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Research Project

THE INFLUENCE OF A PRACTITIONER'S TOUCH AND HIGH CARDIAC COHERENCE ON THE PATIENT'S HEART RATE VARIABILITY

The effect of a practitioner's touch and high cardiac coherence on the patient's heart rate variability: a placebo controlled clinical trial

Scientific paper to acquire the title 'D.O. IN OSTEOPATHY' granted by the F.I.C.O.
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Declaration

I hereby assure that the presented work is compiled by my own hands and has not been submitted elsewhere for examination/review. Foreign sources are identified and labelled with information about their origin.

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ABSTRACT

TITLE: The influence of a practitioner's touch and high cardiac coherence on the patient's heart rate variability. RESEARCH TITLE: The effect of a practitioner's touch and high cardiac coherence on the patient's heart rate variability: a placebo controlled clinical trial. NAME: Buschmann J. TUTOR: Van Nooten W. METHODOLOGICAL TUTOR: Quaghebeur J. YEAR: 2017. BACKGROUND: Research has proven that touch can influence another person's heart rate variability (HRV). Studies suggest that a higher cardiac coherence can be obtained when being in the presence of someone with high cardiac coherence. OBJECTIVE: To investigate the effect of a practitioner's touch and high cardiac coherence on the participant's HRV. METHOD: Volunteers were randomized in two groups. The experimental group stayed five minutes in absence of the practitioner, followed by ten minutes (two measurements of five minutes). Hereafter the practitioner held the participant's cranium, and intentionally increased his own cardiac coherence by being in a positive, relaxed state. The placebo group stayed five minutes in solitude, followed by ten minutes (two measurements of five minutes) during a sham intervention without the practitioner's touch, nor proximity. A Polar V800 device was used for evaluation of the Root Mean Square of Successive Difference (RMSSD), a time-domain measure of HRV. RESULTS: Twenty-four participants (10 men; 14 women) took part of the study. No significant difference was found between placebo and experimental group for gender (X_2: p=0,1), height, weight and BMI (MW-U: p-values respectively 0,8; 0,2; 0,3). The participants in the placebo group were significant older compared to the experimental group (MW-U: p=0,02). The participants touched on the head by the practitioner with high cardiac coherence showed no significant increase in RMSSD values after 10 minutes compared to the baseline measures, between placebo and experimental group (ANCOVA: p=0,35). Effect analysis within the experimental group showed no significant difference (Wilcoxon signed ranks test: p=0,14). DISCUSSION: The participant's 'receptivity' and psychosocial factors might have played a role in these results. To show the real impact of high cardiac coherence, a practitioner group with low cardiac coherence should have been added in this study. In order to better distinguish whether the participant's increase in HRV is due to the practitioner's high cardiac coherence and/or due to the effect of the physical contact, future research should be done under four different conditions: while being touched by a person with high cardiac coherence, while being in the presence of a person with high cardiac coherence (without touch), while being touched by a person not knowing what the experiment is about and finally, while being in the absence of any presence whatsoever. CONCLUSION: This study, lacking power, cannot suggest that osteopaths can have a positive effect on the patient's HRV, by holding the patient's cranium, while focusing on his own cardiac coherence.

Keywords: heart rate variability, vagal activity, cardiac coherence, electromagnetic field

ABSTRACT

TITEL: De invloed van aanraking door een therapeut met hoge hartcoherentie op de hartslagvariabiliteit van zijn patiënt

ONDERZOEKSTITEL: Het effect van aanraking door een therapeut met hoge hartcoherentie op de hartslagvariabiliteit van zijn patiënt: een klinische studie

AUTEUR: Buschmann J. TUTOR: Van Nooten W. METHODOLOGISCHE TUTOR: Quaghebeur J. JAAR: 2017

ACHTERGROND: Onderzoek heeft aangetoond dat aanraking iemands hartslagvariabiliteit (HRV) kan beïnvloeden. Verder suggereert een studie dat een hogere coherentie bekomen kan worden, wanneer men zich in de nabijheid bevindt van een persoon met hoge hartcoherentie. DOEL: Onderzoeken wat het effect is van aanraking door een therapeut met hoge hartcoherentie op de HRV van de deelnemer. METHODOLOGIE: De deelnemers werden gerandomiseerd in twee groepen. De experimentele groep bleef eerst vijf minuten alleen, gevolgd door tien minuten met de aanwezigheid van een therapeut die zich bewust richtte op zijn eigen hartcoherentie door positieve emoties op te wekken en ontspannen te zijn, terwijl hij het hoofd van de deelnemer vasthield. De placebogroep bleef vijf minuten alleen, gevolgd door een placebo interventie van tien minuten, zonder aanraking, noch nabijheid van de therapeut. Een Polar V800 werd gebruikt om de RMSSD waarden te meten. RESULTATEN: Vierentwintig deelnemers (10 mannen; 14 vrouwen) namen deel aan deze studie. Er was geen statistisch significant verschil wat betreft gender (X_2: p=0,1), hoogte, gewicht en BMI (MW-U: p-waarden respectievelijk 0,8; 0,2; 0,3). De deelnemers in de placebogroep waren statistisch ouder dan de deelnemers in de experimentele groep (MW-U: p=0,02). De deelnemers die aan het hoofd werden vastgehouden door een therapeut met hoge hartcoherentie vertoonden een significante stijging van de RMSSD waarden na 10 minuten, vergeleken met de baseline. Deze stijging was niet significant na de analyse van covarianten tussen de placebo- en experimentele groep (ANCOVA: p=0,35); en niet significant wanneer de analyse werd toegepast binnenin de experimentele groep (Wilcoxon signed ranks test: p=0,14). DISCUSSIE: De 'receptiviteit' van de patiënt en andere psychosociale factoren kunnen een rol hebben gespeeld in de bekomen resultaten. Om de impact van een hoge hartcoherentie aan te tonen zou een groep therapeuten met lage hartcoherentie moeten zijn toegevoegd in deze studie. CONCLUSIE: Deze studie waarbij de *power* ontbreekt, kan niet suggereren dat aanraking door de therapeut, gecombineerd met hoge hartcoherentie, de HRV van patienten positief beïnvloedt.

Trefwoorden:hartslagvariabiliteit,vagale activiteit,hartcoherentie,elektromagnetisch veld

PREFACE

Does the electromagnetic field of a practitioner's heart influence that of a patient? To what extend are the practitioner’s stress levels, intentions and emotions relevant to the treatment outcome?
To what extend is a patient (or a person) capable of managing his own health?

The subtle relationship between, on the one hand, the practitioner and his patient (interpersonal), and on the other, the patient and his disease (intrapersonal), is absolutely intriguing.

Studies on Heart Rate Variability (HRV) and on cardiac coherence seem to hold some answers.

In search for the most beneficial ‘state of being’ for a healthcare practitioner, this work is submitted to obtain the title of Osteopath D.O. and hopefully counts as fundamental research on the influence of a practitioner’s touch and high cardiac coherence on a patient’s heart rate variability.

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1. INTRODUCTION

Even the mere presence of a practitioner has an influence on certain physiological outcome parameters of a patient (Benedetti, 2013; McPartland and Skinner, 2005).

In the premise to gain more understanding about this phenomenon, this study will put its focus on the heart, more specifically on the heart rate variability (HRV) and on cardiac coherence.

Heart rate variability quantifies the variation in the heart's beat-to-beat changes. It largely reflects vagal nerve activity (Chapleau and Sabharwal, 2011; De Couck et al. 2013; Kuo et al., 2005; McCraty and Childre, 2010), since the vagal nerve, the tenth cranial nerve with an important parasympathetic function, is - amongst other functions - responsible for heart rate modifications.

Furthermore, HRV is an important indicator of a person's health status (Task Force, 1996).
The higher his HRV values, the better he will recover from stressful events. High HRV values are also correlated to a better and more efficient working endocrine, immunologic and cardiovascular system (McCraty et al., 2009; Weber et al., 2010). It regulates physiological homeostasis in order to promote growth and restoration (Weber et al., 2010, Porges, 2011).
In the case of lower HRV values, the risk for future disease is higher (Weber et al., 2010).

Cardiac coherence can be defined as a stable, harmonic and sine-wave-like signal from the heart. It is reflected as a high amplitude peak in the low frequency range of the HRV power spectrum (McCraty et al., 2009). Cardiac coherence results in a more balanced autonomic nervous system towards increased parasympathetic activity, necessary to maintain homeostasis (Shaffer et al., 2014).

The level of cardiac coherence can consciously be generated within an individual by (intrapersonal) regulating one's respiratory rhythms and by focusing on positive feelings like appreciation, gratitude and love (Morris, 2010; McCraty, 2003; McCraty et al., 2009; McCraty and Childre, 2010).

Cardiac coherence can also be enhanced in a person, when another person is in a high coherent state (interpersonal) (Morris, 2010). Research shows that these coherent

signals are able to pull other biological oscillators into synchronisation with its rhythm, leading to harmonisation of those systems (Morris, 2010; Rein et al., 1995).
So, it can be possible for a practitioner to enable a patient to achieve high cardiac coherence. When the practitioner's heart generates a highly ordered, sine-wave-like coherent signal, synchronisation between both heart signals can occur. Whether or not the patient will cohere with the practitioner's heart signal is 'unconsciously' his choice (Morris, 2010).

Since seventy-five to ninety percent of all visits to primary care physicians result from stress related disorders, the importance of a balanced autonomic nervous system (ANS) is obvious (Boone and Anthony, 2003). Generally, stress can be evaluated in the ANS as excessive sympathetic activity and poor or decreased parasympathetic activity. As a result, homeostatic processes are disrupted. But efficient vagal activity warrants physiological homeostasis, in order to promote growth and restoration (Weber et al., 2010; Porges, 2011).

In previous scientific research, the impact of the practitioner's touch of the patient, while consciously altering his own cardiac coherence, hasn't been investigated thoroughly yet, in an osteopathic setting.
Hand-holding was investigated between two friends in order to see whether HRV changed (Pishbin et al., 2010). Although this change was significant in some of the HRV measurements, it was not significant in all of them.
Some articles propose to investigate in future study the transfer of the practitioner's cardiac field (McCraty et al.,1998) or the practitioner's strong rhythms (McPartland and Mein, 1997) onto patients, in order to produce significant effects in biological tissues (intrapersonal) and in a patient (interpersonal). In a case report of Leskowitz (2008), a hypothesis is made that a "facilitative field" of coherent energy enables others to achieve high cardiac coherence (Leskowitz, 2008).

So, this research will investigate whether a change in a specific HRV parameter can be made, if touch is combined with intentional increase in cardiac coherence, in order to obtain higher states of homeostasis for the patient and thus quicker recovery.

The aim of this study is to investigate the influence of a practitioner's touch and high cardiac coherence on his patient by measuring the Heart Rate Variability (HRV) of the latter, while the practitioner is only focusing on his own cardiac coherence and holding the patient's cranium, without any osteopathic treatment whatsoever.

The research question is to know whether the heart rate variability of a patient can change as a result of self-aware touch and high cardiac coherence, in order to obtain a more balanced system and the quickest recovery for the patient.

2. LITERATURE STUDY

The following chapters will describe in detail the importance of an obtained balanced autonomic nervous system in the practitioner, the influence of his coherent state on the patient and the possible effect of this heart coherence combined with touch on the patient's health.

Chapter 2.1. focuses on the heart and its electromagnetic and neurological communication pathways.
Chapter 2.2. focuses on heart rate variability (HRV) as a measure for vagal outflow, its clinical implications and the variables influencing HRV.
Chapter 2.3. discusses cardiac coherence which is reflected within HRV frequency measures, its clinical implications and variables influencing cardiac coherence.
Chapter 2.4. expands on entrainment and its effect.
Chapter 2.5. examines factors influencing health outcomes in general.

2.1. Signals of the heart

The heart communicates with the brain and other parts of the body on four different levels: (1) neurologically: through the transmission of neural impulses, (2) biochemically: through hormones and neurotransmitters, (3) biophysically: through pressure and sound waves, and (4) energetically: through electromagnetic field interactions (McCraty et al., 2009).

This research will focus on the communication on an electromagnetic and on a neurological level. Neural communication from the brain to the heart via parasympathetic and sympathetic fibers is widely accepted. However, the communication on an energetic perspective is still subject to further investigation.

2.1.1. Electromagnetic communication: inter- and intrapersonal

The communication via the electromagnetic field is understood by the heart emitting an electromagnetic field that extends far beyond the physical body. On the one hand there is the intrapersonal communication within one person: from the heart to the brain and to all other organs; on the other hand there is the interpersonal communication: from one person to another.

The electromagnetic field is an energetic vibration with two components: an electrical and a magnetic component (Rennison SJ, 2006).

The electrical component of these electromagnetical signals generated by the heart is measured by an electrocardiogram (ECG). Its electrical voltage is about 60 times greater in amplitude than the electrical activity produced by the brain and measured by an electroencephalogram (EEG) (McCraty et al., 1998 & 2009). Indeed, the voltage of the heart is usually expressed in millivolt (mV) and that of the brain in microvolt (µV).
The magnetic component of the heart's field is many times stronger than the magnetic field produced by the brain (McCraty and Childre, 2010) (Cfr. Figure 1). This field can be measured approximately 3 feet away from the body, with sensitive magnetometers or Superconducting Quantum Interference Device (SQUID) (McCraty et al., 2009).

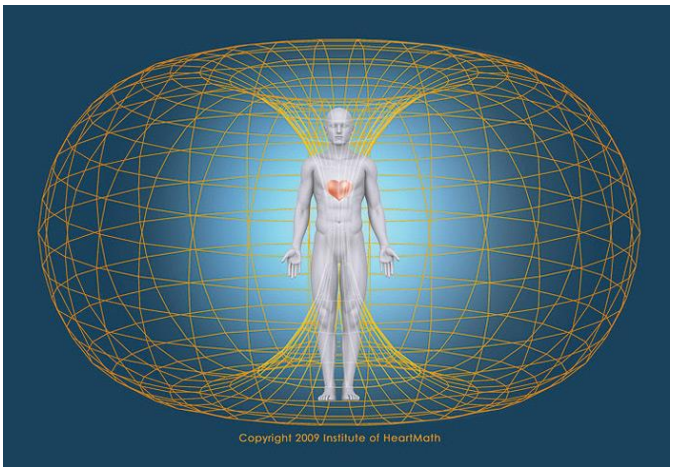

Figure 1: The magnetic field of one individual's heart (HeartMath.org).

The connection between electricity and magnetism was found in 1820 by Hans Christian Oersted. He discovered that a wire, carrying an electrical current, causes a parallel placed compass needle to deflect (Chodos et al., 2008). This has become a basic law of physics: Ampère's Law. It says that when currents flow through conductors such as wires or living tissues, magnetic fields must be produced in the surrounding space.

2.1.2. Neurological communication

As to the transfer of neurological information concerning stress or relaxation, the heart has not only its own intrinsic nervous system, but is also innervated by the parasympathetic and sympathetic nervous system.

Its own intrinsic nervous system consists of chemosensory neurons and mechanosensory neurons, the atrioventricular node and the sinoatrial node (McCraty and Shaffer, 2015).
About 1% of the myocardial cells are specialized to generate action potentials spontaneously. So, the heart can contract without outside signals. The heart's own pacemaker cells located in the sinoatrial node fire at around a hundred beats per minute.
However, the heart rate is mainly under the influence of sympathetic and parasympathetic branches of the autonomic nervous system. Parasympathetic activity slows heart rate, while sympathetic activity speeds it up (Silverthorn, 2007). Hence, at rest, the heart is set to be under vagal tone, because it outputs signals much quicker than the orthosympathetic nervous system (Chapleau et al., 2010; Nunan et al, 2010; Silverthorn, 2007).

The sympathetic fibers innervating the heart originate in the upper four to five thoracic segments of the spinal cord. The parasympathetic nerve innervating the heart is the vagal nerve, which has its origin in the medulla oblongata, more specifically in the dorsal vagal nucleus and in the nucleus tractus solitarius (Figure 2) (Silverthorn, 2007).
The vagal nerve - consisting for ± 80% of afferent fibers - carries information from the heart to the medulla, after passing through the nodose ganglion (Silverthorn, 2007).

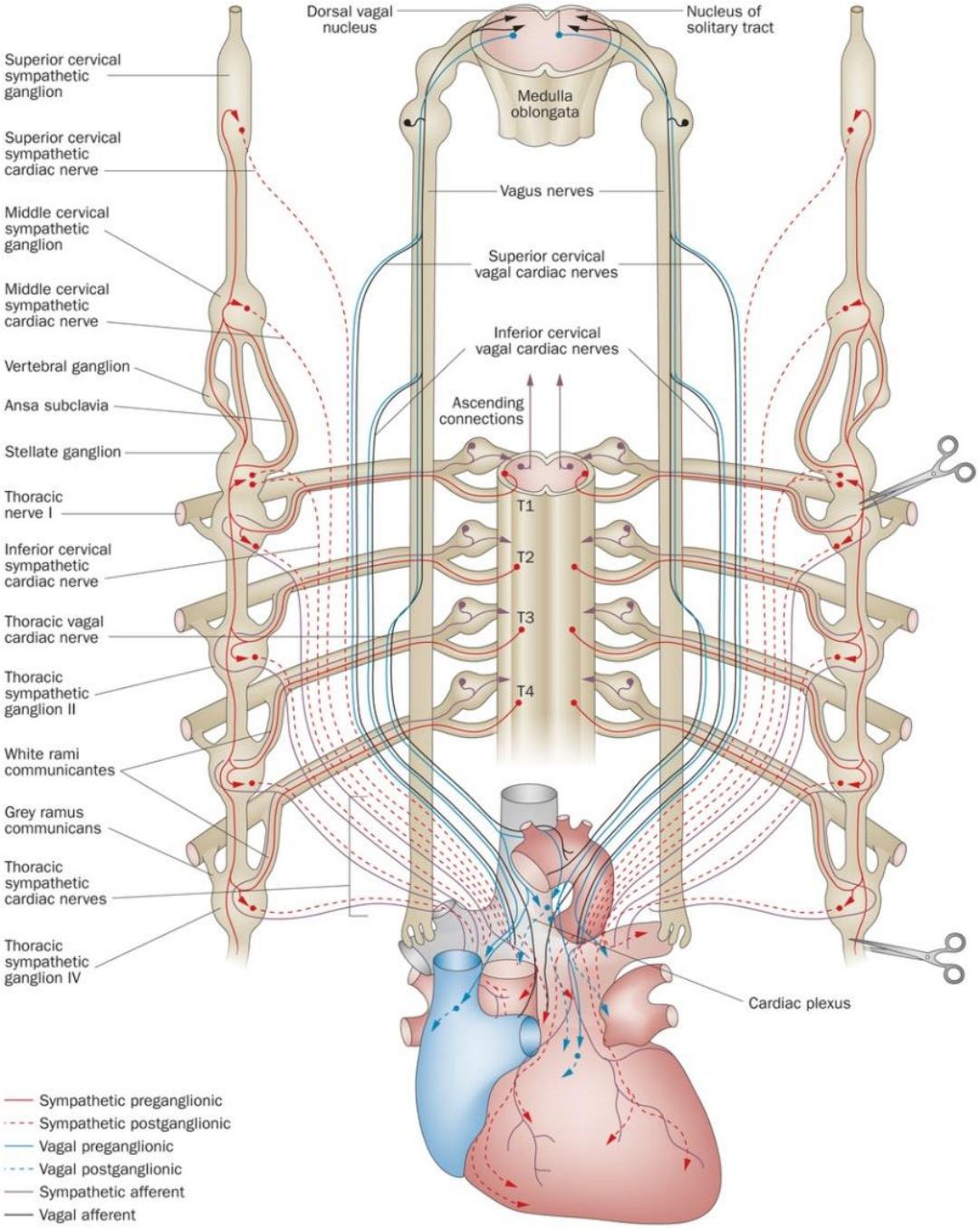

Figure 2: Sympathetic and parasympathetic innervation of the heart (Schwartz, 2014).

Heart rate variability (HRV), a tool used to estimate this vagal activity, will be discussed in the next chapter.

2.2. *Heart rate variability: index to quantify vagal output*

Heart rate variability analysis represents a non-invasive method for analyzing the function of the autonomic nervous system, more specifically the efferent vagal nerve activity (Chapleau and Sabharwal, 2011; De Couck et al. 2013; Kuo et al., 2005; McCraty and Childre, 2010).

In particular, HRV quantifies the changes in the intervals between successive R-peaks of the QRS complex in an electrocardiogram (measured in milliseconds) (Cfr. Figure 3).

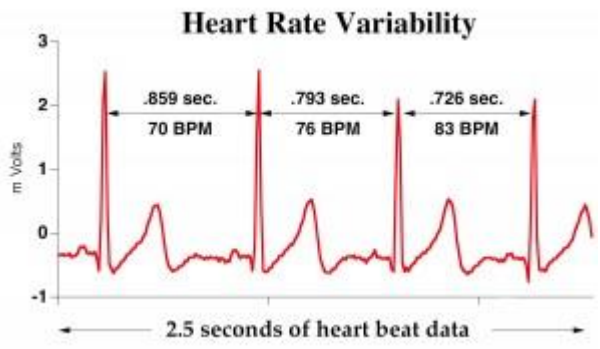

Figure 3: Heart rate variability: a measure of beat-to-beat changes between successive R-peaks of the QRS complex (HeartMath.com).

2.2.1. Methods to analyse HRV

The most common approaches to assess HRV are frequency-domain (power spectral density) and time-domain analysis. (Billman, 2001; Nunan et al., 2010; Task Force, 1996; Valentini and Parati, 2009).

It is the time-domain analysis which will be used for this research.

2.2.1.1. Frequency-domain measurements

As the name suggests, frequency domain measurements are based on power spectral density analysis, which can convert the “power” of a series of heart beats into its frequency components. The power (or height) of the peak at a certain frequency reflects the amplitude of the rhythm. The frequency reflects the period of time over which this rhythm occurs. In brief, it quantifies the variability of RR-intervals, thus HRV, over a range of *frequencies* (Cfr. Figure 4) (Task Force, 1996).

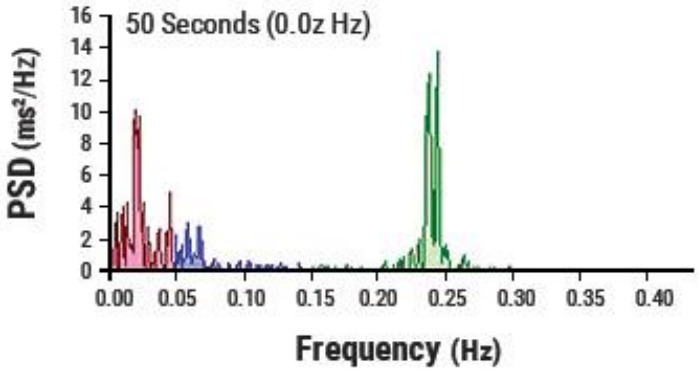

Figure 4: A typical HRV recording over a 15 minutes period in resting conditions in a healthy individual. Power spectral density (PSD) analysis separates the HRV waveform into VLF, LF and HF bands (McCraty and Shaffer, 2015; Shaffer et al., 2014).

The spectral power is distributed within three major frequency bands: very low frequency (VLF): below 0.04 Hz, low frequency (LF) between 0.04 - 0.15 Hz and high frequency (HF) between 0.16 - 0.4 Hz (Billman, 2011; Chapleau and Sabharwal, 2011; McCraty and Shaffer, 2015; Shaffer et al., 2014; Task Force, 1996; Valentini and Parati, 2009).

Concerning whether the HF or LF power component of the HRV reflects para- or orthosympathetic activity, Task Force (1996) reports that several researches have been done.

The HF power component reflects the parasympathetic nervous system. As Task Force (1996) stipulates, vagotomy down regulates the HF power component and vagal stimulation reinforces it. Hence, the reflection of the efferent vagus nerve activity by the HF power component (Task Force, 1996).

The LF power component reflects sympathetic activity or a combination of sympathetic and parasympathetic activity (Billman, 2011; Task Force, 1996; Valentini and Parati, 2009).

The reflection of the VLF power component is still unknown (Task Force, 1996).

2.2.1.2. Time-domain measurements

The time domain measurements of HRV are calculations based on variations in moments of time. So, either the heart rate at any point in time, or the intervals between successive normal beats are derived from an ECG (Billman, 2011).

The Root Mean Square of Successive Differences (RMSSD) are the primary time-domain measurements, used to estimate the vagally mediated changes, reflected in HRV (McCraty and Shaffer, 2015).
This value is obtained by first calculating each successive time difference between the R peaks of the ECG (in milliseconds). Each separate value is then squared and from these values an average is determined. The root of this average is the RMSSD (Billman, 2011; McCraty and Shaffer, 2015; Shaffer et al., 2014; Task Force, 1996). RMSSD is correlated with the HF power component (r = 0.95) and with the LF power component of the HRV (r = 0.82) (Shaffer et al., 2014).

2.2.2. Clinical implications of HRV

Several studies have been done on health implications of high or low HRV within an individual (patient or practitioner). These are expressed in high or low *values*.

In general, scientists and physicians consider HRV to be an important indicator of health and fitness (McCraty and Childre, 2010; Shaffer et al., 2014).
As to individuals with a high HRV value, an important research of Weber et al. (2010) elicits that individuals return much faster to a state of physiological homeostasis after having performed a brief mental stress test; whereas individuals with low HRV are impaired, regarding to their recovery in cardiovascular, endocrine, as well as immune outcomes (Weber et al., 2010).

As to individuals with a low HRV value, a wide range of diseases, such as cardiovascular disease (Billman, 2011; Shaffer et al., 2014; Task Force, 1996), diabetes mellitus (Task Force, 1996), adverse prognosis of cancer (De Couck et al., 2013-2014-2016; Mouton et al., 2011), depressive disorders such as bipolar disorder (Fatisson et al., 2016; Faurholt-Jepsen et al., 2017) and all-cause mortality (Task Force, 1996) is observed.

Hence, low HRV may identify healthy subjects at risk for future disease, be it cardiovascular (in the first place), (auto-) immune or other stress-related conditions (Weber et al., 2010).

As HRV largely reflects the vagal nerve, Porges states in his book 'The polyvagal theory' (2011): "Vagal tone has two roles. First, during states of low environmental demands (e.g., sleep or quiet states), vagal tones foster physiological homeostasis to promote growth and restoration. Second, during states characterized by environmental challenges, the vagus acts as a brake to rapidly regulate cardiac output and thus metabolic output. [...] In individuals with high vagal tone and appropriate vagal regulation capacities, the autonomic nervous system has the capacity to react (i.e., appropriate reactivity and expressivity) and to return rapidly to homeostasis (i.e., self-regulation and self-soothing)." (Porges, 2011).

2.2.3. Variables influencing HRV

There are different factors that can have a possible influence on the HRV within one individual, but also when more than one individual is concerned.

2.2.3.1. Variables influencing HRV *within* one individual

There are several factors that influence HRV within an individual.

HRV lowers with advancing age (Nunan et al., 2010; Umentani et al., 1998; Valentini and Parati, 2009). Females have lower HRV (Valentini and Parati, 2009). Unhealthy lifestyle habits, such as smoking and second-hand smoking, have a negative effect on HRV (Valentini and Parati, 2009). Supine and standing posture influences HRV (Valentini and Parati, 2009). HRV values are highly variable under paced breathing conditions (Nunan et al., 2010). HRV is also influenced by diet and physical and mental stress (Nunan et al., 2010; Pishbin et al., 2010; Valentini and Parati, 2009). Last but not least, HRV can be transmitted through genes (Valentini and Parati, 2009).
Physical activity as a significant factor to alter HRV is inconclusive (Valentini and Parati, 2009).

Listed below are the variables with self-regulatory capacity for the practitioner, as well as for the patient, in order to obtain a high HRV: respiratory rhythms, emotions and stress.

2.2.3.1.1. Respiratory rhythms

A quantitative systematic review of normal values for short-term HRV in healthy adults, by Nunan et al. (2010), reports that RMSSD values are highly variable under paced breathing, particularly in supine position. Under paced breathing condition, the mean RMSSD is 22% higher than under free breathing conditions (Cfr. Table 1) (Nunan et al., 2010).

Table 1: Comparison of absolute HRV values according to breathing patterns (Nunan et al., 2010).

Mean absolute values according to free (FB) or paced breathing (PB) pattern				
HRV measures	No. of studies		Mean value	
	FB	PB	FB	PB
RMSSD (ms)	8	4	43	55

2.2.3.1.2. Emotions

McCraty et al. (1995) conclude that emotional experiences play an important role in determining sympathovagal balance. Anger does not result in a significant change in the high frequency range of HRV (HF HRV correlates highly with the RMSSD value, used as measure in this osteopathic research). In contrast, appreciation produces an increase in HF HRV ($p < 0.05$). In conclusion, being in an emotional state of appreciation shifts the autonomic nervous system toward increased parasympathetic activity (McCraty et al., 1995).

Tiller et al. (1996) showed evidence that participants who are trained in consciously focusing on a loving state, generate a marked increase in the HF HRV after five minutes, compared to their baseline measures ($p < 0.01$) (Tiller et al., 1996).

Lane et al. (2009) also report that the HRV is influenced by emotions. Subjects were monitored while watching short films which activate relatively 'pure' emotions, versus emotionally 'neutral' short films. Results show a lower activation of the parasympathetic nervous system while watching films of happiness, sadness and disgust, compared to watching 'neutral' films.

Furthermore, they conclude that HF HRV measures during emotional conditions are not related to the respiratory rhythm (Lane et al., 2009).

2.2.3.1.3. Stress

In a research of Weber et al. (2010), subjects with a low resting HRV and subjects with a high resting HRV underwent an acute mental stress test. High HRV individuals showed expected stress-associated decrease of RMSSD during the stress task and returned to baseline levels, during recovery. On the other hand, low HRV individuals stayed at significantly lower RMSSD levels, unaffected by the stage of task, with no post-stress recovery (Cfr. Figure 5) (Weber et al., 2010).

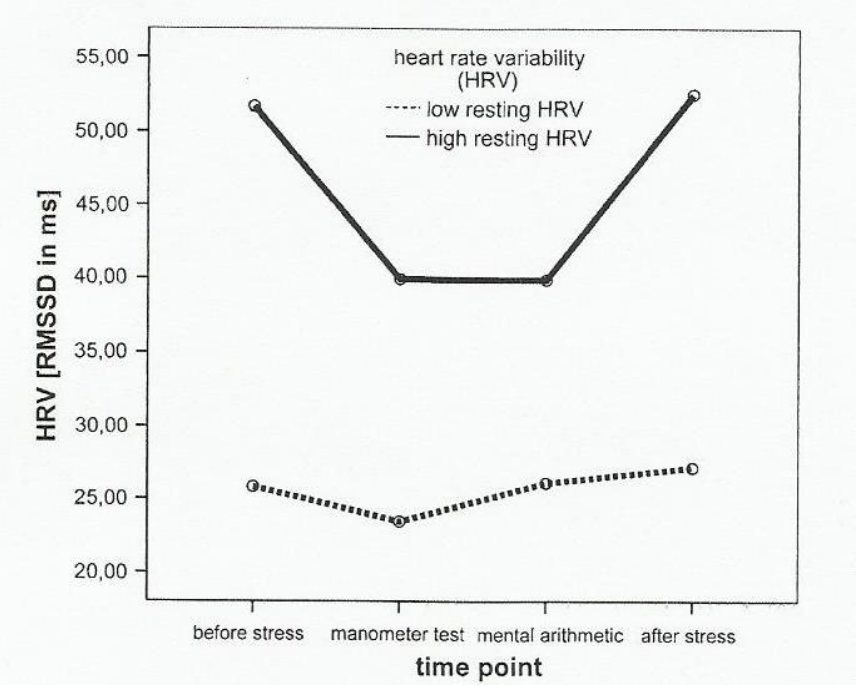

Figure 5: "HRV (RMSSD) in high (n = 20) versus low (n = 23) HRV subjects during the combined stress task. Shown are means of 5-min phases (R1 before stress, manometer test, mental arithmetic, R2 after stress). The high HRV subjects show higher overall HRV levels [...] and a significant stress associated modulation of HRV in contrast to the low HRV subjects [...]."
(Weber et al., 2010)

2.2.3.2. Variable influencing HRV *between* individuals

Touch is a variable influencing HRV, when more than one individual is concerned, such as in the relationship between practitioner and patient.

2.2.3.2.1. Touch

Pishbin et al. (2010) conclude in a study population of sixteen young female friends (age: 22-26) that physical contact (hand-holding) increases HRV, compared to the baseline measure without physical contact. Increased RMSSD values show a near-significant trend (p-value = 0.06) and HF power increases significantly (p-value = 0.02). Both time-domain and frequency-domain measurements indicate an increased parasympathetic activation (Pishbin et al., 2010).

It is unclear whether the increased HRV is due to the feelings of friendship and connection or whether it is due to the physical touch, regardless of the friendship.

2.3. Cardiac coherence

In order to have a significant impact on another person's HRV, cardiac coherence is required.

In general, in physics, the term 'coherence' is used to describe an ordered distribution of energy in a waveform. A sine wave, for instance, is a perfectly coherent wave. The more stable the frequency, amplitude and shape of the waveform, the higher the degree of coherence, order and stability in the rhythmic activity, generated by an oscillatory system, such as the heart (McCraty et al., 2009) (Cfr. Figure 6).

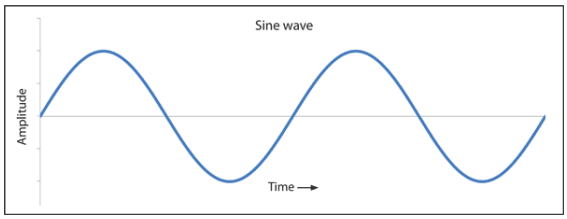

Figure 6: An example of a sine wave like rhythmic signal

Rollin McCraty, executive vice president and director of research in the Institute of HeartMath (a non-profit research centre in California) introduced, together with colleagues, the term 'physiological coherence', also known as cardiac coherence (McCraty and Shaffer, 2015). It is characterised by its smooth, rhythmical waves at a frequency of around 0.1 Hz (McCraty et al., 2009).

Cardiac coherence is reflected in the low frequency range (LF) of a power spectrum graph of an electrocardiogram. Within this graph, emotions can be detected. In the low frequency range of an ECG, 'positive' emotions, such as appreciation, love and gratitude are characterized by strong, harmonic waves. In the high frequency range of an ECG, 'negative' emotions, such as unhappiness, anger, jealousy, are detected as weak, chaotic waves.

As coherence implies order, structure, harmony, and alignment within and amongst systems (McCraty and Shaffer, 2015), it is a state of optimal functioning (Rennison SJ, 2006), resulting in efficient functioning of the whole (Rein et al., 1995).

Hence, a coherent heart signal has a much greater impact on other biological oscillating systems than an incoherent, chaotic heart signal (Rein et al., 1995). A low coherent heart signal will not result in a highly efficient state of growth and restoration, because of the lack of order and consistency. In order to illustrate this, William A. Tiller, professor emeritus at Stanford University, gave following example: "The shift from

incoherence to coherence can bring dramatic effects: a 60-watt light bulb whose light waves could be made coherent as a laser, would have the power to bore a hole through the sun from 90 million miles away. "(Rennison, 2006).

2.3.1. Method to quantify cardiac coherence

In order to assess cardiac coherence, a review of McCraty et al. (2009) states: "Heart rhythm coherence is reflected in the HRV power spectrum as a large increase in power in the low-frequency (LF) band (typically around 0.1 Hz) and a decrease in power in the very low-frequency (VLF) and high-frequency (HF) bands.
A coherent heart rhythm can therefore be defined as a relatively harmonic (sine wave-like) signal with a very narrow, high-amplitude peak in the LF region of the HRV power spectrum with no major peaks in the VLF or HF regions. Coherence thus approximates the LF/(VLF+HF) ratio." (McCraty et al., 2009).

As stated in chapter 2.3., positive emotions such as love and appreciation are reflected in the low frequency range of the power spectrum.

The method to quantify heart rhythm coherence is described in the same above mentioned review of McCraty et al. (2009): "Coherence is assessed by identifying the maximum peak in the 0.04 - 0.26 Hz range of the HRV power spectrum, calculating the integral in a window 0.030 Hz wide, centred on the highest peak in that region, then calculating the total power of the entire spectrum.

The coherence ratio is formulated as: (peak power / (total power − peak power)) (Childre & Martin, 1999)." (Cfr. Figure 7).

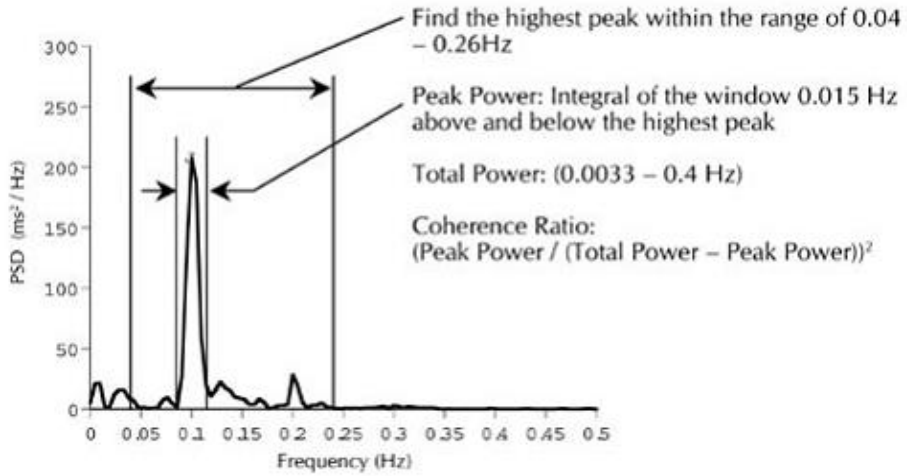

Figure 7: Heart rhythm coherence ratio calculation (McCraty et al., 2009).

2.3.2. Clinical implications of cardiac coherence

Important, positive health outcomes as a result of high cardiac coherence are summarized in the underneath mentioned researches.

Cardiac coherence is associated with a high degree of order and harmony in the functioning of the body's diverse oscillatory systems, such as (1) a sine wave-like pattern in the heart rhythms, (2) a general shift in autonomic balance towards increased parasympathetic activity, (3) increased synchronization between the heart and the brain and, finally, (4) entrainment between oscillatory systems *within* an individual (i.e. heart rhythm pattern, respiration, and blood pressure rhythms) (Shaffer et al., 2014) and even entrainment of those systems *between* individuals (Morris, 2010) [Chapter 2.4. expands on the entrainment and its effect, within an individual and between individuals] .

In an integrative review of McCraty et al. (2009) on "The Coherent Heart" many significant improvements due to coherence-building interventions are listed, including increased immune system function, improved autonomic nervous system function and balance and, finally, increased dehydroepiandrosterone (DHEA)/cortisol levels. Also on a psychological level, changes are recorded: reduction in depression, anxiety and anger, and increase in positive emotions, such as gratitude, caring and peacefulness. This leads to greater emotional stability, increased mental clarity and improved cognitive functioning. Furthermore, they report a significant reduction in blood pressure in individuals with hypertension; reduced depression in patients with congestive heart failure and finally, improved glycemic regulation and quality of life, in patients with diabetes (McCraty et al., 2009).

2.3.3. Variables influencing cardiac coherence

2.3.3.1. Cardiac coherence *within* one individual

As respiration and emotion had an impact on the HRV of an individual, they also influence cardiac coherence.

The institute of HeartMath has done research on consciously self-generating cardiac coherence and has concluded that cardiac coherence can be generated by: (1) regulation of one's breathing rhythms, while (2) visualizing the heart and (3) focusing

on positive feelings of appreciation and gratitude (McCraty and Childre, 2010; McCraty and Shaffer, 2015).

Two parameters, that can be consciously generated, are described in detail below.

2.3.3.1.1. Respiratory rhythms

Respiratory changes can be made consciously. This means that a person can impose a breathing rhythm on his heart rhythm. Hence, breathing slowly and at a rhythmic pace can facilitate coherence (McCraty et al., 2009).

Breathing at a rate of six breaths per minute (a 10-second rhythm, which equals 0,1 Hz) is recommended to obtain this coherent state (McCraty and Childre, 2010; McCraty and Shaffer, 2015).

2.3.3.1.2. Emotions

It is clear that the coherent state of the heart rate is influenced by emotions (Cfr. Figure 8). Mental and emotional stress and some 'negative' emotions, such as anger and frustration are illustrated by an irregular curve of heart rate. 'Positive' emotions, such as feelings of appreciation and love, are associated with a more coherent or sinusoidal heart rate curve (McCraty et al., 2009; McCraty and Childre, 2010).

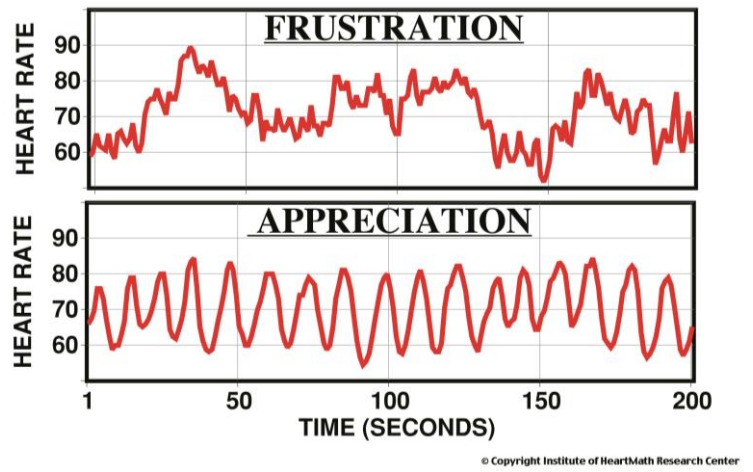

Figure 8: The effect of emotions on heart rhythm patterns (McCraty and Childre, 2010).

McCraty and Childre (2010) report in an overview, different emotions represented in heart rhythm patterns. Anger is characterized by VLF HRV, which is associated with sympathetic nervous system activity. Relaxation on the other hand, is characterized by increased power in the HF region of the power spectrum, reflecting increased parasympathetic activity. Appreciation is associated with a large, narrow peak in the LF region, centred around 0.1 Hz, which means increased parasympathetic activity (Cfr. Figure 9) (McCraty and Childre, 2010).

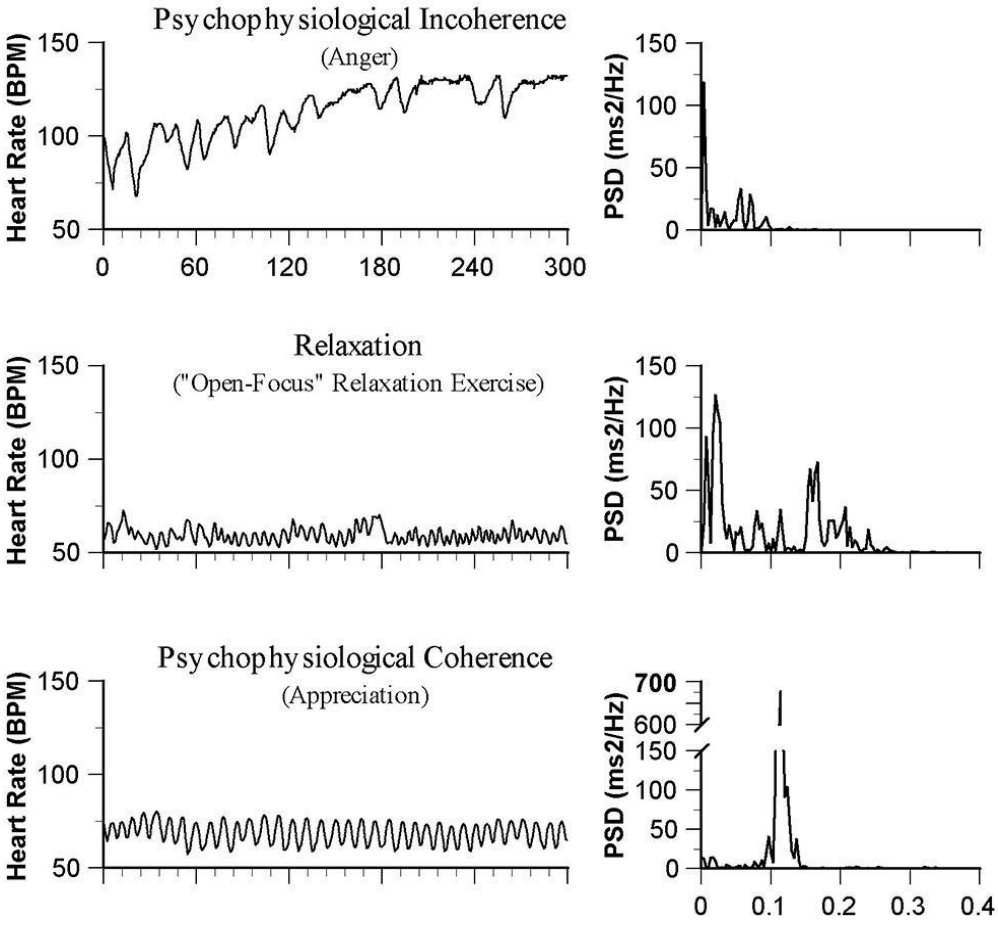

Figure 9: Heart rate tachograms (left-hand graphs) and power spectral density plots (right-hand graphs) during anger, relaxation and appreciation (McCraty and Childre, 2010).

In the integral review of McCraty et al. on heart coherence (2009), it is emphasized that coherence is associated with positive emotions *independent* of conscious alterations in one's breathing rhythm (McCraty et al., 2009).

2.3.4. Cardiac coherence *between* individuals

Morris (2010) examined the possibility that people, trained in achieving high states of heart coherence, could facilitate coherence in other people, by being in close proximity. This brief report investigates fifteen participants who were trained to achieve high HRV coherence (HRVC) and fifteen non-trained participants. Three of the trained participants were paired with one receiver, who was not given this training. Different intentions were assigned to the senders, as well as to the receivers. The sender was either asked to (1) achieve high HRVC without paying attention to the receiver, or was asked to (2) set the intention with care and compassion to increase the coherence of the receiver, or was asked to (3) relax. The receiver was either asked (a) to achieve high coherence through a cue card and a brief demonstration, or was asked (b) to relax.

This study concludes that higher levels of coherence among senders correlate to higher levels of synchronization among the receivers.

Furthermore, best results are attained when both sender and receiver are focusing on increasing their own coherence. They suggest that trying too hard to obtain coherence in someone else might be counter-productive (Morris, 2010).

2.4. High cardiac coherence can result in: Entrainment

Since the heart is the strongest oscillator in the body, it produces very strong rhythmic signals and thus, pulls other oscillators into synchronisation with its rhythms when functioning in a coherent mode, leading to entrainment (Pishbin et al., 2010; McCraty et al., 1998).

In 1665, Christiaan Huygens, inventor of the pendulum clock, was the first to mention 'entrainment'. He notes that clocks with the same length of pendulum begin to swing in synchrony with each other (McPartland and Mein, 1997).

Since then, entrainment has been defined in different ways. Listed below are the definitions applicable in health science.
In the article "Entrainment and the cranial rhythmic impulse", McPartland and Mein (1997) define entrainment as the integration or harmonisation of oscillators (McPartland and Mein, 1997).
In a preliminary survey of McCraty et al. (1996) about "Head-Heart Entrainment", 'frequency-locked entrainment' is defined as occurring "when the oscillators are nonlinear and the coupling causes the two oscillators to lock into a common frequency. As the frequency difference between the two nonlinear systems is reduced, a point is reached where the combined system output suddenly consists of only one single dominant frequency." (McCraty et al., 1996). The frequency difference between the oscillations drops to zero. It is also referred to as "frequency pulled", because the frequency of the dominant system will be adopted (McCraty et al., 2009; McCraty and Shaffer, 2015).

Entrainment can occur between oscillatory systems within one individual, but also between individuals.

2.4.1. Entrainment between oscillatory systems *within* one individual

A specific technique, based on Heartmath's research on self-generating cardiac coherence is the Freeze-Frame (FF) technique. It is a registered trademark from the Institute of HeartMath and is a one-minute, positive emotion refocusing exercise, used in the moment that stress is experienced, to change perception and modify the psychophysiological stress response. Figure 10 illustrates an increased synchronization between the sympathetic and the parasympathetic nervous system

causing entrainment between heart rhythm, respiratory rhythms and blood pressure rhythms after using the Freeze-Frame technique (Tiller et al., 1996).

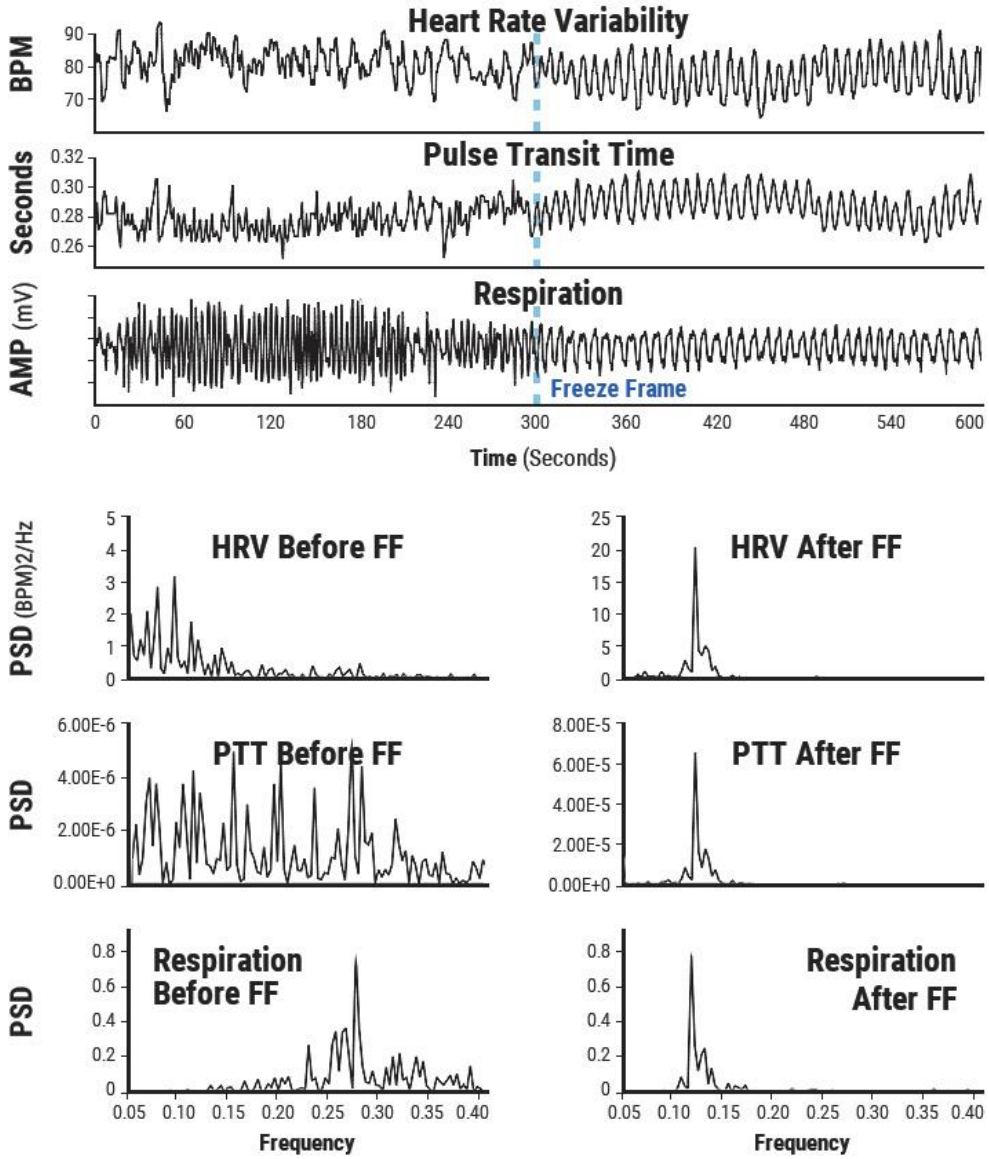

Figure 10: Entrainment between heart rate variability (HRV), blood pressure and respiration. Top graphs show beats per minute (BPM), pulse transit time (PTT) and respiratory rhythms over a ten minute period of time. Bottom graphs show power spectral density (PSD) analysis before and after the HeartMath's freeze frame (FF) technique (Tiller et al., 1996).

2.4.2. Entrainment *between* individuals

Entrainment can also occur between individuals, such as practitioner and patient.
In order to achieve entrainment, different factors have to be taken into account: the practitioner's focus on self, the practitioner's cardiac coherence, the interpersonal relationship and the patient's receptivity. The conclusions of several researches are listed below.

2.4.2.1. The practitioner's focus on self

To harness entrainment, McPartland and Skinner (2005) refer to several methods, including meditation, focusing on the heart, on the breath and/or on feelings of love. Centred attention on parts of the body, rich in biological oscillators, can also improve cardiac entrainment (McPartland and Skinner, 2005).
In addition, as already mentioned above, the research of Morris (2010) concludes that the best way to achieve entrainment is to focus on increasing your own coherence (Morris, 2010).

2.4.2.2. The practitioner's cardiac coherence

Morris (2010) statistically proves entrainment between individuals, when at least one person is being in a high state of cardiac coherence. In an example between two people, they noticed that one subject's highly coherent heart rate leads the other subject into a higher state of coherence (Morris, 2010).

2.4.2.3. The interpersonal relationship

Morris (2010) reported in his article about achieving collective coherence that the interpersonal relationship between individuals correlates statistically with the level of synchronisation between their heart rates. He concludes that bonding between two individuals matter more than the intention of one person to increase another person's cardiac coherence (Morris, 2010).

2.4.2.4. The patient's 'receptivity'

An interesting research on the receptivity of patients to the intention and attention of the practitioner was executed by Russek and Schwartz (1994). They conclude that subjects who rated themselves as 'having been raised by loving parents', registered the practitioner's cardiac signals more strongly, and somewhat more quickly. So, these subjects are better 'receivers' of others' cardiac signal (Russek and Schwartz, 1994).

2.5. Factors influencing health outcomes in general

A patient's health outcomes are influenced by his practitioner, whether he really treats his patient or not (Benedetti, 2014). In osteopathy, as in any other therapeutic setting, it is important to understand the impact of the practitioner's state of awareness, as well as his focus and intention.

This chapter is not a comprehensive, rigorous study of all the factors influencing the patient's health outcomes, but some are listed below: from the point of view of the patient, as well as from the point of view of the practitioner.

2.5.1. From the point of view of the practitioner

2.5.1.1. The practitioner's level of consciousness

James S. Jealous (°1943) - teacher-physician and student of Sutherland, the founder of osteopathy in the cranial field - states in an article of McPartland and Skinner (2005): "The practitioner's consciousness has a primary role in the depth of therapeutic changes arising in patients." (McPartland and Skinner, 2005).

2.5.1.2. The practitioner's intention

Andrew Taylor Still (°1828 - †1917), founder of osteopathy, knew that his mindset as a physician had an important impact on his patients. His intention was to focus on 'health' in patients and to keep the image of 'normal' anatomy in mind (McPartland and Skinner, 2005).

Rein (1996) writes in an overview of original experimental data about the effect of conscious intention on tumor cell growth. He concludes that the most effective intention, while feeling unconditional love, was to bring the cultured tumor cells to their natural order. There was an inhibition of tumor growth of 39% compared to the unexposed cells (Rein, 1996).

Radin et al. (2004) investigated the effects of healing intention and 'intentional space conditioning' on cultured human brain cells. Healing intention is defined in the article as "the act of holding a benevolent desire for another human being to achieve or sustain a state of health, or more generally, a state in which life is enhanced". The space conditioning is described as healing intention, practiced repeatedly, at the same

location. Four experienced Johrei - a spiritual healing practice founded in Japan by Mokichi Okada (°1882 - †1955) - practitioners took part in this three day experiment. They conclude that the healthy, treated brain cells grew more, as the experiment progressed. They also suggest that repeated exposure to healing intentions and space conditioning meditation results in increased growth (Radin and Yount, 2004).

2.5.1.3. The practitioner's attention towards his patient

The practitioner's empathic and compassionate behaviour, when the patient expresses pain, may lead to changes in therapeutic outcomes, regardless of the efficacy of a treatment (Benedetti, 2014).

In order to "synchronize the practitioner's attention", James Jealous suggests to breath slowly and regularly and to soften the muscles above the pubic bone (McPartland and Skinner, 2005).

2.5.2. From the point of view of the patient

2.5.2.1. Patient's psychosocial factors

A patient's trust in his care giver is an important element that has beneficial effects on his overall health status. Patients base their trust on the practitioner's competence, compassion, confidentiality, reliability and communication (Benedetti, 2014).

Other research has found that health outcomes are more positive, when patients are feeling a sense of familiarity and friendliness towards the practitioner (Morris, 2010).

Figure 11 represents the psychosocial factors influencing the patient, such as: the words pronounced by health care givers, the appearance of health professionals, the interaction between the practitioner and the patient, the patient's memories and previous experiences and, finally, the patient's personal beliefs and expectations. Their influence on the patient's own health outcomes is not to underestimate (Benedetti, 2014).

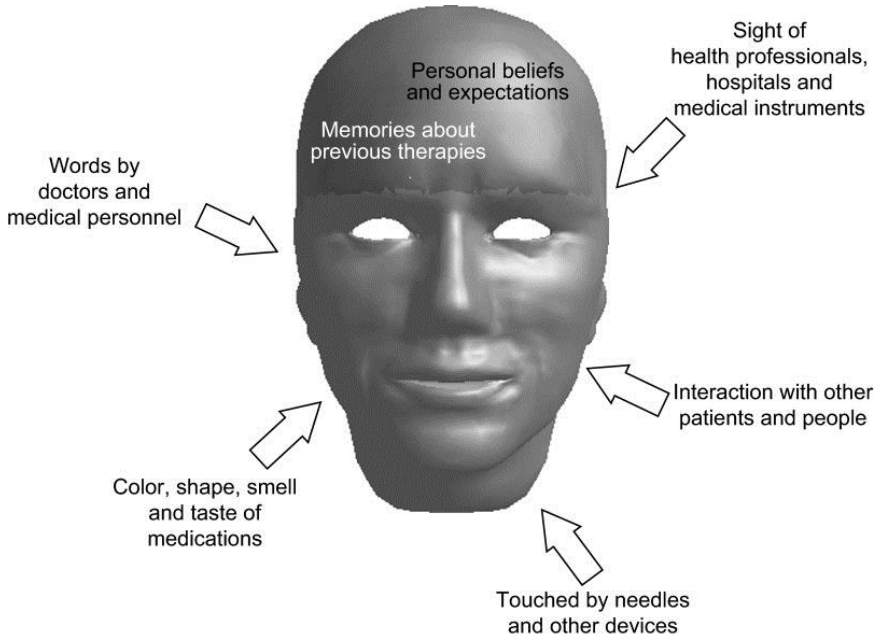

Figure 11: The psychosocial context around the patient (Benedetti, 2014).

2.6. Devices to measure heart rate variability

2.6.1. Electrocardiograph

In order to measure the heart rate variability (HRV), the heart's beat-to-beat changes were initially recorded by an electro-cardiograph (Billman, 2011). Nowadays, however, there are also other, more commercial devices available on the market.

2.6.2. Polar V800

The Polar V800 is an example of a more commercial device that also isolate the RR-intervals in a QRS complex.

HRV parameters, derived from the V800 recordings, are highly comparable to an electrocardiogram and are proven to be valid and reliable (Giles et al., 2016). It are the time-domain measurements, more specifically the Root Mean Square of Successive Differences (RMSSD) of the HRV, that are recorded (Cfr. Chapter 2.2.1.2.). RMSSD is significantly correlated with the high-frequency band of the frequency-domain HRV measures (r = 0.95) (Shaffer et al., 2014).

As to the interpretation of the obtained values, two articles refer to the normal values of standard measures of heart rate variability: one study on the long-term HRV values and one study on the short-term HRV values. In 1996, guidelines for 24 hour HRV values were published by an International Task Force, consisting of members from the European Society of Cardiology and the North American Society for Pacing and Electrophysiology (Task force, 1996). In 2010, Nunan et al. also published a review with short-term measures of HRV in healthy adult populations (Nunan et al., 2010). Table 2 shows the normal RMSSD values in a healthy population.

Table 2: Normal RMSSD values ± standard deviation (SD) in a healthy population

	RMSSD Mean ± SD (ms)	Population	Comments
Task force (1996)	27 ± 12	Large normal population	24 hour recording
Nunan (2010)	42 ± 15 21 19	Healthy adults Male population Female population	Short-term HRV measures

3. RESEARCH

3.1. Methodology

3.1.1. Measurements

3.1.1.1. Polar V800

In order to measure the HRV of the participants, the Polar V800 was used. In general, the HRV is derived from an electrocardiogram. But, in order to ensure a maximum of comfort for the patient, as well as for the practitioner, there was a preference for the Polar V800.

The convenience of this device allowed the participants to be in an osteopathic setting of well-being, which was indeed crucial, because of the important number of variables able to influence the participant's HRV (Cfr. Chapter 2.2.).

The participants wore a heart rate monitor chest strap, connected to the Polar V800 watch (Cfr. Figure 12).

Figure 12: Polar V800 and heart rate sensor (polar.com).

3.1.2. Study design

This placebo controlled clinical trial examined the influence of the practitioner's touch and high cardiac coherence on the patient's heart rate variability, through self-aware focus of the practitioner on his own coherent state, while holding the patient's cranium, without any osteopathic treatment whatsoever.

3.1.3. Hypotheses

The hypothesis of this clinical trial is that the heart rate variability (HRV) of a patient can change due to the practitioner's touch and high cardiac coherence, while holding the patient's cranium, without any osteopathic treatment whatsoever.

Null hypothesis (H0): "A practitioner's self-aware touch and focus on high cardiac coherence has no effect on the patient's heart rate variability."

Alternate hypothesis (H1): "A practitioner's self-aware touch and focus on high cardiac coherence has an effect on the patient's heart rate variability."

3.1.4. Population

3.1.4.1. Inclusion criteria

The participants, eligible for this study, were men and women presenting at an osteopathic practice, 20-60 years of age, with normal weight (BMI between 18,5 and 30 kg/m2). They came in with a physical complaint and expected to receive help.

3.1.4.2. Exclusion criteria

The selected exclusion criteria were: no psychiatric illness or other psychopathology and, finally, no clients taking severe drugs to regulate heartbeat disturbances.

3.1.4.3. Randomisation

Twenty-four subjects were assigned into two groups: one experimental group (A) and one placebo group (B). Block randomization was applied to ensure an equal number of participants in each group. Randomisation was performed by using permuted blocks (AABB).

3.1.4.4. Blinding

The subjects were blinded for the group allocation. Only the osteopathic practitioner, trained to achieve high cardiac coherence, knew about the two interventions (Cfr. Chapter 3.1.5.) in the different treatment groups. He was also the executer of both interventions.

The practitioner remained blinded to the measured values of the Polar V800.

3.1.4.5. At baseline

During the recruitment and at baseline, the emphasis was on an osteopathic intervention to improve 'overall health'. An information form was given to the participant (Cfr. Addendum 12.1.), stating that the person could be subjected to either the placebo group or the experimental group. Both groups were subjected to a measurement of the heart rate, through a chest strap, for fifteen minutes. Participants were not told that this research was focused on improving their HRV by means of the practitioner's touch and high cardiac coherence.

At the beginning of the study all participants signed an 'informed consent form' (Cfr. Addendum 12.2.).

The Short Form 36 Health Survey (SF 36) was used to elicit the participant's general state of health. This multidimensional instrument contains eight items: general health perception, physical functioning, social functioning, role limitations due to physical problems, role limitations due to an emotional problem, mental health, vitality and pain. The item scores were summed and transformed into a hundred point scale. The higher their score, the better their health (Cfr. Addendum 12.3.). Research has shown it to be reliable and valid (Van der Zee and Sanderman, 1993).

These item scores were not used as in- or exclusion criteria. They were consulted to evaluate preliminary differences between the participants.

3.1.5. Intervention

The intervention took place in an independent osteopathic practice in Edegem (Belgium). The room was a standard osteopathic room without Wi-Fi devices, computer, cell phone or other electrical devices. Furthermore, no music, candles, aroma therapy or other relaxing tools were present.

Prior to each trial, all subjects were asked to recall from talking, from falling asleep, from moving exaggeratedly or/and from intentionally altering their breath pace. They were also asked to turn off their cell phone.

The trial consisted of a baseline period of five minutes, followed by an intervention of ten minutes (Cfr. Figure 13).

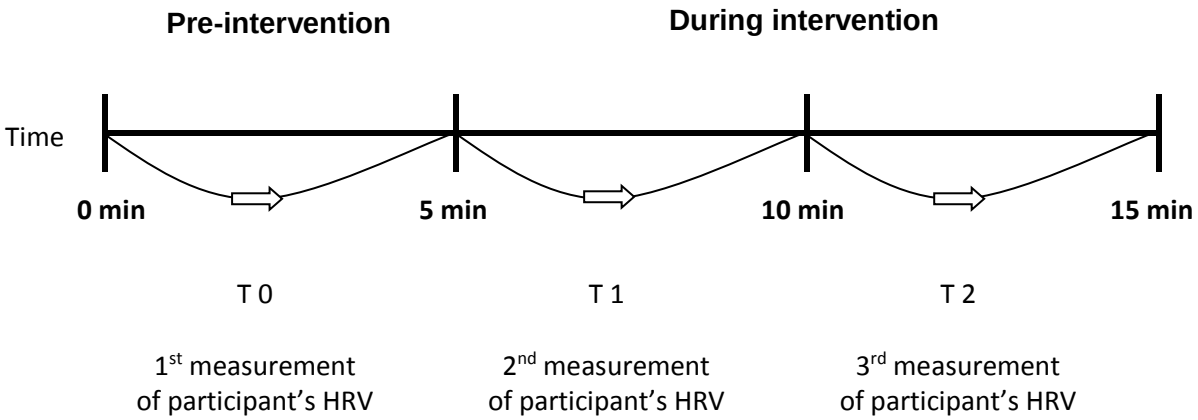

Figure 13: Overview of measurements, timing and interventions

3.1.5.1. The practitioner, performing the intervention in the experimental group

The practitioner, performing every intervention, was trained to achieve high cardiac coherence. Before the intervention, he was informed about HRV, cardiac coherence and the multiple variables influencing these outcome measurements.

During the intervention the practitioner, as well as the participant, wore the Polar V800, to measure their heart rate variability.

The Inner Balance™ iOS application, utilizing the HeartMath iOS Pulse sensor, was used as an auto-feedback tool for the practitioner (Cfr. Figure 14). The HRV and coherent state, visually represented in graphic tables and charts, helped the practitioner to maintain high cardiac coherence during his 'intervention' in the experimental group (Cfr. Figure 15).

Figure 14: Inner Balance™ and HeartMath iOS Pulse sensor with ear clip (heartmath.co.uk).

Figure 15: Inner Balance™ representing HRV and coherent state on graphic tables and charts, used by the practitioner to maintain high cardiac coherence (heartmath.co.uk).

3.1.5.2. Pre-intervention measurement of five minutes

As recommended by The Task Force (1996), a baseline period of five minutes was ensured to measure the participant's HRV. All were lying in supine position on the examination table. No participant or other person was in his or her near proximity (within a range of 4 meter).

3.1.5.3. An intervention of ten minutes

3.1.5.3.1. Experimental group

After the five minutes of pre-intervention the practitioner came in the treatment room and sat up straight at the head end of the table, feet symmetrical on the floor, forearms on the table. For the next ten minutes, he placed his hands on each side of the subject's head: the index fingers on the ala major, behind the lateral corners of the eyes; the middle fingers on the temporal bones, in front of the ears; the ring fingers on the temporal bones, behind the ears; the little fingers on each side of the occiput and finally, the thumbs on top of the subject's head. The pressure applied was five to ten gram. The practitioner's hands were room temperature.

While the practitioner was holding the cranium of the subject, an energetic field was created that held and surrounded both participant and practitioner. Afterwards he focused on his own field within this 'common' field. He synchronized his own respiratory and cardiac rhythm by focusing on positive emotions and feelings of

appreciation. Figure 16 is a representation of how the practitioner conceptualizes the energetic fields during the intervention in the experimental group.

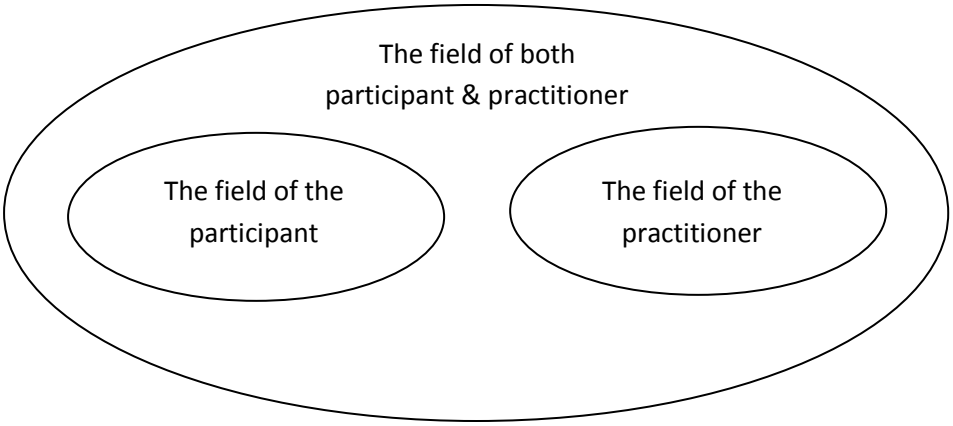

Figure 16: Visual representation of the energetic fields during the intervention in the experimental group

3.1.5.3.2. Placebo group

The placebo intervention, which took place after the first five minutes of baseline measures, consisted solely of clipping the HeartMath iOS Pulse sensor on the ear of the subject (Cfr. Figure 17), where after the practitioner disappeared again for the next ten minutes. No touch was applied.

Figure 17: HeartMath iOS Pulse sensor with ear clip (heartmath.co.uk).

3.1.6. Data and power analysis

The data of the Polar V800's registrations were sent to a web service 'Polar FlowSync' for further analysis. In this program, it is possible to select the RMSSD. SPSS 20 (IBM) software evaluated the data, which were processed and represented in a report sheet. To show significance, p-values had to be below 0.05.

The power of this research is 30%. A power of 80% could have been reached, if 86 subjects would have been included in the study; 43 subjects per group.

3.2. Results

3.2.1. Sample characteristics

The study sample consisted of twenty-four Belgian participants. Two groups were randomly assigned.

The placebo group consisted of seven men and five women with a mean age of 45 years and a BMI of 22,6 kg/m². Most of them worked (with a mean of 35 ±23 working hours per week). Their overall health state was good (with a mean of 68 ±20%) (Cfr. Table 3). Their RMSSD was normal, as in a healthy population (mean of 30 ±9 ms) (Cfr. Table 4).

The experimental group consisted of three men and nine women with a mean age of 32 years and a BMI of 21,9 kg/m². Most of them worked (with a mean of 33 ±20 working hours per week). Their overall health state was good (with a mean of 70 ±14 %) (Cfr. Table 3). Their RMSSD was normal, as in a healthy population (mean of 42 ±23 ms) (Cfr. Table 4).

Table 3: Variables of the questionnaires between the placebo group and the experimental group at intake.

Variable	**Placebo group (n = 12)**	**Experimental group (n = 12)**
Mean age ± SD	45 ±11	32 ±9
BMI ± SD (kg/m^2)	22,6 ±2	21,9 ±2
Working hours ± SD (h/week)	35 ±23	33 ±20
SF 36 ± SD (%)	68 ±20	70 ±14
- General health perception ± SD (%)	64 ±18	65 ±17
- Physical functioning ± SD (%)	75 ±23	88 ±9
- Physical role functioning ± SD (%)	58 ±46	75 ±37
- Emotional role functioning ± SD (%)	75 ±29	72 ±40
- Social role functioning ± SD (%)	79 ±28	69 ±17
- Painfree ± SD (%)	63 ±22	69 ±20
- Vitality ± SD (%)	62 ±26	58 ±16
- Emotional wellbeing ± SD (%)	71 ±16	67 ±17

Table 4: The RMSSD values of the participants during the first five minutes of the experiment without intervention, in the placebo group and in the experimental group.

Variable	**Placebo group (n = 12)**	**Experimental group (n = 12)**
Mean RMSSD (ms) **0-5 minutes**	30 ±9	43 ±23

3.2.2. Test of normality

The Shapiro-Wilk test was used to assess the normality of the distribution within the placebo and the experimental group. The variables are not distributed normally when the p-value is below 0,05 and a normal distribution can be assumed, when this value is greater than 0,05.

This test showed that the experimental group did not differ with regard to age, BMI, working hours and total SF 36 scores. All these p-values were greater than 0.05. However, the RMSSD at baseline and two items of the SF 36 were statistically different ($p < 0.05$): physical and emotional role functioning.

In the placebo group, the Shapiro-Wilk test showed no statistical difference with regard to the BMI and the total SF 36 scores ($p > 0.05$). However, the age, the working hours and three items of the SF 36 did show statistical differences ($p < 0.05$).

So, since the p-value was lower than 0,05 for some variables within each group, the dataset was not distributed normally. This had impact on the results of the tests, conducted further below.

3.2.3. Differences between groups for the subject variables

3.2.3.1. Mann Whitney U test for scaled variables

The Mann Whitney U test was used to examine whether there was a difference between the two groups (experimental and placebo) for the following variables: number of working hours per week, height, weight, BMI and age. Since some subject variables were not normally distributed, a non-parametric test was used in order to test for differences.

The null hypothesis was: “There are no significant differences between the scores for the two populations.”

No significant difference was found between placebo and experimental group for the subject variables height, weight and BMI (MW-U: p-values respectively 0,8; 0,2; 0,3). The participants in the placebo group were significantly older compared to the experimental group (MW-U: p-value = 0,02) (Cfr. Figure 18).

For height, weight and BMI, there was no significant difference between the two groups.

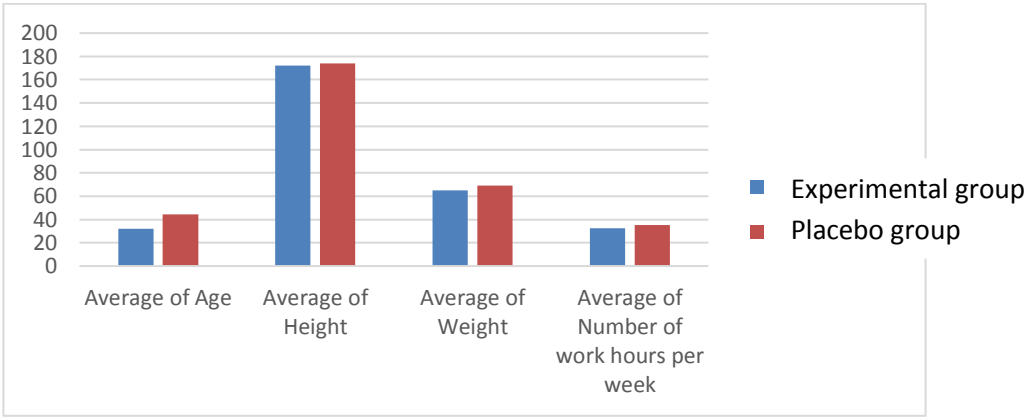

Figure 18: Bar chart of the average of age, height, weight and number of working hours per week for the experimental and placebo group

3.2.3.2. Chi-Square test for nominal scaled variable

Since gender is a nominal scaled variable, a Chi-Square test was performed to see whether or not there was a significant difference between the experimental and placebo group. A p-value > 0,05 could be observed implying there was no significant difference between both groups, with regard to number of men or women (X_2: p-value = 0.098).

3.2.4. Comparison of HRV within the experimental group (Wilcoxon signed ranks test)

The Wilcoxon signed rank test was used to compare the HRV scores at T0, compared to T1 and at T0, compared to T2 within the experimental group.

The null hypotheses were the following: (1) “There are no differences between the RMSSD scores at the first and the next five minutes of the intervention.” and (2) “There are no differences between the RMSSD scores at the first and the last five minutes of the intervention.” When the p-value was < 0,05, the null hypothesis was rejected.

Within the experimental group, no significant difference was measured in the RMSSD values of the participants between the first five minutes, where the participant was alone, and the next five minutes, where the practitioner was intentionally increasing his own HRV coherence, while touching the participant’s cranium (Wilcoxon signed ranks test: p-value = 0,34), as well as between the first five minutes, where the participant was alone, and the last five minutes, where the practitioner was intentionally increasing his own HRV coherence, while touching the participant’s cranium (Wilcoxon signed ranks test: p-value = 0,14) (Cfr. Table 5).

Table 5: The RMSSD values of the participants in the experimental group, during the first, the next and the last five minutes of the intervention.

Variable	Experimental group (n = 12)		
	T 0	**T 1**	p-value
	0-5 minutes	**5-10 minutes**	
Mean RMSSD	43	46	0,34

Variable	Experimental group (n = 12)		
	T 0	**T 2**	p-value
	0-5 minutes	**10-15 minutes**	
Mean RMSSD	43	49	0,14

3.2.5. Comparison of HRV within the placebo group (Wilcoxon signed ranks test)

Likewise, the Wilcoxon signed rank test was used to compare the HRV scores at T0, compared to T1 and at T0 compared to T2, in the placebo group.

The null hypotheses were the following: (1) “There are no differences between the RMSSD scores at the first and the next five minutes of the sham intervention.” and (2) “There are no differences between the RMSSD scores at the first and the last five minutes of the sham intervention.” When the p-value was < 0,05 , the null hypothesis was rejected.

The values of the participants in the placebo group showed no significant difference in the RMSSD values between the first five minutes, where the participant was alone (Wilcoxon signed ranks test: p-value = 1,00), and the following five minutes, where the sham intervention took place, as well as between the first five minutes and the last five minutes, where the sham intervention took place (Wilcoxon signed ranks test: p-value = 0,40) (Cfr. Table 6).

Table 6: The RMSSD values of the participants in the placebo group, during the first, the next and the last five minutes of the intervention.

Variable	Placebo group (n = 12)		p-value
	T 0 **0-5 minutes** **RMSSD 1**	**T 1** **5-10 minutes** **RMSSD 2**	
Mean RMSSD	30	29	1,00

Variable	Placebo group (n = 12)		p-value
	T 0 **0-5 minutes** **RMSSD 1**	**T 2** **10-15 minutes** **RMSSD 3**	
Mean RMSSD	30	32	0,40

3.2.6. Comparison of HRV between the placebo and experimental group (ANCOVA)

The ANCOVA (analysis of covariance) determined whether there were any significant differences between the mean RMSSD values of the placebo and experimental group.

The null hypotheses were the following: (1) “There are no differences between the experimental and the placebo group for the RMSSD scores at the first and the next five minutes of the intervention”; (2) “There are no differences between the experimental and the placebo group for the RMSSD scores at the first and the last five minutes of the intervention”. When the p-value was < 0,05, the null hypothesis was rejected.

As can be seen in the table below, there is no significant difference between the experimental and the placebo group for the RMSSD1 scores, compared to the RMSSD2 scores (ANCOVA: p-value = 0,230). Furthermore, there is no significant difference between both groups for RMSSD3 controlling for RMSSD1 scores (ANCOVA: p-value = 0,349) (Cfr. Table 7).

Table 7: The RMSSD values of the participants in the placebo and in the experimental group during the first, the next and the last five minutes of the intervention

Variable	**Placebo group (n = 12)**	**Experimental group (n = 12)**	p-value
Mean RMSSD (ms)			
0-5 minutes (RMSSD 1)	30	43	
5-10 minutes (RMSSD 2)	29	46	0,230

Variable	**Placebo group (n = 12)**	**Experimental group (n = 12)**	p-value
Mean RMSSD (ms)			
0-5 minutes (RMSSD 1)	30	43	
10-15 minutes (RMSSD 3)	32	48	0,349

3.3. Discussion

The aim of this study was to investigate the effect of a practitioner's touch and high cardiac coherence on the participant's HRV, through self-aware focus of the practitioner on his own cardiac coherence, while holding the participant's cranium, without any osteopathic treatment whatsoever.

Three measurements were taken: (1) at baseline: during the first five minutes (where the participants of both groups were alone), (2) during the second five minutes and (3) during the last five minutes. The intervention for both groups took place during the second and third five minutes, where the participants were either submitted to an intervention where the practitioner was in high cardiac coherence, while holding the participant's cranium (intervention group), or to a sham intervention without the practitioner's touch, nor proximity (placebo group).

In the experimental group, the measured mean RMSSD values are 43 ms during the first five minutes, 46 ms during the second five minutes and 49 ms during the last five minutes. In the placebo group, the measured mean RMSSD values are approximately the same: 30 ms during the first five minutes, 29 ms during the second five minutes and 32 ms during the last five minutes.

Within the experimental group, there is no statistically significant difference between the mean RMSSD value at baseline, compared, on the one hand, to the mean RMSSD value during the second measurement and, on the other, to the mean RMSSD value during the last measurement (where the participants were touched on the cranium by the practitioner in high cardiac coherence) (Wilcoxon signed ranks test: p-value respectively 0,34 and 0,14).
Within the placebo group, there is no statistically significant difference between the mean RMSSD value at baseline, compared, on the one hand, to the mean RMSSD value during the second measurement and, on the other, to the mean RMSSD value during the last measurement (where the participants were experiencing a sham intervention without the practitioner's touch, nor proximity) (Wilcoxon signed ranks test: p-value respectively 1,00 and 0,40).

Between the experimental group and the placebo group, there is no statistically significant difference for the mean RMSSD value at baseline, compared to the mean RMSSD value during the second measurement of five minutes (where the intervention was different for the experimental and for the placebo group) (ANCOVA: p=0,230).

Between the experimental group and the placebo group, there is no statistically significant difference for the mean RMSSD value at baseline, compared to the mean RMSSD value during the last measurement of five minutes (where the intervention was different for the experimental and for the placebo group) (ANCOVA: p=0,349).

The not significant increase in RMSSD values in the experimental group suggests a more balanced autonomic nervous system within these individuals, predisposing them to enhanced recovery in cardiovascular, endocrine and immune outcome parameters (Weber et al., 2010). This increase of parasympathetic activity, towards a better sympathovagal balance, may be beneficial in the treatment of a wide range of diseases, such as cardiovascular disease, all-cause mortality, adverse prognosis of cancer, hypertension (Billman, 2011; De Couck et al., 2013-2014-2016; Mouton et al., 2011; Shaffer et al., 2014; Task Force, 1996).

Importantly, practitioners performing osteopathic techniques - whether cranio-sacral, visceral or structural - combined with touch and increased cardiac coherence will be the most efficient in their contribution to health restoration of their patients.

There are a number of possible factors that provide an explanation for these findings, since the intervention in the experimental group involved both touch and a non-touch technique to increase cardiac coherence.

A possible factor influencing the increase in RMSSD values in the experimental group may be due to the positive effect of physical contact (touch).
As to this subject, Pishbin et al. (2010) conclude that two friends holding hands during five minutes increase their HRV values, reflected both in time-domain and in frequency-domain measurements. Remarkable is that they report an increase 'close to significant' in the RMSSD values between the placebo group and the experimental group. More specifically, the mean RMSSD before holding hands was 41,1ms and the mean RMSSD during five minutes of hand-holding was 45,6ms (Pishbin et al., 2010). Whereas in this present study, there is a statistically significant difference between the experimental and placebo group for the RMSSD values at baseline, compared to the mean RMSSD during the last measurement. It should be noted that the intervention of both studies are different by population, timing and methodology. Pishbin et al.'s study allowed for dialogue between the two friends during 5 minutes, whereas this present study was conducted in a therapeutic setting and in silence during 10 minutes.
Furthermore, Coan et al. (2006) investigates married women who were subjected to the threat of electric shock in three different conditions: while holding their husband's

hand, while holding the hand of an anonymous male experimenter, or while holding no hand at all. They conclude that the higher the marital quality, the lesser they record stress responses. Holding the stranger's hand does not decrease unpleasantness (Coan et al., 2006).

In other words, both studies - Pishbin et al. and Coan et al. - suggest that familiar feelings are primordial in order to experience a positive effect as a result of touch. Indeed, as literature suggests, positive emotions, like appreciation and love, cause an increase in HRV levels (McCraty et al., 1995; Tiller et al., 1996). So, it might have been the positive feelings associated with touch that have led to their increased HRV values.

In contrast with the two above mentioned studies, this present trial is done in a different context (therapeutic) and with individuals not knowing each other.

So in conclusion, since the practitioner was not familiar to the participants and since Benedetti (2013) confirms the importance of a good practitioner-patient relationship (Benedetti, 2013) - which was not the case here - the application of the practitioner's hands on the participant's cranium might have been experienced as stressful, rather than relaxing, for the person involved.

The effect on HRV of mere touch, without familiar feelings between the participants has not been investigated thoroughly yet. Therefore, an increase in HRV values as a result of touch alone cannot be excluded.

Consequently, the increased RMSSD value in the participants of the experimental group could possibly be explained by the non-touch technique to increase cardiac coherence. Entrainment between the high cardiac coherence of the practitioner and the electromagnetic field of the patient may be a factor influencing these results.

As to this subject, Morris (2010) investigates the possibility that people, trained in achieving high states of heart coherence, could facilitate coherence in other people, by being in close proximity. They conclude that a high level of coherence within a trained person correlates to higher levels of synchronisation with the non-trained participant (Morris, 2010).

Another possible factor influencing the increase in RMSSD values could be found in nonspecific effects, such as mental and psychological factors.

As to the participants, they can be mostly excluded. Indeed, both groups - the experimental as well as the placebo group - were affected by similar mental and psychological factors at the exact moment of the intervention; both positive (i.e. the participant might have felt reassured; or might have felt relaxed to lay down; etcetera ...) as well as negative (i.e. the participant might have felt a certain discomfort being

asked unexpectedly to participate in a research; or might have felt challenged to lay on his back, without doing anything; or might have been in a bad mood; etcetera ...). For the participants in the experimental group though, it might have been more stressful (touch). But apparently, this was not a prevailing factor, since their RMSSD values increased. As Morris (2010) suggests in his study, these subtle, psychophysiological factors could influence the 'receptivity' of participants, who are consciously or unconsciously accepting or rejecting the presence of the practitioner (Morris, 2010).
As to the practitioner, the positive intention to improve health might have influenced the RMSSD values, although, in this study, the attention of the practitioner was on himself and his intention was to increase his own cardiac coherence.

The fact that no statistical significance was found in the RMSSD measured between the last five minutes, compared to the first five minutes of the intervention *within* the experimental group, may be due to different methodological factors which will be discussed in following chapter. They can be seen as useful, constructive advice for future research.

3.3.1. Discussion of method

First, a larger study population might have enlarged the possibility to measure statistical differences within the experimental group. Nevertheless, following studies do show statistically significant differences in short-term HRV while measuring a small sample group: the first one, Morris (2010), investigating cardiac coherence between people within a group of thirty subjects; and the second one, Pishbin et al. (2010), investigating physical contact between two people within a group of sixteen subjects (Morris, 2010; Pishbin et al., 2010).

Second, the HRV was measured over a fifteen minute period of time. It might be possible that more significant results would have shown up in the experimental group, between the baseline measurement (where the participant was alone), compared, on the one hand, to the second and, on the other, to the third measurement (where the practitioner was intentionally increasing his own HRV coherence, while touching the participant's cranium), if the period of intervention would have been longer. Nevertheless, in previous studies, such brief measure of HRV did show significant differences in HRV (McCraty et al., 2004; Morris, 2010; Pishbin et al., 2010).

Third, similar to previous section, but without applying any touch, Radin et al. (2004) state that it was only after repeated healing intentions, and for a period of three days that changes in cell growth occurred (Radin et al., 2004). So, repeated exposure to the

high cardiac coherence of the practitioner could have lead to more statistically significant results.

Forth, it is possible that the time-domain measurements did not show enough difference in short-term HRV values. As Nunan et al. (2010) and Shaffer et al. (2014) report, time-domain measures of HRV do not provide quantification for short-term autonomic dynamics as *specifically* as frequency-domain analysis of HRV does (Nunan et al., 2010; Shaffer et al., 2014). However, Weber et al. (2010) do show statistically significant changes in time-domain measures, namely in the RMSSD levels, while measuring short-term HRV values before and after a stress test (autonomic dynamics) (Weber et al., 2010).

Fifth, no reliable and valid scientific tool is capable of measuring cardiac coherence. Therefore, the device *Inner Balance*™ - used by the practitioner to measure his cardiac coherence – only served as a personal auto-feedback tool. So, this study relies exclusively on the practitioner's capacity to obtain high cardiac coherence. In other words, it was the HRV and not the cardiac coherence of the participants that was documented scientifically.
Futhermore, on the one hand, Heartmath publishes a formula to measure cardiac coherence on the basis of HRV; on the other hand however, the practitioner had to conclude that when cardiac coherence on the screen of the *Inner Balance*™ was increasing, the HRV measures of the Polar V800 did not increase accordingly.
The practitioner's mean RMSSD was 33 ms during the intervention. This is a value that is higher than the mean RMSSD of a standard female population, which is 19 ms (Nunan et al., 2010). However, the participants in the experimental group had a higher mean RMSSD (mean RMSSD of the participants was 43 ms) than the practitioner at the moment of the intervention.

Sixth, the practitioner's coherence device, *Inner Balance*™, indicated a high coherence during the intervention. It is unclear in literature what the mean absolute value of cardiac coherence is and what *degree* would be considered as beneficial for entrainment. As Morris (2010) states, the *degree* of coherence in the individual's cardiac rhythms is an important factor in determining synchronization between the two subjects: the higher the degree of coherence, the more synchronisation between two heart rhythms. Quantification of a specific degree however, is not mentioned (Morris, 2010).

Finally, the professional skills of the practitioner were not taken into account. In this research, the practitioner was a student in his final year osteopathy. Consequently, the competence of an experienced osteopath lacked. Many factors, such as the self-confidence of the practitioner, do play a role in the outcome measurements of the participant. As Benedetti (2013) states, health professionals can submit a lot of information (positive or negative) to the patient through their attitudes and behaviours (Benedetti, 2013).

3.3.2. Further research

In future studies more useful information can be gained by measuring the electromagnetic energy field of the heart with a superconducting quantum interference device (SQUID).

Future research should be made on the participant's mental and emotional conditions at the exact moment of the intervention, and not on the previous days and months, as was assessed by the SF 36 in this research.

More scientific power will be obtained when including not only more participants, but also different practitioners.

In order to better distinguish whether the participant's increase in HRV is due to the practitioner's high cardiac coherence and/or due to the effect of the physical contact, future research should be done under four different conditions: while being touched by a person with high cardiac coherence (as done in this research), while being in the presence of a person with high cardiac coherence (without touch), while being touched by a person not knowing what the experiment is about and finally, while being in the absence of any presence whatsoever.

The influence of a *low* cardiac coherence of the practitioner on the HRV of a patient is also to be investigated yet.

In conclusion, this study is a first attempt to see whether a trend in the experimental group could be notified. Hence, further research should be done on a greater scale and hopefully, after present investigation, with more statistically significant differences.

3.4. Conclusion

Statistics showed a not significant increase in RMSSD values *within* the experimental group.

This study, lacking power, cannot suggest that osteopaths can have a positive effect on the patient's HRV, by holding the patient's cranium, while focusing on his own cardiac coherence.

4. LIST OF ABBREVIATIONS

ANCOVA	Analysis of covariance
ANS	Autonomic nervous system
BMI	Body Mass Index
BPM	Beats Per Minute
DHEA	Dehydroepiandrosterone
ECG	Electrocardiogram
EEG	Electro-encephalogram
FF	Freeze Frame
H0	Null hypothesis
H1	Alternate hypothesis
HF	High frequency
HRV	Heart rate variability
HRVC	Heart rate variability coherence
LF	Low frequency
n	number
ms	millisecond
MW-U	Mann-Whitney U test
PSD	Power Spectral Density
PTT	Pulse Transit Time
RMSSD	Root mean square of successive differences
RSA	Respiratory Sinus Arrhythmia
SD	Standard Deviation
SF 36	Short Form (36) Health Survey
SQUID	Superconducting Quantum Interference Device
VLF	Very low frequency
X_2	Chi-square

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6. ADDENDUM

6.1. Information for the participant

Informatie voor de deelnemer

Titel van de studie:

Een osteopatische interventie: een gerandomiseerde klinische studie

Gelieve onderstaande informatie te lezen om u te helpen beslissen of u al dan niet aan deze studie wenst deel te nemen. Indien er vragen zouden zijn omtrent deze informatie kan u zich wenden tot de persoon vermeld onderaan deze brochure. Als u beslist om deel te nemen aan deze studie, zal u gevraagd worden een "Toestemmingsformulier" (bijgevoegd bij deze informatiebrochure) te tekenen. U houdt deze informatiebrochure bij zodat u deze in de toekomst nog kan raadplegen.

Doel van de studie

Deze studie heeft tot doel te onderzoeken of een osteopatische interventie kan bijdragen tot het kortstondig verbeteren van de gezondheid.

Praktisch

Uw deelname aan de studie omvat het participeren aan een osteopatische interventie dat doorgaat in de zelfstandige praktijk te Edegem. U wordt bij toeval onderverdeeld in de interventiegroep of in de controlegroep. Beide groepen worden onderworpen aan een meting met behulp van een Polar borstband. Gedurende 10 minuten wordt de activiteit van het hart gemeten. Het is de bedoeling dat dit programma een verandering in de gezondheidstoestand teweeg brengt.
Voor het gezondheidsprogramma ondergaat u enkele evaluaties: u wordt gevraagd om verschillende vragenlijsten in te vullen. De meting neemt 10 minuten in beslag.

Uw risico's

Bij geen enkele meting wordt u blootgesteld aan schadelijke stoffen en/of stralen. U moet ook helemaal geen medicatie innemen. Bijgevolg zijn de risico's verbonden aan uw deelname te verwaarlozen.

Uw deelname aan de studie is vrijwillig en u kan de studie op elk moment stoppen. Indien u akkoord gaat om aan deze studie deel te nemen, zal u gevraagd worden het "Toestemmingsformulier" te ondertekenen.

Kosten / Vergoedingen

Er zijn geen kosten voor u verbonden aan de deelname aan de studie en u zal niet vergoed worden voor deelname aan deze studie.

Vertrouwelijkheid

De informatie die verzameld wordt tijdens deze studie is vertrouwelijk. Uw naam zal niet vermeld zijn op de rapporten en publicaties die voortvloeien uit deze studie. Op de studiedocumenten zal U geïdentificeerd worden d.m.v. een uniek patiënt identificatienummer. Als u hiermee akkoord bent, worden de gegevens -verzameld tijdens deze studie- in een gegevensbestand opgenomen. Indien u dit wenst, krijgt u inzage in uw persoonlijke gegevens zoals opgenomen in het gegevensbestand en kan u hierover eventuele aanpassingen vragen.

Indien U vragen hebt, aarzel niet om onderstaande personen te contacteren.

Julie Buschmann (buschmannjulie@gmail.com)
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2100 Deurne
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6.2. Informed consent form

TOESTEMMINGSFORMULIER (Informed Consent)

Titel van de studie:

Een osteopatische interventie: een gerandomiseerde klinische studie

INSTRUCTIES VOOR DE WERKNEMER: gelieve deze vragenlijst zelf in te vullen.

Hebt u de informatiebrochure voor de werknemer gelezen ? JA/ NEEN

Hebt u de mogelijkheid gehad om vragen te stellen over de studie ? JA/ NEEN

Hebt u genoeg antwoorden gekregen op al uw vragen ? JA /NEEN

Hebt u genoeg informatie ontvangen over de studie ? JA /NEEN

Begrijpt u dat u vrij bent om de studie stop te zetten :

* op elk moment

* zonder verantwoording te moeten geven voor de stopzetting JA/ NEEN

Gaat u akkoord om deel te nemen aan deze studie ? JA /NEEN

Gaat u akkoord om uw gegevens verzameld tijdens deze studie op te

nemen in een gegevensbestand?
JA /NEEN

Handtekening van de werknemer : _____

Datum : ____ / ____ / _____

dag maand jaar

Naam van de werknemer : _____

Handtekening van de onderzoeker : _____

Datum : ____ / ____ / _____

dag maand jaar

Naam van de onderzoeker: _____

6.3. SF 36

SF-36 GEZONDHEIDSTOESTAND VRAGENLIJST

INSTRUCTIE: Deze vragenlijst gaat over uw standpunten t.a.v. uw gezondheid. Met behulp van deze gegevens kan worden bijgehouden hoe u zich voelt en hoe goed u in staat bent uw gebruikelijke bezigheden uit te voeren.

Beantwoord elke vraag door het antwoord op de aangegeven wijze te markeren. Als u niet zeker weet hoe u een vraag moet beantwoorden, geef dan het best mogelijke antwoord.

1. Hoe zou u over het algemeen uw gezondheid noemen?

(omcirkel één cijfer)

Uitstekend	1
Zeer goed	2
Goed	3
Matig	4
Slecht	5

2. Hoe beoordeelt u nu uw gezondheid over het algemeen, vergeleken met een jaar geleden?

(omcirkel één cijfer)

Veel beter nu dan een jaar geleden	1
Wat beter nu dan een jaar geleden	2
Ongeveer hetzelfde nu als een jaar geleden . . .	3
Wat slechter nu dan een jaar geleden	4
Veel slechter nu dan een jaar geleden	5

3. De volgende vragen gaan over bezigheden die u misschien doet op een doorsnee dag. Wordt u door uw gezondheid op dit moment beperkt bij deze bezigheden? Zo ja, in welke mate?

(omcirkel één cijfer op elke regel)

BEZIGHEDEN	Ja, ernstig beperkt	Ja, een beetje beperkt	Nee, helemaal niet beperkt
a. **Forse inspanning**, zoals hardlopen, tillen van zware voorwerpen, een veeleisende sport beoefenen	1	2	3
b. **Matige inspanning**, zoals een tafel verplaatsen, stofzuigen, zwemmen of fietsen	1	2	3
c. Boodschappen tillen of dragen	1	2	3
d. **Een paar** trappen oplopen	1	2	3
e. **Eén** trap oplopen	1	2	3
f. Bukken, knielen of hurken	1	2	3
g. **Meer dan een kilometer** lopen	1	2	3
h. **Een paar honderd meter** lopen	1	2	3
i. Ongeveer **honderd meter** lopen	1	2	3
j. Uzelf wassen of aankleden	1	2	3

4. Heeft u in de afgelopen 4 weken, een van de volgende problemen bij uw werk of andere dagelijkse bezigheden gehad, ten gevolge van uw lichamelijke gezondheid?

(omcirkel één cijfer op elke regel)

	JA	NEE
a. U besteedde **minder tijd** aan werk of andere bezigheden	1	2
b. U heeft **minder bereikt** dan u zou willen	1	2
c. U was beperkt in het **soort** werk of andere bezigheden	1	2
d. U had **moeite** om uw werk of andere bezigheden uit te voeren (het kostte u bv. extra inspanning)	1	2

5. Heeft u in de afgelopen 4 weken, een van de volgende problemen ondervonden bij uw werk of andere dagelijkse bezigheden ten gevolge van emotionele problemen (zoals depressieve of angstige gevoelens)?

(omcirkel één cijfer op elke regel)

	JA	NEE
a. U besteedde **minder tijd** aan werk of andere bezigheden	1	2
b. U heeft **minder bereikt** dan u zou willen	1	2
c. U deed uw werk of andere bezigheden niet zo **zorgvuldig** als gewoonlijk	1	2

6. In hoeverre hebben uw lichamelijke gezondheid of emotionele problemen u gedurende de afgelopen 4 weken gehinderd in uw normale omgang met familie, vrienden of buren, of bij activiteiten in groepsverband?

(omcirkel één cijfer)

Helemaal niet 1

Enigszins 2

Nogal 3

Veel 4

Heel erg veel 5

7. Hoeveel lichamelijke pijn heeft u de afgelopen 4 weken gehad?

(omcirkel één cijfer)

Geen 1

Heel licht 2

Licht 3

Nogal 4

Ernstig 5

Heel ernstig 6

8. In welke mate bent u de afgelopen 4 weken door pijn gehinderd in uw normale werk (zowel werk buitenshuis als huishoudelijk werk)?

(omcirkel één cijfer)

Helemaal niet	1
Een klein beetje	2
Nogal	3
Veel	4
Heel erg veel	5

9. Deze vragen gaan over hoe u zich voelt en hoe het met u ging in de afgelopen 4 weken. Wilt u a.u.b. bij elke vraag het antwoord geven dat het best benadert hoe u zich voelde. Hoe vaak gedurende de afgelopen 4 weken

(omcirkel één cijfer op elke regel)

	altijd	meestal	vaak	soms	zelden	nooit
a. Voelde u zich levenslustig?	1	2	3	4	5	6
b. Was u erg zenuwachtig?	1	2	3	4	5	6
c. Zat u zo in de put dat niets u kon opvrolijken?	1	2	3	4	5	6
d. Voelde u zich rustig en tevreden?	1	2	3	4	5	6
e. Had u veel energie?	1	2	3	4	5	6
f. Voelde u zich somber en neerslachtig?	1	2	3	4	5	6
g. Voelde u zich uitgeput?	1	2	3	4	5	6
h. Was u een gelukkig mens?	1	2	3	4	5	6
i. Voelde u zich moe?	1	2	3	4	5	6

10. Hoe vaak hebben uw lichamelijke gezondheid of emotionele problemen u gedurende de afgelopen 4 weken gehinderd bij uw sociale activiteiten (zoals vrienden of familie bezoeken, etc)?

(omcirkel één cijfer)

Altijd	1
Meestal	2
Soms	3
Zelden	4
Nooit	5

11. Hoe JUIST of ONJUIST is elk van de volgende uitspraken voor u?

(omcirkel één cijfer op elke regel)

	volkomen juist	grotendeels juist	weet ik niet	grotendeels onjuist	volkomen onjuist
a. Ik lijk wat gemakkelijker ziek te worden	1	2	3	4	5
b. Ik ben even gezond als andere mensen	1	2	3	4	5
c. Ik verwacht dat mijn gezondheid achteruit zal gaan	1	2	3	4	5
d. Mijn gezondheid is uitstekend	1	2	3	4	5

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6.4. ADDENDUM OSTEOPATHIC RELEVANCE

Nicholas Handoll D.O., an internationally known osteopath, wrote in '*Anatomy of Potency'*: "In the practice of cranial osteopathy, one must understand the essentially linear concepts of anatomy and physiology as well as the nonlinear concepts related to the energy that binds and operates the systems." (Handoll, 2000).

Indeed, osteopathy encompasses much more than the physical body, as Andrew Taylor Still (1828-1917), founder of osteopathy, understood while formulating the first osteopathic principle: "The person is a unit of body, spirit, and mind." (www.osteopathic.org). Furthermore, Still wrote: "First there is the material body; second the spiritual being; third a being of mind which is far superior to all vital motions and material forms, whose duty is to wisely manage this great engine of life." (Lewis, 2012).

What Still meant with the concept of 'mind' has been elaborated by John Lewis in *'A.T.Still, From the Dry Bone to the Living Man'*: "The Knowable aspect of mind, the experiential part informed by the senses, was to Still simply the *subjective.* This multi-faceted faculty encompassed rational thought, feelings, emotions and a host of arcane powers. Though disparaged by early scientists as a source of error, Still recognized the supreme importance of the mind to both doctor and patient. […] and that his body is under his mind, and obeys its orders all the time." (Lewis, 2012, p. 265).

These thought, feelings and emotions (which Still calls mind) are more and more being incorporated in scientific studies. This research is about the influence of the doctor/practitioner; about what he brings into the osteopathic treatment room: his thought, his emotions, his presence, his awareness and his level of relaxation or stress. In other words, the focus lies upon the influence of the 'beingness' of a practitioner, rather than on his 'doingness'.

Among the key skills essential to the practice of biodynamic craniosacral osteopathy is the power of presence. Ged Sumner, craniosacral therapist, and Steve Haines, biodynamic craniosacral therapist, wrote about this essential skill in his book *'Cranial Intelligence'*: "Just being there is no small thing. […] As a craniosacral therapist, you bring into the therapeutic space your beingness. The more deeply you can manifest this, the more powerfully people respond to your touch and presence." (Sumner&Haines, 2010).

The aim of this research was indeed to investigate the effect of a practitioner's touch and high cardiac coherence on the participant's HRV, by consciously choosing to focus on breath and positive feelings, while holding the participant's cranium, without any osteopathic treatment whatsoever.

High cardiac coherence might be a key element to access the second principle of osteopathy: "The body is capable of self-regulation, self-healing, and health maintenance" (www.osteopathic.org) (McCraty and Shaffer, 2015). It is associated with a high degree of order, harmony and efficiency. One of its characteristics is a more balanced autonomic nervous system (McCraty and Shaffer, 2015; Shaffer et al., 2014).

Scientific research has proven that one person with high cardiac coherence could enable another to achieve high cardiac coherence (Morris, 2010). So, if a practitioner can consciously bring himself in a state of balanced awareness by focusing on positive feelings and, by doing so, activate his parasympathetic nervous system, indeed, the effects of therapeutic techniques involving touch - and even, mere proximity - may be amplified, leading to a quicker recovery of the patient.

Paul Lee D.O. quotes in his book *'Interface: Mechanisms of Spirit in Osteopathy'* Larry Dossey M.D. who describes three eras of medicine in his book *'Reinventing Medicine'*: the first characterized by a conventional, cause-and-effect, statistical and scientific approach; the second, mind-body medicine, characterized by psychosomatic and various alternative techniques; and the third, nonlocal medicine, where the mind plays a fundamental role in the healing of the patient, and where intention plays a significant role in healing, both from the mind of the physician and from the mind of the patient (Lee, 2005).

On 1 August 1915, before the American Osteopathic Association convention in Portland, Oregon, Still drafted an appeal to keep osteopathy pure. He ended with the words "D.O. means Dig On." (Lewis, 2012).

The explorer for truth must first declare his independence of all obligations or brotherhoods of any kind whatsoever. He must be free to think and reason. – A.T.STILL (Lee, 2005).

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Sincere gratitude goes to Wendy Van Nooten, my tutor. She inspired me to do research on the topic of entrainment, which has given me the opportunity to grow as a practitioner and as a scientist, but also as a person. Now, more than ever, I understand the importance of my influence, as a practitioner, on the patient. I also have the tools now to “modulate my own system” in order to be a more efficient healthcare provider.

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