one point, must learn to recognise and understand the patterns of faulty behaviour and retrain itself. Cognitive reappraisal is an important component of cognitive behavioural therapies which reframes negative appraisals in a positive light. Cognitive appraisal, as well as mindfulness, both stimulate the prefrontal cortex regulation of the brain stem and limbic systems (Southwick & Charney, 2012). These are both 'top-down' approaches that utilise the cognitive brain to have effect on the subcortical systems. Cognitive appraisal has been effective in treating PTSD and depression and is strongly linked with resilience (Southwick & Charney, 2012).

The hippocampus is also affected by trauma (McEwen, 2001, cited in Seo et al., 2018) and as a result its involvement with the processing of nociceptive information and pain perception as well (Collebrusco et al., 2018). In an animal model of PTSD by Rao and colleagues (2016), there was an increase in pro-inflammatory cytokines and a decrease in the production of tumour necrosis factor (TNF) in the hippocampus of rats by increased neuropathic pain. This evidence of inflammation could be a contributing factor to pain in PTSD (Cited in Collebrusco et al., 2018).

Women with PTSD who suffered sexual abuse during childhood showed a 5% reduction in left hippocampus volume compared to control groups (Collebrusco et al., 2018). Another study on victims of childhood abuse by Dannlowski and colleagues (2012) also showed a reduction in grey matter volume of the hippocampus, and increased amygdala activation in response to threatening facial expression stimuli (Cited in Seo et al., 2018).

There has been much debate regarding the hypothesis as to why the hippocampus shrinks with trauma. Yehuda (2001) proclaims that it is in fact the increase in number and sensitivity of the glucocorticoid receptors that leads to neurodegeneration, despite the fact that cortisol levels decrease as is the case with PTSD (Cited in Collebrusco et al., 2018). PTSD shows not only a decrease in function of the hippocampus but also the anterior cingulate cortex, and medial prefrontal cortex, which all play a role in the regulation of emotions. The function of the anterior cingulate cortex as an effective filter is inhibited, and therefore the ability to engage attention skills is hindered (Tait, 2012). This hypo functioning of structures related to emotion regulation may explain the autonomic fight, flight or freeze, and neuroendocrine responses commonly seen in PTSD, as they are no longer able to inhibit the amygdala fear response (Gupta, 2013).

The insula and its surrounding structures have an important role in interoception and resilience (Haase et al., 2016), (Van der Werff et al., 2013, cited in Grabbe & Miller-Karas, 2017). These structures help to regulate social interaction, empathy, and sense of self (Cauda, Geminiani, & Vercelli, 2014, cited in Grabbe & Miller-Karas, 2017). Cumulative trauma decreases the activity in these areas (Van der Kolk, 2014), and acute trauma leads to a diminished volume (Herringa, Phillips, Almeida, Insana, & Germain, 2012, cited in Grabbe & Miller-Karas, 2017), both of which can influence awareness and perception.

2.4 Touch and interoception

“The function of touch is to retain interoceptive homeostasis”
(Critchley et al., 2004).

2.4.1 Touch

The power of touch is extraordinary. Touch and closeness are human needs and we yearn for social contact, something that not only contributes to survival (safety in numbers) but is also a part of how we function. Walter and McGlone (2013) emphasised the importance of touch for nurture and attachment during early development in children (cited from McGlone et al., 2017). In adulthood, touch has been shown to benefit a person's state of health and well-being (House et al., 1988; Berscheid, 2003, cited from McGlone, 2017).

Embodiment is influenced through the act of touching, or being touched (Calsius, 2020). The experience of soft, loving touch stimulates care, attachment and the reward system, activating the release of hormones such as dopamine, oxytocin, and vasopressin, which aid in reducing pain, anxiety, and physiological stress responses, enhancing a feeling of

safety and cognitive awareness (Morhenn et al., 2012; Nicolai, 2010; Luyten et al., 2010, cited in p.90-93, Calsius, 2020). The powerful effect of touch also positively influences stress reactions later in life, as shown by studies of rodents and the effects of maternal licking and grooming of rat pups (Champagne & Meaney, 2007; Meanard et al., 2004, cited from McGlone et al., 2017). A study by Hellstrom and colleagues (2012) showed that increased levels of glucocorticoid receptor expression and decreased responses to stress were shown by pups that had received a great amount of affection in the form of licking and grooming.

Our sensory systems and body awareness including exteroception, proprioception and interoception, enable us to sense, perceive and process the effects of touch, in other words, how it feels, where it is felt, and how the organism reacts to these sensations. Andrew Taylor Still (1899) once said “The soul of man with all the streams of pure living water seems to dwell in the fascia of his body.” Our connective tissue, the fascia, is what connects us. It is our organ of innerness, embryologically developed between two outer layers of ectoderm and endoderm (Van der Waal, 2014). It is also the largest sensory organ in our bodies, together with its encased muscles (Schleip, 2003, Part 1).

Tozzi (2013) proposed that fascia has the ability to hold memories. Heine (1990, cited in Tozzi, 2013) showed that emotional trauma can alter the collagen structure in fascia, leaving an ‘emotional scar’, caused by the release of Substance P from nerve endings, primarily stimulated by the hypothalamus. Through vibrational, biomagnetic and bioelectric fields between the therapist and patient during bodywork, information regarding the past and present state of the matrix may be shared (Oschman & Oschman, 1994, cited in Tozzi, 2013) which may lead to trauma recall and accompanying sensations.

Osteopathy, specifically its high velocity thrust and vibration techniques, may stimulate Pacini corpuscles, which react to light palpation with rapid variations and vibration (Schleip, 2003). Ruffini capsules are stimulated by slow impulses and steady pressure, so approaches such as myofascial techniques can influence these receptors, increasing the local proprioceptive attention, and in turn decreasing the sympathetic activity (Van den Berg & Capri, 1999, cited in Schleip et al., 2003). Mechanical tension and pressure may stimulate free nerve endings (interstitial muscle receptors) (Collebrusco et al., 2018).

Myofascial therapy stimulates intrafascial mechanoreceptors. This proprioceptive information passes on to the central nervous system, which changes tonus regulation of the tissue’s motor units. By slow deep pressure, it is thought that the Ruffini endings and some interstitial receptors are involved, and possibly other receptors such as spindle receptors and intrafascial Golgi receptors. Both Ruffini receptors and interoceptive receptors can influence the autonomic system, which may reduce sympathetic tone or influence vasodilation (Schleip, 2003).

2.4.2 Interoception

“In order to change, people need to become aware of their sensations and the way that their bodies interact with the world around them. Physical self-awareness is the first step in releasing the tyranny of the past.”

(p.101, Van der Kolk, 2014)

From a very early stage, when we are still in the womb, our sensory world is activated. We hear the soft sounds of blood flowing, the noises of the intestinal tract, and hear and feel the constant heartbeat, movements and vibrations of our mother. When we are born, we feel the soft skin to skin contact with our caregivers, the wetness of a wet nappy, the rumbling of our hungry bellies, and the sensation that we are sleepy. All these sensations tell us something, they communicate with us to help regulate our homeostasis. These sensations are affected by internal and external factors (p.93, Van der Kolk, 2014).

When we respond to danger or safety, it is neuroception that acts automatically, without us having to think. We are not conscious of these choices. However, we can be aware of the bodily sensations that occur in response. These physiological reactions are sensed as interoception (p142-143, Porges, 2017), although we are not always consciously aware of these processes (Khalsa et al., 2018). Calsius (p.92, 2020) informs us that a great deal of what is felt internally does not reach the anterior insula or conscious awareness. Yet if we turn our focus inwards, we can increase our awareness of certain sensations.

Interoception is often termed the ‘sixth sense’, or ‘seventh sense’ following proprioception. It is the “distinct cortical image of homeostatic afferent activity that reflects all aspects of the physiological condition of all tissues of the body” (Craig, 2003). This includes feelings of hunger, thirst, pain, air hunger, temperature, itch, muscular and visceral sensations, vasomotor activity, sexual arousal, heartbeat, wine tasting, and sensual or soft touch. Interoception plays an important role in homeostatic and allostatic reflexes, emotion, motivation, social perception, interaction, and self-awareness (Tsakiris & Critchley, 2016).

Interoceptive receptors are free nerve endings found in hair covered skin, and fascia throughout the body, including the viscera. This interoceptive information is relayed to the insula via small diameter A delta (type III), C primary afferent and the more recently discovered C-tactile afferents (C group type IV) (Craig, 2009).

The majority of nerve endings in musculoskeletal tissue are predominantly interoceptive, and not proprioceptive. Approximately 80% of afferent fibres within the fascia of the endomysium and perimysium end in free nerve endings. These ‘interstitial muscle receptors’ (p.92, Schleip, 2012) are a combination of unmyelinated C-fibres, and myelinated A delta fibres. 90% of these fibres are slow conducting C-fibres which directly activate the insula, therefore play a great role in interoception (Schleip, 2003). These free nerve endings include a variety of thermo-, chemo-, and multimodal functions, however the majority function as mechanoreceptors. The mechanoreceptors are responsible for sensing pressure, tension and deformation. Approximately 40% of these are low

threshold receptors, responding to light or soft touch (Mitchell & Schmidt, 1977, cited in p.92, Schleip et al., 2012).

Visceral interoceptive receptors are found in the Meissner's and Auerbach's plexus, and have a direct pathway to the thalamus and insula (pp.89-94, Schleip et al., 2012). These receptors have a great influence on reducing sympathetic tone and altering the local vascular pressure in the fascia (Schleip, 2003).

The interoceptive pathway differs to exteroception and proprioception that travel via specific pathways to higher cortical structures (pp.90-93, Calsius, 2020). Proprioceptive pathways seem to be the same for both mammals and primates, however, it slightly differs when concerning interoception. There is a phylogenetic development of the interoceptive pathway, which is exclusive to primates, meaning that how we experience bodily sensations is slightly different to non-primates (Craig, 2003). We, as humans, integrate these sensory experiences into conscious awareness and emotional experiences of the environment and the self (Craig, 2009).

Afferent interoceptive information synapses in the lamina I of the dorsal horn in the spinal cord. From here on, there are two optional pathways. The more indirect pathway, also applicable to mammals, passes through the parabrachial nucleus in the brainstem, which is in close relation to the amygdala and hypothalamus. It then continues to the thalamus (ventromedial thalamic nucleus) before reaching the insula (Craig, 2009).

However, the more evolved and direct "lamina I spinothalamocortical pathway" skips the parabrachial nucleus to go straight to the Thalamus, relaying sensory and motor information, which according to Craig (2002, cited in Critchley et al., 2004) converges with vagal afferents, and then passes the information to the insular cortex. The posterior insula receives this information and creates the first interoceptive image of the incoming homeostatic state (Fogel, 2011, cited in p.90-93, Calsius, 2020).

It then continues to the anterior insula, where emotions are integrated into conscious awareness, and together with the anterior cingulate cortex responsible for the outing of these feelings, they form an emotional complex (p.91, Schleip et al., 2012). The anterior insula, specifically the right anterior insula is responsible for absolute awareness of interoceptive information, from both bodily processes and emotional states (Critchley et al., 2014). Studies that have caused changes in autonomic arousal have indicated an increase in activity of the anterior insula (Critchley et al., 2000; 2001; 2002; 2003, Cameron & Minoshima, 2002; Harper et al., 2000, cited in Critchley et al., 2004).

The structures involved in interoception are therefore the peripheral receptors, spino-thalamic pathways, thalamic nuclei, the anterior and posterior insula representing the limbic sensory cortex, and the anterior cingulate cortex as the limbic motor cortex (Augustine, 1996; Craig, 2007, cited in Haase, 2016). The insula and associated structures are the centre of interoception and resilience (Haase et al., 2016)

Interoceptive awareness is the measure for the correlation between interoceptive accuracy and interoceptive sensibility. It is the ability and sensitivity of receiving, processing and responding to your internal sensations, and plays a role in determining the perception of stress as either a threat or challenge (Craig, 2003).

Psychological trauma, specifically cumulative trauma, can have an impact on interoceptive awareness, greatly reducing the perception and understanding of bodily sensations (Van der Kolk, 2014). There are many somatoemotional disorders that are associated with altered interoception, such as irritable bowel syndrome and depression. Anxiety and depression can alter interoceptive awareness by amplifying and exaggerating afferent sensations (Paulus & Stein, 2010). Critchley and colleagues (2004) stated that having an increased interoceptive sensitivity can make it difficult to focus when asked to complete an interoceptive task.

PTSD alters interoceptive awareness (Wald and Taylor, 2008). This may be a coping mechanism, to shut off bodily sensations that are too unbearable to deal with. Yehuda (Southwick et al., 2014) notes that PTSD can occur due to lower resilience, however, PTSD could in fact be a resilient way of coping with an unbearable trauma.

Interoception is closely correlated to resilience, as it connects the internal sensations to conscious goal directed action in the process of regulating homeostasis (Paulus et al., 2009, cited in Haase et al., 2016). In a study by Haase and colleagues (2016), individuals with lower resilience were found to have increased activation in the insula and thalamus during exposure to adverse stimuli, as compared to those with high resilience.

Therapies such as mindfulness, which bring the attention to somatic awareness, are recommended for PTSD (Van der Kolk, 2006). Mindfulness practice strengthens the medial prefrontal cortex, which is an important part of trauma recovery (D'argembeau et al., 2007; Farb et al., 2007; Holzel et al., 2008, cited in p.96, Van der Kolk, 2014). The medial prefrontal cortex is the part of the brain that observes these sensations sent from the insula, and processes them emotionally (p.95, Van der Kolk, 2014).

Body-oriented therapies that focus on interoception bring the individual into living in the present moment, rather than bringing the emotions and responses of the past into the present, such as is the case with PTSD. It is important to address the internal sensations and increase the self-awareness instead of focusing on the understanding and narrative of the past. Trauma can be embedded in action tendencies and physiological state which is felt in breath, gestures, movement, emotion, perception of senses and thought, therefore therapy needs to enhance the self-awareness of what is present and past in order to harness self-regulation, and create new ways of engaging and orienting (Van der Kolk, 2006)

Another important part of the recovery process is regaining a sense of agency, or the feeling that one has control of their actions and consequences, and a knowing that they have some capacity to influence their own thoughts and behaviour. Agency depends on

our sense of interoception. A greater awareness increases our potential to take charge of our own lives. We cannot know why we feel a certain way if we do not recognise exactly what we feel. Schleip (2003, Part 2) suggests in myofascial work that if the intention is to increase the self-regulating capacity of the persons nervous system, then we should also include the person more actively in the process, guiding micro movements, moving from a didactic to a democratic approach. Imagery with specific functional intention may work better than directing purely mechanical movement (Reed, 1996, cited in Schleip, 2003). This method of approach is also recommended by the author through her experience working with movement and dance therapy for people with Parkinson's disease. These disorders can often be experienced as traumatic, and it is hypothesised that redefining certain pathways in the brain through the use of imagery, and experiencing movement autonomy through proprioceptive and interoceptive pathways, may benefit overall well-being.

2.4.3 The use of interoception in somatic and osteopathic therapy

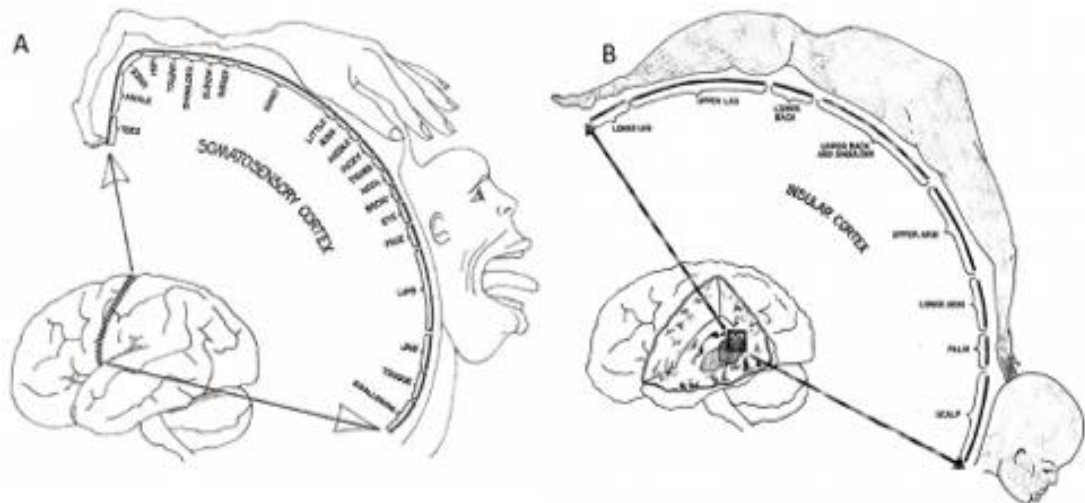


Figure 1. Penfield somatosensory homunculus

The well-known Penfield somatosensory homunculus (A) showing innervation density of fast conducting low threshold mechanoreceptors, and a proposed homunculus mapping of the insular cortex (B), which represents innervation density of C-tactile afferents which project to the dorsal posterior insular cortex, and have a denser representation in proximal body parts (McGlone et al., 2017).

Still was a great advocate of interoceptive awareness. He relied heavily on his own interoceptive qualities, allowing him to be his own guinea pig. Many of his techniques he applied to himself. For instance, he constructed a helmet that restricted movement of certain cranial bones, allowing him to feel first-hand the internal sensations and effects of a specific compression. A V-shaped apparatus was used to mirror the effects of a CV4 technique, which gave compression to the occiput and fourth ventricle. Although he almost lost consciousness in this CV4 experiment, he immediately felt the sensations of

warmth, movement of fluid throughout the spinal column, ventricles and around the brain, as well as movement in the sacrum (IACST). He was able to perceive and process this interoceptive information to support his theories of practice and gain more knowledge and understanding.

Osteopathy uses touch-based techniques to influence the connective tissue mobility, allowing a greater freedom in all tissues. It works with the mesoderm, the middle skin, however its effects are felt beyond this. A majority of the receptors in the fascia, a derivative of mesoderm, are interoceptive, therefore the hands-on approach of osteopathy can have a great influence on these receptors and in turn, interoceptive awareness, which has a role in regulating the autonomic nervous system and homeostasis. It also has an anti-inflammatory role, however for the sake of this thesis, we are concentrating on the overall effect regarding homeostasis and the autonomic activity, acknowledging the role of inflammation processes rather than detailing them.

Olausson and colleagues (2008, cited in Edwards et al., 2018) noted that a sympathetic reaction could be brought on by light touch of a mere 0.8 Newtons of pressure with a velocity of 0.2 cm/s on hair covered skin. A parasympathetic response on the other hand, can be activated by touch of as little as 2.5 N of pressure with a velocity of 1-5cm/s (Lindgren et al., 2010).

McGlone et al. (2017) showed the relation between C-tactile afferents and the therapeutic effects of osteopathy. Touch, specifically soft touch, as used in many osteopathic techniques, directly affects C-tactile receptors responding to slow velocity and low force, and therefore directly influences interoceptive awareness. Referring to the proposed affective homunculus above, it is evident that the location of touch on the body is also of great importance in stimulation of these C-fibres, and that the focus on these specific areas may influence the therapeutic impact on self-regulation and homeostasis. Fairhurst and colleagues (2014, cited in McGlone et al., 2017) noted that stimulation of these C-fibres can reduce autonomic arousal.

Stress and trauma take their toll on the gastro-intestinal tract. As shown in Chapter 1, PTSD, anxiety, and depression are all associated with a dysfunctional gut microbiota, as well as an altered sense of interoception. Somatoform disorders such as irritable bowel syndrome also suffer from a disturbed interoceptive pathway. With this in mind, visceral osteopathic techniques may be effective in regulating the interoceptive awareness via the C-tactile receptors within the enteric nervous system, and therefore enhancing the self-regulating capacity of the body (p.93, Schleip et al., 2012). Both interoception and vagal tone are closely linked with mental health outcomes, however much still needs to be learnt of their relationship (Edwards et al., 2018)

Edwards and colleagues (2018) did a comparison study between cranial deep touch and OMT mobilisation of the TMJ, in relation to interoceptive accuracy, heart rate variability and range of movement (ROM). They noted an increase in interoceptive accuracy after both forms of therapy, showing that osteopathy can affect interoception pathways in

numerous ways. Many osteopaths may be unaware of this therapeutic effect in regard to interoception, however it is an important pathway for homeostasis and allostasis, and for the awareness and integration of bodily sensations, emotions and self. Therapists should therefore know what they are working with, and the possible emotional outcomes that may present themselves.

The study also showed increased HRV on the deep touch group, which correlated with other studies and the positive influence of deep touch on the parasympathetic nervous system (Lindgren et al., 2010; Chen et al., 2013). However, the OMT group had no improvements in HRV, which contradicts findings from previous studies in which OMT increased HRV. This may have been due to the fact that the OMT technique was a mobilisation of the TMJ, a relatively invasive technique comparing to other softer techniques, which could have influenced the autonomic state (Edwards et al., 2018).

Mechanical stimulation of ergoreceptors in the muscle tissue, which send information over the muscle workload to the insula, can influence the sympathetic activity, which causes an increase in local blood circulation. Stimulating other free nerve endings enhances the viscosity and hydration of the matrix (Schleip, 2003). The stimulation of the interoceptive receptors can lead to a strong autonomic response, therefore it is important to communicate with the patient and their present sensations. These can range from feelings such as warmth, nausea, pulsation or relaxation to emotional release, altered body perception and self-awareness (Schleip et al., 2012)

Critchley and colleagues (2004) found that the interoceptive attention to heartbeat compared to exteroception of note detection increased the activity of the lateral somatomotor centre, inferior frontal cortex and anterior insula, as well as the supplementary motor cortex and dorsal anterior cingulate cortex. Occipital cortex activity was reduced. Due to the anatomical positioning of the insula, being part of the cerebral cortex and yet surrounded by the limbic system, and anterior to the pons, it is connected to both the emotional brain and the thinking brain. These connections play a role in empathy and social interaction. Due to these connections, body awareness or mindfulness can be helpful in regulating emotions and impulsive behaviour (Haase et al., 2015, 2016).

The awareness of and attention to breath is a simple way to become in tune with our interoceptive awareness. An increase of frequency of breathing which may occur due to arousal state, can seem threatening and increase anxiety (von Leupoldt et al., 2011, cited in Haase et al., 2016). As Liem (2020) informs us in his treatment approach involving bifocal integration, it is not just simply about breathing, but guiding the breath. For instance, a patient that becomes anxious may breathe faster, therefore guidance to breathe slower may help. It may also bring too much focus to the breath, therefore taking the focus away from the breath and feeling which parts of your body are in contact with the table and then returning to the breath may be of aid in this situation. In the event of immobilisation, the therapist may guide the patient to breathe deeper. Focusing inwards,

or interoceptive awareness may play an important role in the prevention of post trauma stress related disorders (Haase et al., 2016).

An osteopath never treats an anterior insula (p. 93, Calsius, 2020), however, with the knowledge of the anatomy and physiology, and respect for the lived experiences of the individual, and the whole being, can, through touch, help to enhance the individual's interoceptive awareness, facilitating and supporting their self-regulation.

2.4.4 Trauma's toll on body image

Survivors of trauma often have negative body image. The confrontation with internal body sensations is often too overwhelming, and they have difficulty feeling and/or being able to acknowledge these perceptions, sensations and emotions. However, being able to tune in to these feelings is necessary to regulate our homeostasis. The internal feelings of the remnants of past trauma must be dealt with first so that these past memories do not intrude into the present.

The medial prefrontal cortex, insula and anterior cingulate all have a role in this bodily awareness and can be activated by learning to focus inwards on these sensations, as well as connecting them to the sensorimotor, cognitive and emotional components of their traumatic experience. The capacity for introspection allows us to translate our internal sensations into a language that we can understand (Van der Kolk, 2006). Therefore, the integration of this sensory information with cognitive processing is an important part of the recovery process. The roles of 'bottom-up' and 'top-down' therapies are both crucial steps in recuperating and building resilience. However, the timing and order is of utmost importance, with first feeling and experiencing 'what' it is, and then asking 'why'.

Trauma can result in warped cognitive beliefs, which maintain chronic patterns of posture and movement, which continue to limit each other. Ogden and colleagues said, "If the patterns of the body's movements and posture influence reason, cognitive self-reflection might not be the only or even the best way of bringing the workings of the mind to consciousness. Reflecting on, exploring, and changing the posture and movement of the body may be as valuable." (Ogden et al., 2020, 00:20:53). Damasio said "We use our minds not to discover facts but to hide them." This includes the body and its sensations (Ogden et al., 2020, 00:25:40).

The physiological processes never really stand still. Physical sensations and emotions are always shifting. Once the distinction is made between a sensation and an emotion, as well as the perception of sensation and emotion, and difference between what is past and present, the individual can realise that there is no static moment, and that they too can influence their physiological processes which control autonomic activity, even with the simple act of focusing on their breath (Van der Kolk, 2006). There is room here for collaboration of osteopathy with more top-down approaches, but also with more body-oriented psychotherapies that connect bottom-up with top-down processing.

2.5 The polyvagal theory and trauma

“An intellectual mind that is unconnected to the heart is an uncultivated mind”.

(B.K.S.Iyengar, 2008)

Our brains and heart are undoubtedly connected. There is a neural connection between our heart and facial expressions, the window of our emotions. Our brains have evolved to encompass social engagement. Reptiles orient, however, mammals orient and then elect to attend or communicate (Porges, 2017). It is our ‘biological imperative’ to connect and socially engage with others (p.51, Porges, 2017). We, as humans, depend greatly on our highly evolved social engagement system. We feel safe when we know that we are connected to others, and to the environment, and vice versa. Not only that but being connected increases our chances of survival. We have evolved in response to the environment, and for survival. The environment influences the form.

Scientist Stephen Porges (2011), founder of the Polyvagal theory, is intrigued by the physiological explanation of psychological states. The Polyvagal theory emerged amidst his researching heart rate and heart rate variability in 1969. The theory is based on the phylogenetic evolution of mammals and humans and explains the role of the vagal complex in regards to emotion and social regulation, and in response to fear and threat.

Touch, connection and social engagement are a necessity for our well-being, and for our survival. A study done in 2007 by Diego and colleagues on the impact of closeness and touch, showed that premature babies who were given contact in the form of massage treatment had improved vagal activity and gastric motility, greater weight gain, and a better chance of survival than the control group (Rivera, 2016). In comparison, early life trauma and neglect that hinder the social engagement system, may lead to a greater risk of anxiety and mood disorders (Chapman et al 2004; Dube et al 2001; Felitti et al 1998; Gladstone et al 2004; McCauley et al 1997, cited in Mutinga, 2020).

Identifying safety and danger is innate and visceral, not cognitive. Porges (2017) termed this risk evaluation of the environment ‘neuroception’. There are three possible responses of the autonomic nervous system when confronted with perceived risk. These responses follow a phylogenetic hierarchy, engaging the appropriate social or defensive behaviour, with the tendency to activate the youngest or newest system first:

1. Social engagement system: Ventral vagal complex, part of the parasympathetic system
2. Fight or flight: Sympathetic system
3. Immobilisation/freeze response: Dorsal vagal complex, part of the parasympathetic system

If social contact and communication is not enough to deal with stress, or ward off a threat or danger, then the defensive responses may be activated.

Our brains have evolved, however the old brain, or the reptilian brain can partially dampen the rational brain, our neocortex, making it difficult to think, and activating the instinctual and unconscious reaction of fighting, escaping, or freezing. If this response is successful, the allostatic process of re-finding homeostasis begins, and the rational brain returns to make sense of it all. If, however, we are unsuccessful in our attempts to fight, escape or as a last resort, to immobilise, the brain continues its path of secreting stress hormones (p.54, Van der Kolk, 2017). This habitual pattern can remain long after the threat has passed, keeping the body in a damaging cycle of emotional and physiological reliving of the trauma.

These three autonomic states described above are also applicable to other situations in life. They work reciprocally with one another, dampening one while the other or others dominate. Situations such as 'play' combine 'fight or flight' with social engagement. Sexual climax and giving birth combine immobilisation with social engagement. The difference here is safety. In a life-threatening situation, there is no feeling of safety, therefore the social engagement system is suppressed.

Psychotherapist, Deb Dana uses a hierarchical ladder as an analogy, one that can be climbed up and down as a tool for trauma therapy, the top of the ladder being safety and social, and the bottom being freeze and immobilisation (Dana, 2019). A circle, however, may be a more organic way of looking at it. The 'hierarchical cycle of response' (see figure 2) created by Magdalena Weinstein (2020) is an interesting and informative way of looking at response to trauma. It gives a clear picture, without having a top and a bottom, therefore the concept of moving through trauma to a state of social engagement may seem more accessible, rather than a struggle to climb upwards. Life is not a one-way ladder; rather it is a dynamic flow.

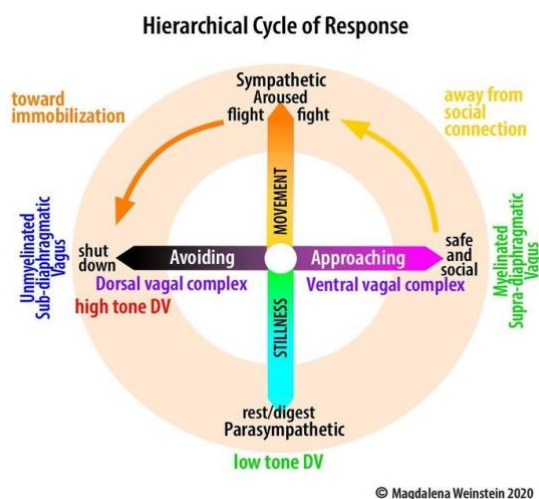


Figure 2. Hierarchical cycle of response, Magdalena Weinstein

2.5.1 The vagal complexes

The vagal nerve is the 10th cranial nerve and is a mixture of motor, sensory and parasympathetic fibres. A large majority of these fibres are afferent, around 80%. That means that the vagus is an imperative information highway relaying signals from a great deal of the viscera to the brain stem and beyond. It is not only known for its important and large role in parasympathetic regulation of the whole organism, but it is also one of the most powerful anti-inflammatory systems that we have (Collebrusco et al., 2018). The term 'Polyvagal' denotes many or several vagal branches. Porges (2011, 2017) noted that the Vagus nerve, or the pneumogastric nerve, as once called by Darwin, has not one but two parts or complexes concerned with the internal environment, these being the ventral and dorsal vagal complex, and relating sequentially to the social engagement system and immobilisation/freeze response.

1. **Ventral vagal complex:**

- Phylogenetically youngest, and exclusively mammalian
- Originates in the nucleus ambiguus, but connects with source nuclei via premotor networks
- Social engagement system: safety, emotion, motion, communication and attention
- In a safe environment: Regulates the social engagement system which promotes safety, emotion, motion, communication and attention
- Supplies supradiaphragmatic organs. The nucleus ambiguus directly innervates a majority of the pharynx and larynx muscles (except the m.stylopharyngeus, m.tensor veil palatini and m.constrictor pharyngeus inferior, which are respectively innervated by the glossopharyngeal nerve and the mandibular branch of trigeminal nerve), and the heart, and is also neuroanatomically connected to source nuclei of other cranial nerves which regulate muscles of facial expression and mastication, neck and head posture, gaze and prosody.
- Myelinated
- Acts as a vagal brake, slowing the heart rate during normal exhalation, and in the case of threat, after the risk has subsided. Baroreceptors are activated by heart rate increase, and via the Nucleus Solitarius (afferent fibres from N.X and N.IX), excitatory signals are sent to the Nucleus Ambiguus which then inhibit the sinoatrial node via the N.X. The majority of the inhibition of the sinoatrial node comes from the right vagus.
By bradycardia, this system is inhibited (Petko & Tadi, 2020).
The majority of the cardio inhibitory motor neurons are located in the NA, and are fast B fibres, however some motor fibres connecting to the cardiac vagus are also from the DMNX and are mostly slower C fibres. (Bennett et al., 1984, cited in Chapter two, Porges, 2017)
- connected with the limbic system: neuroception of safety inhibit the limbic activity, enhancing the social engagement system (Chapter1, 2, Porges, 2017, Schwaber et al., 1980, cited in Porges, 1995).

2. Dorsal vagal complex:

- Phylogenetically oldest system, seen in reptiles and mammals
- Originates from Nucleus dorsalis/Dorsal motor nucleus in the dorsomedial medulla oblongata, dorsal to the nucleus ambiguus and ventral to the base of the fourth ventricle
- In a safe environment: Enhances health, growth, and restoration/recovery, passive and reflexive regulation through parasympathetic innervation of the sub diaphragmatic viscera and digestive tract up until 2/3 colon transversum
- In a non-safe environment: dampens action of ventral vagal complex and parasympathetic innervation to sub diaphragmatic organs, and leads to immobilisation/freeze/dissociation/vasovagal syncope in response to danger. Slow C fibres, exclusive to the dorsal vagus (Jordan et al., 1982, cited in Porges, 2017), and a small amount of B fibres, slow down the heart rate via the sinoatrial and atrioventricular node, causing neurogenic bradycardia (Machado & Brody, 1988; Jerrel et al., 1986, cited in Chapter 2, Porges, 2017). The right vagus innervates the sinoatrial node, and the left vagus innervates the Atrioventricular node
- Unmyelinated

Though the name ‘Polyvagal’ can be deceiving, these vagal complexes are not only strictly adherent to the vagal nerve but also incorporate the structures and functions of certain surrounding cranial nerves and nuclei via premotor networks. For example, the nucleus ambiguus directly innervates muscles of the pharynx and the larynx, and also the heart. However, facial expression is not directly innervated by the nucleus ambiguus but by the facial nerve(CN.VII), just as the middle ear muscles (m.tensor tympani and m.stapedius), and certain neck muscles (m.sternocleidomastoideus and m.trapezius) are innervated by the trigeminal nerve(CN.V), facial nerve(CN.VII) and accessory nerve(CN.XI) respectively (Liem, 2020).

These nuclei are all located in the Special visceral efferent column in the brain stem, supplying the branchiomotoric muscles (Fritzch et al., 2017 in Liem, 2020), and can therefore influence each other via premotor networks in the lateral parvicellular and intermediate reticular formation (Fay & Norgren, 1997; Travers & Norgren, 1983; Büttner-Ennever & Horn, 2014, in Liem, 2020). Both the dorsal motor nucleus and the nucleus ambiguus are situated in the intermediate reticular formation, where the cardiovascular, respiratory, swallowing, and vomiting regulation also reside. Afferent information from the Vagus, Trigemini and Upper cervical area connect to the premotor networks in the reticular formation (Büttner-Ennever & Horn, 2014, in Liem, 2020). The vagal afferents also connect via the solitary nucleus tractus to vagal motor nuclei (dorsal and ambiguus).

The Periaqueductal gray (PAG) receives a majority of sensory information, inclusive pain, and the afferents of the vagal nerve. The PAG has a role in autonomic function and responses to stressful stimuli. It forms a connection between the limbic system and hypothalamus, and certain autonomic and premotor brain stem nuclei responsible for

breathing and emotional motor systems. The vagus nerve travels through the PAG, hypothalamus, amygdala, insula, cingulate and prefrontal cortex. The CN.X can therefore influence learned fear, anxiety, and other behaviours (Klarer et al., 2014; 2018, cited in Liem, 2020).

Evolutionary changes in the mammalian neural systems to support the survival response, allowed a more rapid escape from predators and the ability to detect subtle changes in the environment. These additional motor systems developed which optimized the chances of survival through communication in the form of facial expression, vocalization and emotions. These afferent motor fibres of communication therefore have a connection with afferent fibres modulating cardiac and pulmonary function. These evolutionary changes demanded a larger supply of oxygen, around four to five times that of reptiles. Porges hypothesises that due to this evolved necessity to provide more oxygen, concepts of emotion, stress, orienting and attention became consequences of this (Part 1, Chapter 2, Porges, 2011).

In a non-stress environment, the SA node regulates the heart, which is directly innervated by both parasympathetic and sympathetic efferents (Borges et al., 2017). The majority of the SA node innervation comes from the right vagus, and the AV node from the left vagus. In threatening situations, the reptilian response is to immobilise or freeze. Reptiles are used to a low ambient vagal tone, and a temporary increase in vagal tone in response to challenge, therefore the immobilisation is adapted and does not cause physiological distress. Mammals are the opposite and have a high ambient vagal tone and a temporary decrease of vagal tone in response to challenge or threat, therefore when NA vagal tone is reduced, the DMNX takes over the cardiac regulation via the SA and AV node and produces a freezing state. This immobilisation response can greatly compromise oxygen resources, decreasing the oxygen to the neocortex and vital organs, possibly causing vasovagal syncope in an attempt to save energy. This collapsed state can induce the release of endogenous opioids, reducing pain in preparation for injury or death (Drolet et al., 2001; Valentino & Van Bockstaele, 2015, cited in Cuevas et al., 2018). If this state is prolonged, it can also lead to cortical anoxia, cardiac ischemia or death (Chapter 2, Porges, 2011).

As we have evolved, so too has our viscerotropic organisation of the vagal system, adapting to and incorporating our ongoing needs in the environment, giving us the ability to turn our heads towards external stimuli to orient sensory receptors. Being able to consciously and voluntarily feed and breathe with the complex actions of sucking, swallowing and breathing, is something specific to mammals (Porges, 1995). Due to this complex system, it has enabled us to socially engage, interact, and adapt to our environment, using facial expression, muscles of mastication, neck and head posture, gaze and prosody.

Prosody is the intonation, tone, stress and rhythm in one's voice. It reveals our intention and is an important part of interaction. The autonomic nervous system is able to detect safety or danger in a voice. To talk and converse, we utilise different cranial nerves: A

combination of CN.V, CN.VII, and CN.VIII to listen, CN.V for the muscles of the mouth, CN.VII for the muscles of facial expression to mimic what we would like to say, and CN.X for breathing, sound and vagal break (Dana, 2018).

Evolving from reptiles to mammals, the middle ear bone detached from the jawbone, which allowed the ventral vagal nerves to connect with the facial and trigeminal nerve innervating the middle ear muscles (Porges, 2015, cited in p.41, Dana, 2018). This made it possible for us to process sound to autonomic state. It also allows us to drown out background noise to focus on social engagement and interaction. Low frequency sounds and vibrations are associated with predators and a higher sensitivity in the dorsal vagal system towards immobilisation, whereas high frequency sounds are associated with danger and a tendency towards the sympathetic system of fight or flight. We are most tuned to hear the frequency band of the human voice, as in social communication. This frequency, and the use of prosody is recognised as safe, and activates the social engagement system (Chapter 13, Porges, 2011).

Trauma affects the autonomic nervous system, therefore also affecting responses to sound. There may be a hypersensitivity to sound, or prosody may be flattened. An abnormal startle response to sounds is a natural occurrence in people with PTSD (McFarlane, 2010). Low frequency sounds such as air conditioners may affect the neuroception of someone that has experienced trauma.

The goal of therapy is to bring the individual from a state of sympathetic hyperarousal or dorsal vagal shut down into a safe state of social engagement. None of these states are constant, or need be constant. We dynamically fluctuate between states during moments of stress and relaxation. 'Play' is an important part of training our adaptive changes of state, and our resilience, combining sympathetic state with safety of the ventral vagal complex. Stress training is also used to build resilience in a safe environment, in order to boost resilience for possible future adversities.

The neural connection between heart and facial expression/emotions allows reciprocal social bonding. The need to connect is typical of human nature, and physical closeness is a necessity in developing these bonds, as well as the reciprocal need to let our guard down, or repress our defence systems (Part 1, Chapter 1, Porges, 2011). The social engagement system promotes feelings of safety, necessary for many physiological processes. Certain hormones are released when we feel safe with one another, such as oxytocin, dopamine and serotonin. A study on mother-child interaction showed a greater level of the hormone oxytocin in the mothers who attended massage class with their child, than those that didn't (Glover, Onozawa, & Hodgkinson, 2002, cited in Rivera, 2016). On the contrary, lower oxytocin levels were found in adult women who were exposed to any form of childhood maltreatment (Heim et al., 2009).

Awareness and knowledge of these systems and how they work and present themselves can help a therapist to optimize their treatment affects for an individual that has experienced trauma. It can be used as a tool to aid in moving through the trauma. We say

moving through trauma instead of healing, because healing implies that there is a disease to be healed, whereas trauma is something that happens to most of us. How we deal with it and move through it to build resilience should be the core goal.

2.5.2. Heart rate variability

The biomarker heart rate variability is used by many fields as an index of mental and physical health. It is a measure of risk assessment for heart problems, diabetes, and PTSD, and used in optimising physical performance. In the field of osteopathy, it is commonly used to show the effects of a technique, or treatment session/sessions on the autonomic nervous system.

Oscillations are a natural part of life, such as the movement of a pendulum, tuning fork, a ball bouncing on a string, or the motion of a swing. There are many oscillations occurring in our body, such as circadian rhythm, heart and respiratory rate, waves in the nervous system, and on a much smaller scale, the movement of atoms in molecules.

HRV describes oscillations in the R-R intervals (the interval between R waves in a heartbeat) and is an index of autonomic function (Borges et al., 2017). RSA is the first oscillation that happens over several cardiac cycles, and the second oscillation is the Mayer waves, or Traube-Hering-Mayer waves as originally termed, around the 10 s cycle (Draghici & Taylor, 2016).

Respiratory sinus arrhythmia (RSA) is a physiological phenomenon of change in heart rate corresponding with respiration. The vagal efferent influence on the heart, or the vagal break, inhibits the sympathetic influence on the heart, decreasing the heart rate on exhalation, and by deactivating the vagal break on the inhalation, allows the sympathetic nervous system to increase the heart rate. RSA was first acknowledged in 1847 by Carl Ludwig, who, using a dog, showed the increase of heart rate accompanying inhalation, and the decrease on the exhalation (Billman, 2011).

In 1910, Heinrich Hering connected the vagal nerve function to the lowering of heart rate during breathing (Hering, 1910, cited in Billman, 2011). During an inhalation, the intra-thoracic and arterial blood pressure decreases, activating baroreceptors. This causes a decrease in parasympathetic vagal tone on the sinoatrial node and releases sympathetic activation on the heart, increasing the heart rate. During an exhalation, the intra-thoracic and arterial blood pressure increase, deactivating baroreceptors, allowing the vagal break or the parasympathetic influence on the sinoatrial node to slow the heart rate down. Traube-Hering-Meyer oscillations represent the waves generated by spontaneous pulsations of the blood and lymphatic flow, mostly with a frequency lower than that of the heart rate and respiration. These oscillations, along with HRV, are associated with autonomic balance (Lundberg, 1960, cited in Whedon & Glassey, 2008).

Of all the mechanisms involved in heart regulation, the myelinated Vagal nerve is the most capable of these fast changes in fluctuation involved in RSA. The right nucleus ambiguus slows down the heart rate via primary vagal input to the sinoatrial node (Petko & Tadi, 2020). The central nucleus of the amygdala has a close relation to the nucleus ambiguus, therefore emotional state is expressed and regulated through these nerve branches (Porges, 1995). The limbic system has also direct inhibitory influences on the cells of origin of the vagus (Schwaber et al., 1980, cited in Porges, 1995). Traumatic stress may also lead to complete inhibition of the NA vagal tone, allowing activation of the sinoatrial and atrioventricular node of the heart via the unmyelinated cardiac vagal branch of the nucleus dorsalis, causing neurogenic bradycardia, and a suppression of RSA (Porges, 1995, 2011).

NA vagal tone is highest during calm activities with low metabolic demands promoting homeostasis such as sleep and is deliberately inhibited in moments of greater challenge or high metabolic demands such as stress, exercise or processing information (Porges, 1995). Therefore, vagal tone during rest may provide an index of homeostatic capability, and during moments of higher metabolic demand, may be an index of adaptive functioning. A low vagal tone can indicate higher risk for physical and mental health issues (Pyne et al., 2016; Carnevali et al., 2018).

HRV can be analysed in time-domain, in frequency domain and with non-linear indices. The heart rhythm fluctuates via two different frequencies and denote the periodic components: the low frequency (0.04-0.15Hz)(LF) and high frequency (0.15-0.4Hz)(HF). In short, the HF may be used as an index of parasympathetic nervous activity, and relation to the respiration, and the LF may represent a combination of both parasympathetic and sympathetic tone. Examples of time domain are SDNN and RMSSD.

In the most cases, HF is a valid representation of the RSA and of the vagal tone, or NA parasympathetic tone on the heart. However, Porges (2007) notes that the RSA is dependent on the breathing frequency, and that if the frequency is below 0.15Hz, then it would be more representative of LF instead of HF. Considering that the average breathing frequency is around 16 times per minute at rest, we can assume that this representation above is fairly adequate. LF is associated with both parasympathetic and sympathetic regulation, and the endogenous blood pressure rhythm via baroreceptors and sudden vasomotor activity (Porges, 2007).

The autonomic nervous system regulates homeostasis. Trauma, as previously discussed, derails the autonomic nervous system, therefore disrupting homeostasis. The balance between the sympathetic and parasympathetic systems is tipped, and the capacity for restoration and growth, which is primarily parasympathetic, is hindered. Considering that the majority of homeostatic processes is regulated by the parasympathetic system, Porges (Chapter 2, 2017) proposes that the parasympathetic system would be the most affected by stress.

RSA gives an objective measurement of parasympathetic nervous activity. The functional output of the NA myelinated vagus on the heart may be monitored by RSA (Chapter 2, Porges, 2011). We can assume from this that a high RSA shows optimal homeostatic capability.

RSA, RMSSD and HF are all closely linked and can be used as a reflection of vagal cardiac influence (Thayer et al., 2012). Porges stated that “The concepts of stress and homeostasis are interdependent and manifested in the activity of the parasympathetic nervous system”. Therefore, cardiac vagal tone can be used as an index of stress and stress vulnerability, and of the parasympathetic state (Porges, 1995, Porges, 2011).

HRV is a non-invasive marker of mental and physical health and resilience. In a non-stress environment, the parasympathetic system is most active, therefore a higher resting HF HRV or cardiac vagal tone shows greater perceived safety and emotional adaptability (Stone et al., 2018). It is also associated with effective self-regulation and greater behavioural flexibility towards goal-oriented behaviour (Porges, 1992; Thayer & Lane, 2000, cited in Edwards et al., 2018), as well as regulating the inflammation response (Czura & Tracey, 2005, cited in Marten et al., 2010).

2.5.3. Stress, trauma and HRV

A lack of variability in HRV affects how the body responds to stress. Traumatized individuals may have an overly exaggerated response to the most minor stress (p.269, Van der Kolk, 2017). Perna and colleagues (2019) suggested that the biomarker, HRV can be used as a possible index of mental health resilience. Studies regarding resilience often use subjective reports, which can be biased. They found after evaluating eight studies that a higher variability in HRV led to more optimal regulation during stress response to adverse stimuli, which inhibited overactivation of the stress pathways after the stress subsided. From this, they concluded that HRV may represent autonomic, endocrine and immune resilience in the face of challenging and stressful situations.

A study in 2002 by Cohen and colleagues showed a low resting HRV and a hyperaroused base state in individuals with PTSD, in other words a decrease in activation of the parasympathetic system and an increase in sympathetic tone (Van der Kolk, 2006). Agorastos et al. (2013) also showed a lower HRV in individuals with PTSD, and an increased sympathetic/decreased parasympathetic balance at night, perhaps due to the amplification of symptoms, in the nocturnal hours.

Other studies have also shown a decreased HRV in individuals with PTSD (Cohen et al., 1997, 2000; Haley et al. 2004; Mellman et al. 2004; Ginsberg et al. 2010; Song et al. 2011; Tan et al. 2011, cited in Agorastos et al., 2013; Sack et al., 2004 cited in Stone et al., 2018). A low HRV has also been found in individuals with anxiety disorders (Kawachi et al. 1995; Friedman and Thayer, 1998, cited in Agorastos et al., 2013), and a decreased HF HRV in individuals with depressive disorders (Kemp et al., 2010; Koenig et al., 2016; Rottenberg, 2007, cited in Stone et al., 2018),

However, Stone et al. (2018) showed that the severity and diagnosis of psychiatric factors such as depression, anxiety and PTSD were not significant predictors of reduced HRV in their model, but rather the history of childhood trauma. Their study reiterated the neurobiological changes that occur with early developmental and childhood trauma, comparing women with both a history of childhood emotional abuse and depression with that of women with depression alone. The group with both childhood emotional abuse and depression showed lower HF HRV than the group with depression alone.

It is thus safe to assume that the physiological response to trauma, and especially the long-term physiological repercussions, which greatly affects the autonomic nervous system, deserves a physiological marker such as HRV, and that this index may be a more reliable marker than diagnostic criteria.

2.6. The way to homeostasis along the road of resilience

Porges states that the “autonomic nervous system regulates the internal environment of our body to maintain homeostasis” and is “continuously servicing the visceral afferents in an attempt to maintain homeostasis and promote physiological stability.” (p.226-227, Porges, 1995; Chapter 4, Porges, 2011). Homeostasis is a dynamic regulation. According to Porges, it is “the autonomic state that fosters visceral needs without external challenges”. Stress would then be “the autonomic state that reflects a disruption of homeostasis due to depressed parasympathetic tone.” (p.227, Porges, 1995, Chapter 4, Porges, 2011). Therefore, stress vulnerability is already predetermined by the state of the autonomic system before a traumatic event has occurred. Low parasympathetic tone or dysregulated homeostasis increases stress vulnerability (Chapter 4, Porges, 2011). If a dysregulated homeostasis affects our stress vulnerability, then surely regulating parasympathetic tone would enhance our homeostatic capacity, and therefore our resilience.

Homeostasis is the ability of maintaining a dynamic balance within the physiological systems (Cannon 1926) and depends on the milieu interieur (Bernard 1865). Cannon derived the term homeostasis from two ancient Greek terms: ‘Homeo’ meaning similar and ‘stasis’ standing still. However, maintaining homeostasis is not static but a dynamic process. As Cannon said, “It is a condition - a condition which may vary, but which is relatively constant” (Godoy et al., 2018).

We need to regulate our homeostasis to have a better chance of survival. Allostasis is the journey to homeostasis from a stressed state. The brain's job is to sense and register internal states, and then take allostatic action, re-finding homeostasis (Haase et al., 2016), because what was will never be again. The question is whether osteopathy can have an effect on the autonomic functioning. The autonomic nervous system is the ‘key’ to homeostasis and the middle person between nervous and immune systems (Kończ-Trzęsicka & Żurowska, 2018).

Bottom-up therapies can positively influence the HRV (Liem, 2020), working from peripheral pathways, or the subcortical approach. According to Taylor and colleagues (2010), stress manifests itself in functional alterations of the executive homeostatic network (prefrontal cortex, insular cortex, anterior cingulate cortex), and leads to reduced HRV and increased proinflammatory cytokines. They suggest that mind-body therapies that integrate both bottom-up and top-down approaches should focus on influencing these homeostatic networks or increasing sympathovagal balance and decreasing cytokines.

Osteopathy has already demonstrated its effects on the HRV, and therefore its indirect influence on the autonomic nervous system (see osteopathy chapter). 90% of the tissue of the nerves is connective tissue and blood vessels (Girardin, 2019). Through the use of specific touch, we can have influence on interoceptive receptors which influence interoceptive awareness and therefore autonomic balance and homeostatic capacity. Osteopathy works with the mesoderm, the middle skin, the connective tissue, to promote metabolic exchange between tissues, enhancing mobility and motility. But above all, osteopathy works with the triune, encompassing the whole being. There are more roads to Rome, or let us rephrase, 'to resilience'.

Chapter Three: Resilience

“According to Darwin’s Origin of Species, it is not the most intellectual of the species that survives; it is not the strongest that survives; but the species that survives is the one that is best able to adapt and adjust to the changing environment in which it finds itself.”

(p.4, Megginson, 1963)

3.1. Definition of resilience

How do we define resilience and what determines resilience? In a world which is faced with much adversity, what does it mean to us, as individuals, as a collective, and as a system? The term resilience is polysemous and remains an ambiguous concept, being broadly used as a marker of health and vitality, in mental and physical health, biological ecology, social context, politics, physiology, engineering, and infrastructure.

Despite the differences depending on context, there is a common thread. Resilience is a dynamic process. It is the ability of a system to continue with certain functioning when confronted with change (Southwick et al., 2014). The term resilience is a non-permanent structure with no set definition or functions, that can and has dynamically adapted to changing theories and review (Goessling-Reisemann et al., 2018). The term resilience is therefore the perfect example of being resilient.

The term ‘resilience’ is derived from the present participle of the Latin verb ‘resilire’, meaning to rebound or recoil. It has also been associated with elasticity and being resistant, or not susceptible to something. Philosopher, Francis Bacon (p.245, 1625) first used this word in the early 17th century to describe the physical phenomena of rebound, reflection and echo. By the beginning of the 1800’s, the term was taken on by physicist Andrew Young, whilst studying the breaking point of metal cylinders and beams, to describe the capacity of a material to withstand a moving force.

The term commonly used in physics was adopted in the late 17th century by Greene and Altree as a metaphor for resiliency of the mind and soul, although it would not be included in psychological research until the mid-20th century (Goessling-Reisemann et al., 2018). The base of ‘resilire’ is ‘salire’, meaning ‘to leap’. Perhaps we could see resilience in the psychological context, as a leap of faith in the face of adversity when all seems futile.

The physiological concept of resilience arose in the late 19th century and was inspired by Bernard’s concept of ‘milieu interieur’. In 1926, Cannon took Bernard’s concept a step further, with homeostasis. Homeostasis is the ability to maintain a dynamic balance within the physiological systems, or as Flechtner (1966, pp.44 ff.) described it, a principle of equilibrium that establishes the stabilisation of process states and system functions,

within specific boundaries, during changing external conditions, particularly with stress, helped by processes of control, internal regulation and adaptation. (cited in Goessling-Reisemann et al., 2018). The endocrine and nervous systems play a great role in maintaining and regulating homeostasis. However, Cannon's (p.50, 1932) only mention of the term 'resiliency' was referring to restorative activity of the organs and blood vessels (Cited in Goessling-Reisemann et al., 2018).

Homeostasis became popular as a principle of self-regulation and stabilisation, and was applied to biology, society and technology, inspiring and stimulating concepts of homeostasis and resilience within biological ecology, bio-cybernetics and psychology (Goessling-Reisemann et al., 2018). Due to the growing popularity of the concept homeostasis, research began to look into the elasticity of the mind, or mental resilience (Miles 1935, p.279, cited in Goesslig-Reisemann et al., 2018).

In the 1950's, psychological research returned to the resilience concept, moving away from the stabilisation theory of homeostasis. If we look at the definition of resilience in physics, it is the capacity of an object to absorb and then release energy, returning to its previous form or shape (Merriam-Webster dictionary, 2020). However, we are constantly adapting, changing and evolving. The body never returns to the same state but a similar state, as Cannon described the return to homeostasis. The environment changes our form constantly.

With adversity or trauma, our form shifts. If our resilience is high, we can adapt and evolve. If there is allostatic overload, and the resilience is low, there is less chance for successful adaptation. It is a dynamic process, the process of overcoming adversity and re-finding homeostasis. Thus, if we take the meaning of resilience in terms of physics, we could then relate it to an individual that regains their homeostatic capacity, instead of their form or shape, as the form has adapted to the new situation.

3.2. Various hypotheses of resilience

Jain and colleagues (2014) have argued that resilience is more than just the return to homeostasis. It is finding a 'new normal' associated with 'stability through change'. The process of learning from past experiences can help us to better adapt through anticipating what may be needed in a situation and changing feedback inputs to increase the efficiency of a system depending on time and context. In other words, it is more to do with allostatic regulation than homeostatic regulation. Allostasis is defined as a dynamic process of gaining stability or homeostasis through physiological or behavioural change or adaptation.

Hohler (2014) termed resilience as the systemic capacity to overcome severe disturbances and stressors, showing systemic probability of survival (cited in Goessling-Reisemann et al., 2018). We need to look at resilience systemically to understand the whole picture. Masten defines resilience as "the capacity of a dynamic system to adapt successfully to

disturbances that threaten the viability, the function, or the development of that system". Her definition is systems orientated, and can be applied not only to human behaviour, but also on a molecular level, and in a society or community context. Her belief is that we can learn a lot from looking at other disciplines and their definitions of resilience (Southwick et al., 2014).

Take, for instance, the earthquake in Concepcion in Chile, 2010. Not only is the resilience of the individual an important factor, but also of the community and of the urban morphology, in the wake of the aftermath, and more importantly, in preparation for possible future disasters. If we look at the urban morphology, the form changes due to the impact of the earthquake, and in anticipation and as prevention of a future impact, the form needs to change for greater adaption possibilities. Just as a body and mind affected by a disaster will change, evolve and adapt to survive.

The urban designer that helps prepare the urban morphology prior to an earthquake is of greater importance than after the disaster has already made its impact. We can look at the body, the mind and the spirit in the same way. If the whole being builds more resilience through form, and internal and external resources, the whole being has a higher capacity to withstand force, and trauma. We can see manual treatment as a prophylaxis for a more resilient whole being, just as an urban designers' adaption of a city as a prophylaxis for the resilience of a city and its infrastructure (Allan et al., 2013).

The following studies (Block & Kremen, 1996; McEwen & Gianaros, 2011; Ong, Bergeman, Bisconti, & Wallace, 2006, cited in Haase et al., 2016) have defined resilience as the ability to harness physiological, emotional and cognitive resources in response to a stressor, and that these resources may also remain available after the stressor has subsided. This definition is arguable however, because the full array of cognitive resources aren't always available in all cases of trauma. For instance, a situation where the perception of escaping or fighting back is impossible, and where moving could cause imminent threat to life, the body's only possible response may be immobilisation. This autonomic response can cause a great deal of the cognitive brain to shut down in an attempt to save energy. Sometimes, the resilient response is in fact immobilisation. It is the autonomic choice of survival.

Resilience has also been used as a term in the watchmaking industry, describing the quality and flexibility of the internal components, which inhibit vibration (Macmillan dictionary blog, 2017). Dr. Rachel Yehuda (Southwick et al., 2014), a professor of psychiatry and neuroscience, referred to a watch commercial that used the words 'takes a licking and keeps on ticking' as a description of resilience, meaning that quality assures it is unbreakable. However, she noted, that when a watch is dropped, there is no room to improve. It is broken. In contrast, when humans are broken from trauma, there is room to move forward, through trauma, and to improve. Yehuda's own definition of resilience is "a reintegration of self that includes a conscious effort to move forward in an insightful integrated positive manner as a result of lessons learned from an adverse experience' (p.3, Southwick et al., 2014).

Not all stress is negative. We need certain stress to build resilience. We need discomfort to grow. However, we need safety to be able to continue evolving. The social engagement system plays a big role here. And our capacity to adapt must not be overridden. A small amount of controlled stress at a young age can also increase our resilience (Meichenbaum and Cameron, 1989). If we take Blechsmidt's principles of embryology and that there is no performance without resistance, and that developmental movements are performances (Van der Waal & Van der Bie, 2015), then we see the necessity of resistance in creating performance, in developing movements, and as a way of building resilience.

Rob Kamps (2011), a hypnotherapist created the G6 model (see figure 3.), which is a reflection on how we relate to an event or situation in six steps, and which depends to a certain extent on our resilience.

- Step 1: Event or situation
- Step 2: Registration of sensory information
- Step 3: Thoughts and opinion over the event or situation
- Step 4: Feelings and emotions
- Step 5: Behaviour
- Step 6: Consequences

Kamp says that we have no control over the event, or the traumatic situation in this case, the sensory information, or the consequences of our actions. What we have the possibility to change is our thoughts, emotions and behaviour.



Figure 3. G6 Model, Rob Kamps

The lack of control over Step 2 is true in the case of a past event because our physiological response to trauma has already happened. However, if we look at the model in how we can react to future adversity, after having been traumatised, the pathway of neuroception, interoception and sensory awareness is dysfunctional and therefore the registration of incoming information may be unclear or faulty. This can then influence the next steps, which then also have the tendency to repeat certain faulty patterns of belief and cognitive thought. Therefore, it is important to address these pathways so that the cycle of the G6 model can continue. In terms of resilience, our level of resilience can then influence Step 2 through to Step 5, so plays a role in how we respond physiologically as well as cognitively, emotionally, and finally, how we behave and act in response to a traumatic event(s) or situation.

Force can act upon us in the way of trauma, whether it physical or emotionally affects us. The form, our form and quality of the structure can change. This change occurs not just to the exterior form but also the nervous system, and right up to a cellular level.

A flexible system is needed in order to adapt to adversity. Just as a skyscraper's structure must be strong but more importantly flexible to resist high winds, a body and a mind must be flexible to adapt to physical and mental trauma. It must be able to move flexibly within our being, and not overload our system. Too much rigidity makes a structure less flexible and mobile, therefore less resilient to external stimuli. A cell membrane needs a good balance of cholesterol, saturated and unsaturated fatty acid chain lipids to ensure resilience of the cell wall, and for it to remain flexible, so that it may adapt to the needs of the cell and the milieu interieur (Kolenberg & van Dun, 2006). Structure and function are reciprocally interrelated. Flexibility in turn increases the structures strength. Strength and flexibility go hand in hand in nature. Without one, the structure will lose its resilience.

3.3. Factors of resilience

What determines resilience? Our ability to adapt to challenges is formed by physiological, cognitive, behavioural, social, affective and environmental factors (Thayer et al., 2012). Our brain positively and functionally adapts to these challenges (Groger et al., 2016, cited in Grabbe & Miller-Karas, 2017). The neural structures involved in promoting resilience include the medial prefrontal cortex, anterior cingulate cortex, hypothalamus, HPA axis and the amygdala (Atkinson, 2015, cited in Friedberg & Malefakis, 2018).

As previously discussed, resilience can be applied to many facets and disciplines. Resilience can be more of a physical nature, utilising strength and stamina to help the body rebound from severe physical demands, or of a more psychological nature entailing the strength of character, social adequacy and flexibility to get through adversity such as work, relation, financial, personal and health problems.

Southwick and Charney (p.13, 2012, cited in Friedberg & Malefakis, 2018) recognised ten “resilience factors” or protective factors for coping with severe adversity and trauma, and associated with post-traumatic growth:

1. Positive but realistic outlook
2. Seek and accept social support
3. Sturdy role models
4. Strong inner moral compass
5. Accepting that which cannot be changed
6. Spirituality and/or religion practice
7. Physical exercise
8. Mental sharpness and emotional strength
9. Create meaning and opportunity from adversity: problem solving
10. Accept personal responsibility for emotional well-being

A healthy support system is essential and strengthens resilience, self-esteem and optimism, immune function, and response to threat and stress. Individuals with lower social support are more susceptible to PTSD, depression and medical disorders (Southwick & Charney, 2012). Masten noted the importance of cultural aspects of resilience that encompass a rich social support through beliefs, practices and learning from each other (Southwick et al., 2014).

Dr. Catherine Panter-Brick believes harnessing resources can help sustain well-being (Southwick et al., 2014). The social ecology of resilience is about how social, cultural, economic, political, or environmental resources can affect individual or family level resilience. For instance, the study mentioned previously in Chapter 1 following the aftermath of the LA earthquake in 1994, shows that resilience was, in this case, not about higher socio-economic status but much more about the family and community support. Those that shared their stories, their food, their experiences, despite a lower socio-economic status, were far more resilient than those without this support system.

Biological resilience is now under the limelight and may prove helpful for future trauma therapy (van der Werff, van den Berg, Pannekoek, Elzinga, & van der Wee, 2013, cited in Grabbe & Miller-Karas, 2017). A greater resilience to stress has been associated with biological factors such as genetic, epigenetic, neurochemical and neuroanatomical mechanisms (Feder, Nestler, Westphal, & Charney, 2010, and Charney, 2004, cited in Friedberg & Malefakis, 2018).

Genes play a role in resilience and response to trauma, but are not the only determinant (Feder et al., 2009, cited in Southwick & Charney, 2012). The stress response regulation may be influenced by genetically mediated differences, for instance, the reactivity of the sympathetic nervous system and the HPA axis (Southwick & Charney, 2012). There is an approximate 32 to 38% heritability of PTSD. Through epigenetics, the positive and negatives of parental care can be passed on through generations, or transgenerational. This can affect both resilience and trauma response (Meaney, 2010, cited in Southwick et al., 2012).

This is evident in the study by Yehuda and colleagues (2005), which revealed the physiological effects of the September 11 World trade centre disaster on cortisol levels of pregnant mothers and their babies. There were two groups, one with mothers that had developed PTSD, and the other group of mothers without PTSD. There was a significant decrease in cortisol levels of mothers with PTSD, and also a correlated decrease in their baby's cortisol levels at one year old, indicating the effects that stress and PTSD can have on a child in the early years of development. It also gives an indication of the possibility of passing on the physiological responses of extreme stress and glucocorticoid programming in utero.

A "learned helplessness", and amplification of emotional and behavioural responses to future trauma via the sympathetic nervous system and HPA axis may stem from repeated childhood trauma (Feder et al., 2009; Davidson & McEwen, 2012; Forgeard et al., 2011, cited in Southwick & Charney, 2012). Neglect can be damaging to a child's development. It is necessary to have a nurturing and supportive caretaker that not only develops the child's sense of safety and social engagement but can also build a child's resilience and neuroplasticity through challenges and novelty. In a study performed on animals, the neuroplasticity in the prefrontal cortex was influenced by early challenges met with successful behavioural control, which supports the whole system for future adversity.

We are born malleable, but we build resilience. It is evident that resilience is built upon life experience and learning, with an increase in resilience seen in older compared to younger age groups (Southwick & Charney, 2012). Al Siebert (pp.71-78, 2005) connected three factors of resilience; self-confidence, self-esteem and self-concept, to the three nervous systems: somatic, autonomic and central. Self-confidence is the competence we feel in accomplishing actions. The somatic nervous system commands physical action, therefore, self-confidence is rooted in the somatic nervous system. Self-esteem comes from a deeper, internal source and concerns our emotional opinions and feelings, how we feel about ourselves. The autonomic nervous system regulates our emotions and is therefore the root of self-esteem. Self-concept is how we see ourselves, who we think we are, and our identity, in other words how the neocortex recognises and computes our external and internal images of ourselves.

These three factors are not only an integral part of one's resilience but are also the building blocks of a sense of self. A sense of self is also connected to our awareness, perception and processing of inner sensations, or our interoceptive awareness. This approach connects the psychological and physiological ideas of resilience, and the knowledge of what influence they may have on the whole being can be useful for osteopaths to have whilst providing treatment.

Self-esteem is related to many mental and physical health indicators and is one of the most widely researched variables in psychology. It promotes the capacity to deal with stress and is useful in moderating experiences of threat and anxiety (Martens, 2010). Siebert's breaking down of resilience factors and relating them to the body's nervous

systems provides an interesting perspective. His relation of self-esteem to the autonomic nervous system is also reflected in a study by Martens and colleagues (2010) who hypothesised that self-esteem levels may influence HRV. This emerged from the knowledge that self-esteem can create a sense of safety from threat, and that the cardiac vagal tone reacts positively to safety. This hypothesis highlights that it is only under certain circumstances that self-esteem may influence vagal tone, and not constantly. The studies showed that positive self-esteem feedback increased vagal tone, those with higher self-esteem exhibit higher vagal tone, and the general level of state self-esteem is associated with resting vagal tone.

Another study by Osteopath Lalonde in 2010, applied global osteopathic and endocranial treatment to individuals with low self-esteem. When compared with the control group who received no treatment, the group that had been treated scored higher on the Self-liking scale (SLSC) and the Rosenberg Self Esteem Scale (SES). HRV was also measured, however it did not have significant changes in this particular study, as compared to their previous research where emotions were directly related to HRV variations. Self-esteem and the heart are closely linked (cited in Tait, 2012).

3.4. Osteopathy and resilience

Osteopathy treats the mobility. If a less than 'normal' form is functional, and there is mobility and freedom in the tissue, there is no need to alter it. It is functional. It has responded to the environment. However, when mobility and function are reduced, it becomes dysfunctional, and can be termed 'osteopathic lesion' or somatic dysfunction (see Chapter Four over osteopathic lesion concept). The resilience of the tissue is reduced.

If we take the concept of rebounding to an original form, from the 1620's definition of resilience, we can take fascia as an example. Fascia that contains a greater percentage of elastin will more easily recoil to its original form. However, fascia and connective tissue containing large amounts of collagen, with a load exceeding 30% length of the tissue, will not bounce or spring back to its original form. It can be overstretched. The fibres will not return to their original state. The tissue loses quality and therefore resiliency. This may affect other parts of the body, but if the whole is resilient, then it will adapt, and other structures can compensate for the lack of flexibility in that part. Resilience is, despite the forces imposed on the body, that it survives and adapts. However, if the whole is less resilient, the compensating and adaptation mechanisms are hindered. The role of osteopathy is to create freedom in mobility, to optimise the resilience of the whole so that it has the chance to self-regulate and adapt. We can see resilience as the dynamic process of regaining homeostatic capacity and autonomic balance, timely and efficiently, to enable self-regulation and self-healing. It is also about recognising our personal state and being able to regulate ourselves towards a more balanced autonomic state.

From a polyvagal perspective, it is the ability of accessing the parasympathetic social engagement state with the capacity to manoeuvre between the other autonomic states,

knowing that there is an accessible connection (Sullivan, n.d.). The act of 'play' can also create resilience, as it is a form of exercising the flexibility of alternating between states of the autonomic nervous system, mixing sympathetic activation with the safety of ventral vagal state.

In the philosophy of osteopathy, form and function influence each other. The body has the innate capacity to heal itself and its self-regulating, self-healing capacity will always strive towards health and homeostasis. As discussed previously with homeostasis, the milieu interieur, or the immediate environment surrounding the cell has great influence on how the cell functions and in turn how the systems of the body, and the body as a whole functions. The surrounding environment determines the health of our cells.

Form is constantly changing with the influence of the environment (internal and external). Our form will never be what it was due to time, and space. We are constantly evolving, however our whole being remains as it is. The Law of conservation of individuality, proposed by the embryologist Blechschmidt, states that the form of an organism can change over time, however the being stays the same, unchanged, throughout these external modifications of form and shape. Just as an embryo is a human being, not becoming one (Van der Waal, Van der Bie, 2015) or just as these carrots and parsnip seen in the photos. What has influenced their form? Could we still call them carrots and parsnip even though their form has been altered? They have still lived out their function of growth. What has changed their form?



The environment has influence on adaptation of form. Planted in shallow pots, they have adapted to their environment and shown resilience, growing to their best ability in spiral form, or branched out horizontally when verticality was an issue. They have found their space, in time, which has influenced their form but not their essence. They still remain what they are. If a form is functional, it is not necessary to alter it. It shows resilience through its adaptational capacity.

Trauma does not change us, but our form. Trauma does not define us. Dr. Steven Southwick, a professor of psychiatry, suggests the need for a change in paradigm of how we look at, research, and treat trauma. Instead of only focusing on the psychopathology, a more positive model encompassing prevention and enhancing resilience could be a valued addition. Yehuda agrees that the continuing discussion regarding the definition of resilience is important to show that trauma is not just about the pathology (Southwick et al., 2014). This emphasises the need for holistic based therapies such as osteopathy whose philosophic principles are based around the strength of the self-healing, self-regulating capacity of the human being.

Osteopathy looks for health instead of disease, just as Yehuda and Southwick highlight the need to focus on the health and resilience of the individual more than the pathology. This may be a unique opportunity of these two fields of therapy to combine their strengths and work towards a health-based model that involves prevention and resilience building as defining features.

There have been no studies specifically regarding the concept of resilience and osteopathy, however we can assume from the knowledge we have that the autonomic nervous system is a regulator of homeostasis, that homeostatic capacity and self-regulation play a role in resilience, and that osteopathic therapy may also promote resilience through its positive influence on the autonomic nervous system, enhancement of interoceptive awareness, and philosophy of treating the whole person. Resilience is something that can be harnessed therapeutically (Friedberg & Malefakis, 2018).

3.5. Prevention, preparation and resilience therapy studies

“Chronic distress from trauma derails the ability to live life resiliently”.
(Grabbe & Miller-Karas, 2017).

We cannot necessarily prevent trauma from occurring, but it is possible to stimulate the individual’s adaptive capacity to deal with trauma in the most resilient way possible, to bounce forward from adversity. Both top-down and bottom-up approaches have shown to improve and enhance resilience, as well as more preventative and educative approaches, including community support.

Improvements in resilience have been noted in cognitive and psychological therapies such as life skills education-based program (Sarkar et al., cited in Lui et al., 2018), intensive

mindfulness meditation training (Hwang et al., 2018) and stress inoculation training (Horn et al., 2016, cited in Lui et al., 2018). Cognitive appraisal has a strong association with resilience and has been effective in treating PTSD and depression (Southwick & Charney, 2012), through stimulating top-down the prefrontal cortex regulation of the brain stem and limbic systems. A study done by Rothschild (2000) revealed that preventative trauma therapy lowers the risk of PTSD in soldiers (cited in p.86, Friedberg & Malefakis, 2018). However, each individual reacts differently to therapy and what may work for one does not mean it works for all.

A study by New and colleagues (2009) showed that non-PTSD subjects could down-regulate more efficiently after viewing adverse stimuli compared to the PTSD group. The up-regulated response seen in the PTSD group may be explained as a possible protective mechanism to cope with trauma exposure, something related to resilience (cited in Friedberg & Malefakis, 2018).

In a study measuring the effectiveness of suicide prevention education within the US Air Force, a dramatic 33% reduction in suicide risk was registered. Suicidal thoughts are relatively common in the PTSD patient population (Upledger et al., 2000). This study was then branched out to community education programmes which had not only a drastic reduction in suicide risk but also decreased extreme domestic violence by 54%, moderate family violence by 30%, homicides by 51% and accidental deaths by 18% (Knox et al., 2003, cited in Callahan, 2010).

It is evident that by increasing community resilience by means of preventative education, it may also decrease certain traumatic exposure to the community, and in turn, most likely have a more favourable financial outcome. Having a resilient community is an essential support structure for all individuals, and in this case, for soldiers and war veterans (Callahan, 2010). Callahan (2010) also notes the important role that osteopaths can play in the community, optimising resilience through treating the whole being, and guiding and educating the client in self-regulation.

The importance of somatic awareness and interoception in building resilience should not be underestimated. Interoceptive awareness, or the ability to sense the internal body's physiological state, is important in enhancing homeostatic efficiency. These interoceptive and emotional processes are closely connected with the homeostatic processes of the ANS and HPA axis (Kanbara & Fukunaga, 2016, Haase et al., 2016).

In a study done by Haase and colleagues (2016), neuroscientific evidence was revealed, supporting the development of resilience through the cultivation of bodily awareness. Their study via self-report and fMRI indicated that individuals with normal to high levels of resilience exhibited reduced thalamic and insular activation in response to adverse stimulation, compared to those with low resilience levels, who exhibited a significant increased activation response. A lower self-reported sense of interoceptive awareness was also associated with individuals with a low resilience. The exaggerated insula activation demonstrated by the lower resilience group supports the theory that reduced

awareness and response to interoceptive signals can impair the decision making when confronted with a stressor and contributes to lower levels of resilience.

We can presume from this research that resilience, or the capacity to perform well during stress can alter associated neural systems involved in the processing of interoceptive information, and that this autonomic stress response may be used as a homeostatic marker. There is much potential for the application of body awareness training to individuals with an altered stress resilience (Haase et al., 2016). There was, however, a lack of comorbidity in the lower resilience group. It would be interesting to integrate individuals with a higher rate of comorbidity and a history of trauma into a future study, to look at measurements of resilience, and how resilience affects the stress response in this particular group of individuals.

In several studies linking resilience and interoception, highly resilient individuals, such as elite war fighters and athletes, showed a reduced activity of the insula and anterior cingulate cortex during aversive interoceptive stimulation and processing of emotions (Paulus et al., 2010; Paulus et al., 2012; Simmons et al., 2012; Thom et al., 2012). In a study by Waugh and colleagues (2008), increased activation was seen in the anterior insula by aversive and fearful images in individuals with a lower resilience, and less activation in individuals with a higher resilience. Due to this correlation between levels of resilience and activation of the insula and anterior cingulate cortex, the concept of balancing the overstimulation of these structures through enhancing interoceptive awareness may help in facilitating resilience.

Paulus and colleagues (2009) indicated the significance of the process of interoception for resilience, as it connects the variation of internal state with goal driven activity towards restoration of the body's homeostatic equilibrium (cited in Haase et al., 2016). If a patient is resilient, they have sufficient internal and external resources to be able to switch easily between 'bottom-up' and 'top-down' processing. However, if the patient is traumatised, they react in survival mode, and may lose the ability to process 'top-down'. It is important to orient the patient to safety and the present moment so that the ventral vagal complex can create a balance to the stress response (p.101, Mutinga, 2020).

When trauma has already occurred, it does not mean that resilience can't be enhanced. Depending on the individual, different paths of therapy will be determined. Each person responds to trauma differently and therefore the response to therapy will also vary. The road of resilience is a journey, a process, that the therapist joins on. The therapist does not create the road, rather they create a safe environment so that the patient can find their way with autonomy.

3.6. Measurements of resilience

There are many ways to measure resilience. These include self-reporting measures such as resilience scales, two common scales being the Connor-Davidson rating scale(CD-RISC)

and Deployment Risk and Resilience Inventory-2(DRRI-2) (Rakesh et al., 2019), and objective biomarkers such as HRV, blood pressure, stress hormones, immune function, and gene methylation (Southwick et al., 2014).

Dr. Panter-Brick, a medical anthropologist, sees an advantage in the use of biomarkers as they connect both the physiological and neurobiological concept of resilience with the cultural resilience concept. They are also an objective measure rather than the subjective, self-reporting measures, which can often be biased. Panter-Brick is an advocate for the use of biomarkers to measure physiological stress before and after a therapy treatment as an index of improvement.

There are many viable biomarkers available. However, HRV is a non-invasive, plausible and easy to measure marker that can be used in evaluating autonomic flexibility, which reveals the capacity of the individual to regulate stress effectively. Thayer and colleagues (p.754, 2012) proposed that “HRV could index the extent to which a medial prefrontal cortex guided “core integration” system is integrated with the brainstem nuclei that directly regulate the heart”. Resilience is complex with many facets, and still needs much research, however HRV proves to be a hopeful psychophysiological index of resilience (An et al., 2020).

Thayer and colleagues (2012) defined HRV as the index of capability of an individual, when faced with stressors, to regulate psychophysiological responses. In a meta-analysis of neuroimaging studies showing the relationship with cerebral blood flow and HRV, the structures responsible for perception of threat and safety, such as the amygdala and medial prefrontal cortex, were strongly associated with HRV. Therefore, HRV may be an index of effective functioning of an individual in response to a changing environment and associated with adaptability and health.

Parasympathetic vagal tone plays a major role in regulating allostatic systems. A higher parasympathetic tone (HF HRV and RMSSD were used in this specific study) suggests superior emotional control, social functioning, regulation of energy modulation and immune system, cognitive functioning and overall health (Laborde et al., 2017; Thayer & Sternberg, 2006, cited in Perna et al., 2019). Therefore, HF and RMSSD are presumed to be suitable biomarkers of mental health resilience, and HF as a possible transdiagnostic biomarker of mental illness (Beauchaine & Thayer, 2015, cited in Perna et al., 2019)

In a study by Alacreu and colleagues (2018) which evaluated individuals during and after perception/attention related task, the individuals with better decision making skills showed superior vagal tone during and following the task, and a more adaptive cardiac autonomic response, revealing decreased stress and greater adaptability (cited in Perna et al., 2019). Through this, we could assume that the action of the prefrontal cortex which represses autonomic control of the heart via the vagus, and which plays a role in decision making, ability to be attentive and make rational decisions, may positively influence the adaptive responses and level of resilience towards stress. Vagal mediated HRV (HF) may

therefore indicate cognitive resilience in regard to competitive stress and self-control tasks (Perna et al., 2019).

HRV has also been proposed as an index of emotional resilience. The conscious processing of emotional experience into awareness speeds up vagal tone, which regulates emotional arousal (Kanbara & Fukunaga, 2016). A study by Nasso and colleagues (2019, cited in Perna et al., 2019) showed the efficiency of adaptive emotional regulation (positive reappraisal) prior to exposure to an emotionally stressful situation. Higher vagal tone was shown before, during and after the event, highlighting the influence of positive reappraisal on increasing the prefrontal activity, and decreasing amygdala stimulation and negative emotion.

Another study revealed that a lower vagal HRV prior to an emotional stressor (film) negatively affected the intensity and duration of disturbing memories for four days after the stressor (Rombold-Bruehl et al., 2017, cited in Perna et al., 2018). This leads us to the possible conclusion that a lower flexibility of the autonomic nervous system may influence the response to stress and the development of disturbing memories.

Pulopulos and colleagues (2018) showed that high HRV can have a positive effect on HPA-axis regulation. A higher HRV index of vagal activity in anticipation of a stressful task was associated with lower cortisol increase during the task, therefore a better regulation of stress-related cortisol which has a positive influence on overall health.

An all-male study by Weber and colleagues (2010, cited in Perna et al., 2018) revealed that a higher HRV(RMSSD) measured prior to and continuing during a mental stressor resulted in a better recovery of cardiovascular, immune and endocrine markers after the stressor. Those with a lower HRV prior to the stressor had relatively no change in HRV during, and recovery of cortisol, diastolic blood pressure and pro-inflammatory cytokine TNF-a was hindered.

In an all-female study by Woody and colleagues (2017), there was an association between a decrease in pro-inflammatory TNF-a and IL-6 one hour after a stressful psychosocial task, and minor decreases in vagal components of HRV, which may in fact prove beneficial for mental health. A high pro-inflammatory response following a mental stressor is not desirable as this can lead to increased risk of depression.

These studies above show that our adaptive capacity to regulate our physiological systems during allostatic stress responses may be conveyed in a higher vagally mediated HRV, and that this may also influence recovery. This implies that vagally mediated HRV can be translated as an expression of autonomic, endocrine and immune resilience during stress and trauma. However, some limitations of these studies were that the participants had no psychiatric or medical illness, some were male or female only, all belonged to a younger age group, and were cross sectional studies. More studies are needed to measure resilience and HRV in individuals with traumatic history, as the brain and the entire organism functions differently.

These two following studies have included participants with a history of trauma. Pyne and colleagues (2016) looked at the effect of stress and trauma on soldiers. HRV levels indicated that individuals with symptoms of PTSD post deployment had in fact lower HF resting state power prior to combat deployment (cited in Perna et al., 2019), therefore indicating that HRV levels prior to trauma play a role in resilience, and the risk of developing PTSD.

A cross-sectional study comparing HRV of soldiers before, during and after a stressor with rest times in between revealed that parasympathetic dominance in the rest periods, and sympathetic dominance during combat related, startle inducing stressors, gave the advantage of a higher HRV, which is favourable for resilience against psychological distress and disorders. Succeeding the short-lived, milder stressor, a dominant parasympathetic tone was associated with less vulnerability to stress. The conclusion of this study was that LF/HF may be a valid marker of resilience during stressful and non-stressful periods (An et al., 2020).

Just as Stone et al (2018) showed that trauma is more a determining factor in a low HRV than psychiatric diagnosis alone, Yehuda's definition of resilience encompasses "a reintegration of self that includes a conscious effort to move forward in an insightful integrated positive manner as a result of lessons learned from an adverse experience" (p.2, Southwick et al., 2014). Therefore, survivors of trauma who develop PTSD may be just as resilient as those that don't develop PTSD (Yehuda & Flory, 2007 cited in Southwick et al., 2014).

Green and colleagues (2010, cited in Rakesh et al., 2019) supported the concept that resilience is more than the absence of PTSD by showing that below 30% of war veterans who had experienced high combat exposure, and ranked high on the CD-RISC resilience scale (translating to higher resilience) also develop PTSD, compared to 80% of those with a low scoring CD-RISC who developed PTSD. However, PTSD severity is not included here.

The idea of preventative therapy is not new. It is the most optimal way of preparing an individual for adversity, however, it is not the only way that resilience can be enhanced. Interventions to boost resilience can be given at any time period, so prior to, during or after a traumatic situation. Depending on the individual and the circumstances determines the effectiveness of the treatment (Southwick et al., 2014). As mentioned previously in Chapter 1 regarding the 9/11 disaster, therapy given too soon after the event can influence the effectiveness of the therapy and can also be detrimental to an individual's healing process. Timing is of utmost importance. Just as the body innately reacts to a physical wound with inflammation, the body needs time to heal. Inflammation is a sign of healing but if we get in the way of nature's ability to self-regulate, we can inflict more damage.

Chapter Four: An Osteopathic Approach to Trauma

4.1. Osteopathic philosophy

“Sickness is an effect caused by the stoppage of some supply of fluid or quality of life”
(Still, 1908, cited in AOA, 2003).

Still thought of health as built on structural integrity. If we think of trauma in terms of a stoppage of fluidity or quality of life, as Still proposed with regards to sickness, the metaphorical concept of immobilisation or ‘freeze’ in response to trauma does not fall far from the tree. Hindrance in the flow of the fluids may cause a stagnation, a sort of freeze in the fluid and tissue, which Mutinga (p.57, 2020) described as crystallisation energy resulting from shock, something that may lead to stagnation in the fluid of being. McCole (1935, cited in Liem, 2015) saw disease as the outcome of structural or anatomical abnormality, when the flow of the fluids becomes inhibited, and physiological disorders may follow. Hulett (1922, cited in Liem, 2015) also believed that disease arose from either structural abnormalities, or from the unsuccessful plight to combat adversity, and therefore is a disruption of the self-regulating capacity.

When experienced osteopaths and osteopathic physicians were asked how emotional trauma affected the fluid and primary respiratory mechanism (PRM), they all acknowledged that it altered its expression, in other words the amplitude, quality, rate and variability of the PRM (Hain, 2011, cited in Tait, 2012). Plotkin and colleagues (2001) found that CRI rate was also lower in individuals with depression. Rollin E. Becker (1997, cited in Tait, 2012) explained that PRM and the inherent motility of the central nervous system might be limited by stress. In other words, trauma is able to enter into our very core coherence and has the capacity to displace it (Tait, 2012).

The role of an osteopath is to focus on health no matter what the presenting problem may be (Fahlgren et al., 2015). The therapist is a facilitator in enhancing freedom and mobility within the tissue and whole being, so that all systems can be and are integrated, and the innate capacity that is within us all can have the freedom to do what it does best. There is an innate quality in us all to strive towards health. Finding health should be osteopathy’s goal, however in its motivation to be proven evidence-based, it has lost its global unity, splitting into separate entities, and showing incongruence regarding philosophy and a world-wide approach.

Health is not just the absence of disease, but a combination of physical, mental and social wellbeing, supporting the triune, consisting of body, mind and spirit.

“Osteopathy is found in Nature, Osteopathy is founded on Nature, Osteopathy is Nature”.

(A.T.Still, 1894, cited in Girardin, 2019)

4.1.1. The osteopathic lesion concept

The concept of the osteopathic lesion stemmed from Still's vision of health and disease, where the hindrance of fluids or their neural control centres may lead to altered flow (p.10, McCole, 1935, cited in Liem, 2015). Still termed it 'mechanical lesion'. Osteopaths can, by means of adjusting through osteopathic manipulative therapy, free the lesion.

Still's lesion concept included possible relations to psychiatric disorders: "bony variations from their normal articulation which results in shortage or overplus in the supply of some or more of the five senses" (pp.158-159, Still, 1992, cited in Ching, 2015). He associated dysfunctions within the nervous and vascular systems as factors relating to diseased mentality.

This concept was furthered by Louisa Burns (1911) who identified heredity and structural degeneration as factors of mental illness, as well as the important physiological factors such as the vascular and nervous hindrance (cited in Ching, 2015). The term lesion evolved, and John Martin Littlejohn proposed the term 'environmental lesion', describing the body as an organism and not a mechanism, contrary to Still's previous lesion concept. A lesion is never purely mechanical because it is always connected with psychological state, function, structure and health (p.66, Littlejohn, 1908, cited in Liem, 2016). Fryette proposed the 'total lesion' concept which included not only the mechanical factors but also all factors leading to disease, such as environmental, emotional, nutritional factors and infectious agents (p.41, Fryette, 1954, cited in Liem, 2016). However, in the mid-1960s, the osteopathic lesion concept was replaced with 'somatic dysfunction', which specified certain criteria for insurance companies and the general population in regard to osteopathic service (Rumney, 1975; Comeaux, 2005, cited in Liem, 2016).

A somatic dysfunction is the altered function of the skeletal, arthrodiagonal and myofascial structures, with their accompanying lymphatic, vascular and neural components. It is a reversible phenomenon and not yet pathological. This term includes multiple facets, and hypothesised models such as the neurofasciogenic model devised by Tozzi, or the nociceptive model by Van Buskirk, however, the term 'somatic dysfunction' can give the illusion of a greater structural dysfunction (Fryer, 2016, cited in Liem, 2016) therefore Liem suggested rethinking the terminology (Liem, 2016).

The word 'somatic' also gives the impression that the osteopath works with and has influence on the soma alone, and this is not entirely true. Dunn proclaimed that OMT was used to "normalise the structural integrity of the body, providing a foundation from which psychotherapy and other therapies could be more effectively employed" (Fitzgerald, 1988, cited in Ching, 2015) and highlighted the interrelation of environmental factors, genetics, psychology and somatic dysfunction. His view was that osteopathy had influence on the psyche via somatic adjustments (Dunn, 1948, cited in Ching, 2015). Somatic dysfunction corresponded with the "organ or avenue through which the personality will find somatic expression for unresolved conflicts." (Dunn, 1950, cited in Ching, 2015).

Focus can be placed on certain aspects, for instance, a yoga instructor may choose a more proprioceptive focus, teaching the placement of the body and its movement in space. However, the teacher can also include more interoceptive pathways, by guiding the student to feel their breath, and heartbeat, and what effect a certain pose has on internal sensations and emotions. Depending on the focus, and the approach of the osteopath, treatment can be directed towards considering the whole being, and not only the soma.

Jean-Pierre Barral commented on trauma and the mechanical, biological, hormonal, chemical and psychological effects of lesions. Post-traumatic syndromes are strongly connected to hormonal-chemical reactions. The force of impact of trauma is then via forces of perception, and sensory and cognitive experience which influences the physiology and biochemical processes (p.89-91, Barral. 1997, cited in Tait, 2012).

A concept well known in psychology is of binding/attaching and releasing/detaching. The one does not exist without the other. The same principle applies to an osteopath's work with the mesenchyme or connective tissue. To be able to connect, the tissue must have the ability to release or separate, showing two forces within; compaction or compression, and loosening or traction (Van der Waal, 2014). One hypothesis might be that if trauma causes a freezing of shock energy in the body as mentioned here above, creating a more gel like consistency compared to sol (p.57, Mutinga, 2020), then we may be able to release the compaction of trauma in the connective tissue through myofascial therapy. This can rehydrate the matrix, altering the viscosity to a more sol-like consistency (Schleip, 2003).

4.1.2. Osteopathic principles

Osteopathy is a holistic, person-centred, non-invasive manual therapy. The principles of osteopathy (Seffinger et al., 2003, cited in Fahlgren et al., 2015) listed below have evolved over the years and continue to evolve:

1. The body is a unit, the person a unit of mind, body, spirit
2. The body is capable of self-regulation, healing and health maintenance
3. Structure and function are reciprocally interrelated
4. Treatment should be based on the three tenets above

One of the principles of osteopathy is the inherent capacity within us for self-regulation and self-healing. Nature has supplied us with our very own chemist, and we have the ability to prescribe ourselves with what we need.

Levine (1997) and Van der Kolk (2014) both acknowledged that trauma derails the ability to self-regulate. Chronic distress from trauma, whether in the form of PTSD, acute trauma disorder, anxiety, depression, somatisation, or other symptoms, can disrupt the capacity to live life resiliently (Grabbe & Miller-Karas, 2017). After a threat, an animal shakes itself to dissipate the physical energy that has arisen from the neuroendocrine response to extreme distress. Factors such as immobility, willpower or medication can cause the natural restorative response of releasing the built-up energy to be suppressed. This

dampening of the restorative response can hinder the natural self-regulation process (Levine, 1997, 01:14:). As a result, disease, a possible outcome of dis-ease, may arise from a disruption of the self-regulating capacity.

Osteopathy is also used as a form of preventative therapy, believing that if there is no obstruction of the fluids, and structural integrity exists, we have the capacity to heal ourselves. The role of an osteopath is to free any obstructions and unlock the innate ability of self-regulation and self-healing, enhancing our natural resilience.

4.1.3. Biopsychosocial model or not

Osteopathy follows the biopsychosocial model, and therefore sees the whole being in relation to physical, psychological and social factors (Engel, 1980). However, Calsius (2020) shows the biopsychosocial model to be relatively objective, reducing the patient to a passive subject, whereas the osteopathic model is much more dynamic, where patients play an active role in their own healing and self-regulation. Williams (2007) stated that to be able to follow the concept of the whole being and the biopsychosocial model, we need to enlarge our idea of dysfunction to include psychological dysfunction. Fahlgren and colleagues (2015) suggested the application of a person-centred instead of a patient-centred approach, which fits more to the true nature of osteopathic philosophy.

Calsius (p.16-21, 2020) saw the limitations of the biopsychosocial model and proposed the four quadrants model by Ken Wilber (Kaplan, 2010, see figure 4.) as a more appropriate way of looking at the person, and in regard to trauma therapy. This model incorporates the experience and the subjectivity of the person on the left side, including a private side and a more collective side. The objective side on the right is what is presented to the outside, both individually and collectively. Calsius (p.19, 2020) suggests that the therapist sees the person as no less than the sum of these four quadrants, including not only what the exterior shows but also the inner subjectivity.

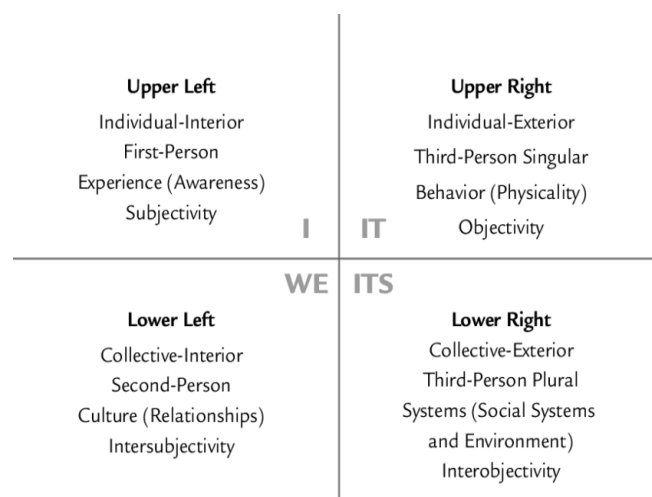


Figure 4. The Four Quadrants Model, Ken Wilber

4.2. The autonomic nervous system and heart rate variability

Osteopathy works with the mesoderm, the middle skin. It is the tissue connecting us. In the philosophy of osteopathy, there is no direct working with the nervous tissue. However, that does not mean that the mobilising of tissue cannot and does not have an effect on the nervous system. Osteopathic manipulative treatment (OMT) has been shown to have hyper-parasympathetic effects (Cerritelli et al., 2020; Edwards et al., 2018; Fornari et al., 2017; Giles et al., 2013; Ginsberg et al., 2014; Henley et al., 2008; Ruffini et al., 2015; Shi et al., 2011; Van Tuijl, 2011). If we look at gastrulation, both the mesoderm and ectoderm are differentiated derivatives of the epiblast. This is one hypothesis to explain why osteopathy may have such effect on neural tissue structures whilst working on the mesoderm (p.81, Moeckel & Mitha, 2008).

Girardin (2019) said that 90% of nerve tissue is composed of connective tissue and blood vessels. It is clear that the mobility and freedom of a nerve relies on the connective tissue components. Still proposed that “the removal of mechanical impediments allows optimal body fluid flow, nerve function, and restoration of health” (p.5, AOA, 2003). If we think and feel on the level of the whole being, instead of parts, we realise that we can and do affect the whole. Furthermore, recognising the possibilities and limits of osteopathy and its influence on sympathovagal balance is important in establishing and refining osteopathic treatment effects (Henley et al., 2008).

Shleip (2003) specifically noted that the deeper forms of touch consistently lend a hand to parasympathetic dominance (cited in Edwards et al., 2018). Touch pressure of as little as 2.5 newtons with a velocity of 1-5cm/sec can increase parasympathetic nervous system activity (Lindgren et al., 2010, cited in Edwards et al., 2018).

As mentioned previously in the chapter *Interoception*, Edwards and colleagues (2018) found that cranial deep touch had a positive influence on HRV, and increased interoceptive accuracy, both of these having a correlation with mental health. When the autonomic nervous system becomes derailed in PTSD, it can cause an array of somatic dysfunctions in the organ systems innervated by the vagus nerve (Lanius et al., 2010, cited in Edwards et al., 2018). The vagal nerve plays a role in modulation of interoceptive accuracy and is closely related to psychological function and mental health.

If OMT can possibly modulate HRV and interoceptive accuracy, such as the outcome produced by cranial deep touch (Edwards et al., 2018), then this may also influence somatic outcomes of chronic pain, and connection of emotional and bodily awareness.

4.2.1. Osteopathic studies on the autonomic nervous system and Heart rate variability

The measurement of heart rate variability can give us an indication of the autonomic nervous system activity, the capacity of self-regulation, and response to stimuli and treatment. Measurements of HRV should be taken over a longer time period, with a follow-up in the days and weeks after the treatment, and not just directly after a treatment, to give an indication of the stability of the autonomic response and the possibility of a longer lasting and more resilient capacity to self-regulate. The following studies are all based on short-term HRV measurements, so during and/or directly after treatment.

Henley et al (2008) indicated the efficiency on one single OMT technique, a cervical myofascial release, which measured HRV as an index of autonomic activity. A tilt table was used to stimulate activation of the sympathetic nervous system in a 50-degree head up tilt. The OMT was performed during the head up tilt on healthy individuals between the ages of 19 and 50 years. The therapy was able to compensate the sympathetic stimulation influenced by the head up tilt, to bring the autonomic state towards parasympathetic tone. Despite respiration remaining quite stable before, during and after the treatment, the LF/HF ratio decreased during the intervention, with a lower LF and increased HF power recorded compared to sham and control groups that showed little variation. This study shows a clear connection between OMT and autonomic activity in a manipulated sympathetic environment, however, due to the exclusion of individuals with medical conditions, there still needs to be further studies to determine the efficiency of OMT for a wider use, and for those with a history of trauma.

Fornari and colleagues (2017) found that under a mental stress challenge, osteopathic intervention can in fact milder the activation of the sympathetic reaction, therefore influencing psychological health and stress regulation. Their approach indicated the efficiency of one single OMT therapy session, with a protocol of craniosacral techniques limited to craniosacral areas, and measured using HRV (LF:HF & HF) and cortisol, showing the effect of an acute mental stressor on the autonomic nervous system and HPA axis. A faster recovery of heart rate and sympathovagal balance occurred as a result of the OMT session, as well as inhibiting the increase in cortisol levels, often seen in response to a stressor. One therapist performed all interventions and was able to decide on techniques based on what was needed, however, limited to craniosacral areas. Critique of this study would be the male-only bias, and the linear, and time and frequency domain limitations of the HRV measurements. For the future it would be interesting to see the use of non-linear and other domains to more precisely measure the complexity of the HRV.

Henderson and colleagues (2010) also used the measurements of salivary cortisol, as well as amylase and salivary flow to indicate the influence of a rib raising technique on the autonomic activity but failed to prove their hypothesis. Directly after the treatment, there was a dampening effect on the sympathetic tone, however, the difference with cortisol and amylase levels failed to show HPA axis and parasympathetic activity influence. It is

worth keeping in mind though, the fact that saliva can only be measured before and after intervention and not during, which limits the response data. In that respect, HRV presents a more viable method of measuring the autonomic activity during interventions to measure direct autonomic response.

Ruffini and colleagues (2015) used HRV as an indirect marker of autonomic nervous system activity and health. Their study consisted of a large group of 57 participants, divided into a therapy group, sham therapy group and a time control group. The therapy group took part in two weekly sessions of OMT, executed by 4 osteopaths, all blinded to HRV data, outcome of the study and study design. HRV was measured before, during and after the treatment.

The OMT intervention was based on a patient's needs basis at the discretion of the therapist, limited to craniocervical techniques, balanced ligamentous tension, and balance membranous tension techniques. The osteopathic therapy had a positive effect on HRV, increasing HF and decreasing LF. Contrary to previous studies such as Henley et al., (2008) and Giles et al., (2013), which focused on specific techniques, this study followed the individualised, patient centred therapy approach, instead of a one-size-fits-all concept. However, the participants were all healthy without pathology, and therefore more study is needed to see the effects of an individually based, patient-centred OMT approach inclusive of pathological factors to completely understand its effectiveness.

Cerritelli and colleagues (2020) tested a range of autonomic parameters, including HRV, skin conductance and thermal images, with the hypothesis that one single OMT session could shift the autonomic activity towards a parasympathetic effect. The participants were divided into a sham therapy and therapeutic group, receiving two sessions over a period of two weeks. The techniques used were limited to craniocervical techniques, balanced ligamentous tension, and balance membranous tension techniques. Measurements of HRV were taken before and after treatments.

The results showed a positive influence on the sympathovagal balance, with an increase in HF compared to the sham group. The vasodilation that occurs with parasympathetic activity and vagal nerve stimulation helps blood flow re-distribution, to decrease the heart rate, and nourish the digestive tract, all promoting a calm and restful state (Cerritelli et al., 2020). As with the previously mentioned tests, these participants were also pathology free and as such, further research on how individuals with a lower baseline HRV may react to OMT is also merited. Due to the lack of a touch free control group, and the limitations of a short-term outcome on HRV, these factors would prove useful additions for future studies, in particular concerning trauma patients.

A study by Girsberger and colleagues (2014) shows the effectiveness of craniocervical therapy in individuals dealing with subjective discomfort. The treatment followed the Upledger craniocervical philosophy and included techniques for the feet, sacrum and thoracic inlet, plus parietal lift and CV4. These techniques were executed by one therapist within a two-day period and were proposed to have an effect on HRV. The HRV was measured prior to and post treatment. Results showed an increase in SDNN (the standard

deviation of all RR-intervals in ms, used as an overall measure of HRV across all frequency ranges) during and after the intervention. TP (TP, total power of RR-interval variability in the frequency range 0.003-0.4 Hz in ms²) increased during the treatment. There were no changes in LF/HF ratio. There was a significant decrease in heart rate after treatment. In conclusion, craniosacral treatment had a beneficial effect on the autonomic activity. Despite the lack of control group, blinding and long-term measurements of HRV, this study did focus on patients with subjective discomforts instead of healthy subjects, providing a much more realistic osteopathic clientele and therefore a more realistic framework for psychological trauma research.

There has been much success with craniosacral techniques, especially the CV4 technique in regard to promoting parasympathetic activity. This success may be due to the close connection with receptors of the occipital muscles and nerves (Ferguson, 2003). Craniosacral techniques of the occiput and its surrounding structures are also closely linked to the brain stem, and the social engagement system. It is precisely these systems that are affected in individuals with a history of trauma, and therefore makes this approach very appealing and potentially beneficial. Other positive implications of the CV4 technique evaluated in a review by Zurowska and colleagues (2017) have aided in sleep onset latency and muscle sympathetic nerve activity (Cutler et al., 2005), improved blood flow and perfusion to the cortical area (Miana et al., 2013) and increased Traube-Hering-Meyer oscillations (Nelson et al., 2006).

The relation of the rate of CRI to Traube-Hering-Meyer oscillations was previously studied by Moskalenko & Kravchenko in 2004 and Nelson et al., in 2002 and 2004 who looked at the influence of cranial manipulation on the Traube-Hering-Meyer and LF oscillations in intracranial fluid (cited in Nelson et al., 2006). Nelson and colleagues (2006) showed that the rate of CRI measured by subjective osteopathic report and Laser Doppler flowmetry had a ratio of 1:2 to Traube-Hering-Meyer oscillations. The therapists were blinded to the flowmetry readings. Subjectively measured Still points and flexion and extension were also visible on the flowmetry as irregularity or relating with the Traube-Hering-Meyer oscillations. This study showed the correspondence of the rate of CRI with low frequency Traube-Hering-Meyer oscillations in blood flow velocity, however further studies must be done to determine the exact mechanisms, and what this may mean for the use and benefits of craniosacral therapy within the osteopathy. Nelson and colleagues hypothesised that due to the correlation of CRI and Traube-Hering-Meyer oscillations, that the Traube-Hering-Meyer oscillations, just as the CRI, may also occur throughout the whole body.

Giles and colleagues (2013) focused on the sub occipital area and its connection to the brain stem. They hypothesised that OMT in this area could influence vagal functions via the close anatomical relationship of the vagal efferent fibres to the occiput's musculoskeletal structures. If the vagus nerve is hindered due to surrounding inflammation or hypertonicity of the muscles, it cannot function optimally, and this may affect its autonomic role in heart rate control. The study involved 19 healthy participants, all receiving three different interventions in a randomised order which included OMT

intervention, time control and sham therapy. OMT therapy was composed of five minutes of posterior cervical musculature soft tissue kneading and stretching, followed by a sub occipital decompression. Results indicated an increase in HF and a decrease in LF/HF ratio during intervention, therefore providing evidence that this technique has direct effect on sympathovagal balance, shifting the balance to a parasympathetic dominance. More study is needed to research possible long-term benefits of this treatment on HRV, and on subjects with a lower HRV.

According to Magoun, the CV4 technique stimulates, nourishes and detoxifies the medulla oblongata and its vital centres (cited in Van Tuijl, 2011), including the vagal nuclei. Upledger (2007, cited in Van Tuijl, 2011) also supported the concept that CV4 brought the autonomic balance more towards parasympathetic tone, and influenced the autonomic control of the secondary respiration. Van Tuijl (2011) compared two different approaches of the CV4 technique to measure the effect duration of each technique on HRV. Sutherland, Magoun and Upledger's approach for the CV4 followed the CRI, while Busquet's approach was to apply compression to the supraocciput transversely. Both versions of the CV4 had a positive effect on the HF HRV during the execution of the technique, however the CV4 technique's (Magoun) influence on the parasympathetic tone remained also after the treatment. This study is therefore an example of how the precision of one technique can determine the efficiency, and therefore outcome of treatment.

In contrast to most studies involving CV4 and HRV/autonomic function, Milnes and Moran's (2007) study failed to reveal a tendency towards parasympathetic activity during the treatment. Three of the ten participants, however, did in fact have an increase in parasympathetic tone during the intervention, which proposes the concept of responders and non-responders.

Taking this concept of non-responders and responders further, we could also look at the therapist and their involvement or state in the therapeutic process. Interpersonal synchrony happens when we interact. It involves our social engagement system and the spontaneous synchronising of neural, physiological, behavioural and affective responses (Semin & Cacioppo, 2008; Wheatley et al., 2012; Rep & Su, 2013, cited in Koole & Tschacher, 2016).

Just like Huygens' explanation of the "sympathy of the clocks", where the swinging of two pendulums occurs simultaneously and in opposite directions, due to the oscillations shared and carried through the wooden beam they both hang from, we can see the patient therapist relationship in the same way. Empathy is also like an oscillation of energies between two people.

The simple pattern of breathing can become synchronised, especially during verbal communication (Yang, 2007, cited in Koole & Tschacher, 2016), and even the way someone says something can be influenced by another (Pickering & Garrod, 2004; Ireland & Pennebaker, 2010, cited in Koole & Tschacher, 2016). Likewise, during conversation, our body rhythms of postural sway and eye gaze can be matched without seeing the other

person (Shockley et al., 2003; Richardson D.C. et al., 2007; Brown-Schmidt & Tanenhaus, 2008, cited in Koole & Tschacher, 2016). Heart rate can also be synchronised in two people who are closely connected and trust each other. There has been scant research into the possibility of synchronised HRV, however it is possible that the physiology can reveal a lot about the therapist-patient connection during treatment, and that perhaps, this too is an influencing factor in responders and non-responders.

A randomised controlled trial by Benjamin and colleagues (2020) showed the positive effects of a six-week osteopathic treatment combined with breathing training on HRV and parasympathetic tone compared to no therapy. The addition of training the efficiency of diaphragmatic breathing may be helpful in increasing parasympathetic tone. This can be a useful and simple inclusion to alter action patterns of traumatized individuals.

A study by Shi et al., (2011) indicated significant effects of cranial osteopathic manipulative medicine (OMM) on HRV and cerebral tissue oxygen saturation in both prefrontal lobes, proposing that this could help to regulate cerebral homeostasis. A suppression and augmentation technique was performed with the intention of altering cerebral tissue oxygen saturation through the inhibition and enhancement of flexion and extension of the cranial bones and creating balance within the cardiac autonomic nervous function. A sham therapy was also given during the session along with these two techniques. Participants were blinded as to the order of techniques given. Suppression was performed via a CV4 technique, and augmentation consisted of enhancing flexion and extension of the Synchronosis sphenobasilaris, placing the hands on the occiput and lateral portions of the temporal bone, stimulating the PRM.

The results showed a decrease in cerebral tissue oxygenation in the prefrontal lobes during the suppression technique. Surprisingly, the augmentation technique had no result on the cerebral tissue oxygenation, but this may be due to the fact that the oxygen levels were not compromised, and the participants were all healthy individuals. However, the HF was increased and LF decreased in both sham and the two OMM techniques. Although this seems contrary, there was a placebo effect during the OMM, which does however show a result following osteopathic principles of the positive effects of manual touch and attention to the person. This also suggests that the autonomic nervous system may be more readily affected by psychological factors than other physiological reactions. The suppression technique may be a valid intervention for individuals with intracranial pressure.

It would be interesting to see what effect this suppression technique may have on individuals with PTSD, whose prefrontal cortex blood flow and function is already diminished (van der Kolk, 2006). Would a CV4 then cause more restriction of cerebral tissue oxygenation in the prefrontal cortex, or could this, following Magoun's philosophy, work as a pump action to nourish and detoxify the medulla oblongata, and replenish circulation of the prefrontal cortex? This leaves room for further studies.

The placebo effect is actually a valid form of therapy. It can be a powerful intervention, unlocking the brain's own pharmacy. If a placebo has effect, then surely this is proof that our minds are undoubtedly linked with our bodies. Placebo involving touch can be difficult, because it is already shown that touch and contact have an influence on the brain and nervous systems through interoception. Bion said that "the purest form of listening is without any memory or desire" (1976, cited in p.139, Calsius, 2020). Osteopaths listen with their hands, and patients feel heard. Even a placebo treatment of hands placed on the body without any memory or desire to do anything, may still have effect on the one receiving. Even a technique where one must 'do nothing' still has influence. We need to look at whether this can be a valued addition to trauma and osteopathy research, or whether this complicates matters more.

Other forms of manual therapy such as physical therapy (Toro-Velasco et al., 2009), traditional Thai massage (Buttagat et al., 2011) and myofascial trigger point therapy (Delaney et al., 2002) have also indicated an ability to increase the parasympathetic dominance (cited in Edwards et al., 2018), showing the physiological influence that touch and contact can have.

The execution of spinal manipulations and myofascial techniques have also been shown to influence autonomic activity.

Welch & Boone (2008) performed both cervical and thoracic manipulations. This study was based on chiropractic manipulation, not osteopathy, and therefore, specific techniques and approach to manipulation may differ. Results were contradictory, showing parasympathetic dominance after the cervical intervention, and sympathetic activity following the thoracic thrust. Pulse and heart rate measurements were taken before and after, however only seven from the forty subjects had HRV measurements taken. Because of the lack of HRV data, further studies would need to take place to more accurately define the effects of this treatment.

A physical therapy study from Budgel & Hirano (2001) showed the effects of a manipulation of C1 and C2 w/o extension on HRV. There was an increase in HF and LF/HF ratio, which could be due to the vestibular stimulation which can instigate a cardiovascular response, or by afference of cervical receptors. Arroyo-Morales et al., (2008) concentrated on specific myofascial techniques for the purpose of positively influencing the parasympathetic reaction. Following high intensity cycling exercise, a myofascial release massage was given, with the intention of regulating blood pressure and HRV, and activating type 3 and 4 mechanoreceptors in the fascia to promote a parasympathetic vegetative response. Results showed a definite recovery of HRV and diastolic blood pressure after the treatment, restoring balance to the autonomic nervous system, and returning to pre-exercise levels.

In summary, osteopathy, whether in the form of a specific technique, or single or multiple sessions, has definite and proven impact on the autonomic nervous system and on HRV.

4.2.2. Measurements and markers

Body therapies follow a 'measuring is knowing' mentality, whereas the psychotherapeutic approach is more concerned with interpretation and an 'attempt to understand' (p.9, Calsius, 2020). Standardised health surveys, often used in osteopathic and psychological research concerning mental health and trauma, are useful in giving a general and subjective idea of what treatment is needed and whether treatment was successful, however osteopathy works with mobility, and vitality, so therefore we also need an objective and dynamic form of testing (Tait, 2012).

Essentially, there are many forms of dynamic testing, however we also have to take into account the trauma factor and that many forms of testing may seem intrusive to individuals with a history of trauma. HRV is a non-invasive and easily applied method, which can be used safely for individuals that have experienced trauma. As discussed earlier in the chapter on the physiology of trauma, HRV is a dynamic oscillation in the physical body, reacting to internal and external factors. It is a physiological measurement of the autonomic activity and therefore shows how the body reacts to stressors and to treatment. HRV is a hopeful psychophysiological index of resilience (An et al., 2020). It is an objective measurement of the body's response to stimulus. Our reactions to trauma and fear and safety all pass through the autonomic system first; the subjectivity comes later. It follows the phylogenetic hierarchy of the brain, from autonomic processes to cognitive thinking.

The consciousness of subjectivity occurs in the cognitive mind, however this cognitive thinking follows autonomic response. We cannot measure subjectivity in an individual whose cognitive processes are not fully functional, as is often the case with trauma. If someone cannot find the words to explain their feelings, how can a self-report measurement give accuracy?

However, if we look at the four quadrants of Wilber then we must take into account both subjective and objective components, and all the four quadrants to include the whole person.

As previously mentioned in a study by Boals (2017), objective trauma is related to higher PTSD symptoms. However, the highest rating of PTSD symptoms was from those who subjectively experienced their trauma as having higher event centrality. Thus, the subjective experience plays a great role in determining risk.

Tait (2020) proposes the use of both quality of life surveys together with mobility testing to reach an overall standard of health based around osteopathic principles and philosophy.

However, HRV could be considered a physiological index of our reaction to the environment and a form of mobility in itself. Combining both the subjective and objective sides of the person, so including both self-reports and HRV measurements, may prove more beneficial, and take the subjectivity bias issue out of the equation. HRV may be a valuable addition to understanding more about trauma and resilience.

4.3. Osteopathic studies on psychological trauma

“And what is trauma is the residue that a past event leaves in your own sensory experiences in your body and it’s not that event out there that becomes intolerable but the physical sensations with which you live that become intolerable and you will do anything to make them go away.”

(Bessel van der Kolk)

4.3.1. Osteopathic influence on trauma treatment

Dunn recognised five factors of OMT which could assist in treating individuals with disorders stemming from trauma (pp.196-199, Dunn, 1948, cited in Ching, 2015):

- the effect of touch
- the reception of the osteopath’s action of therapy felt in the patient’s body, which may lead to an altered sense of body image, reduction of emotional tension secondary to release of musculoskeletal tension, influence of enhanced visceral function on mental processes
- the effect of the osteopath’s attention

The latter is important for clinical studies, in terms of recognising the influence that a placebo effect may have, based purely on the attention given to the individual.

As previously noted, Dunn saw the value of using OMT to create a base for which the benefits of psychotherapy could be optimised. He emphasised the advantages of osteopathy due to its holistic approach, treating the whole being, and its ability, through somatic adjustments, to affect the psyche (Dunn, 1948, cited in Ching, 2015). As Williams (2007) so aptly put it, osteopathy may seem purely a physical therapy, however, any decrease in symptoms, and/or pain can have a substantial psychological effect.

The benefits of osteopathic treatment to enhance the effectiveness of psychotherapy are noted in Dunn’s experiences with a patient suffering from paranoia and stomach pain, who believed he was being poisoned. After treating thoracic dysfunctions with OMT, his symptoms greatly improved. The osteopathic intervention managed to free the relation between the structure and the nervous system, giving the psychotherapy a more effective base to make advancements in treating the underlying paranoia (Fitzgerald, 1988, cited in Ching, 2015). The soma can have effect on the psyche, and the psyche on the soma.

An osteopath works with the person to enhance the innate adaptive qualities of self-regulation and self-healing, supporting homeostasis. The patient is ultimately responsible for these processes, with the osteopath playing the role more of a listening ear and catalyst. The emphasis shifts from a didactic to an autonomous process, allowing the patient a sense of control or awareness over their own processes, something that has

been altered along the way (McLaren, 2010). A Chinese saying says “Give a man a fish, and you feed him for a day. Teach him how to fish, and you feed him for a lifetime.” (cited in Schleip, 2003, Part 2).

Trauma has been shown to alter the regulatory capacity of the autonomic nervous system, and interoceptive awareness (Van der Kolk, 2014; Waugh et al., 2008), affecting HRV (Agorastos et al., 2013; Cohen et al., 2002, cited in Van der Kolk, 2006; Stone et al., 2018;) and resilience (Haase et al., 2016; Waugh et al., 2008, Porges, 2011). Trauma, according to Damasio, can stimulate an increase in subcortical brain regions and reduce activity in the frontal lobes (Van der Kolk, 2006), resulting in emotions and responses that cannot be clearly processed or understood.

Osteopathic therapy helps in modulating the autonomic nervous system (Henley et al., 2008; Giles et al., 2013; Ruffini et al., 2015), influencing the HRV. The role of specific touch also enhances interoceptive awareness (Schleip et al., 2012; McGlone et al., 2017; Edwards et al., 2018) and increases parasympathetic dominance (Schleip et al., 2012; Edwards et al., 2018; Lindgren et al., 2010). It is important to create a safe environment when providing osteopathic treatment, so that the ventral vagal complex can be stimulated, and in doing so, the parasympathetic influence of the vagus nerve, of rest, digest and healing, can be activated. This, in turn, will help to build resilience.

Osteopathy presents a hands-on, patient-centred, holistic approach, which, as Liem (2020) stated, can increase relaxation in both mind and body, hindering the sympathetic effects on the heart, and the over stimulus of the HPA axis. Part of the close link between interoception and resilience is about connecting perception of internal sensations with conscious and purposeful action towards regulating homeostasis (Haase et al., 2016).

In line with this, we could hypothesize that osteopathy may be a suitable and beneficial therapeutic and/or complementary therapy in treating trauma, and that it may play a role in preventative therapy by building on resilience through enhancing the self-regulation and homeostatic capacity of the person.

There are many approaches to treating trauma within the osteopathic profession, however there is a general consensus in the literature that certain methods or philosophies may have more effect. Some of these in particular are the low impact techniques, including myofascial work and its influence on interoceptive receptors and Ruffini endings (Schleip, 2003), and craniosacral work, stimulating the autonomic activity towards parasympathetic dominance (Cerritelli et al., 2020; Fornari et al, 2017; Girsberger et al., 2014; Henley et al., 2008; Ruffini et al., 2015; Van Tuijl, 2011). However, some studies have limited it to a minimalist one technique or one system approach, whereas others have followed a protocol of steps and techniques or have left it to the discretion of the therapist to decide on a patient’s needs basis. Interestingly, almost all have had a positive influence on the patient’s symptoms and well-being.

There have been numerous studies indicating the effects of osteopathic therapy on psychological trauma, specifically PTSD. This is because it is generally easier to fit into specific diagnostic criteria, and often receives financial support from institutions such as the military, who are looking for ways, especially preventative ones, to decrease the individual and financial risk that comes with veteran disability and medical care.

As Callahan (2010) revealed, evidence-based care alone could save the US military an estimate of \$1.7 billion over a two-year period (Tanielian & Jaycox, 2008). With prevention, risk factor reduction and a holistic application to care, the savings are estimated to be much more. Callahan reiterated the role that osteopaths could have in prevention and recovery of PTSD and saw this as a great opportunity for osteopathy.

Most military and veteran PTSD studies have involved male-only participants, however, the statistics show that almost 75% of women employed in the military will experience at least one form of sexual contact violence or sexual abuse by male peers in their career (Lovy & Berkowitz, 2012). One of the few studies which focused on women veterans and active servicewomen with PTSD (Schnurr et al., 2007) revealed that the most commonly identified worst experienced trauma was sexual trauma at 68.3%, compared to war zone exposure which only rated 5.6%. These statistics are significantly high, and it is surprising when we see that many studies about PTSD are focused on male participants, particularly when there is a significant ongoing war of sexual violence occurring right under the military's very nose.

4.3.2. Sexual Violence

Statistics show that one in three women and one in six men have experienced contact sexual violence, and one in five or 19.1% of women and 1.5% of men have been raped (The national intimate partner and sexual violence survey, 2017). The statistics for women in general are greater than for men. 20% of women and 8% of men will develop PTSD in response to trauma, and over the span of a lifetime, 10-14% of women and 5-6% of men will develop PTSD (Lovy & Berkowitz, 2012). As many as 46% of women and 65% of men develop PTSD after rape which makes it the greatest risk, closely followed by neglect (Kessler et al., 1995, cited in Rakesh et al., 2019).

Sexual violence against men and women can result not only in PTSD but in symptoms and disorders such as irritable bowel syndrome, asthma, chronic pain, sleeping problems, chronic headaches, and limits to daily life activities (The National Intimate Partner and Sexual Violence Survey (2010-2012), 2017; Luce et al., 2018, cited in Cuevas, 2017). Surprisingly, there are little to no studies on osteopathy and sexual trauma. The few research papers and guidelines that are available are based on the neurobiology, and the management, treatment and self-care of patients that have experienced sexual trauma, as considerations for osteopathic patient care (Cuevas et al., 2017; Michael-Anna, 2018).

Although touch and manual therapy have a beneficial effect, touch is not always welcome, especially in those with a history of sexual abuse or violence. Touch may induce a 'freeze'

or sympathetic response. There may be reluctance to seek help, disclose the past, and trust in the therapist (Cuevas et al., 2017). More than 50% of childhood sexual assault survivors have experienced tonic immobility during an episode of sexual assault (Fuse & Forsyth, 2007; Heidt & Forsyth, 2005, cited in Cuevas et al., 2017). There is a great need to invest in educating therapists in how to deal with the sensitivity of trauma in the best way possible. Touch, as mentioned in earlier chapters, can increase interoception, stimulate hormones such as oxytocin, dopamine, and vasopressin (Morhenn et al., 2012; Nicolai, 2010; Luyten et al., 2010, cited in p.90-93, Calsius, 2020), alters local vascular pressure, and influences autonomic activity (Collebrusco et al., 2018; Schleip, 2003).

The effects of body-orientated therapy on women that have experienced child sexual abuse were positively supported in a study by Price (2006). Twenty-four women were divided into two groups, one of body-orientated therapy consisting of massage, body awareness exercises and inner body focus processing which also involved the emotional processing of psychotherapy, and a control group of massage only. Personal psychotherapy was continued during the study. Both groups received eight sessions over a period of ten weeks applied to fully clothed bodies. A list of self-report measures was completed directly after treatment at two and four weeks, and at one month and three months follow-ups.

The massage therapy stimulated the participants to engage in psychotherapy. One commented that they had been avoiding talking to a therapist about their past, but after massage, they felt ready to disclose their experiences. Prior massage experience had not provided as much self-motivated therapeutic activity, however this may be due to the safety factor. Participating in a study that was supervised, and utilised massage therapists that were experienced in dealing with sexual trauma, may also have helped. The participants attained a greater behavioural perspective, which promoted self-care and their relationship with their bodies.

The body-orientated therapy group gained motivation to continue the journey of body awareness through applying somatic awareness exercises in daily life. Their perception of somatic experience increased, which also enhanced their psychotherapeutic work. There was a considerable improvement in both groups from directly following treatment to three months follow-up. Dissociation decreased and body awareness increased which had effect on perception of self-embodiment. From this, body-oriented therapies can be seen as a helpful adjuvant therapy for the treatment of sexual trauma.

In a following study from Price (2007), it was indicated that body-oriented therapy reduced the physical and emotional dissociation experienced by individuals traumatised by sexual violence, in a declining manner over time, up to three months follow-up. Both of Price's aforementioned studies show evidence that support the use of body oriented therapies as a beneficial adjunctive therapy in the treatment of sexual trauma, however, considering the lack of a touch free control group and the limits of a maximum three month follow-up, this may be helpful for future studies, to further investigate the efficacy of touch based therapies.

4.3.3. PTSD in Veterans of War

Upledger and his colleagues created a study in 2000, which was inspired by their unpublished pilot study in 1993, a successful two-week craniosacral intensive program for Vietnam veterans with PTSD. This study in 2000 consisted of a two weeks intensive treatment program for twenty-four Vietnam veterans, all fitting the diagnostic criteria of PTSD, except one, the only woman in the study. Craniosacral therapy was used as a core treatment method along with related and supporting therapies, in the hope of reducing PTSD symptoms. These other therapies and sessions involved were group discussions, meditation, Energy Cyst release, SomatoEmotional release, and therapeutic imagery and dialogue. When necessary, the additional use of acupuncture, acupressure, spinal manipulation, myofascial release, massage, visceral manipulation, and hypnotherapy were incorporated. Two psychotherapy sessions were offered separately during the two weeks, with the possibility of more on a patient need's basis.

The craniosacral and supporting therapies all involve the idea of the still point. For instance, SomatoEmotional release is a method using touch with intention, promoting movement and positions of the body. A standstill of the craniosacral rhythm occurs when the process is flowing effectively. The same situation can occur during craniosacral therapy, as is well known, and during energy cyst therapy. Therapeutic imagery is applied during therapy, using these moments of stillness, which often correspond with a certain image in the patient's mind. A dialogue occurs between the patient's image and body sensations.

Spouses were invited to be involved in creating a supportive network and lodging and meals were also supplied for the duration of the treatment weeks. It follows a similar approach to the Still-Heinrich Sanatorium, in the sense that it was also a close-knit environment, where the patients were fully immersed in the treatment, and which centred around osteopathic therapy, supported by related therapies. The Still-Heinrich Sanatorium was a successful centre for osteopathic treatment of mental and nervous conditions, which included relaxation techniques, recreational activities and family therapy in their philosophy of holistic treatment, to support the OMT (Ching, 2015).

The measurement methods of Upledger's study were subjectively based self-reports, and a craniosacral examination testing the motion of the sacrum, occiput, sphenoid, temporal bones and the cranial rhythmic impulse (CRI). All tests were done prior to treatment, and after six months, with additional tests (Brief Symptom Inventory (BSI), and Beck Hopelessness Scale (BHS)) at two weeks and one-month post treatment. The results were extremely positive and clinically and statistically evident, with improvements made in all areas, as symptoms were reduced. It was recommended that participants continue craniosacral therapy on a less intensive basis, the frequency depending on each individual, and that they may benefit from lessons in socialisation, as many had lived in isolation for a long period of time.

An exception of this study is that it did not exclude comorbidity or the use of psychotropic medication and other drugs. All participants had previously used illegal drugs to deal with their PTSD symptoms and six had been hospitalised for suicidal tendencies and depression. Although this wide inclusion possibly makes it more challenging to study, it does give a much more realistic view of trauma, considering that more than 80% of PTSD cases have comorbidity, and therefore presents more realistic research for trauma treatment.

Upledger's study managed to incorporate and combine the two worlds of trauma therapy, the somatic or 'bottom-up' approach within osteopathy and its derivatives, and the cognitive approach or 'top-down' approach within psychotherapy. Criticism towards this study focused on the small number of participants, gender bias (as the participants were mostly men), lack of control group, subjective bias of self-report measurements within the questionnaires and also in craniosacral therapist subjectivity, and the fact that it was not only craniosacral therapy but a combination of therapies which makes it difficult to determine efficiency of one single therapy.

However, the conclusion that Upledger and his team made is realistic. It implies that PTSD may be more effectively and successfully treated when the craniosacral system is also addressed and corrected, along with the release of foreign energies and conscious and non-conscious integration. It is exactly the combination of these treatments that works so efficiently, as Upledger and his colleagues found. This patient-centred approach, built on trust, and encompassing the whole being.

An immersion report from the Upledger Program for military post-traumatic stress (Perry et al., 2016) evaluated the influence of craniosacral therapy on veterans of war. It was an all -male participatory group of six veterans, all presenting with depressive symptoms, and three with presumed PTSD diagnosis. The treatment consisted of a five-day intensive program, following the Upledger craniosacral therapy method, and given twice a day for a total of five hours.

There was a remarkable improvement during the five-day immersion in overall well-being, social function and activity with a marked decrease in physical pain, fatigue, and anxiety. It is worthy to note that there were long-term benefits of reduced depression and insomnia at the five-month follow-up. Four of the six participants had a 20-point drop on the PTSD checklist, which is twice the minimal clinically important difference, and two of the three with presumed PTSD diagnosis were no longer fitting the diagnosis. Although the measurements were all based on self-reports and therefore subjective, it does give us a great indication of the value of craniosacral therapy in reducing PTSD symptoms both short and long term.

A pilot study by Dr. Lisa Chavez revealed that craniosacral therapy was also able to reduce anxiety and somatic symptoms in Tibetan ex-political prisoners who had experienced torture during exile. Improvements were measured via three self-report surveys: The Harvard Trauma Questionnaire, a W.H.O. Brief Quality of Life survey, and the Hopkins

Symptom Checklist-25. The control group that received no therapy had increased symptoms (cited in Rivera, 2016). There is little information available on this pilot study which raises the question of reliability.

4.3.4. Human energy fields and the endocranial approach

Another study by Mounce-Halasz (2014) looked at the effects of general osteopathic treatment on pain symptoms in PTSD. Forty male veterans between the age of thirty and sixty-five years, all clinically diagnosed with PTSD, took part in the study which spanned over ten weeks. Six osteopathic sessions were given, one every two weeks, to accompany the standard medical care for PTSD. The control group received only standardised medical care, including conventional medicine and psychotherapy.

The Visual Analogue Scale (VAS) for pain was measured at the beginning, and at week six and ten, as well as a PTSD survey pre and post-study. Therapy encompassed the vision and philosophy of the human energy fields. A succession of tests were performed, which informed the therapist of the patient's individual needs. If the tissue did not express PRM or rhythmic impulse, then the therapist would feel if it resided in the physical body or in an energy field. Two options followed, with either a release of foreign energy or finding in the physical body where the energy wanted to reside. Depending on whether it was a field lesion or lesion in the physical body, appropriate techniques were engaged.

Interestingly, the field tissue lesion most often treated was the kidney, in 20 out of 21 subjects. Chinese medicine relates the kidney to fear. This corresponds with the adrenal gland superior to the kidney, which releases adrenaline when fear sets in (Shapiro, 2006, cited in Mounce-Halasz, 2014). Fear, according to Chinese medicine, can also be seen in the eyes, and the 'Shen', the soul or spirit which shines through our eyes, can be blunted by trauma and fear. However, this occurrence of treating the kidney in a surprisingly large number of participants leads us to question whether this was a coincidental diagnosis, or more a predetermined hypothesis from the researchers. The study itself proved to be successful in reducing the pain level over a six-week period, with reduction on the VAS from 6.74(baseline) to 2.76 at week ten. In conclusion, general osteopathic treatment tailored to the needs of the individual may be an effective intervention for pain relief in PTSD, however it would be interesting to see the results of the same study undertaken by a different therapist, and a further follow-up at six months to review long-term outcome of treatment.

Tait (2012) studied the effects of global osteopathic and endocranial treatment on individuals who had experienced war related trauma as children. The participants were between twenty-one and thirty-four years old, all having lived through the Croatian war of independence. Subjects were separated into a global osteopathic treatment group, and a combined global and endocranial osteopathic treatment group, and received six to eight treatments over a period of nine weeks. The endocranial examination results determined whether or not endocranial treatment was necessary. The endocranial concept, developed by Philippe Druelle, is the belief that osteopathic therapy has the capacity to

influence not only the mobility of the cranium bones, membranes and cerebrospinal fluid, but also the contents of the central nervous system. Their hypothesis was that endocranial therapy may have a positive influence on the areas subjected to trauma response such as the anterior cingulate cortex and cortico-limbic structures. Measurements to determine treatment efficiency were taken before, during and directly after treatment through a series of standardised health surveys including SF-36 Health survey, the World Health Organization Quality of Life BREF (WHOQOL-BREF), and the three-part Stroop test. Additionally, a three-week post treatment measurement of the WHOQOL-BREF, SF-36 and Stroop tests was taken.

It was evident that the combination of GOT and endocranial treatment had superior results in regard to physical and mental health and to reaction times of the Stroop test, compared to the GOT only group, indicating that endocranial treatment is a valuable addition to treatment of individuals with traumatic history. What is interesting, as seen by the Stroop test conclusions, is that osteopathic treatment influenced cognitive processing that was a reflection of lower and upper motor neurons as mediated by the anterior cingulate cortex. This may not only have an influence on cognitive processing but also on quality of life.

Desilets and Isaac-Vilette (2007, cited in Tait, 2012) also applied the concept of central chain and endocranial spasms from Phillipe Druelle, alongside craniosacral and musculoskeletal techniques in the treatment of individuals with PTSD. Compression at the occipito-atlas joint and L5-S1 was a common find. There was improvement in both the placebo treatment group and therapeutic group, which leads us back to the concept of placebo and the fact that placebo will always have an effect. Due to this, Desilets and Isaac-Vilette recommended removing the control group for future studies.

4.3.5. Natural disasters

A project led by Collebrusco and team (2018) by the name of “Una mano per salute” (Lending a hand for health), came into existence directly after the disastrous earthquake in Amatrice, Italy in 2016. This gave the trauma-struck people of Amatrice and surroundings a chance to receive therapeutic help, in the hope of reducing long term damage to mental and physical health, and also created a social support network, helping to build resilience as a community as well as individually. Over 500 free treatments were given not only to survivors but also to the emergency workers involved in search and rescue and clean up.

The allostatic load of a disaster such as this hinders the ability to self-regulate. Collebrusco and team proposed that osteopathy could prove a valid and beneficial addition to the treatment and prevention of PTSD, alongside psychological therapy support. Within this proposal, they would then be able to rate effectiveness of osteopathic techniques which may be suitable for the stress response. An external party supplied free psychological assistance immediately following the disaster, however it was cancelled after the second session without notice or explanation, causing a great level of distress to the individuals

that had partaken in these services, and offered their trust. As a result, the effects of osteopathy as a complementary therapy to psychotherapy cannot be measured here.

The study took a sample from 20 survivors that had participated in four sessions of osteopathic therapy within a period of four months and beginning less than four months after the earthquake disaster. The sessions were given 15 days apart to give time to process, and to not overload the individual in such an alert state. There was an absence of PTSD diagnosis in this study, however, considering the timing of the intervention in the months directly after the traumatic event, a diagnosis was not possible, and the present symptoms of post-traumatic stress and somatic disorders were considered evidence enough.

Their explanation of the physiological process of trauma is that it begins with tissue inflammation from the activation of neuroglia and multiplication of proinflammatory cytokines in the cerebrospinal circulatory system. As a consequence, inflammation in the meningeal complex occurs, which influences the brain functioning and the regulation of the autonomic nervous system via the hypothalamus. This, in turn, can affect the visceral and musculoskeletal systems.

Each individual had one or two of these parts that stood out, and related to their character structure, however there was a definite heterogeneity of symptoms despite the variation in age, gender, occupation, and previous health issues. The treatment modality had a maximalist approach and consisted of three parts, relating to the musculo skeletal, visceral, and craniosacral systems. The aim was to find equilibrium and homeostasis, stimulate lymph flow and balance the autonomic activity, enhancing the individual's ability to better deal with stress factors. Therapy began with craniosacral therapy to influence the parasympathetic activity and promote relaxation and trust. Overall, an indirect approach was used to find equilibrium in the deep aponeurosis. Their preference went to dosing the therapy, and therefore chose many indirect techniques instead of one direct action. Due to the hyper alert state, time is needed to digest and process. The same principle was taken with respect to frequency of sessions.

Improvements were measured through several self-report surveys, with increased quality of life, general well-being by 32%, and decreased anxiety levels. Therefore, OMT can be a valuable therapy in managing extreme stress states and preventing PTSD in individuals dealing with the trauma of natural or man-made disasters. However, the addition of a control group for future studies is needed to show the difference between no therapy and osteopathic therapy. The use of biomarkers of stress such as HRV could also be useful to provide more objective measurement.

The protocol therapy treatment makes a valid point, however, one that cannot be repeated enough: each patient is different and requires an individual approach. Their treatment plan was designed for the majority but may not benefit everyone. However, as Collebrusco and colleagues state, neither physical or psychological aid alone would be sufficient in dealing with a traumatic natural disaster, and they recommend multi-intervention to confront the complexity of trauma. They believe that combining their

OMT therapeutic model with psychological approaches such as CBT and EMDR to manage PTSD, would not only cut healthcare costs drastically, but would pave the way for a better system, allocating the right resources to optimise the patient's well-being and health (Collebrusco et al., 2018).

It is difficult to come to a definite conclusion regarding the benefits of collaboration between osteopathy and psychotherapy in this research due to the sudden withdrawal of the counselling sessions. In light of this, a combined therapy group is advisable for future studies, to reveal the benefits of collaboration of the two fields, compared to osteopathy alone, in the treatment of trauma in the months directly following a traumatic event.

4.3.6. Bifocal integration

Torsten Liem (2020) and his approach to psychological trauma works with the concept of the polyvagal theory and the connection of the heart, head/face and abdomen. He suggests that osteopathic therapy can bring the body and mind into a relaxed state, hindering the sympathetic effects on the heart, and the over stimulus of the HPA axis. Liem has created a system of emotional integration for individuals with psychological trauma, bringing awareness to the connections between state, somatic dysfunction and internal and external factors. His hypothesised trauma treatment protocol involves a specific palpation practice, inspired in part by methods used in yoga, vipassana meditation and body therapy, positive psychology, somatic experiencing, bilateral stimulation, neurolinguistic body programming, neurogenic hesitation, resource work, human developmental dynamics and non-violent communication (Liem, 2020). The treatment method combines and acknowledges both a bottom-up and top-down approach, allowing the individual to integrate their bodily sensations and emotions into understanding and acknowledgement.

The treatment consists of four phases. The first phase, or establishment of the therapeutic relationship, slows down the pace, giving time for the patient to feel seen and heard, to discuss the patient's needs and strategies for coping. The outcome of the therapy relies much more on the therapist-patient relationship than on the use of certain techniques (Porges & Liem, 2016). An examination is performed, to note areas of tension such as around the plexus coeliacus, heart, suboccipital regions, throat, neck, eyes, and spinal transition regions. The next phase concerns stabilisation and fosters the development of trust, and stress reducing concepts, through a psychoeducative and deep learning approach, creating a strong base to support the next phases. Osteopathic manipulative therapy is also used in this phase to create optimal freedom for function. It is proposed that by stimulating vagal cardiopulmonary and afferent fibres of the trigeminal nerve, via myofasciocutaneous sensors in the face, that this may promote the PAG-limbic-prefrontal circuit activity, facilitating the safe and social state of the myelinated vagus.

The third phase is the confrontation phase using the bifocal integration process. Awareness of the resources that can be used as an anchor if the stress response escalates allows the patient autonomy and gives a sense of safety. The patient is then

asked to envisage and rate their stress or trauma on a scale from 0 to 10, and where they perceive that sensation in the body to be. The line of sight is then adjusted to increase the sensation of arousal. The same principle follows for the most pleasant body region and the line of sight that correlates with an increase in a pleasant sensation. More resources are harnessed if necessary. As the therapist palpates either the region of most stressful or pleasant sensation, the patient switches line of sight between the two already set directions. The therapist may follow the eye movements with micro movements within the palpation. Depending on the patient's response, the therapist acts as coregulatory, intervening only if necessary, with breathing instructions to aid the specific state. This might be deeper breathing to accompany a state of freeze, or to decrease the pace of breathing in the case of a sympathetic hyperarousal. During the increase of arousal, the patient is reminded of being able to use their resources to remain relaxed. The therapist encourages awareness of bodily sensations, and the newly perceived interoception allows memories of the trauma to become explicit rather than implicit (Porges & Liem, 2016). The question during this process is "what happens?" instead of "what is it?", creating a sense of dynamic flow and openness to the present situation, an alert presence that is aware that the dysfunctional patterns are no longer relevant to the present (Liem, 2020).

The use of visual fields is based on the concept of brainspotting, a psychotherapeutic approach to trauma therapy that combines the concepts of EMDR and Somatic Experiencing. The hypothesis of Grand, a promoter of brainspotting, is that certain eye positioning creates a neurophysiological response of emotional imbalance and may activate subcortical systems (Grand, 2013, cited in Masson et al., 2017). A case study by Masson and colleagues (2017) used brainspotting on a survivor of the Bataclan attack in Paris, 2015. The treatment was successful in processing the traumatic event, and a follow-up subjective report a few weeks after the treatment showed that the symptoms had significantly decreased. There are various case studies and reports highlighting the positive influence that brainspotting has had on traumatic disorders and anxiety (Brainspotting, 2020) however further studies must be done to define the approach and include a larger sample group.

Rosenberg (2018, 08:09:46) has had positive experiences in clinical practice with what he calls the 'basic exercise', however this has not been researched. It is a stimulation of the occipital muscles via a light pressure of the hands on the occipital bone, as the eyes gaze to the left and to the right in concession, holding the gaze for up to a minute or until the autonomic nervous system gives a signal of release such as yawning, swallowing or a deep breath. The concept of the technique is to use the direct neural connection of the occipital muscles with the associated eye muscles, which has effect on the top cervical vertebra, allowing vascular freedom to the brainstem, and as a result, enhances both the ventral vagal complex and the parasympathetic tone.

4.3.7. Fascial unwinding

An approach that is used widely for the release of trauma memory and tension patterns in the fascia is fascial unwinding. There are many different hypotheses over the mechanisms of fascial unwinding. One of these is that fascial unwinding uses the stimulation of mechanoreceptors in the fascia through gentle touch and stretch, activating the parasympathetic nervous system to enhance relaxation, as well as the central nervous system related to movement and muscle tone (Minansy, 2009)

The definition of the unwinding concept is “a manual technique involving constant feedback to the osteopathic practitioner who is passively moving a portion of the patient’s body in response to the sensation of movement. Its forces are localized using the sensations of ease and bind over wider regions.” (AACOM, 2006, cited in Minansy, 2009). The part of the body that is being treated is supported so that the sensation of gravity and reactive proprioceptive tone are reduced, facilitating relaxation so that the body can move guided by stretching sensation to find areas of ease. The osteopath passively facilitates these movements.

Upledger (1987, cited in Minansy, 2009) proposed that fascia can hold memories independent of the nervous system, however the mechanisms of unwinding are still not completely clear. It is, however, clear that the purpose of the technique is to enhance the inherent homeostatic physiological mechanisms. Minansy (2009) suggested that the mechanisms of unwinding are in fact due to ideomotor movements, an unconscious reflex action of involuntary muscle movements. This, in turn, creates a tissue response, which gives feedback to the central nervous system. Ideomotor action can activate muscle action by simply thinking of an action (Spitz, 1997, cited in Minansy, 2009). Especially in the case of trauma, emotional release may occur, with accompanying vegetative responses such as shivering, sweating, and eructation. Touch can trigger a memory, known as state dependent memory, where the individual must return to the previous same state to be able to recall it (Colman, 2001). Upledger (1987, cited in Minansy, 2009) acknowledged the intention of the therapist and the openness of the patient was paramount to the outcome of fascial unwinding.

4.3.8. Treating possible symptoms of trauma such as anxiety and depression

Osteopathy has also been found to effect depression and anxiety, which are common reactions of trauma. It is beyond the scope of this thesis to include every symptom and response to trauma and its corresponding research, however some examples of these studies are mentioned here.

Bastian (2008) indicated a positive reduction in anxiety in individuals after osteopathic treatment. A global osteopathic approach was engaged, with the goal of diminishing the sympathetic dominance, focusing on related cranial and thoracic areas (cited in Mounce-Halasz, 2014). Anxiety can be paralleled to a state of fight or flight. The system is in a

chronic hyperreactive state and reacts to fear which is unknown, conflicting and/or internal. Anxiety warns the body of danger, even if it isn't real.

Blumer and colleagues (2017) recommended osteopathic treatment approaches that improve HRV, considering that low HRV has been associated with individuals with anxiety problems.

Techniques such as myofascial or manipulation of the upper cervical area, suboccipital decompression, craniosacral techniques, and diaphragm relaxation. The individual's present anxiety levels will determine the mode of treatment. Blumer and colleagues also recommended the use of a HRV biofeedback system to help the individual become aware of the physiological nature of the anxiety.

Plotkin and colleagues (2001) proposed OMT as an adjunctive therapy for premenopausal women with depression. The participants were divided into a control group and therapy group, and treatment was given over a period of eight weeks. Both groups were given standard conventional therapy, which involved a psychotherapy session involving cognitive behavioural therapy and neurolinguistic programming once a week, and the antidepressant drug paroxetine (Paxil) hydrochloride. They also received a structural osteopathic examination prior to, in the middle of, and after the treatment period. The therapy group received treatment at the discretion of the therapist depending on patient needs, though most therapists chose more low impact techniques. The control group received only structural examination.

The average CRI rate of individuals with depression has been previously determined as 6.42 cycles per min. Woods (1961, cited in Plotkin et al., 2001) noted that psychiatric disorders may have an influence on reducing CRI. This study showed an increase in CRI rate from 6.2 cycles/min prior to treatment, to 8.83 cycles/min post study, however this was based on subjective empirical measurements and therefore may be subject to bias. Depression scores were measured via the Zung depression scale. All women who had received OMT increased to the normal range, however, less than 30% of the control group improved. Plotkin and colleagues (2001) suggested the possibility of the rate of CRI as a representative measure of the state of depression, (1961, cited in Plotkin et al., 2001) however this would need to be further researched. This study reveals the importance of the mind and body in treating mental illness, and the much-needed collaboration between conventional therapy and osteopathy for the treatment of depression.

For future studies, the addition of a 'no touch' control group may be beneficial to remove the placebo therapy effect that may have occurred in the control group due to the use of contact in the physical examination, as well as a more objective measurement of CRI.

[4.3.9. Summary](#)

The therapeutic approaches taken in these studies have ranged from specific craniosacral and myofascial release techniques to general osteopathic treatment on a patient's needs basis. What is evident is that the majority of the studies have chosen low impact techniques, either premeditated or on a find-and-fix basis. Although each individual needs

an individual approach, and no patient is the same, the fact that traumatisation has altered the neuroception means that this asks for a special and empathetic approach to touch and treatment. For instance, a woman with a history of sexual abuse may not feel comfortable with a manipulation to the pelvic area. This does not however always rule out high impact techniques in the case of trauma, as high velocity thrust techniques in the lower lumbar and cervical area have been shown to enhance parasympathetic tone. It merely reiterates that every patient is different, with a different story and response.

Scientific research shows that stimulation of the interoceptive receptors in the fascia through soft touch (Schleip et al., 2012; McGlone et al., 2017; Lindgren et al., 2010) and low impact techniques such as craniosacral and myofascial techniques may increase the parasympathetic tone (McGlone et al., 2017; Schleip et al., 2012; Edwards et al., 2018; Henley et al., 2008; Fornari et al., 2017; Ruffini et al., 2015; Cerritelli et al., 2020; Girsberger et al., 2014; Van Tuijl et al., 2011). Manipulative techniques have also influenced the autonomic nervous system but may depend on location as to the autonomic effect, as shown in thoracic manipulation which stimulated the sympathetic system (Welch & Boone, 2008). However, the idea of low impact techniques and treatment perhaps conform more to the autonomic state of the traumatised individual.

Working with trauma is delicate work. Facilitation of a safe and social state via the myelinated vagus is needed in trauma therapy, supported by the patient therapist relationship as well as during osteopathic treatment. Stimulation of myofasciocutaneous sensors in the face as suggested by Liem (2020) is one example of how we may enhance certain pathways associated with the social engagement system and safety.

Timing, sequence, and catering to the individual's personal needs is essential. Trust must be built before any treatment takes place and important questions need to be asked: which state does the patient present themselves in? How do they feel now, in this present moment? This present state should determine therapy, not the trauma of the past, or protocol.

From these studies, we can conclude that osteopathic therapy is a valid and beneficial approach and addition to trauma therapy. However, focus needs to go to researching the effects of osteopathy on long-term outcomes, as trauma related disorders, specifically PTSD, tend to be chronic disorders. At the same time, there also needs to be more use of 'no touch' control groups in future research to clearly define these differences.

More research is needed into the possible benefits of osteopathic therapy in building resilience for future trauma, and what exact physiological approaches are involved. This would demand a longitudinal study approach rather than cross sectional, and the use of a physiological marker such as HRV as well as subjective self-report measurements. However, it shows promise, considering the positive results of osteopathic therapy on HRV in healthy individuals as a marker of resilience, and the improvements and recovery rate of already traumatised individuals, and that this is in itself, a form of resilience. It would also be interesting to further research the correlation between CRI and Traube-Hering-Meyer oscillations (Nelson et al., 2006), to determine further mechanisms

involved, and the influence that craniosacral therapy may have within the osteopathic treatment.

The argument that osteopathy can be used as a preventative therapy, effectively assisting before a traumatic event has occurred, remains to be substantiated, as there is insufficient evidence. However, it is evident that osteopathic intervention applied in the weeks and months following a traumatic event may aid in the reduction of adverse symptoms and PTSD, and therefore, can be seen as helping prevent trauma-related disorders after the traumatic event has occurred. Future research should look at the timing of therapeutic intervention after a traumatic event, and which periods may optimise or have negative impact on treatment outcome, a question that has been discussed within psychology but not thoroughly enough within the osteopathic world.

4.4. Osteopathic collaboration with psychotherapy

4.4.1. 'Top-down' or 'bottom-up'?

Most patients we receive in the osteopathy present with somatic issues or complaints. Rarely is it purely psychological. An osteopath is considered 'bottom-up' therapy although we are concerned with the whole triune. The approach may be via the physical body, which may then have effect on the other parts, the psychological and spiritual body. Osteopathic, touch-based therapy with its holistic approach influences the interoceptive awareness, and autonomic activity, enhancing sympathovagal balance, facilitating self-regulation and homeostatic efficiency, and has proven to be a valuable addition to trauma therapy. However, no therapy is purely 'bottom-up' or 'top-down', as osteopathic research into placebo therapy has shown. Attention to and focus on a patient is a therapy in itself.

Liem (2020) reminds us of the importance of the therapist-patient relationship and its significant role in therapy outcome. It is not only important 'what' we do relating to techniques, but 'how' we approach the individual, the triune, just as the recovery of trauma initially involves exploration of 'what' we feel, followed by the 'why' we feel certain sensations. Calsius clearly places osteopathy in the realm of somatic bodywork, and psychotherapy and analysis in the realm of psyche. What occurs in between these two is the world of body psychotherapy or as Calsius terms it, experiential bodywork, which involves a more innovative framework within the concept of body psychotherapy.

In this world located in the middle of the psychosomatic spectrum, "the physical structures and processes are not the goal of the treatment, but a "means of" (p.8, Calsius, 2020). Calsius's (p.9, 2020) explanation of the differences in the philosophy between the two worlds of osteopathy and psychotherapy are logic versus hermeneutic (interpretation). However, the approaches and beliefs differ between each individual osteopath, and therefore this is a gross generalisation. Body therapies follow a 'measuring

is knowing' mentality, whereas the psychotherapeutic approach is more concerned with interpretation and an 'attempt to understand'.

Do we begin with a 'top-down' or 'bottom-up' approach?

Psychology has its entrance via the psyche. 'Top down' approaches, such as cognitive behavioural therapy, exposure therapy, hypnosis and mindfulness begin with the cognitive brain, and 'bottom up' therapies such as Somatic Experiencing and osteopathy are orientated sub-cortically. The positive effects of talk therapy and 'top down' approaches are evident in past trauma therapy research. 'Top-down' therapy may be useful for understanding and providing insight into trauma, and cognition helps to cope and adjust after trauma, and train the cognitive brain to re-story (Boals, 2017). Mindfulness, also a 'top-down' approach, has had significant effect on both interoceptive awareness and recovery from trauma (D'argembeau et al., 2007; Farb et al., 2007; Holzel et al., 2008, cited in p.96, Van der Kolk, 2014). Research on body-oriented therapies is growing slowly but is still limited, perhaps due to the fact that body psychotherapy has been divided into many individual branches, each with their own concepts and methods.

Even during 'bottom-up' therapy, the mind comes along for the ride, however the top-down processing can inhibit the process of the body letting go and ignore or be unaware of the sensory signals. If the prefrontal cortex is stimulated too soon, it can risk re-living the trauma. At the same time, extreme emotions and response to trauma can also inhibit the cognitive processing. The action patterns in the body need to be released to change the faulty cognitive beliefs. There is a great learning process that occurs in trauma therapy. Insight comes from a relaxed autonomic state and the cognitive brain can learn from trauma and find the ability to rationalise and understand. Its role is not to interfere with the natural processes of restorative response, but to support them where needed.

We need both our cognitive brains and our subcortical systems to be what we are, and we need to be aware of the sensations in our bodies to allow us to self-regulate, and to find homeostatic balance. However, we have gotten so caught up in wanting to understand everything that we miss the importance of feeling. We ignore that instinctual gut feeling, or primal instinct, that feels rather than understands. The fibres of the vagal complex that help regulate our homeostasis are 80% afferent, bringing information from the body to the brain. Our internal sensations are extremely important in defining our self-concept, homeostatic capacity, and in turn our resilience to deal with adverse situations.

"Knowing what we feel is the first step to knowing why we feel that way"
(p.95, Van der Kolk, 2014).

[4.4.2. Holism](#)

The definition of holism according to the Merriam Webster dictionary (2020) is "a theory that the universe and especially living nature is correctly seen in terms of interacting

wholes (as of living organisms) that are more than the mere sum of elementary particles.” On a philosophical level, it mirrors the idea that the parts of the whole do not equate to the whole itself. For example, if we broke a car into parts, the parts would materialistically add up to the whole, however these parts would not function in the same way by themselves. It is the interaction of these parts that create the car and its movements. Just as a clutch needs a gear box and a drivetrain to drive a car, we too must consider both the parts of the body *and* their interactions with each other when we consider the whole.

We live our lives holistically, in that we take in and perceive our environment through all five senses, not just one. Nature does not exist as parts, but we have dismantled it so as to understand it better. Consider conventional medicine, with all its specialists in different buildings, hardly conversing with each other. Nutrition study is not compulsory in medical school for training gastroenterologists (Raman et al., 2009). A psychologist is not always offered to a patient before a life-changing operation such as a proctocolectomy. There is a need to work together and collaborate more for the benefit of the patient's health and if we view medicine through a holistic lens, integration is an integral part it.

If we look at Masten’s definition of resilience (as mentioned in the resilience chapter), it is “the capacity of a dynamic system to adapt successfully to disturbances that threaten the viability, the function, or the development of that system”. Her belief is that we can learn a lot from looking at other disciplines and their definitions of resilience (Southwick et al., 2014).

Holistic is not a noun but an adjective, something “relating to or concerned with wholes or with complete systems rather than with the analysis of, treatment of, or dissection into part”. The function of an adjective is to modify or describe a noun. In the case of medicine, it modifies the concept of medicine to something more complete. Perhaps we can see it not as a modification but as a simplification, going from separate parts to an entirety. Some allopathic therapies can therefore choose to be holistic, whereas not all osteopathy follows a holistic way of thinking.

There are important aspects to both holistic and allopathic therapies that can benefit the patient greatly. The goal is not to persuade the other necessarily, but to remain open, continue learning, and look further than the clutch. Just as a clutch needs a gear box to move the drive train, if we can have more interaction with these parts in the whole system, we will have a more optimal effect on the health of an individual. The focus should be on being aware of the effects that we can have as therapists and being aware of where our limits are within our specialty. As MacLaren (2010) stated “Medicine is strengthened, not weakened, by having the two traditions of allopathic reductionist biology and osteopathic holism.”

As explored in previous chapters, osteopathy has an effect on psychological trauma through a supportive therapist-patient relationship and the physiological effects of specific touch, which stimulates parasympathetic activity and interoceptive awareness, in

turn enhancing the self-regulating and self-healing capacity. This also has an effect on the resilience of an individual.

As Calsius (pp.8-10, 2020) explains, trauma therapy in the world of psychology has evolved, moving from strictly talk therapy, such as psychoanalysis and cognitive behavioural therapy, to a more physical approach, such as somatic experiencing. It is continuing to move towards the midline, towards a more somatically aware model of therapy. Osteopathy, at the other extreme of somatic therapy, is also slowly migrating towards the midline, through research into the effects of touch and therapy on the psyche, and the awareness of the therapist patient relationship. However, many osteopaths are aware of the effects that can be achieved but are not well versed in how to respond to these effects. This leaves many osteopaths feeling that they are not prepared and equipped to deal with all responses stemming from trauma, and uncovers the need for more post-graduate courses, which can provide the appropriate knowledge, training and support.

Psychotherapy has come a long way since the days of Janet and Freud. With the addition of neuroscientific research on psychological trauma, there has been a growing interest in the physiological responses to trauma and the importance of treating not only the mind but also the soma.

[4.4.3. Collaboration past and present](#)

Since the days of Still, osteopathic therapy has treated trauma and psychological disorders, and with success. In 1914, the Still-Hindreth Sanatorium opened a holistic centre for the treatment of mental disorders. OMT was the primary therapy used in this centre, with other treatments supporting the osteopathy such as relaxation and recreational activity, and family therapy. However, as the Freudian paradigm linking touch to sexuality era dawned, there was less use of OMT.

In the late 1980's, collaboration between psychiatry and osteopathy at the Laughlin Pavilion grew, and the OMT service was contacted by the psychiatric service for consulting over some of the patients (Ching, 2015). Osteopath Theodore Jordan also received referrals of psychiatric patients from the Doctors Hospital in Columbus (Ching, 2015). Charlotte Weaver, who also branched out in teaching and developing cranial osteopathy, reported having significantly positive results in treating patients with psychiatric disorders. Dunn acknowledged the importance of normalising the structural integrity of the body in osteopathic treatment to lay a foundation so that other therapies including psychotherapy could be more effective (Ching, 2015).

There is an increasing interest in complementary and alternative medicines for mental health issues. In a study by Libby, Pilver and Desai in 2013, sampling 599 individuals in the USA with PTSD, it was revealed that 24% had sought traditional mental health services only, whereas approximately 40% had sought CAM (complementary and alternative

medicine), with 20% used as a complementary therapy in combination with conventional therapy and 18% as an alternative treatment (Libby, Pilver, & Desai, 2012).

The various types of CAM therapies are many, however, this is an example of the need to combine ideas and concepts. In doing so, we may be able to improve treatment for PTSD and other disorders stemming from trauma. If almost half of the individuals with PTSD are in search of something that they cannot find or is insufficient within the conventional methods of therapy, then perhaps we need to think outside the boxes of dualistic medicine.

A workforce survey of osteopaths in Australia (Adams et al., 2018), completed by 992 practising osteopaths, revealed that 19.3% worked in a multi-practitioner location that was shared with a psychologist or counsellor. 15.5% of the osteopaths received referrals from a psychologist or counsellor, and 35.2% referred patients to a psychologist or counsellor. This rate of referral was less than alternative therapies such as acupuncture and homeopathy. However, the rates of referral to and from general practitioners rated highly at 88.5 and 89.3 respectively. When the osteopaths were asked where the focus should be directed in terms of osteopathic research, the greatest response was towards creating a better understanding of the role of osteopathy in health care, specifically for general practitioners and other conventional health professionals. Despite the great number of referrals related to the general practitioner, there is still an almost unanimous voice from the osteopathic world stating that their role in health care needs further research to be fully understood by the general and conventional health care. Perhaps more understanding can then generate a greater collaboration between psychologists and osteopaths. In the Netherlands, there is not much information concerning the collaboration between psychotherapists and osteopaths, although there is a definite physiological background supporting the benefits of such collaboration.

The Benelux Osteosurvey (p.112, Keyser-Hoogenkamp & Keyser et al., 2013) shows that only a small 36.3% of referrals to Dutch osteopaths comes from a general practitioner, compared with 73.5% via word of mouth, or an acquaintance, however the referrals from psychologists and counsellors in the Netherlands are not specified in this particular survey. This follows in line with the study from Libby, Pilver and Desai (2013) and that the patient often 'self-refers' themselves to an osteopath.

There is a definite difference in the health care systems, the present stand and recognition of osteopathy, and the promotion of, and methods of promoting osteopathy in the Netherlands and Australia.

91.7% of osteopaths in the Netherlands work as independents (zelfstandig), and 99% work in a private practice. One third of these work in a group practice, although it is not clear in the survey whether this is with other osteopaths only or other forms of therapy (Keyser-Hoogenkamp & Keyser et al., 2013). 32.4% of osteopaths in France/Luxembourg work in a group practice, and 51.9% of these osteopaths work alongside psychologists (p.37, Keyser-Hoogenkamp & Keyser et al., 2013). This is compared to 83.7% of Australian osteopaths who work in a multi-practitioner practice, including other osteopaths and

various other disciplines such as acupuncture, naturopathy, psychology and massage therapy.

This data cannot be compared fairly however, due to the lack of complete information, and differing focus on survey questions. Specific information and research focusing on patient referral between psychology and osteopathy in the Netherlands would be beneficial to further work on collaboration between these two forms of therapy, especially in trauma therapy. The importance of bringing awareness to the conventional health care world of the role and benefits of osteopathy is an important topic to address in both Australia and the Netherlands and is an area that needs to be further researched.

The benefits of osteopathy as an adjunctive therapy to conventional psychotherapy and medicine for people with depression has been highlighted in the Plotkin and colleague's (2001) study. All participants who received OMT as adjunctive therapy improved on the Zung depression scale compared to less than 30% of the control group who only received psychotherapy and medication.

Upledger and colleagues (2000) concluded that PTSD could be more successfully treated with the addition of treatment to the craniosacral system, accompanying other supportive therapies, including psychotherapy. There was careful attention paid to inclusivity of both 'bottom-up' and 'top-down' approaches. 12 of the 24 participants were also referred to the study by two counsellors. Interestingly, these two counsellors were also Vietnam veterans and had participated in previous craniosacral treatment programs, which inspired them to become craniosacral practitioners themselves (Upledger et al., 2000).

Collebrusco and team (2018) also collaborated with counsellors during their osteopathic intervention for the survivors of the earthquake disaster in Amatrice. Unfortunately, the counselling sessions were abruptly cancelled without explanation, thus the effects of collaboration cannot be noted here. Mounce-Halazs (2014) revealed osteopathic treatment to be an effective additional therapy to the standardised medical care, including conventional medication and psychotherapy, supplied to veterans by the study physician. Timing and approach are key, taking order into consideration, such as the Denmark study mentioned in Chapter One (Rosenberg, 2018, 06:39:12) that noted that traumatised individuals fared better when body-focused therapy was given prior to talk therapy.

Williams (2007) suggested the possibility of integrating cognitive behavioural approaches into osteopathy, similar to trials in the physiotherapy world for the pain management of non-specific lower back pain (Hay et al., 2005). Participants were randomly assigned to either a pain management programme, which included a treatment plan including exercise, education and coping strategies, run by physiotherapists who had received a two-day cognitive behavioural training, or a manual therapy-based intervention only. Although this study did not show a significant difference between the two groups, it may be due to the brief two-day duration of the cognitive training course, and the fact that

there was a low level of physiological distress in participants. Other studies have shown that cognitive behavioural based programmes can help as an addition to exercise programmes (Frost et al., 1998; BEAM, 2004, cited in Williams, 2007).

This kind of training as an addition to the osteopathic practice may be a valued addition, to create more understanding of the cognitive processes during treatment, however it cannot replace an experienced psychotherapist's role. It merely provides the osteopath with a more rounded approach to therapy and treating the whole and can build a foundation for further talk therapy.

4.4.4. Resilience

How can the fields of osteopathy and psychology work together, building on each other's strengths, while creating a more efficient and resilient concept of trauma therapy? Trauma therapy can only be strengthened, not weakened, by having the two traditions of holistic osteopathic manual therapy and conventional psychotherapy collaborating. We are stronger when we know our own weaknesses, or when we are honest about the things we don't know and are aware of those areas that need improvement or additional help. By knowing our own limits, we can build resilience together.

HRV is commonly used as a biomarker of autonomic activity and self-regulating capacity in osteopathy, and to measure resilience in psychology. It has been shown that osteopathy positively influences HRV (see chapter HRV). Our resilience depends on our ability to self-regulate, and to re-find homeostasis after stress or trauma. HRV may be able to bridge the gap between psychological and osteopathic research, combining both 'top-down' and 'bottom-up' concepts, to study the influences that osteopathy, with its preventative and therapeutic approach, and as a complementary therapy to psychotherapy, may have on resilience.

If we take Siebert's idea of the three parts of resilience embodied in the three nervous systems, then we need to look at all parts to be able to build resilience. Self-esteem is housed in the autonomic nervous system. We can build self-esteem by creating a sense of safety through trust in the therapist, and bodily awareness through the power of touch, stimulating proprioceptive and interoceptive receptors. Self-confidence lives in the somatic nervous system, and through correcting misalignment in the bodily structures, we can provide balance and strength so that one can confidently execute action and movement. Self-concept is housed in the central nervous system, and through cognitive guidance, the conscious perception of 'I' or 'me' in relation to the environment becomes clear, as well as our processing of our identity and who we are. Therefore, both bottom-up and top-down approaches complement each other and are needed here to build resilience.

4.4.5. Learning from nature

“Why should osteopaths and psychotherapists work together? It is basic evolution. Osteopathy is based on evolution. They are one and the same. Osteopathy is applied evolution”.

(McConnell, 1913, cited in Girardin, 2019)

If we look at the phylogenetic development of the brain, we see how complex it has become but more importantly where it has originated from. It is no wonder that through this highly evolved cognitive brain, we have lost contact with our instinctual brain, and our feelings and sensations within the body. When traumatic experiences are unexplainable, we must look further, to our distant relatives, to see that it is not only about consciously understanding an experience but also about how it resonates within us. Once we have felt this, and are aware of these sensations, then our newly evolved brains can start to piece the puzzle together.

There is a greater recognition of the physiological effects of trauma, and the way that the body needs to be addressed during therapy to fully process what is past and present. In order to do this, the insula, anterior cingulate, and medial prefrontal cortex need to be activated in order to integrate and process internal sensations, while connecting with emotional, sensorimotor and cognitive parts of the traumatic experience (Van der Kolk, 2006).

Trauma can shift the autonomic activity and inhibit the neocortex’s ability to function properly. There is a bombardment of “subcortically initiated responses” (Van der Kolk, p.1, 2006) and thus, cognitive therapies by themselves aren’t enough to recalibrate these autonomic survival responses. Van der Kolk recommends approaches that enhance sensory awareness and mindful movement, exercising the medial prefrontal cortex, anterior cingulate and insula, being able to feel comfortable with the internal sensations and recognising them for what they are, whilst combining sensorimotor and emotional aspects of their trauma (p.12, Van der Kolk, 2006).

In 1999, Damasio, a neuroscientist well known for his work with emotions, complemented the brain for its good housekeeping. In other words, the anatomical positioning of the structures governing emotion and attention being close to one another makes sense, and their closeness to structures regulating and indicating the physiological state of the body also go without saying. Managing life and homeostatic regulation, which go hand in hand, is impossible without the information from the body’s present physiological state (Foreword, Ogden et al., 2020). Cognitive and emotional processing greatly influence sensorimotor processing and the body, and vice versa. Ogden and team (2020) suggest examining the interrelation of cognition, sensorimotor responses and emotions in therapy.

Collebrusco and colleagues (p.52, 2018) noted that neither a purely physical or psychological approach to therapy alone could be sufficient to process, elaborate and

overcome the traumatic effects of such a natural catastrophe. Whether the approach is more somatic or psychological, we are concerned with the same request for help, and the same patient, or more specifically, the same person. There is not one right way. It is individual/person based. However, we must not only respect the individual but also the hierarchy of our system, and nature and evolution.

4.5. Improvements

“You know your anatomy and your physiology thoroughly... but when you place your hands on the body of a patient do not forget that a living soul lives there”
(Andrew Taylor Still, cited in Collebrusco et al., 2018)

As osteopathic studies treating psychological trauma have shown, there is a diverse array of approaches taken. All have had a positive influence on the majority of these individual's recovery and from this, it can be assumed that osteopathy, as a whole, is a successful form of therapy in aiding recovery from trauma, and as a complementary therapy. However, there is still much to be learnt and to improve on.

Trauma alters both the interoception and neuroception and thus osteopaths have an important role in creating a sense of safety when considering the practice environment, the therapist-patient relationship, their approach to therapy and touch, having sufficient tools and knowledge to deal with the trauma response, and being responsible for their own personal therapy.

4.5.1. Education

Osteopaths are not trained psychotherapists and therefore cannot be expected to be able to deal with the diverse array of emotional responses that may occur in therapy. There are, of course, varying levels of knowledge, education, background, interest, empathy and involvement between osteopaths, however generally speaking, psychotherapy is not something that is taught in osteopathic undergraduate education.

In the Netherlands (College Sutherland, Amsterdam), psychological education in undergraduate osteopathic education takes place in classes that focus on the therapist-patient relationship, learning the skills of communication and therapeutic conversation and how to reflect on a personal level and with one another, as well as delving into personal therapy and developmental psychology. The aim is to create awareness of the integral functioning of the human psyche, and how one can integrate their bodily sensations, feelings, thoughts and actions not only personally, but also within the osteopathic learning process, and for future practices. Toos Bartlema, with a background in Reichian body psychotherapy, introduced this imperative part of the osteopathic training, supplying a strong foundation for the osteopath to build upon (Bartlema, 2006). However, it is important that this approach be applied and integrated into all practical and theoretical teachings within osteopathic education.

There are a few post-graduate courses offered here in Europe by institutions and osteopaths specialised in this area, such as Mutinga, Calsius and Schleip. These venture deeper into the subject of trauma and how to work with it; a valuable and useful addition considering at least 70% of the population will experience at least one form of trauma in their lifetime (Kessler et al., 2017). However, these courses are not compulsory. It would be beneficial for both future therapists and their patients to have an introduction to trauma care in undergraduate education.

Williams (2007) suggested the possibility of integrating cognitive behavioural approaches into the osteopathy session, such as those trialled in the physiotherapy world for pain management of non-specific lower back pain (Hay et al., 2005) and used as an addition to exercise programmes (Frost et al., 1998; BEAM, 2004, cited in Williams, 2007). It would be interesting to see how cognitive behavioural training may benefit osteopathic therapy in treating trauma. Courses are not a replacement for a complete education but may help to broaden understanding and give the osteopath more tools to use, if and when needed.

When it comes to sexual trauma, education for health care practitioners is fairly minimal or non-existent (Scriver & Kennedy, 2016, cited in Michael-Anna, 2018). Osteopathic education supplies a bare minimum of what is needed to deal with the complexity of sexual trauma. Considering the statistics that one in three women and one in six men have had at least one experience of contact sexual violence in their lifetime (The National Intimate Partner and Sexual Violence Survey 2010-2012), and sexual violence against women can result not only in PTSD but in somatic disorders and complaints of the digestive tract, cardiopulmonary and nervous system, urogenital tract and depression (Jina & Thomas, 2012, cited in Cuevas et al., 2017), suggests that there is a need to provide more education about sexual trauma, both at an undergraduate and post-graduate level. Trauma-informed care helps to expand the therapist's knowledge, confidence and skillset, and assists in managing, educating, and treating patients with a history of experiencing sexual violence, so that they can receive the best possible care. Providing education focusing on the effects of sexual violence has been shown to increase awareness and understanding, leading to a better care for victims (Kennedy, Vellinga, Bonner, Stewart & McGrath, 2013, cited in Michael-Anna, 2018).

4.5.2. Personal therapy for the therapist

One of the most important preparatory steps for working with trauma is personal therapy. Only when we have looked inside ourselves, become aware and learn to integrate our own internal sensations and processes, do we have the ability to help another. Working with the self is an open-ended process, however creating space for this awareness of self on the path towards self-actualisation is important.

Mutinga (pp.96-97, 2020) stated that the therapist must contain as little resistance as possible on a mechanical, electromagnetic and fluidic level, in order to be a conductor of shock energy, and to allow the shock energy from the patient to dissipate. Personal

therapy has been shown to benefit not only the therapist but also the quality of therapy, creating more authentic connection between the therapist and the patient relationship, and avoiding any harmful interventions (Strozier & Stacey, 2001, cited in Malikiiosi - Loizos, 2013).

Personal therapy is mandatory in most psychological education courses. It is imperative that one learns what it feels like to be a patient before one can treat patients. Freud himself stated "But where and how is the poor wretch to acquire the ideal qualification which he will need in this profession? The answer is in an analysis of himself, with which his preparation for his future activity begins" (p.246, Freud, 1937, 1964, cited in Malikiiosi-Loizos, 2013).

It is also an important and essential part of the osteopath's learning process to sense what it is like to be a patient, physically, mentally, and emotionally. It is imperative that the student experiences being on the receiving end of treatment from school peers, utilising proprioception and interoception to help build greater body awareness, combining their sensations with cognitive processing and reasoning, as well as having a deeper understanding of what that may entail for a patient who may have difficulty with bodily awareness.

We need to first accomplish a sufficient level of psychological maturity, adjustment and personal awareness ourselves, before considering helping someone in that same quest, particularly when treating those with a traumatic history (Norcross, 2005, cited in Malikiiosi-Loizos). If we can build on our own personal resilience, then this will supply us with the confidence and trust needed to deal with the various situations that may arise in the therapist-patient relationship (Orlinsky, Norcross, et al., 2005). Personal therapy begins in undergraduate education and should continue throughout the osteopath's career, as a means of deepening personal discovery, awareness and understanding of the self, and in order to prevent possible vicarious trauma that may occur when the allostatic load overcomes the therapist.

[4.5.3. Vicarious trauma](#)

Vicarious trauma is when a therapist empathetically engages with a patient while listening to their stories of trauma, however, there is an over-involvement, and countertransference may occur. Many therapists feel they do not have the tools to deal with the experience of the patient (Brady, Guy, Poelstra & Brokaw, 1999; Correa, Labronici & Trigueiro, 2009, cited in Michael-Anna, 2018). This is where professional resilience plays an important role in maintaining balance and keeping burnout at bay.

Baird and Jenkins (2003, cited in Michael-Anna, 2018) noted that fresh graduates and less-experienced practitioners were more prone to burnout, thereby highlighting a need for further educational tools to boost professional resilience. This reiterates the importance of personal therapy in both undergraduate and post-graduate education, as something beneficial to both therapist and client.

4.5.4. Therapist-patient relationship

We rely on our ability to co-regulate. In turn, it helps us to self-regulate. The ventral vagal system allows us to interact and creates a sense of safety. With the use of prosody, eye contact, open posture and gestures, empathy and reciprocity, it can instil trust and openness in the therapist-patient relationship, allowing the patient to feel comfortable sharing. A therapist should be able to read the physiological signs of a patient during anamnesis and treatment and act on this accordingly. Being in tune with the patient and the patient's experiences provides a space where there is trust and room for disclosure (Liem, 2020).

Synchrony can occur between patient and therapist when there is sufficient trust. Behavioural synchrony can cause neural synchrony, and this can positively influence effective communication (Jiang et al., 2015, cited in Koole & Tschacher, 2016). However, this also works in less positive situations, and therefore it is important that the therapist balances the energy by counteracting and bringing them back to homeostatic balance (Koole & Tschacher, 2016).

Creating and respecting boundaries is essential so that both patient and therapist can remain in a professional therapeutic relationship. Over-involvement may hinder the treatment benefits and therefore the recovery process of the patient (Michael-Anna, 2014). Special attention should be paid to the physical and psychological boundaries of individuals with a history of sexual trauma, as re-enactment of the violation of boundaries may occur unintentionally (Draucker & Martsof, 2004, cited in Michael-Anna, 2014).

4.5.5. Creating a sense of safety

Creating a safe environment is the initial and most crucial step in the therapy session. That is, the external factors must be neutral so that the number of possible triggers in the surrounding environment and within the therapist-patient relationship are at a bare minimum. We can look to the polyvagal theory and the physiology of the nervous system itself to find ways of establishing trust and a safe haven between the therapist and patient.

As Liem (2020) said, slowing down the pace is necessary to decrease the possibility of hyperarousal.

Deb Dana (2019, 00:35:10), founder of the Sensorimotor therapy approach, composed a list of four R's in order to shift into a more ventral vagal state of ease:

Recognise autonomic state:

Recognising in what state we are in in the present moment and being able to shift from neuroception to perception.

Respect adaptive survival response:

Respecting the mechanisms of survival, and recognising that this is a form of autonomic protection

Regulate or co-regulate into ventral vagal state:

Using internal and external resources to find a safe ventral vagal state.

Re-story:

Re-story is about the 'top-down' processing, exploration, and self-inquiry of our sensations and experiences.

If a patient is resilient, they have sufficient internal and external resources to be able to switch easily between 'bottom-up' and 'top-down' processing. However, if the patient is traumatised, they react in survival mode, and may lose the ability to process 'top-down'. It is important to orient the patient to safety and the present moment so that the ventral vagal complex can create a balance to the stress response (p.101, Mutinga, 2020).

The cranial nerves help us to sense safety and danger in the surrounding environment. Our senses of smell, vision, hearing, touch and taste gives us information which our thalamus and amygdala react to, with the exception of the sense of smell which bypasses the thalamus and goes directly to the primary olfactory cortex. In order to create a safe environment, we need to take the ventral vagal complex (the social engagement system) into account and look at the pathways affected. For instance, our sight informs us of whether or not the surroundings are safe. The CN.II enables vision, CN.III, IV and VI control the eye muscles, and CN.XI controls the movement of the neck and head via the trapezius and Sternocleidomastoideus muscles, so that we are able to move our eyes and head towards the area of danger. Creating a soft visual environment, with the use of natural elements can help. A window looking out to nature, or even a picture of nature has been shown to calm the nervous system. Soft colours can help create a more relaxed atmosphere (Rosenberg, 2020, 07:29:50).

Our sense of hearing comes from the Nervus Vestibulocochlearis, which enables us to listen, and which is also responsible for our equilibrium. The Nervus Facialis innervates the Stapedius muscle which dampens out certain frequencies in sound, and the Nervus Trigemini innervates the Tensor tympani muscle which tenses the Membrana tympani. Low frequencies can create a sense of danger such as the threat of a predator, whereas high frequencies present signals of pain and danger. Both can stimulate an immediate autonomic response. It is useful to be aware of low-sounding frequencies such as an air-conditioning machine that may disrupt the sense of safety (Rosenberg, 2020, 04:11:04).

Our hearing is tuned to the frequency of the human voice, thanks to the help of the stapedius and tensor tympani. As such, the pace and prosody of the voice in therapy can aid to calm the patient (Rosenberg, 2020, 04:12:13). Exercises using the voice, such as singing and chanting, make use of cranial nerves involved in listening and hearing. The trigeminal nerve innervates the muscles to move the mouth, vagal innervation regulates breath control and larynx, and the facial nerve innervates the facial muscles to express what we are singing. Thus, talking and singing is a perfect way to exercise the social engagement system. Studies have shown that chanting decreases depression and anxiety and singing in groups can increase the HRV (Rosenberg, 2020, 04:12:13).

Music, dancing, singing, and art have been used throughout history and in various cultures in the treatment of trauma. They are modes of self-expression and can be used in therapy or as an addition to therapy to enhance the ventral vagal complex. Music therapy has been successfully used in the wake of disasters such as the 'Black Saturday' fires in Australia and following the September 11 World Trade Centre attacks (Garrido et al., 2015). Using the element of relaxing music can stimulate the parasympathetic nervous system and influence HRV (Ellis & Thayer, 2010).

The pathways of hearing and sight are connected via the eyelid and middle ear muscles therefore, the use of eye contact during therapy is of great importance. Many clients may find eye contact difficult, and therefore rely more on the use of the auditory pathway to feel safe (Rosenberg, 2020, 04:11:04, 07:29:42).

Our sense of touch, as previously discussed, is of great importance, and has a great impact on interoceptive awareness. The use of heavy blankets can also stimulate deep pressure receptors during therapy and give the patient an extra sense of relaxation and safety. Touch, however, may also trigger a sudden autonomic response. The therapist needs to be aware that certain touch, pressure, and location of touch may stimulate a sympathetic reaction or immobilisation.

Steven Rosenberg, a Craniosacral therapist and Rolfer, uses a series of tests inspired by Porges and Levine (Rosenberg, 2020, 03:32:38) to examine the vagal function:

1. Monitoring pulse and blood pressure correlated to breathing: HRV (CN.X)
2. Uvula test: to test the pharyngeal branch (CN.IX, X) (03:58:01)
3. Trap squeeze test: Trapezius muscle (CN.XI)

The use of rocking motion and vibration can enhance the parasympathetic vagus, as was shown in a study of the use of a rocking chair by individuals with dementia, whose symptoms of depression and anxiety decreased and sense of balance improved (Watson et al., 1998).

[4.5.6. Sexual violence and touch in therapy](#)

Clients that have experienced sexual violence may have problems with touch and intimacy. Therefore, it is important to communicate clearly with them, and ask for their consent before proceeding. They may feel more comfortable with a female or male therapist, or with a friend or partner joining them in the therapy room. It is crucial that both the client and therapist can set safe boundaries within the therapy.

Michael-Anna (2018) collected and evaluated a variety of literature, and personal experiences from patients and osteopaths, regarding osteopathic treatment of individuals with a history of sexual trauma in New Zealand. It was found that all of the osteopaths interviewed had treated patients who had experienced sexual trauma, however the majority felt that there needed to be more awareness of how to deal with the reactions that can occur in therapy. None of them had been trained in psychology and stated

unanimously that they would not hesitate to refer a patient to a psychologist. However, empathy and knowing how to respond appropriately to patient disclosure is of utmost importance for their recovery, and if not properly addressed, can contribute to unsafe practice and possibly cause further damage (p.53, Michael-Anna, 2018). When the therapist lacks the tools and understanding to deal with the effects of sexual violence, the patient can suffer (Havig, 2008, cited in Michael-Anna, 2018).

Osteopaths must be aware of the effect that touch therapy may have on someone with a history of sexual violence. Stalker, Schachter and Teram (1999, cited in Michael-Anna, 2018) stated that this awareness can benefit the quality of care giving, and the outcome of manual therapy sessions. Therapy may stimulate hyperarousal and memories of trauma, or immobilisation, therefore it is important to pay attention to changes in state and check in on the patient during treatment. The ability to listen, be empathetic, provide adequate time frames, and be conscious of the way touch is given all helps to create a foundation of trust and safety. Communicating each step, asking for consent from the patient beforehand, checking in on them during therapy and giving the time for them to adjust and feel safe will allow for more transparency (Michael-Anna, 2018).

Osteopaths must be aware of the position they may place the patient in. For example, asking a patient to lie face up allows them to keep the therapist in view and see what is going on. Lying them face down may increase their anxiety. They may also feel more comfortable being treated through their clothes. An osteopath also needs to know when is necessary to refer a patient, and to be aware of appropriate services to refer their patients to.

Cuevas and colleagues (2018) composed a trauma informed care and practice model as a guide for practicing therapists in dealing with sexual trauma. This model includes universal precautions and strategies, with a patient centered approach. An understanding of trauma and its possible effects is needed, and a wide network should be available including external resources and trauma related services, for eventual collaboration and/or referrals. A therapist must also be able to deal with their own reactions to a patient's response, and to their own history; for this, personal therapy is recommended. Clinical intake questions regarding sexual trauma are asked using a trauma-informed care approach, giving space and respect to the patient's responses. The same principle applies for contact in therapy. A calm explanation of the nature and purpose of a technique may be helpful and checking in on the patient during treatment is important. The awareness and understanding from the therapist of what the patient has experienced is vital and creates a sense of safety.

The NVO guidelines (SWOO, 2016) states four competencies required by osteopaths when treating intimate zones on a person; mindfulness of your own reactions and interactions, emotional self-management, creating trust and safety for the patient, and clinical wisdom.

Treatment techniques of the intimate zones include a summary of mechanical, neurological, circulatory/respiratory, bioenergetic and metabolic techniques, however the biopsychosocial approach is very limited, with a simple explanation noting the

relaxation of these zones may have a beneficial effect on the functioning of psycho-emotional problems.

The guidelines are well-written in terms of providing a medical and ethical safeguard for an osteopath treating an intimate area, however it leaves out much information regarding sexual trauma and its influence on somatic disorders, response to therapy, therapy outcome, and the therapeutic relationship. The anamnesis questions provide a fair indication for differential diagnosis, however they lack the four quadrant integration, or the related subjective feelings. Asking someone "how does this make you feel?" is an extremely important part of the process and could play a role in the patient's recovery.

Just as Michael-Anna (2018) concluded in her study regarding osteopathic education in regard to the care and management of patients with sexual trauma in New Zealand, there is also a shortage in formal education here in the Netherlands in preparing young graduates and osteopaths to deal with the same issues. We must be aware of the impact that inadequate response to sexual trauma can have on a patient's recovery. Further research and the addition of educational programs is needed to provide the skills and knowledge regarding trauma-informed care to support both patients and therapists alike.

[4.5.7. Knowing where the limits are and when to refer a patient](#)

Heller (2012, cited in Calsius, 2020) stated that body therapies such as osteopathy can often evoke strong emotions and reactions during a treatment, but that the therapist is not always equipped to deal with this response. A study done in New Zealand interviewing professional osteopaths on their knowledge and expertise in the area of trauma, found that most osteopaths felt that their education was not sufficient to help them deal with certain traumatic responses, and the majority felt comfortable to refer them to psychologists (Michael-Anna, 2018).

Osteopaths have great tools that can be applied to a difficult body, however they are not specifically trained in dealing with the releases that are a consequence of this. Psychotherapists/psychologists have the framework and toolbox to deal with the emotional journey and release but not necessarily the bodily expertise (Calsius, 2020). This of course depends on the therapist's own approach, and where their interests lie, but it does however highlight once more the strength of a collaboration between the two fields.

If there is doubt about the scope to which a therapist can treat a patient with osteopathic treatment, then referral to someone specialised in trauma therapy is recommended. Signs indicating the need for a referral may be red or yellow flags such as hyper-aggressive behaviour, self-harm, suicidal tendencies, avoidance behaviour, constant recalling of trauma that disrupts daily life, and an inability to receive touch. It is the responsibility of the osteopath to have a list of referral services, groups and specialists that are equipped and skilled to deal with the responses (Cuevas et al., 2018). Recognising our limits is an important part of patient care.

4.5.8. Long term resilience building

If a patient is traumatised, they may react in survival mode, and lose the ability to process 'top down'. Orienting the patient to safety and to the present moment is important, to stimulate the ventral vagal complex and create a balance to the stress response (p.101, Mutinga, 2020). Eventually, the individual can learn to integrate this into daily life.

Integration into daily activities is the next challenging step, however with guidance and coping skills learned from the therapist, the person can live in the present, in 'being', without the fear of the past, and from a centred ventral vagal state (Porges & Liem, 2016), learning to move easily between autonomic states to promote flexibility in the system, and resilience, so that future trauma can be prevented. As Deb Dana said, homeostasis is when all the three parts of the autonomic nervous system are in dynamic equilibrium (Dana, 2019, 00:29:04). It is important to acknowledge that working with trauma is not only about what is broken, but remembering how we survived (Van der Kolk, 2006). That is the power of resilience.

5. Discussion

This thesis presents a broad investigation into past and present literature regarding psychological trauma and its physiological effects, the role of osteopathy as a complementary form of trauma therapy, the collaboration between psychotherapy and osteopathy, and heart rate variability and resilience in association with trauma. The wide-ranging topic proved challenging within the set time frame, however it was important to search broadly, as there has been little scientific research done regarding trauma and osteopathy, and the terrain must first be explored and knowledge gathered before we can map it out.

The initial question posed was whether osteopathy could play a role as a complementary form of therapy in the treatment of psychological trauma by enhancing resilience, and facilitating the self-regulatory, self-healing capacity and autonomy of the individual, to help them better deal with the effects of trauma, either from the past or as a foundation for future adversities.

It was necessary to first research the physiological and psychological effects of trauma before determining the validity of this hypothesis. The focus of this research concentrated on the neurobiological responses, interoception and resilience factors involved in trauma. The polyvagal theory was chosen as an initial approach to this research.

Psychological trauma affects the neuroendocrine, neurobiological and immune systems. The response to trauma is innate and autonomic. The autonomic nervous system may respond with either a hyperarousal by the sympathetic nervous system, or immobilisation in fear, stimulated by the dorsal vagal system, dampening the functioning of the ventral vagal complex, the social engagement system. A reduced functioning of the medial prefrontal cortex, hippocampus and anterior cingulate cortex leads to an overstimulated fear response as the amygdala cannot be inhibited (Gupta, 2013), and therefore the neuroception of safety and danger shifts. The HPA axis becomes deregulated, as shown by a lower cortisol level in individuals who have experienced trauma (Beyans et al., 2008; Kolassa et al., 2007; Meinlschmidt & Heim, 2005; Fries et al., 2005, cited in Seo et al., 2018). This altered autonomic activity decreases the capacity for homeostasis and self-regulation (Van der Kolk, 2014).

During traumatic memory provocation, Van der Kolk (2006) found an increased cerebral outflow in the amygdala, insula, right medial orbitofrontal cortex, anterior temporal pole with a decrease in the left anterior prefrontal cortex, specifically Broca's area, responsible for communication and speaking. Increased activity in the anterior insula has also been shown during autonomic arousal (Critchley et al., 2004), and during adverse stimuli in individuals with a lower resilience (Haase et al., 2016). The insula receives interoceptive information from bodily sensations and emotional states and the anterior insula integrates them into emotional awareness.

Trauma alters interoceptive awareness (Van der Kolk, 2014; Waugh et al., 2008), influencing homeostatic and allostatic regulation, and resilience. This altered

interoceptive awareness, together with the preverbal nature of trauma, highlights the potential for a more body-oriented, bottom-up approach to therapy. As Ogden (2020, 00:20:53) stated, the faulty neuroception and awareness of sensations and action patterns of the body must first be addressed before the cognitive patterns and beliefs can be altered.

Evidence based research in trauma therapy was mainly dominated by conventional top-down forms of psychotherapy, specifically cognitive behavioural therapy and prolonged exposure in the treatment of PTSD, however, in the last decades there has been an abundance of research dedicated to the neurobiological effects of trauma, increasing knowledge of how the brain functions and therefore lending support to the subcortical approaches.

Osteopathy is a holistic and person-centred manual therapy that uses a bottom-up approach. The importance of the therapist-patient relationship in creating safety, and the role of the therapist as a facilitator rather than leader, optimises the capacity for self-regulation. Osteopathic research on psychological trauma is limited. However, the results of the studies up till now have proved positive. The shortage of studies show that this is an area which lacks scientific research, not experience, as 'psychosomatic' disorders make up a large group of clientele in the osteopathy.

Both global and more specific approaches were used in the osteopathic trauma intervention studies. There was a noticeable preference leaning towards the softer techniques, such as craniosacral and myofascial therapy. These have been known to positively influence the parasympathetic tone, as measured by HRV (Cerritelli et al., 2020; Edwards et al., 2018; Fornari et al., 2017; Giles et al., 2013; Ginsberg et al., 2014; Henley et al., 2008; Ruffini et al., 2015; Shi et al., 2011; Van Tuijl, 2011). One of the possible mechanisms involved may be the stimulation of Ruffini endings and interoceptive receptors (C-tactile afferents) through soft touch-based therapies such as craniosacral therapy and myofascial treatment (Chen et al., 2013; Edwards et al., 2018; Lindgren et al., 2010; Schleip, 2003; Schleip, 2012). C-tactile afferents are found in abundance in hair covered skin, in fascia of the musculoskeletal system and also within the enteric nervous system. Stimulation of these receptors may influence interoceptive awareness, enhancing the self-regulating processes.

Due to the strong link that exists between resilience and interoception (Haase et al., 2016; Paulus et al., 2010; Paulus et al., 2012; Simmons et al., 2012; Thom et al., 2012; Waugh et al., 2008), enhancing interoceptive awareness through osteopathic manual therapy may play a role in facilitating resilience. The neuroscientific evidence showing that the insular cortex responds differently to adverse stimuli depending on an individual's level of resilience (Haase et al., 2016) may be helpful in promoting further research to understand the possible role of osteopathy in supporting resilience.

Much trauma research has focused specifically on PTSD and veterans of war, with studies consisting mainly of male-only subjects, looking specifically at combat trauma, and often

without comorbidity (which excludes a majority of PTSD sufferers). The fact that the worst rated trauma by women veterans was sexual trauma at 68.3%, compared to 5.6% that chose combat trauma (Schnurr et al., 2007), as well as the high rate of sexual trauma in the general population, shows the explicit need for more research in this area, as well as greater awareness.

Results from the osteopathic studies of trauma intervention revealed that research is still limited, especially in regard to sexual trauma. Further studies should include larger sample groups that are gender balanced, the addition of control groups (also without touch), allowing for comorbidity, considering subjectivity of trauma experience as well as objective diagnosis, including the addition of an objective marker such as HRV to measure autonomic response and resilience over a longer period, and looking at long-term outcomes due to the chronicity of trauma related disorders. Additionally, the timing of therapeutic intervention after a traumatic event deserves further research, to determine the most optimal period to begin therapy in regard to treatment outcome.

Trauma's influence on the autonomic activity has been measured by heart rate variability (Haase et al., 2016; Waugh et al., 2008, Porges, 2011). HRV is a non-invasive and simple way to measure the effects of therapy and help towards a better understanding of the role of resilience in trauma. The use of heart rate variability as a biomarker for future trauma research can give an objective measurement of the physiological response to trauma and therapy, in addition to more subjective self-report methods commonly used. The proposal regarding the effects of osteopathic treatment on resilience, as a preventative therapy for future adversities remains theoretically strong, however further research is needed, and would require a longitudinal study approach.

Furthermore, suitable formal education is needed to train osteopaths in dealing with trauma and the responses that may arise during therapeutic sessions. Undergraduate education in the Netherlands provides a strong foundation for personal therapy and the therapist patient relationship, however there is a need for further integration within all aspects of the osteopathic education and profession. This research has made apparent the shortage of information and formal education available for osteopaths in regard to trauma and trauma informed care, especially sexual trauma. More information regarding the status of trauma care in the Netherlands is needed for further research. Providing surveys may be an efficient way of collecting data regarding the subjective and objective needs of therapists and patients in trauma care, and in determining what is already provided and where improvements can be made. Further training and/or workshops for undergraduate and postgraduate education to benefit both the therapist and patient are recommended.

Integrating the worlds of psychotherapy and osteopathy is a way of learning from each other's strengths and creating a more resilient and beneficial form of trauma therapy, with a holistic, person-centred approach. Collaboration of osteopathy and psychotherapy has proven beneficial for trauma therapy outcomes, with the inclusion of both top-down and bottom-up processing. Further research is required to determine the efficiency of

collaboration with more body-oriented forms of psychotherapy, however, there is great potential.

6. Conclusion

Due to the nature of psychological trauma, and the inhibition of the cognitive brain and overstimulation of the subcortical processes, it is evident that a bottom-up approach may be beneficial in regulating autonomic activity and altering faulty neuroception. Osteopathy is a holistic, person-centred manual therapy that has been shown to reduce the symptoms of traumatic stress through various approaches, with the focus on enhancing the self-regulating and self-healing capacity of the individual. Measurements of heart rate variability clearly show the influence on sympathovagal balance, aiding in self-regulation and homeostasis. The use of touch to stimulate interoceptive receptors may improve interoceptive awareness, which also plays a role in self-regulation and resilience. Resilience may be a determining factor in both susceptibility to and recovery from trauma. Therefore, more research is needed here to define the role of osteopathy in facilitating resilience, for both the recovery process, and for future adversities.

Osteopathy can be a valuable complementary form of trauma therapy. A collaboration between the two fields of osteopathy and psychology has already shown much potential in proving beneficial for the outcome of trauma treatment, addressing both top-down and bottom-up processing of trauma. The use of heart rate variability is a more objective and physiological measurement of the trauma response, and together with subjective feedback from self-report methods, may create a better understanding of the mechanisms of resilience and the role it may play for both trauma therapy and research.

Psychological trauma affects a large proportion of the population. Therefore, it is essential that provision of resources, training and education regarding trauma informed care are available so that the osteopath is sufficiently equipped, and which will benefit both therapist and patient. Moving the focus of trauma towards health and resilience rather than the pathology or diagnostic term will help us to move through trauma.

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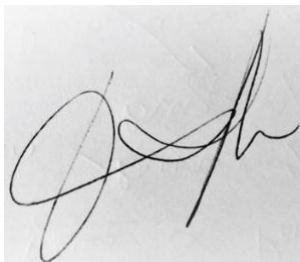
Ondergetekende is als promotor van **Francesca Peniguel**

op de hoogte van de opzet, de structuur en de inhoud van de thesis,

'Osteopathy, psychological trauma and the road of resilience.'

die ter beoordeling aan het NACO wordt aangeboden ter afsluiting van de opleiding Osteopathie aan het Osteopathie College Sutherland te Amsterdam en het behalen van de titel DO.

Rik Hoste DO MSc
Osteopaat

A handwritten signature in black ink on a light-colored background. The signature is stylized and appears to be 'Rik Hoste'.