Are respiration movements and position of thorax associated with low heart rate variability?

- a pilot study

Abstract: The Global Body Examination (GBE) is an examination performed by physiotherapists to register deviations from ideal musculoskeletal conditions. When performed by a qualified tester the GBE has proved to have good psychometric properties, and the test separates significantly between groups of psychiatric patients and groups of healthy people. HRV is a measure of heart rate variability, and an indirect measure of the functioning of the autonomic nervous system. In this study I have examined 15 healthy adults with both the GBE and HRV to see if there is a correlation between the HRV and one of four domains in the GBE, that of respiration. My study shows a correlation of -, 559 and a p-value of 0.019. This indicates that people with low HRV generally has more deviation from ideal musculoskeletal conditions in the respirational muscles.

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Content

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1.0 Introduction

The Reich/Braatøy tradition in Norway is a psychotherapeutic tradition with close ties to the outer body and to physiotherapy. On a theoretical level the idea of a parasympathetic state or activation has a strong standing within the tradition. Reich spoke of a muscular armor that prevented the psychiatric patient from relaxation and pleasure. He also labeled the muscular armor "hypersympatikotonia", i.e a state whith overactivation of the sympathetic nervous system. In contrast his ideal was to be able to let the parasympathetic division of the autonomic nervous system (ANS) dominate over the sympathetic, at least from time to time. For Reich the lack of parasympathetic domination and the muscular armor was one and the same condition, so a particular connection between the ANS and the musculoskeletal system was hypothesized.

The idea of the muscular armor has been operationalized to a certain extent in the form of systematic body examinations developed by psychiatrists and physiotherapists in Norway. Whether or not these tests capture what lies in Reich´s concept of the muscular armor is a big question. But the tests certainly captures traits that are relevant to psychotherapy, and a substantial amount of high level research has established that there is a strong connection between psychopathology and deviations in the musculoskeletal system[1]. That these findings have anything to do with the ANS has however not been established by the research, so to explore such a connection is one of the goals in my study.

Stephen Porges, one of the pioneers in the field of heart rate variability studies, has presented his polyvagal theory, or sometimes called the neuroception theory, in opposition against what he calls the arousal paradigm in psychophysiology. He claims that the arousal theory has been too much focused on the sympathetic branch of the ANS, and that it has neglected the bidirectional aspects of autonomic regulation, i.e. left out the signaling from the body and back to the regulating areas in the central nervous system. Part of the problem has been that the parasympathetic activation used to be more or less impossible to measure, while the sympaticus could easily be measured. With HRV this is no longer so.

Since the idea of a state with parasympathetic domination has been strong in the Reich/Braatøy tradition, I was interested to explore the association between results of the body examinations in this tradition with HRV.

2.0 GBE: history and present usage

[1] Kvaale et. al (2015)

The global body examination (GBE) comes out of a tradition of body examinations developed in Norway by Norwegian physiotherapists. Its basis lies in psychoanalytic psycho-somatic thinking from the 1920´s with people like Sandor Ferenczhi, Otto Fenichel and Wilhelm Reich. These people and their thinking influenced central Norwegian health workers in the 1930´s, amongst them the psychiatrists Trygve Braatøy and Nic Waal. Nic Waal became the pioneer of child psychiatry in Norway, and she developed her own institute, the Nic Waal institute, still operating today, albeit without much of Waal´s original ideas. Trygve Braatøy became the head of the psychiatric department at the Ullevål sykehus in Oslo in the 1940´s. Both where respected scholars and well known public figures in Norway, and Braatøy wrote books and articles that where widely read.

Nic Waal had been a patient and a student of Wilhelm Reich and learned his bodyoriented psychotherapy, the charachteranalytic vegetotherapy, as Reich called it at that time. This treatment was a cathartic treatment that aimed at releasing strong emotions connected to the patient`s infantile conflicts. In Reichs view these unexpressed emotions where the driving force behind the patients symptoms, and if they were satisfactory released the symptoms would disappear. Reich thought that this one method would apply to every psychiatric patient, no matter diagnosis and severity. Waal shared much of Reichs thinking, but she was concerned that some patients, especially those who lacked ego strength, would not be able to handle the cathartic breakthroughs. Waal assumed the severity of a patient`s infantile emotional burden could be jugded by examining the psychomotor apparatus of the patient. This line of thought was in agreement with clinical thinking in the tradition, which suggested that grave conflicts in early childhood would leave grave marks in the patient´s body. She therefore wanted a standardized test to separate the patients that could handle the cathartic therapy from the ones who were so marked that they needed a more conservative, non-intrusive, therapy. Waal also wanted to use her test for diagnostical purposes and as a lead in the therapeutic approach. A major aspect of Waals test was an examination of the patient`s habitual holding of the body and his resistance to passive movements. Some palpation of muscles was also included. The head, face, and the hands were examined thoroughly, for instance: the wrinkles on the forehead, horizontal and vertical ones.

The extremities where also examined, and not the least, respiration and its movements in the whole truncus. The whole examination was performed in prone and supine position, lying on a coach. There where around 90 variables in the test, and the values where registered typically within a set of fixed categories. For instance the horizontal wrinkles of the forehead where marked as ”none”, ”traces of”, ”some” and ”many”. Waals test was developed in the 1940´s and widely used as a clinical tool. Its validity was however disputed and the reliability was considered questionable.

Trygve Braatøy developed his own body psychotherapy that had some traits in common with Reich´s method. His aim was also to release strong emotions that were thought to be held in the body. Braatøy wrote about this in his major book[2] ”De nervøse sinn”. He found that a release of tension in spastic musculature provoked an emotional breakthrough only if a hampering of the respirational movements were released simultaneously. Braatøy presented an etiology for the spastic musculature, where he believed that the patient at some point in his life had started hampering his breath with the purpose of holding back expression of emotions. This hampering of the breath was done, partly unconscious, with skeletal muscles that in different ways links to the respirational movements macro anatomically and neuroanatomical.

Braatøys method consisted in working with muscles, in different ways, and thereby release the fuller respiration and the underlying emotion. The reaction from the respiration on touch and muscle grips was called ”the respirational answer”. Braatøy emphasizes that this anatomical approach can only work within the framework of a more general psychotherapeutic situation.

In the 1940´s Braatøy met with the physiotherapist Aadel Bülow-Hanssen who was also interested in the relationship between respiration, emotion and muscle tension, and he invited her to work with him. Based on Braatøys insights, and her own experience from 20 years orthopedic practice, Bülow -Hanssen developed a physiotherapeutic method that aimed to release the free breathing in the patient in a more gradual way. This method was first called the Bülow-method, and later named Norwegian Psychomotor Physiotherapy. The Bülow -method was less cathartically oriented than Braatøys original method, but apparently it had much of the same therapeutic effect. In the 1950´s and 60´s Bülow had many Norwegian students and the Norwegian Psychomotor Physiotherapy grew into a lively movement. Many of these practitioners found jobs in psychiatric hospitals. Braatøy died in 1952 only 49 years old, so he did not live to see this happen.

One of Bülow-Hansen’s students, Lillemor Johnsen, worked at Dikemark psychiatric hospital in the 1960´s and she began to develop a body examination that resembled Nic Waals, but instead of functional tests, Johnsen palpated muscles in certain places that where central in Bülow-

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[2] Braatøy (1947).

Hansen's method, and scored the tone of the muscles. Like Waal, Johnsen used her method as guidance in the therapeutical work. At this time a handful of young psychiatrists that worked together with the physiotherapists in the psychiatric hospitals became interested in this way of testing, and they encouraged physiotherapists to develop tests, among these were Berit Bunkan and Marit Sundsvoll who both had been students of Bülow-Hanssen and who developed their own tests. These tests contained both functional variables and muscle tone variables.

In the early 1970´s Marit Sundsvoll established a collaboration with the psychiatrist, professor Per Vaglum[3], and together they started systematic research, using Sundsvolls test on different groups of patients and on healthy control groups. Marit Sundsvoll was the first to put numbers as values for the variables. In this way the deviation from the ideal muscular conditions could be given a number, and a global score from the test could be expressed. Vaglum and Sundsvold[4] found significant differences between the healthy control group and the patient groups. The patients had in general less agility and more resistance to passive movements than the healty controls. There were also differences between the different groups of patients, but these differences where not great. The more serious illnesses, like psychosis, had however generally greater scores in the test than the lighter illnesses like personality disorders and substance abuse. Sundsvoll called her test *global fysioterapeutisk muskelundersøkelse* (global physiotherapeutic muscle examination) GFM. Between 1978 and 1987 ten scientific articles where published[5] and reliability studies were conducted with satisfactory results.

Around the same time as Sundsvold developed her test another of Bulow-Hansen's students, Berit Bunkan also developed a similar test to Sundsvold´s. In the 1990´s Bunkan conducted studies much like the ones Sundsvold had done 20 years earlier. Bunkans collaborator was the psychiatrist, professor Svein Friis, who had also worked with Sundsvold earlier. Bunkans results resembled those of Sundsvold and she found significant and large differences between patients and healthy adults, and smaller yet significant differences between different groups of patients. The different groups were psychotic patients, non-psychotic psychiatric patients, and pain syndrome patients. In Bunkans test palpation of muscles

[3] Bunkan (2015) p. 262.
[4] Sundsvoll M, Vaglum P, Østberg B (1982)
[5] Bunkan (2015) p. 263.

was also included. Bunkans method was also tested[6] for reliability with good results.

In 2004 a collaboration began between Bunkan and one of Sundsvolds students, Alice Kvaale, with the aim of merging the two tests into one scientifically based test. Professor Svein Friis was also part of the project. In the following years 98 patients and 34 healthy adults were examined by the two physiotherapists. Out of 52 items from Kvaales test, and 112 from Bunkans, 53 items were selected from both tests with regard to how well they separated between patient groups, and how well they correlated with each other[7]. The new 53-item test was called Global Body Examination (GBE), and consisted of four main domains: posture, respiration, movement and palpation. Since 2004 around ten scientific papers has been published about GBE.

3.0 HRV: history and present usage

Heart rate variability (HRV) is the measure of the variability in interbeat intervals of the heart. If the heart beats like a metronome, the variability is zero. In healthy individuals the value of the interbeat intervals follows certain patterns when seen over a period of time. The most prominent of these patterns is the rise of interbeat intervals during expiration and lowering of the interbeat intervals during inspiration, also called the respiratory sinus arrhythmia (RSA). Some cardiologists explain this to patients as "the dancing heart". The greater the variation, the healthier patients, is a general rule.

HRV and RSA had been known at least since the heydays of physiological research in the late 1800´s, but its clinical relevance was first discussed[8] in the 1960´s. About this time[9] mathematical methods were also developed to give HRV a numerical expression. But the computing was laborious and not comparable with today`s easily available software that makes HRV-calculation simple. Since the 1990´s however, measuring of HRV has become widespread both within the field of cardiology and in the psychophysiological field. This popularity is probably due to better equipment and the more available computing.

Today, two different statistical approaches are used, time domain methods and frequency domain methods.

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[6] Bunkan et. al (2002)
[7] Kvaale et al. 2015 p. 2
[8] Task force (1996)
[9] Porges (2011) p. 4

Time domain methods

The time-domain method`s falls into two classes. The first class consists of giving the total variation in interbeat intervals an expression, where the standard deviation of the interbeat intervals (SDNN) is the simplest variable. The second class measures the time difference between successive interbeat intervals, and gives this the variation in this difference an expression. The most used variable in this class is the square root of the mean squared differences of successive interbeat intervals (RMSSD). Another option is simply to measure the percentage of interbeat intervals that vary with more than 50 milliseconds from the former interbeat interval. This measure is called PNN50.

Frequency domain methods

In the second way, the frequencies of the variation of the interbeat intervals are held as a constant (the x-axis), and the amplitude of the variation is given as a function of the different frequencies (the y-axis). An example: the normal respiration frequency in humans is 12 revolutions per minutes, and this equals 0.2 hertz. If the sinus arrhythmia is present in the heart rate variability this can be seen as a greater value of the function around 0.2 hertz, this will give a typical peak (see ill. 1). The value of the function is usually given as "power", that is area under the curve for a specific range of frequencies. The frequencies are categorized into high frequency, low frequency and very low frequency, and the power is calculated within each category.

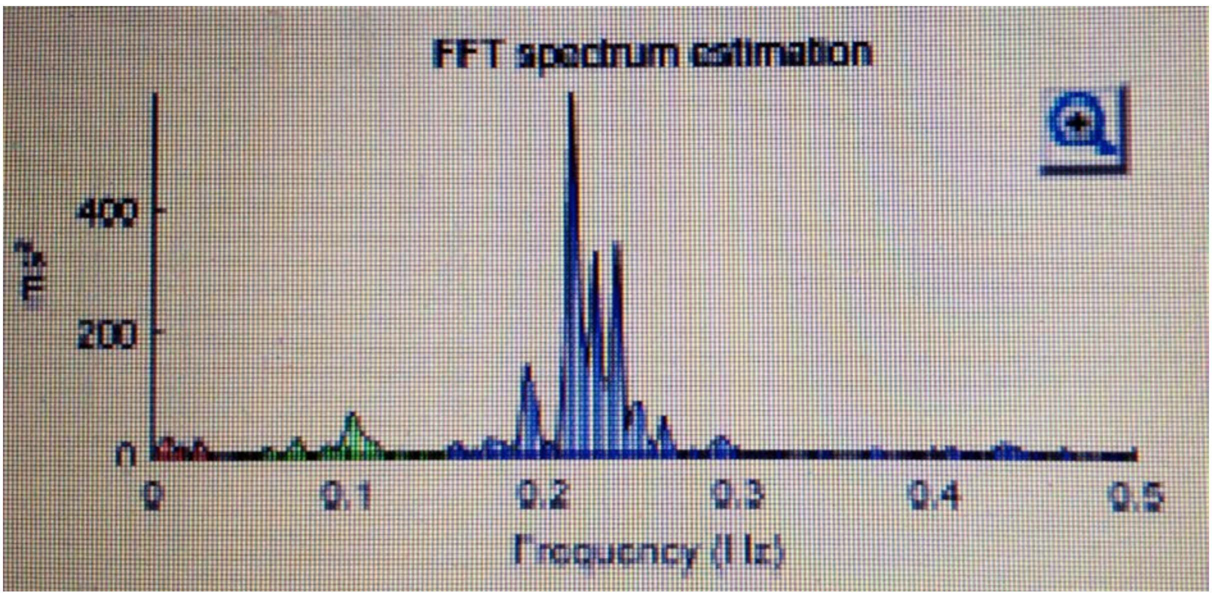

Illustration 1.

Clinical interpretation of HRV

Within somatic medicine HRV has been used mainly in the field of cardiology. HRV-values are shown, in numerous studies, to give a good prediction of morbidity and mortality for patients with coronary disease[10], especially post infarction patients. HRV is widely believed to be an indicator of the general function of the autonomic nervous system.

Within psychology and psychiatry HRV has been linked to the concept of emotional regulation. Emotional regulation is a concept that has grown out of the fusion between psychodynamic theory and developmental psychology[11], and it means the ability to adjust the relationship between emotions, emotional expression and behavior in social settings. Even though the notion of emotional regulation is not very well defined, there is a rather general agreement that higher HRV corresponds to a greater capacity for emotional regulation[12]. Exactly which role HRV and autonomic functioning plays in emotional regulation is rather unclear. Several authorities in the fields has proposed models to explain the relationship between autonomic functioning in general, vagal control of the heart more specifically, and emotional regulation. Julian Thayer[13] has proposed one such model which he calls the Model of Neurovisceral Integration. Stephen Porges[14] has suggested another model called Neuroception and Polyvagal Theory. To discuss these models is beyond the scope of this dissertation, but it would certainly be interesting to do so.

Both Porges and Thayer view emotional regulation as a rather centralized enterprise, where the regulation is controlled via feedback loops between the periphery, the brainstem and higher areas of the brain. Porges stays more or less in the brainstem, whereas Thayer relates to the theories of Joseph LeDoux, and the relationship between brainstem, cortex and intermediary structures, especially the amygdala.

More important than the model`s that links HRV with emotional regulation is the amount of empirical studies that links low HRV with a number of psychiatric and psychological disorders[15].

4.0 The hypothesis

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[10] Rajendra Acharaya K, Paul Joseph N, Kannathal N, Choo Min Lim, Suri J (2006)

[11] Fonagy P, Gergely G, Jurist E. L., Target M (2002).
[12] Bradely M. Appelhans, Luecken L.J. (2006) p. 235.
[13] Thayer J, Åhs F , Fredrikson M, Sollers JJ, Wagger T. p. 746.
[14] Porges S (2011).
[15] See for instance Bradely M. Appelhans, Luecken L.J. (2006) p. 235.

My hypothesis was that there would be a negative correlation between HRV and findings in the respiration domain of the GBE, so that people with strong deviations from ideal musculoskeletal conditions in the respiration domain would have lower HRV. I could also have chosen to correlate the total score in the GBE with HRV, but for method reasons I chose to use only the respiration score in the correlation. Within the tradition that GBE comes from, the respiration domain is also considered primary, and the other domains are considered secondary. The respiration domain has shown, as has the other domains, ability on its own to separate between groups of patients and between patients and healthy individuals. Since the respiration domain is anatomically and neuroanatomically closer linked to the thorax and the heart than are the other domains, this also seemed more intuitive.

Porges has criticized mainstream psychophysiology in the 20th century to be too focused on the sympathetic branch of the autonomic nervous system, and to pay too little attention to the parasympathetic branch[16]. He claims this is an inheritance from Walter B. Cannon who coined the fight-or-flight response in the 1920´s. Alongside the standard psychophysiology that measures mostly the sympathetic branch of the autonomic nervous system, and the hypothalamus-pituitary-adrenal (HPA) line, there exists a tradition that speaks of a similar response as the fight-or-flight response, only symmetrically opposite, where the parasympathetic branch of the autonomic nervous systems dominates over the sympathetic one.

Wilhelm Reichs expressed such views in his 1934[17] article "The basic antithesis of Vegetative Life Functions". Here Reich distinguishes between a state of anxiety and a state of sexuality. The anxiety state is understood as an organism's withdrawal from the world, and the sexual state is considered as an organism's engagement into the world. Reich uses the sympathetic and the parasympathetic branches of the nervous system and their antithetical innervations of organs to sum up the two different states. The anxiety state would then be characterized by dilated pupils, cold pale skin, fast heartbeat, reduced intestine movements etc. Whereas the sexual state is characterized by the opposite: constriction of pupils, warm red skin, slow heartbeat, increased intestine movements etc. Today Reich's use of the word sexual state might be misleading, in later writings he uses the word lust and lustful instead which might be better. The important issue is that he speaks of a global state in the organism where the parasympathetic branch of the autonomic nervous system dominates. Reich also included striated muscle tension in his discussion, without concluding whether the

[16] Porges (2011) p. 64.
[17] Reich (1974) p. 83.

parasympathetically dominated state provokes an increase or decrease in muscle tone.

In the 1960´s the American physiology professor and internist, Herbert Benson[18], coined the "relaxation response", a global response he claimed was associated with different meditation, relaxation and hypnosis techniques. In his years as a professor at Harvard Medical School Benson conducted many studies where he measured oxygen consumption, respiratory rate, heart rate, alpha waves, blood pressure and muscle tension during meditation and relaxation techniques. Herbert Benson explicitly coined the term "relaxation response" with a reference to Walter B. Cannon's fight-or-flight response. In his many studies with various relaxation techniques he generally found, with some differences, a lowering of oxygen consumption, respiration rate, heart rate and blood pressure (only amongst hypertonic people), during the relaxation. He also found a decrease of muscle tone.

Benson partly based his theoretical framework on another physiologist, the Swiss Nobel prize winner Walter R. Hess, who coined the term trophotropic response[19]. The trophotropic response was according to Hess a condition of parasympathetic nervous activity, muscle relaxation and cortical beta rhythm synchronization.

Trygve Braatøy wrote[20] about what he calls the neuromuscular hypertension or defense attitude. This is understood as a global attitude that involves both the nervous system and the motoric system. In general he argues that the separation between the autonomic and the somatic nervous system cannot be drawn sharply from a physiological regulation perspective. And neither from an emotional regulation perspective, we might add. As an example he argues that the regulation of striated muscles in the diaphragm and the smooth muscles in the bronchi must work together in the regulation of respiration movements. If the smooth bronchial muscles do not dilate properly in the expirational face, the striated muscles work against the pressure from air that is trapped inside the lungs.

Braatøy further points to his clinical experience that systematic muscle relaxation, as for instance done with Edmund Jacobson's progressive relaxation, can produce both autonomic reactions such as sweating, change of skin coloration and emotional reactions or breakthroughs. He therefore

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[18] Benson (1975).
[19] Benson (1975) s. 68
[20] Braatøy (1947) p. 75

concludes that the regulation of smooth muscles in autonomically innervated organs and the regulation of striated muscles form the somatic nervous system are inseparable, at least partially.

An important question for me is this: Why has Bunkan et al and Sundsvoll et al found that the respirational findings are increased in psychiatric patients, compared to healthy controls, and why is the increase greater the more severe the psychiatric disease is? One answer could be the general claim from the bodyoriented psychotherapists, that patients restrict their breathing as a way of controlling emotions. And that people with great emotional difficulties have thoraxes and breathing patterns that are marked from that. In this way the control of the breathing pattern, or the restriction of the breathing, would be a somatic aspect of a psychological defense mechanism against an emotion. According to William James[21] , and his thoughts are still state of the art in this field, an emotion is essentially a specific way of experiencing one's body reacting to a certain situation, or thought (I am not differentiating between feeling and emotion here). Those reactions takes place in all of the body systems, but the organs innervated by the autonomic nervous system plays a special role. Popular expressions like "I felt it my belly", "my heart jumped" or "my blood vessels froze to ice" points to this. Those organs are never the less far from available for voluntary or automatized control, in contrast to the voluntary or automatized movements of the motoric system, hereunder many of the striated respirational muscles. So we could argue, much in the same way as a COPD patient adjusts his breathing to be able to ventilate better, or a person with a rib fracture adjusts his breathing to avoid pain, the emotionally burdened person adjust his breathing to interfere into the autonomous nervous system and thereby manipulate his or her emotions.

Another answer would be that the restriction of the respirational movements is part of a global neuromuscular response, such as a fight-or-flight response, which acts as a defense mechanism against some perceived external threat. These two answers need not exclude each other either.

In general Braatøy claims that people with neurotic traits, with psychiatric disorders we would say today, have problems relaxing[22]. They are trapped in some defensive state that prevents them from relaxing, both in a muscular and a more mental way. In the body psychotherapy and the psychomotor physiotherapy one of the aims of the treatment is to help the patient relax. In the psychomotor physiotherapy the aim of each treatment is to get the patient into what is called "the parasympathetic phase".

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[21] Kandel E R, Schwartz, Jessell, Siegelbaum S A, Hudspeth A J (2013) p. 1081.
[22] Braatøy (1947) p. 77

Clinically the competent practitioner feels that she is able to judge whether or not the patient falls into that state, much in the same way as the hypnotherapist feels he is able to judge whether or not the patient is in a hypnotic state. An important question however, is whether or not the clinically recognizable state the psychomotor physiotherapist calls the parasympathetic phase really is a parasympathetic phase.

This brings us back to Porges claim that the mainstream psychophysiology of the 20th century has had its focus in the sympathetic branch of the autonomic nervous system. On aspect of this is that historically it has been difficult to measure the parasympathetic activity, whereas the sympathetic activity has been available for measuring for example via heart rate and electro dermal activity. With HRV this is no longer such a big problem, therefor we now see a big interest in taking the parasympathetic branch of the autonomous nervous system into account in psychophysiology.

When one measures the baseline HRV one usually have the patient or test person sit down in a quiet restful place, and ask him or her to relax as good as he or she can. It is naturally for me to interpret the result in the way that a person with a greater baseline HRV has a better ability to relax. I would then expect this person not to be very emotionally burdened, and hence have less deviation from an ideal breathing pattern and positioning of the thorax. And as an opposite, if the respiration examination of the GBE shows much deviation from the ideal, then I would expect a more emotionally burdened person with less ability to relax and a lower HRV. Of course there would be exceptions form this, and my expectation would be on a group level.

5.0 The method and setup

I conducted the experiments together with Berit Bunkan who has been my teacher in this field since 2012. Within a total of 4 days, during two weekends in December 2014 and January 2015, we examined 15 healthy adults, 7 men and 8 women, between the age of 26 and 57 years old. The participants where not under treatment for any illness and their BMI was between 18 and 25. The participants were recruited from friends and family. One of the participants, a young man, was excluded after the examination when it revealed that he had a pathological sinus arrhythmia. He had a RMSSD of 239.

The examinations where done in the university college of Oslo and Akershus´s outpatient clinic for physiotherapy education in Oslo. Two and two participants were taken in at the same time and led to two different rooms. In one of the rooms Berit Bunkan conducted the GBE examination, in the other room I conducted a 10 minute ECG-uptake on the participant while he or she was sitting in a chair and was asked to relax as good as they could without falling asleep, moving to much or apply any specific relaxation method (such as breathing exercise, mindfulness or anything like that). When Bunkan was finished with her examination, the two participants switched rooms.

The results of the GBE-examinations where written down on a prefabricated scheme[23]. Since my focus in this dissertation is the respiration domain I will go a little bit more into details here. The respiration domain has four subdomains: position of thorax, thoracic movement, basal movement and tension. The position of thorax discriminates between a thorax that is to full or inspirational than what is considered ideal, and one that is to flat or expirational than ideal. This is considered by inspection in the upright position both on the ventral and the dorsal side. As elsewhere, the value of the deviation is given a number that ranges from -7 (extreme flatness) to 7 (extreme fullness), where 0 is the ideal condition. The thoracic movement is inspected both in upright position and in the supine position, in the middle thoracic area and in the lower area. The basal movement is inspected, upright and supine, in the medial hypogastrium, the lateral epigastrium and the lateral low costal area. The tension is inspected in the diaphragmatic area and one looks at contraction in expiratory muscles and shortening of the same muscles. In the end all the items are summed up, and the patient is given a global score.

The ECG was conducted as a one lead ECG with three AG/AgCL electrodes. The negative electrode was placed on the participants right clavicula, the positive was placed on his or her left lower costa and the neutral electrode was placed on the right lower costa. The electrodes where attached to a Biopack PM150 data collector, and the data collector transmitted the data to a portable computer with the software Acknowledge 4.2. The 10 minutes ECG signal was then exported as a text file, and processed in the HRV software Artiifact 2.09. In artiifact 300 seconds, that is 5 minutes, from the ten, usually from the end of the registration was picked out, and every QRS-complex was seen through manually to make sure that no false R-R intervals was registered by the software. Then the software computed the different expressions of HRV from the 5 minutes.

6.0 Results, discussion, conclusion and further research

In my experiments I collected a large amount of data. I will not analyze and present all of this here. I will give a brief presentation on the general

[23] See appendix.

findings in the respiration domain of the GBE examination and in the HRV examination. Then I will look at the correlation between the global respirational score and one score from each of the two domains in the HRV, the RMSSD from the time domain and the HF from the frequency domain. I will discuss the strength of the correlation and the possibilities of getting different results with further studies and a greater number of participants.

Global respiration score

The respiration domain[24] has 20 items, each of which can be scaled from -7 to 7. The global score is given when all the scores are added together and divided by 20. Before the addition the minus signs are dropped, so that a deviation of -3 counts as a 3. The global score is then simply the mean deviation from the ideal. For healthy adults in Bunkan and Kvaales material the average value of this score is 1.3 with an interquartile range of 0.6. In my material this average was 1.75. In comparison, the psychosis patients in Bunkan and Kvaales material had an average score of 2.7, with an interquartile range of 0.9. The scores (see. table 1) in my material, varied from 0.2 to 3.2.

Person	Respirasjon	Hf	Rmssd	Log10-HF
1	1.7	71.4	19.9	1.85
2	1.6	128.9	13.6	2.11
3	1.5	1295.0	41.3	3.11
4	2.65	489.5	23.4	2.69
5	0.5	1992.9	72.0	3.29
6	1.6	107.5	14.5	2.03
7	0.65	165.57	28.0	2.21
8	0.2	3013.67	74.03	3.48
9	2.55	582.22	35.56	2.77
10	2.3	117.7	15.41	2.07
11	2.3	192.2	13.0	2.28
12	1.35	1187.4	66.5	3.07
13	1.05	15760.8	239.2	4.19
14	3.2	639.1	39.47	2.80
15	3.15	19.5	8.31	1.29

Table 1.

RMSSD and HF

The information in the RMSSD more or less equals the mean successive (MSD) difference between RR intervals of the ECG. By squaring and rooting

[24] See appendix 2.

I suppose one gets a variable with better statistical properties. The beat to beat regulation of the heart is almost solely dependent on the vagal innervation[25], therefor RMSSD is considered a fairly good measure of the parasympathetic activity. In my material the average value of the RMSSD was 33.2 ms. In comparison, in a systematic review[26] of normal values for healthy adults this number is 42 ms, with a standard deviation of 15 ms.

The HF is also considered to reflect the vagal input to the heart. I my material the average HF value was 714 ms2. In comparison the systematic review of normal values for healthy adults presents this number as 657 ms2 with a standard deviation of 777 ms2. In my correlation the HF is given in normalized values, that is the log10 of each value is used.

Correlation

In graphic terms the correlation between the global respiration score and the HF and RMSSD is given here:

[25] Thayer J, Åhs F , Fredrikson M, Sollers JJ, Wagger T. (2012) p. 748

[26] Nunan D, Sandercock G, Brodie A (2010) p. 1407

Table 1. Respiration (x-axis) and RMSSD (Y-axis).

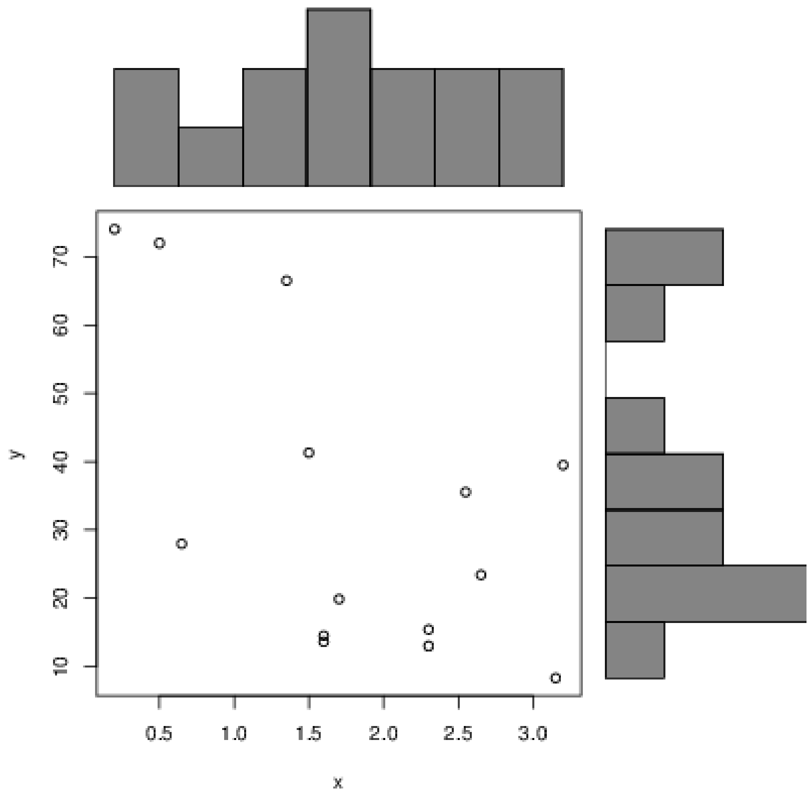
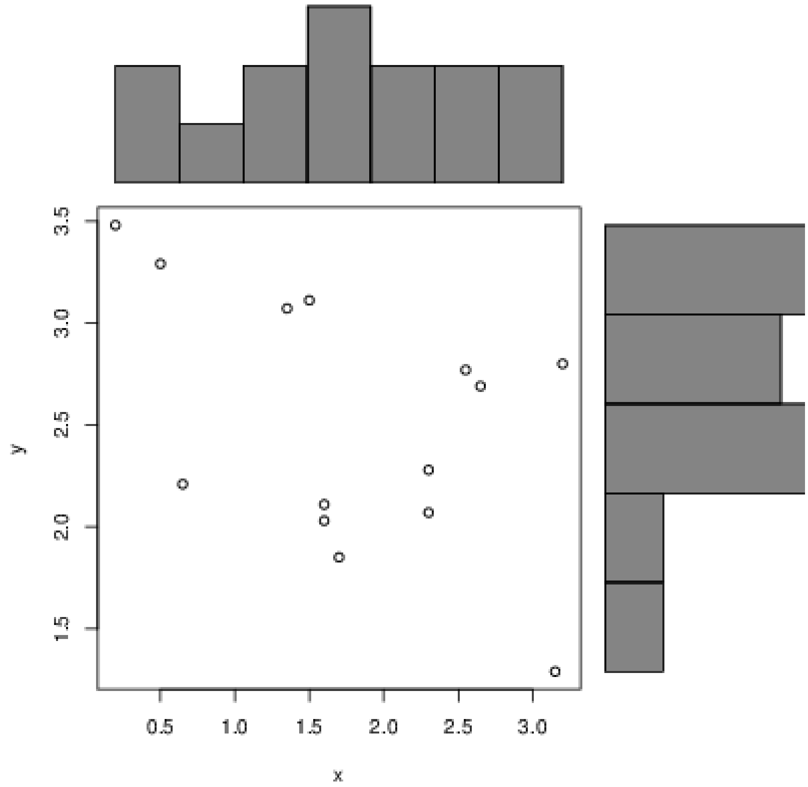


Table 2. Respiration (x-axis) and HF (y-axis).



As we can see from the graphics the correlation is moderate but clear. Using SPSS Software and Pearson correlation I got

-.559 and a p-value of 0.019 when correlating the global respiration score with RMSSD, and -.345 and a p-value of 0.04 when correlating the global respiration score with HF. Both p-values are calculated with a 1-tailed test, since I had a clear hypothesis on which way the correlation would go. Why the correlation with HF is so much less I cannot answer. A correlation done between the HF and RMSSD showed .887, which may be a little less than expected.

Discussion, conclusion and further studies

With a correlation around -.56 the results are significant on a 5% level even with as few numbers as 14 participants. So there is a connection here that is very unlikely to be arbitrary. Still, the correlations are not as strong as I would like or expect them to be, given my hypothesis. However, earlier studies have shown[27] that as much as 40% of the variability in a baseline measurement of HRV reflects situational factors and not lasting traits of the

[27] Bertsch K, Hagemann D, Naumann E, Scachinger H, Schulz A (2012) p. 672

person. This is why two or more recordings under similar condition are recommended if one wants to measure a more lasting trait. So, if my hypothesis is true, I could expect a better correlation with one or two more recordings of the baseline HRV in the participants, since what I want to correlate with the global respiration score is a general trait. So that is one aspect of further studies. Another aspect would be to include more participants, hopefully to make the results more solid.

It is known that baseline HRV decreases with age. This might also be expected with the global respiration score. This way age might be a confounding factor for the correlation I have found. In further studies this could be dealt with by examining people in the same age group. There could also be other confounding factors behind the correlation I have found.

A last big question is how to interpret the correlation. In my hypothesis chapter I have discussed a number of ideas that could shed light over this question. I have proposed that the person with a high global respiration score has a hampering of his respiration due to a neuromuscular condition that prevents him from relaxing completely. This condition with a hampering of the respiration is understood in the bodypsychoterapeutic tradition as related to repression of emotion. Although I believe this to be the case, my empirical material, or a bigger material with the same results, does not in itself give foundation for such an idea. To give foundation for such a hypothesis a bigger work is needed, not the least going into the different neurophysiological models, for example the ones worked out by Thayer and Porges. Other kind of empirical studies could also be done. So I restrict my conclusion to the thesis that my material suggests a neuromuscular condition that involves both the regulation of the ANS and the striated muscles central in respiration.

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8.0 Appendix

1GFM-skjema 7 jan 12 BH Bunkan

The Global Body Examination (GBE) Kvåle and Bunkan

Tallskalaer for holdning, Respirasjon og Bevegelser

Ekstremt	+ - 7
Grovt avvik	+ - 6
Uttalt avvik	+ - 5
Betydelig avvik	+ - 4
Tydelig avvik	+ -3
Aning avvik	+ - 2
Ubetydelig avvik	+ - 1
Ideell	0

Skala for Muskelkonsistens

Stenhård/ Uttalt slapp	+ - 7
Svært hard, svært slapp	+ - 6
Betydelig hard/ slapp	+ - 5
Tydelig hard/ slapp	+ - 4
Aning hard/slapp	+ - 3
Ubetydelig hard/slapp	+ - 2
Middels	+ - 1
Ideell	0

Posture Subscale items		item scaling							
Posture I Upper extremity		0	1	2	3	4	5	6	7
1 Upright: albow flexion + flexed, - extended	V22								
2 Supine Leg resting position + tense (not relaxed)	V68								
3 Supine Shoulder protraction + protracted	V71								
	3								
Posture II Pelvo-lumbar region									
4 Upright: Pelvic tilt standing + increased - decreased	V7								
5 Upright Lumbar lordosis + increased - decreased	V8								
6 Supine: Lumbar lordosis + increased., - decreased	V69								
	3								
Posture III									
7 Upright Body axis angulation -	V1								
Upright Thoracic kyphosis - inceased + decreased.	V11								
9 Upright Head posture standing + fremskutt	V14								
Total sum 9	3								

1

Respiration		item scaling							
Tension subscale 4		0	1	2	3	4	5	6	7
1 Upright Rhythm + unrhytmical	V32								
2 Upright: Expiratory muscles constriction + (shortened)	V34								
3 Upright: Expiratory muscles * + contraction (marked activity)	V35								
4 Supine Expiratory muscles + constriction (marked reduction)	V78								
5 Supine Expiratory muscles + marked contractions	V79								
	5								

Basal respiratory Movement Subscale 3									
6 Upright Medial Hypogastrium + increased - decresed	v36a								
7 Uprigh Lateral Hypogastrium + increased - decresed	v38a								
8 Upright Low costal mov. Ventral +increased - decresed	v39a								
9 Supine Medial Hypogastrium + increased - decresed	v36b								
10 Supine lateral epigastrium + increased - decresed	v38b								
11 Supine 'low costal movem. Vent. + increased - decresed	V39b								
	6								

2

Thoracic movement subscale 2									
12 Supine: High thoracic movem. + increas. – decreased	V73								
13 Supine : Mid thoracic movem. + increas. –decreased.	V74								
14 Supine: Low thoracic movem. + increas. – decreased	V75								
15 Upright Mid thoracic movem. + increas. -decreased	V28								
16 UprightLow thoracic movem. + increased – decreased	V29								
	5								

Position of the thorax subscale 1

17 Upright: Ventral upper part ? + inspiratory posi.- expirat.pos.	V23								
18 Upright: Vental lower pos. + inspiratory posi.- expirat.pos.	V24								
19 Upright: Dorsal upper part ? + inspiratory posi.- expirat.pos.	V25								
20 Upright: Dorsal lower pos. + inspiratory posi.- expiratory position	V26								
	4								

Sum 20