Comparison between CV4 and EV4

via Biofeedback-measurement

MASTER THESIS

zur Erlangung des Grades

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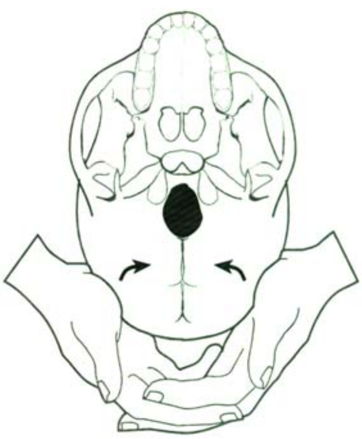

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Statistik von Dr. Michael Benesch

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1 Introduction

During my study of osteopathy and further seminars given by Jealous two craniosacral techniques caught my attention.

The compression of the fourth ventricle (CV4) and the expansion of the fourth ventricle (EV4) are fluctuation techniques (fluid techniques) and should have an effect on the longitudinal fluctuation of the cerebrospinal fluid. Both techniques focus on the area of the fourth ventricle on which floor the physiological centres especially those for respiration and cardiovascular circulation, are located. This area is connected via "regulation circuits" to other brain regions and their surrounding areas. I often thought about whether there could be a difference between both techniques, as patients treated with an EV4 often felt alert whereas those treated with CV4 felt rather tired; however, both techniques in general showed a relaxing effect in combination with a calm and harmonious breathing. As various indications subsisted I decided to study these techniques in more detail.

I came in contact with the biofeedback-system (BFB) per chance as I was looking for an appropriate non-invasive measuring method. This tool allows the study and measure of psycho-physiological body functions, as heart-rate, breathing-frequency and breathing-amplitude, skin-conductivity and skin-temperature through which remarks about a persons current vegetative tension level can be made. The advantages of this measuring method are that it can be reproduced, allows a course measurement and is valid. The smallest varying during the procedure can be simultaneously measured and noted as well as observed on the computer screen. This method is usually used therapeutically to make aware and to voluntarily influence, even control autonomous functions.

In order to render craniosacral techniques objectively, it is important to understand which procedures and changes take place during a therapeutic intervention. The question also arose whether changes during a CV4 and EV4 technique could be proven by measurable physiological parameters or whether one of the techniques could show typical characteristics.

Therfore, it was logical to use this measuring method for documentation and controlling.

CV4 is a generally well known and applied technique that is used in a broad spectrum of indication. This technique going back to Sutherland in 1939[1] and is often described in osteopathic literature. In "Contribution of Thought" Sutherland[2] mentions repeatedly CV4 in connection with the importance and meaning of the fourth ventricle, its neighbouring autonomous centres (especially breathing and cardiovascular circulation) and the value of cerebrospinal fluid fluctuation for the craniosacral activity. After CV4, he also described the relaxing effect on the spine, through which secondary osteopathic lesions were less felt.

Magoun[3] and Wales[4] described CV4 in detail and documented that, as a response of this technique, breathing slowed down and became more regular, the pulse became normal and the surface of the skin less humid.

I heard these statements several times during my osteopathic training (from Arlot, Jealous, Shaver …) but I could not find any studies or publications in my research that lent weight to them. Osteopathic treatment has an old empirical history but a lot of osteopathic statements are not scientifically proven and I had to notice a lack of relevant studies.

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1 UPLEDGER John: Lehrbuch der Kraniosakral-Therapie, 2. Auflage, Heidelberg, Karl f. Haug Verlag, 1994, p.54

2 SUTHERLAND William: Contributions of Thought, 2nd Edition, (edited by A. Strand Sutherland, A. Wales), Sutherland Cranial Teaching Foundation, Portland, Oregon: Rudra Press, 1998, e.g. p.219

3 MAGOUN Harold: Osteopathy in the Cranial Field, Original Edition, 1951, 2nd Printing, Sutherland Cranial Teaching Foundation, Cincinnati, Ohio: The C. J. Krehbiel Company, 1997, p.81-85

4 WALES Ann: "The management, reactions and systemic effects of fluctuation of the cerebrospinal fluid" in: Journal of the Osteopathic Cranial Association, p.35-47 published by The Osteopathic Cranial Association, 1953

Dovesmith[5] believes that the strengthening of the occiput's extension such as that occurring in CV4 and the longitudinal fluctuation has a sympathetic effect; but that the flexion or lateral fluctuation has an opposite (parasympathetic) influence.

The EV4 technique procedure and its application realm which is identical to that of the CV4 were only documented in written form by Liem.[6] Further information about the EV4 technique originates from my class notes. Jealous noted a harmonising regulating effect for the both techniques, but he also indicated that: *"EV4 takes the potency from the midline, the CV4 brings it to the midline"*.[7]

Based on these facts, I decided to explore in my thesis these craniosacral techniques in relation to the effect on autonomous body functions, as a technique's effect also determines the realm of indications and the therapeutic procedure. Additionally, the cranial techniques were compared with a placebo-technique in order, to objectify them and to get more basic information, which could underline the effect of CV4 or EV4.

For this study I chose exclusively healthy subjects in order to obtain comparison values for people with specific pathologies that could be later used as basis for further research. The following quote from Sutherland confirmed this decision: "*Through knowledge of the normal you can diagnose the abnormal."*[8]

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[5] DOVESMITH Edith: "Fluid fluctuation and the autonomic system"
in: Journal of the Osteopathic Cranial Association, p.55
published by The Osteopathic Cranial Association, 1953

[6] LIEM Thorsten: Kraniosakrale Osteopathie, Stuttgart: Hippokrates Verlag, 1998, p.334

[7] JEALOUS James: WSO Seminar: Biodynamische Kranialosteopathie , notes Pöttmes, 2000

[8] SUTHERLAND William Garner: Contributions of Thought, 2nd Edition, (edited by A. Strand Sutherland, A. Wales), Sutherland Cranial Teaching Foundation, Portland, Oregon: Rudra Press, 1998, p.346

1.1 Hypothesis / questions

Hypothesis I

"different technique – same effect?"

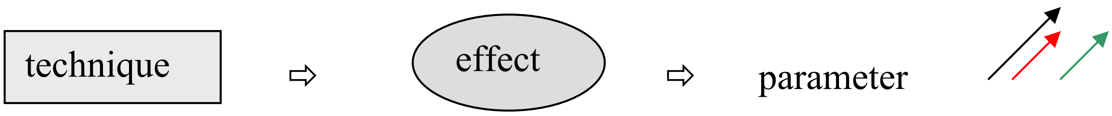
Hypothesis II

"different technique – different effect?"

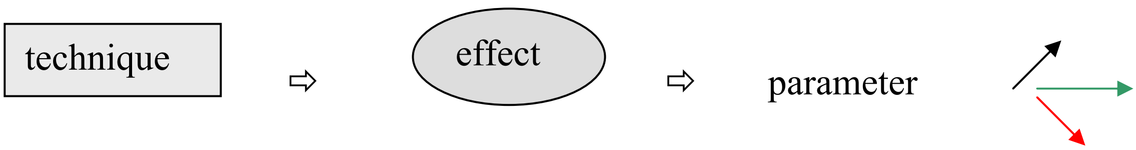
The purpose of this study is the **comparison** between the **CV4 and EV4 craniosacral techniques in relation to measurable parameters of autonomous body functions** such as **skin-conductivity, skin-temperature, heart-rate, breathing-rate and breathing-amplitude.**

The comparison with the placebo technique serves as factor to objectify the cranial techniques and shall exclude influences due to expectation. Furthermore the placebo-technique could underline the existence of an effect by the cranial techniques.

- In the case of hypothesis I, this would mean that the above mentioned parameters would change in the **same way** but possibly with different intensity.



- Ad hypothesis II: on the other hand the techniques could show **characteristic signs** whereas one or several parameters would change specifically via the procedure; they could also show a more sympatheticotone or parasympatheticotone effect that would lead to a different measuring data.



The BFB baseline is the base measurement and a reference value in order to recognize changes occurring through the technique used during the measuring process.

	⇔	EV4-technique
baseline	⇔	CV4-technique
	⇔	placebo-technique

Which parameters change if CV4 is compared to EV4?

CV4-technique	⇔	EV4-technique

Which parameters change in comparison with the placebo-technique?

placebo-technique	⇔	CV4-technique
	⇔	EV4-technique

2 Anatomical and physiological fundamentals

The following section describes the anatomical and physiological fundamentals pertaining to the CV4 and EV4 cranial techniques.
The books listed below are used as basis.

DUUS Peter:[9] Neurologisch-topische Diagnostik
FALLER Adolf:[10] Der Körper des Menschen
NETTER Frank:[11] Nervensystem I, Neuroanatomie und Physiologie
SCHMIDT Robert et al:[12] Physiologie des Menschen
SCHMIDT Robert:[13] Physiologie kompakt
SOBOTTA Johannes:[14] Atlas der Anatomie des Menschen

The occipital bone serves as interface and is the binding structural element to the membrane and liquor system. The fluctuation of the cerebrospinal fluid (CSF) should play an important role in the effect of these techniques. The physiological centres are located on the floor of the fourth ventricle; they significantly contribute to the regulation of breath- and heart frequency, skin moisture and vasodilatation.

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9 DUUS Peter: Neurologisch-topische Diagnostik, Anatomie, Physiologie, Klinik, Stuttgart, New York: Thieme Verlag, 2001

10 FALLER Adolf: Der Körper des Menschen, 13. Auflage (neu bearbeitet von M. und G. Schünke), Stuttgart, New York: Thieme Verlag, 1999

11 NETTER Frank: Nervensystem I, Neuroanatomie und Physiologie, Bd. 5, Farbatlanten der Medizin, (Hrsg. G. Krämer), Stuttgart, New York: Georg Thieme Verlag, 1987

12 SCHMIDT Robert et al: Physiologie des Menschen, 28. Auflage, Berlin, Heidelberg, New York: Springer Verlag, 2000

13 SCHMIDT Robert: Physiologie kompakt, 4. Auflage, Berlin, Heidelberg, New York: Springer Verlag, 2001

14 SOBOTTA Johannes: Atlas der Anatomie des Menschen, 20. Auflage, Bd.1, (Hrsg. R. Putz, R. Papst) München, Wien, Baltimore: Urban & Schwarzenberg Verlag, 1993

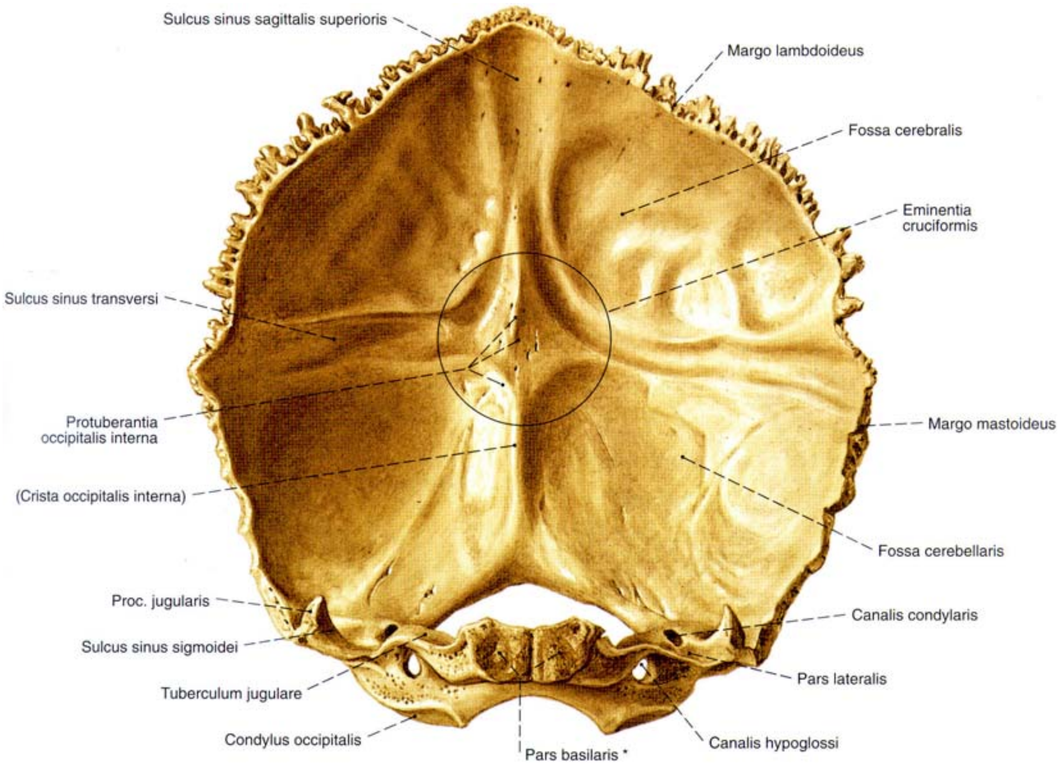

fig. 1 occipital bone

2.1 Occipital bone

The interface used to conduct the CV4 and EV4 cranial techniques is the occipital bone, the posterior base of the cranium. It consists of the basilar part, the squamous portion and the two condylar parts. The occipital bone is a part of the posterior cranial fossa, and together with the sphenoid, constitutes the SBS (sphenobasilar-symphysis). It is in contact through sutures laterally with the temporal bone, on top with the parietal bone and at the bottom with the condylar parts. The IX., X., XI. cranial nerves, the jugular vein, the inferior petrosus sinus and sigmoid sinus and the posterior meningeal artery all go through the jugular foramen, the opening located between the temporal bone and the occipital bone. A large part of the venal blood, approximately 80%, is drained via the jugular vein. Dural tensions or restrictions in the region of the jugular foramen can influence the function of the structures passing through it.

On the inner surface of the squamous portion of the occipital bone one can clearly see the superior sagittal sinus to whose edges the falx cerebri and falx cerebelli are attached. Stretching outwards from the confluence of the sinuses, the transverse sulcus is the point of attachment for the tentorium.

The medulla oblongata is located in the clivus region, passes through the foramen magnum and continues downwards as spinal cord. The field of the neck muscles insertion is located on the outer convex wall of the occipital bone. Through its anatomical characteristics, it is clear that the occipital bone is an important connecting link to the membrane system. It is also a point of connection to the cardiovascular and fascial systems as well as the nerval, skeletal and muscular system.

2.2 Intra-cranial membrane system

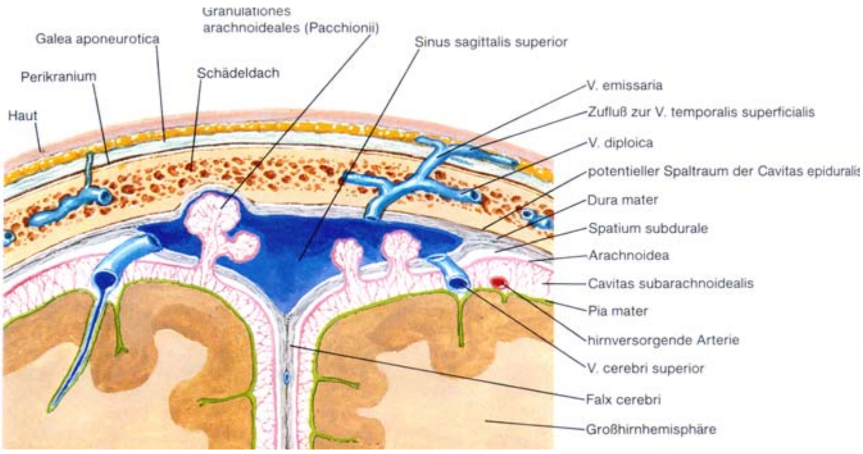

fig. 2 meningen

Arachnoid and Pia mater (Leptomeninx)

The arachnoid, which has no vessels, is located immediately next to the dura mater and bridges over all the wrinkles and crevasses, in contrast to the pia mater, a layer highly supplied with blood, which closely follows all of the brain’s convolutions and also has a nutritional function. The subarachnoidal space which is filled with CSF is located between the arachnoid and the pia mater.

Dura mater (Pachymeninx)

The inelastic dura mater lines the inner surface of the cranium and the spinal channel. It consists of the outer periostal and inner meningeal layer. In specific areas, the meningeal layer of the dura separates itself from the periostal layer and forms a cavity for the venal sinus system.

The meningeal layers branch out to reunite and form the septum (duplicates of the dura) which runs vertically (falx cerebri and falx cerebelli), and horizontally (tentorium).

The falx cerebri acts as partition between the hemispheres of brain. It runs in the shape of a crescent from the crista galli along the sagittal sinus to the internal protuberance of the occipital bone. Its basis forms the straight sinus and becomes the tentorium. The falx cerebelli separates the two hemispheres of the cerebellum below the sinus. It springs forth on the underside of the straight sinus from the lower layer of the tentorium and leads to the foramen magnum.

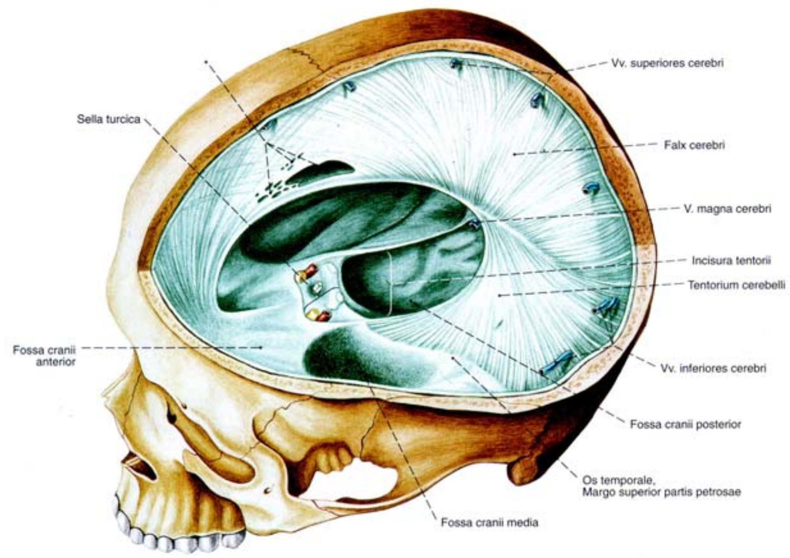

fig. 3 tentorium and falx

The tentorium stretches in the form of a tent from the straight sinus between the cerebrum and cerebellum. The great circumference (outer border) attaches posteriorly to the internal protuberance. Following laterally the transverse and the sigmoid sinuses to the upper margin of the temporal bone's petrous part, the great circumference finally attaches to the posterior clinoid processes. The brainstem goes through the opening of the inner tentorium border, a free edge.

It is attached to the anterior clinoid processes.

The diaphragm of the sella turcica has an opening called the diaphragmatic hiatus through which the pituitary stalk runs.

This membrane system permits the transmission, balancing and distribution of tension. Sutherland described this system as "reciprocal tension membrane". The dynamic stillpoint or point of equilibrium which is connected to all membranes is located in the region of the straight sinus and is called "Sutherland's Fulcrum".[15]

[15] MAGOUN Harold: Osteopathy in the cranial field, Original Edition, 1951, 2nd Printing, Sutherland Cranial Teaching Foundation, Cincinnati, Ohio: The C. J. Krehbiel Company, 1997, p.39

2.3 Cerebrospinal fluid (CSF)

2.3.1 Formation and circulation

The CSF is a watery, clear and chemically stable liquid that constantly renews itself within a few hours and contains energy sources such as nutrients (glucose, amino-acids); micro-nutrients (Vit.C, Vit.B, Na+, K+, etc.); proteins (immunoglobine, viral antibodies, etc.); endorphins; hormones and neurotransmitters.

> The CSF is produced by the choroid plexus in the ventricular system but also around the vascular system and in the subarachnoidal space. Sympathetic and parasympathetic nerves can be seen in the choroid plexus. They innervate the blood vessels as well as the epithelium. The parasympathetic tissues originate almost in their entirety from the superior cervical ganglion. A rising sympathetic tone leads to a decrease of the liquor production of up to 30%, while the liquor production of the parasympathetic increases up to 100%.[16]

The CSF of the lateral ventricles circulates through the inter-ventricular foramina (Monroi) to the third ventricle, and from there through the aquaeduct cerebri (Sylvius) to the fourth ventricle. The liquor originating from all of these production areas flows through the median aperture (Magendii) and the lateral aperture (Luschkae) to the subarachnoidal space, where it circulates around the two hemispheres of the cerebrum and the spinal cord.

[16] LIEM Torsten: Kraniosacrale Osteopathie, Hippokrates Verlag, Stuttgart 1998, p.214

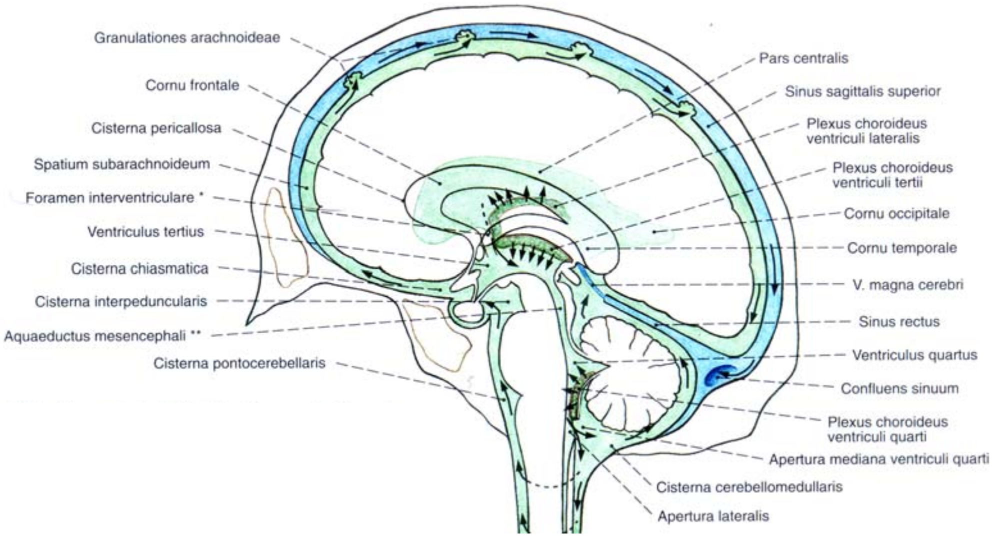

fig. 4 CSF - circulation

The liquor re-absorption occurs in the venal system via the arachnoid granulations (Paccioni) laying in the superior sagittal sinus as well as through the capillary vessel walls in the CNS (central nervous system) and in the pia mater. At this point the blood-brain barrier keeps the liquor stable. The subarachnoidal space extends to the change of the cerebral to the spinal nerves where the liquors flows through thick venal plexi and microtobuli of collagen fibers to the connective tissues and eventually reaches the lymphatic system.

The liquor production depends on the arterial system while its re-absorption depends on the venal system; thus follows a functional connection between the liquor, the venal and arterial systems, as well as a connex liquor – lymphatic system. A better exchange between cells, liquor, venal-, arterial-, and lymphatic systems should result from the CV4 and EV4 technique.

According to Sutherland, it is important that the rhythmical fluctuations of the CSF extend themselves unobstructed in the head. Should the free flow of the CSF be restricted, the whole body could suffer from disorders and malfunctions.[17]

[17] SUTHERLAND William Garner: Contributions of thought, 2nd Edition, (edited by A. Strand Sutherland, A. Wales), Sutherland Cranial Teaching Foundation, Portland, Oregon: Rudra Press, 1998, p.176, p.194

2.3.2 Function and tasks

The cerebrospinal fluid's hydrodynamic cushioning buffer function gathers forces occuring both inside and out, distributes them and thus acts as protection for the brain and spinal cord. The liquor overwhelmingly takes over the lymphatic and immunological function in the CNS as it is responsible for the exchange of substances between blood and nervous tissues. The liquor also feeds nerve cells and disposes of cell waste (brain kidney). Capillary endothel cells and choroid plexus are a part of the blood-brain barrier that is responsible for the selective substance exchange for the proper maintenance of biochemical functions. The liquor also takes over the transportation of neurotransmitters as well as hypothalamic- and neuro-hypophyseal substances.

2.3.3 External Liquor space

The subrachnoidal space filled with cerebrospinal fluid and located between the arachnoid and the pia mater is a thin slit and extends only in certain areas to cisterns. The liquor surrounds the spinal cord up to the 2nd sacral vertebra in the subarachnoidal space.

2.3.4 Internal Liquor space

The ventricular system consists of both semicircular lateral ventricles of the cerebrum; the small third ventricle; as well as the fourth ventricle which extends cone-pike between the pons, medulla and cerebellum.

2.3.5 Projection / ventricle-system

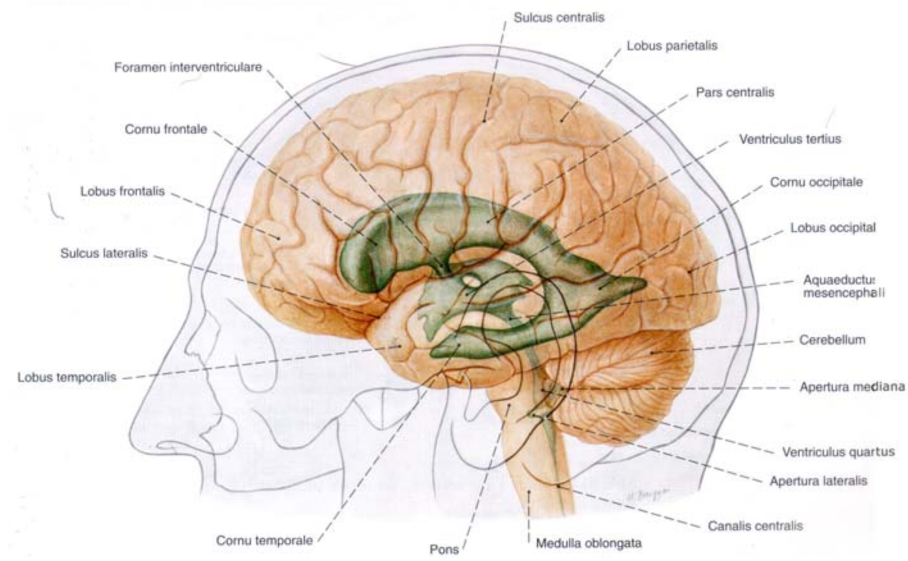

fig. 5 projection / ventricle-system

from the front:

frontal tuber ⇨ anterior part of the lateral ventricles

Glabella ⇨ 3rd ventricle

Nasion ⇨ 4th ventricle

posterior:

squamous portion of the occipital bone ⇨ 4th ventricle

2.4 Autonomic nervous system (ANS)

2.4.1 General:

The parameters measured in this study (skin-conductance, skin-temperature, pulse-rate, and respiratory frequency) are body functions that are controlled, regulated and fine-tuned through the autonomic nervous system. The ANS is to a large extent independent from our will; however, numerous combinations and interrelationships between the somatic and the autonomic nervous system exist. The **central ANS** consists of parts of the cortex, thalamus, hypothalamus, limbic system and reticular formation.

In the inter brain, the third ventricle divides the **thalamus** into two halves; the hypothalamus lies at the base of the third ventricle. The thalamus acts as switchboard to the cortex. The thalamus is also known as the ***"door to consciousness"*** as all information from the environment and the senses flow through its core. These afferent senses (with the exception of odour) meet in the thalamus, are judged, weighted, filtered, associated with a feeling and finally further directed; but only a fraction of this process reaches the consciousness.

The thalamus is an important integration and co-ordination organ.

The hypothalamus is with its neural, neuro-secretal and hormonal function the single most important regulation centre of all the autonomic functions that guarantee the homeostasis necessary for life. It coordinates the endocrine and the ANS.

The central ANS controls the peripheral ANS, consisting of the sympathetic and parasympathetic. The sympathetic nerve increases performance levels under stress and emergency situations, as it activates organ functions that are necessary for intellectual and physical work. The parasympathetic serves the metabolism, regeneration, and the gathering of physical reserves. Its activity is increased in rest and sleep; however, a functional synergy exists between both parts of the ANS which affects the whole organism.

Afferents:

All the information going to the central nervous system from the visceral and skin receptors travels with the sympathetic and parasympathetic nerves. Approximately 80% of the vagus are afferents. This afferent system serves autonomic regulation and allows specific closed-loop control systems through the fine-tuning of permanent information in order to keep specific values, such as blood pressure, constant.

Efferents:

Sympathetic:

The original sympathetic cells are located in the thoracic as well as lumbar side-horns, and leave the spinal cord through the front-horns. The changeover to the postganglionary II. neurone occurs in the sympathetic trunc or in the ganglions of the outer periphery (superior, middle and inferior cervical ganglion, etc.). The transmitting substance is acetylcholin. The postganglionary fibres then lean towards the effected organ where they use adrenaline and noradrenaline as transmitters (adrenerg system).

Parasympathetic:

The original cells lie in centres of the brain, like the medulla, but also in the sacral part of the spinal cord. The preganglionary nerve fibres run with the oculomotor nerve (III), trigeminal nerve (V), facial nerve (VII), glossopharyngeal nerve (IX) and especially with the vagus nerve (X) to the ganglions located near the organ, where they are switched to the postganglionary II neurone. The conduction in all peripheral synapses of the parasympathetic occurs via acetylcholin.

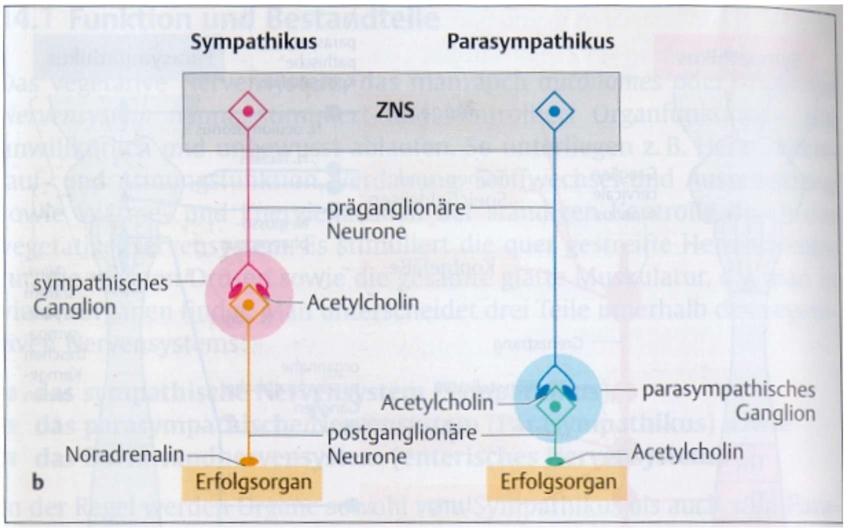

fig. 6 sympathetic / parasympathetic

2.4.2 Cardio-vasculary and respiratory regulation

As discussed above, the hypothalamus is the most important regulation centre. There are regions with parasympathetic and sympathetic functions. When the rostral part of the hypothalamus is stimulated, especially the praeoptic area, the result is an increased parasympathetic activity involving sweating, vasodilatation, increased salivation, decrease in blood pressure and pulse as well as bladder contractions and rising gastrointestinal activity.[18]

The centres for respiratory and cardiovasculary regulation with autonomous centres for blood pressure, heart activity, vasodilatation, inspiration and expiration, etc. are located on the floor of the fourth ventricle, in the medulla oblongata. This allows a common regulation of the cardiac and respiratory functions. Various pieces of information from the cortex, other autonomic centres and the periphery are processed in this area.

[18] DUUS Peter: Neurologisch-topische Diagnostik; Anatomie, Physiologie, Klinik, Stuttgart, New York: Thieme Verlag, 2001, p.278

In the realm of long-term circulatory system regulation, the release of renin causes the creation of angiotensin II which has a strong vaso-constricting effect and therefore causes blood pressure to rise.

ADH = anti-diuretic hormone (= vasopressin) causes a strong constriction in most peripheral vessels.[19]

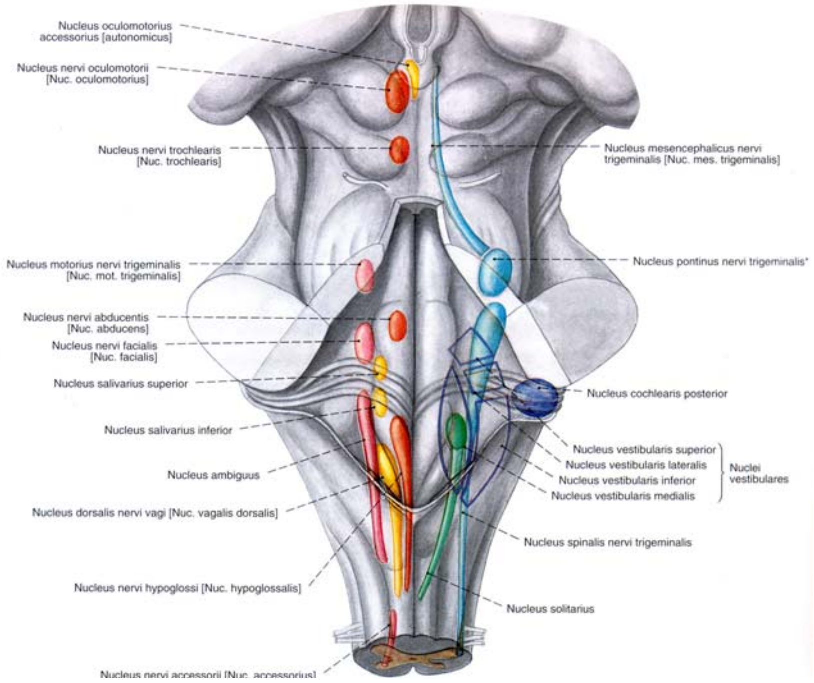

fig. 7 cerebral nerves nucleii

[19] SCHMIDT Robert et al: Physiologie des Menschen, 28. Auflage, Berlin, Heidelberg, New York: Springer Verlag, 2000, p.544

2.4.2.1 Cardiovasculatory centre:

In the reticular formation, afferent impulses travel from presso and chemo-receptors in the carotid sinus and the aortic arch via the vagus nerve and the glossopharyngeal nerve to the solitary tract nuclei, where they are then further transmitted and processed. This network of neural transmission and switching controls the efferent activity of pre-ganglionary sympathetic and parasympathetic neurones; thus ensures the short-term regulation of blood pressure and its adaptation to various conditions.

A resting pulse normally lies between 60 and 80 beats per minute, depending on one's fitness level.

Efferent impulses travelling through the vagus nerve diverge as rami cardiaci on both sides, and go to the right side of the heart and to the sinoatrial nodes. Their restricting effect on the sympathetic fibres causes a decrease in pulse.

Other impulses cause a functional restriction of the sympathetic fibres controlling the width of blood vessels that leads to vasodilatation.

2.4.2.2 Respiratory centre

Because of its vital importance, respiratory rhythm can only be consciously influenced in the short term. Respiration rhythm at rest usually lies around 10-14/cpm for adults and 14-16/cpm for youths.[20] Chemical breath regulation ensures the body's equilibrium and that respiration is adapted to its metabolic needs.

The respiratory centre controls itself to a large extent. Changes in arterial blood gases (partial compression of CO2 and O2) and pH play the biggest role in respiratory regulation.[21] The tension level of the pulmonary alveoli provides feedback to the respiratory centre via the vagus nerve. Chemo-receptors in the

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[20] SCHMIDT Robert: Physiologie kompakt, 4. Auflage, Berlin, Heidelberg, New York: Springer Verlag, 2001, p 227

[21] FALLER Adolf: Der Körper des Menschen, 13. Auflage (neu bearbeitet von M. und G. Schünke), Stuttgart, New York: Thieme Verlag, 1999, p.363

carotid sinus respond through sinus nerves and chemo-receptors in the aortic arch via depressor nerves. One discerns the expiration centre from the inspiration centre. Various respiratory neurones are synoptically connected to a neurone network in the medulla oblongata. The breathing rhythm occurs in the "Prae-Boetzinger complex " (respiratory centre). Most afferent nerve fibres run along the vagus nerve or glossopharyngeal nerve to the switching cores in the solitary tract nuclei, where interneurones are located. These interneurones change the activity of the respiratory network through oligosynaptic connections and adapt respiration to the prevailing circumstances.[22]

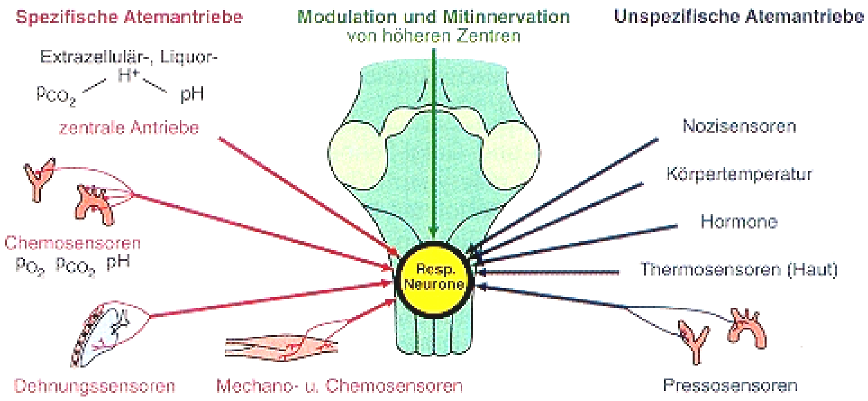

fig. 8 breath regulation

2.4.3 Cutaneous blood supply

Blood circulation is necessary to thermo-regulation, as well as nutrition and metabolism. The sympathetic nervous system gets information and impulses from the cortex, hypothalamus and the vasomotoric centres of the medulla.

There are numerous (adrenerg) sympathetic fibres in the distal (acral) skin regions. They set free noradrenaline and cause a vasoconstriction. These fibres are useful to the (tonic base activity) of vessels. The postganglionary sympathetic fibres that innervate blood vessels proceed in the arterial vessels on the border between adventitious and middle tunica while in the veins; they carry

[22] SCHMIDT Robert et al: Physiologie des Menschen, 28. Auflage,
Berlin, Heidelberg, New York: Springer Verlag, 2000, p.594, p.603

through the middle tunica. Dilatory reactions therefore depend on a central inhibition of this activity.

Sympathetic-cholinergic-vasodilatating fibres probably also exist in humans. From the cortex going around the medulla oblongata, a vasodilatation occurs in response to strong emotions such as anger or fear.

Parasympathetic cholinergic vasodilating fibres come from the VII., IX., X. cerebral nerve and from the sacral marrow. Their switching occurs via the postganglionary neurone either in or in immediate proximity to the effected organ. They have no tonic base activity. A functional vessel innervating of significance could only until now be demonstrated in the small pia arteries of the brain, the coronary arteries and the genital organs.[23]

A vasodilatation can also occur through stimulation of nociceptive afferent neurones via mechanical or chemical stimulation of the skin.

Circulating hormones also influence the tone of peripheral vessels; however, this mechanism only plays a secondary role.

2.4.4 Skin moisture

Skin moisture serves first and foremost the purpose of thermoregulation; it is also an expression of man's vegetative state of reaction. The sweat glands are only regulated by sympathetic synapses in which acetylcholin is used as transmitter. The sympathetic tone increases sweat glands secretion, thus skin moisture.

[23] SCHMIDT Robert et al: Physiologie des Menschen, 28. Auflage, Berlin, Heidelberg, New York: Springer Verlag, 2000, p.525

2.4.5 Summary table of sympathetic and parasympathetic activity Parameters measured by biofeedback

parasympathetic	**sympathetic**	**parameter**
pulse-rate slowing down ⇩	increase ⇧	pulse-rate
breathing rate slowing down ⇩	increase ⇧	breath frequence -amplitude
vasodilatation (adrenerg)	vasoconstriction	temperature
decrease ⇩	increase ⇧ (cholinerg)	skin-conduction

tab. 1 sympathicus / parasympathicus / parameter

3 Fundamentals of the craniosacral techniques

The following section deals with the fundamentals pertaining to the CV4 and EV4 cranial techniques. The following books are used as basis.

BECKER Rollin:[24] The Stillness of Life

JEALOUS James:[25] script „Emergence of Originality"

LIEM Thorsten:[26] Kraniosakrale Osteopathie

MAGOUN Harold:[27] Osteopathy in the Cranial Field

SUTHERLAND William Garner:[28] Contributions of Thought

3.1 History

The craniosacral concept was developed by Sutherland between 1898-1954.
He expanded Still´s ground principles of osteopathy to the cranium. Through thoughts, experiments and clinical observations, he researched and identified relationships between the mobility of sutures, fluids, membranes and certain dysfunctions respectively diseases. Sutherland discovered a slowly pulsating movement that was independent from the heart and breathing rhythms and that could be influenced by subtile manual methods of treatment. The similarity between the dynamic of the embryological development and the pulmonary breathing lead to the phrase: "primary respiratory mechanism"[29] (=PRM).

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[24] BECKER Rollin: The Stillness of Life, (edited by R. Brooks), Portland: Stillness Press, 2000

[25] JEALOUS James: WSO Seminar: Biodynamische Kranialosteopathie, script „Emergence of Originality", Vienna, 1998

[26] LIEM Thorsten: Kraniosakrale Osteopathie, Stuttgart: Hippokrates Verlag, 1998

[27] MAGOUN Harold: Osteopathy in the Cranial Field, Original Edition, 1951, 2nd Printing, Sutherland Cranial Teaching Foundation, Cincinnati, Ohio: The C. J. Krehbiel Company, 1997

[28] SUTHERLAND William: Contributions of Thought, 2nd Edition, (edited by A. Strand Sutherland, A. Wales), Sutherland Cranial Teaching Foundation, Portland, Oregon: Rudra Press, 1998

[29] MAGOUN Harold: Osteopathy in the Cranial Field, Original Edition, 1951, 2nd Printing, Sutherland Cranial Teaching Foundation, Cincinnati, Ohio: The C. J. Krehbiel Company, 1997, p.15

3.2 Primary respiratory mechanism

The craniosacral rhythm or cranial rhythmic impulse (=CRI) has a frequency of 6 – 14 cycles per minute. There is also a somewhat slower rhythm of 2 ½ cycles and with 6-10 cycles in 10 minutes.[30] In the flexion-phase = cranial inspiration, the head and the body become wider and somewhat shorter, in the extension-phase = cranial expiration phase, smaller and longer. To bring the subject to a neutral stage and "synchronizing" with the practitioner at the beginning of the treatment is a precondition.

3.3 The five fundamentals of the CRI

- inherent mobility of CNS, based on neuroglia mobility
- CSF fluctuation
- membrane system mobility
- movement of the cranial bones
- movement of the sacrum (the cranial rhythm is transmittered to the sacrum via the dura mater)

The goal of the craniosacral techniques is the decrease of tension in the membrane system, the improvement in mobility of articulary restrictions, especially in the head area, as well as the improvement in the CSF fluctuation. The resulting optimization of arterial, venal and lymphatic circulation leads to an improved function of the physiological system on the biodynamic, bioelectrical and biochemical level. All of the body's exchanges (functions) are stimulated and thus support the body in its quest for homöostasis. The resulting systemic effect grabs the individual as a whole and reflects osteopathic basic thought.

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[30] JEALOUS James: WSO Seminar: Biodynamische Kranialosteopathie, script "Emergence of Originality",Vienna, 1998

- Life is movement
- The body is a unit
- Structure and function reciprocally affect each other
- Rule of the arteries
- The body has the power to heal itself

3.4 CV4 and EV4 working mechanism

The CSF longitudinal fluctuation is brought to a stillpoint via the occipital bone. CV4 prevents the flexion phase and EV4 prevents the extension phase of the CRI. The anatomical connection between the occipital bone and the tentorium causes a change in the membrane system's tension, which should lead to changes in pressure and hydrodynamic behavior in intracranial fluids. These pressure, tension and flow changes influence, even stimulate the neighbouring physiological centres.

A parasympathetic effect raises liquor production and a stagnating fluctuation could be once again accelerated by the stimulation of the exchange process (production and resorption).

A further thought model for those workings of this effect is the one offered by Jealous. The "biodynamic cranial osteopathy" communicates with the natural laws of primary respiration and their healing power. *"CV4 is a technique that takes us back to the first function of life which is the movement of the midline in the embryonic plate. It reorganizes all electrical processes in the body around their origin"* and *"EV4 takes the potency from the midline, the CV4 brings it to the midline"***.**[31] Sutherland and Becker[32] also repeatedly mentioned on the ground laying meaning of this potency for the craniosacral work. For Still[33], the CSF was: *„one of the highest known elements"* and an important element for

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[31] JEALOUS James: WSO Seminar: Biodynamische Kranialosteopathie, notes, Pöttmes, 2000

[32] BECKER Rollin: The Stillness of Life, (edited by R.Brooks), Portland: Stillness Press, 2000

[33] STILL Andrew Taylor: The Philosophy and Mechanical Principles of Osteopathy, 1902, Kirksville: Osteopathic Enterprise, 1986, p.44-45

man's health. He said: *„the great river of life must be tapped and the withering field irrigated at once, or the harvest of health be forever lost".*

Gould and Gross[34] (1999) study offers an interesting aspect to this theme. Experiments showed that apes possessed (developed) new brain cells in the fourth ventricle region that moved to other brain regions, mature and are then included in the brain's working mechanism. It is possible that people also have this potential for regeneration and this process could possibly be supported or stimulated by a CV4 or EV4 technique.

3.5 Indications and contraindications

Indications:

Harmonisation and **regulation** of the ANS' physiological centres and harmonisation at a hormonal, vegetative, muscular and chemical level…

Improvement in metabolism: improvement of the arterial, venal and lymphatic circulation, increase in immunity, decrease in fever during infections and inflammations.

Decrease of tension: muscular hypertension, high blood-pressure, tachycardia…

Contraindications:

Danger of encephalorrhagy, aneurysm, acute head injury, acute stroke.

Relative contraindications: carcinoma and Aids

[34]GOULD Elizabeth, GROSS Charles: "New Brain Cells in Highest Brain Areas", published by Steven Schultz, Princeton University, 1999, http://www.newswise.com/articles/1999/10/NEURO/PTU.html [4.5.2002]

4 Material and method

4.1 Biofeedback (BFB)

BFB is learning through the response of physiological functions that normally occur unconsciously (e.g. increased muscle tension during mental stress) and their influence in the realm of a therapeutic goal (relaxation under stress).

With the BFB training, the test subject can develop a growing consciousness about specific internal physiological functions; attain control over them; and apply them to every day life.

The goal of this method is to offer the client an economical, rapidly effective assistance, e.g. sicknesses involving either pain, psychosomatic symptoms, psychological and psychiatric disorders, neuromuscular and neurological disorders, as well as urological diseases.

BFB is also an important part of muscular diagnostics, in particular (psycho-) vegetative states of tension.

4.1.1 Biofeedback – technical conditions

The biofeedback unit's instruction manual served as information source for the technical data and for the correct manipulation of sensor application.

The study uses the computer supported biofeedback system called SOFT from Insight Instruments, SOFTdat model 8020-B, with the "Comfort program". Using sensors connected on one side to specific body parts of the test subject and to the SOFT-dat on the other side, the person's physiological parameters are taken.

4.1.2 Comfort Program

- ☞ The chosen measuring parameters are saved in the menu under ***„last setting“*** and are available for further similar sessions.
- ☞ ***Mark***: this indicates that markers can be placed and shown on the screen. They are numbered and can be viewed under review.
- ☞ ***Stop***: this indicates the end of the session
- ☞ ***End with save:*** the captured data can be designated by a name with a maximum of 8 spaces and saved on the PC.
- ☞ ***Export data:*** the software offers the possibility to deliver the indicated data in various formats for further processing.

<u>Arrangement of the instruments</u>

blue: multi sensor and cable

red: breathing sensor 1 and 2, cable, stand

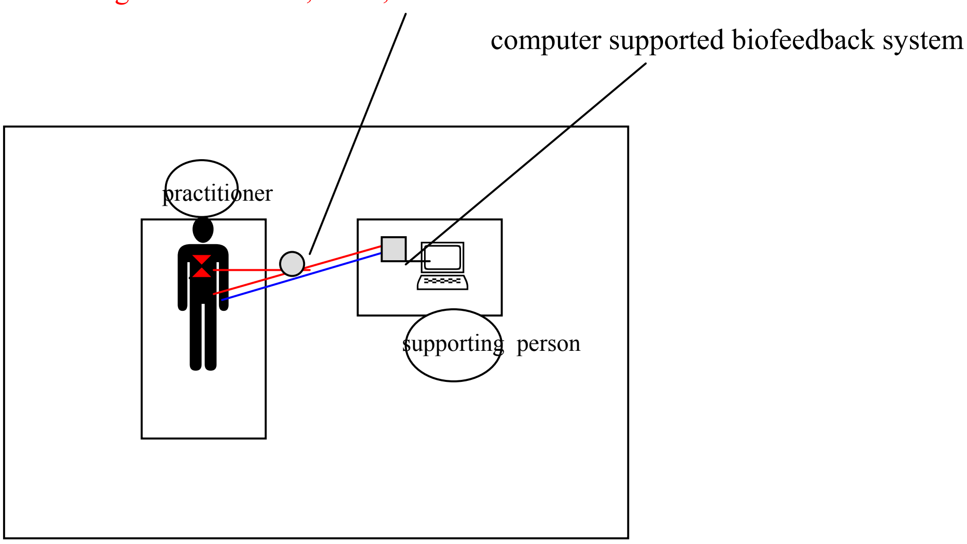


fig. 9 arrangement of the instruments

4.1.3 Sensors

4.1.3.1 Multi sensor

This multisensor simultaneously captures three physiological measurements:

- ☞ electrical skin conductivity
- ☞ pulse rate
- ☞ skin temperature

fig. 10 multi sensor

4.1.3.1.1 EDG = electro dermography

This measures the electric conductivity of the skin, which is a relative measurement tool for sweat gland activity and thus for the activity of the sympathetic as well. Every mental stimulation has a direct effect on the skin resistance.

Technical facts:

- Unit of electrical skin conductance: Siemens (S)
- Electrical conductivity is the reciprocal value of the skin's electrical resistance
- Unit of the skin's electrical resistance: Ohm (Ω)
- The report is done digitally in micro-Siemens (μS)
- The surface area of both sensors is 50.3 mm^2
- The skin conductance value is marked four times per second

4.1.3.1.2 PPG: Pulse plethysmography

- Registration of blood volume pulse via photoplethysmography
- Changes in the blood volume's relative size are measured
- Pulse rate unit (fp): bpm (beats per minute)
- Pulse parameters are marked nine times per second

4.1.3.1.3 TEM: Thermistor measurement

Registration of the skin's temperature trends via a thermistor. It can capture measures between 21 to 38 degrees. The dissolution is extremely high (0.02 degree) in order to exactly capture trends. The measurement is not meant for the measurement or observation of exact body temperature but rather only for an interpretation of the behaviour of temperature which is represented relatively.
The temperature is marked five times per second.

4.1.3.2 Breathing sensor1 and 2

Two small instruments affixed to a pedestal and attached via cable to SOFT-dat are used to register breathing activity without physical contact using infrared light. This is done to measure the relative size of breath movements in the chest and abdominal areas.

- Breath frequency unit: breath/minute (cycles per minute)
- Input of breath amplitude: %
- Breath is measured five times per second

fig. 11 breathing sensor

4.1.3.3 Fastening of sensors

4.1.3.3.1 Multisensor fastening

The test subject's hands are to be cleaned with soap prior to the test and the ring finger of the non-dominating hand wiped with alcohol. The multisensor is attached to the inner side of the non-dominating hand's 4th finger, as fingers with strongly calloused skin are not adequate for this purpose.

The inner side of the finger is placed on the multisensor and pushed forward to the guiding border. The guiding border is used to guarantee a definite positioning of the finger on the sensor.

The fastening belt is placed around the finger, slightly placed over the finger and zipped shut so that the finger's surface fully lies on the sensor.

The finger may at no time be tied too tightly as this will cause wrong measurement values to be taken – pressure that is too strong will cut off blood circulation.

The test subject's hand should be positioned as to have finger and sensor up in the air (they shall not rest against something). Hand or finger movements are to be avoided as they could compromise results.

4.1.3.3.2 Breathing sensors positioning

The distance between the active surface of the breathing surface and any area from which breathing movements are to be taken should be approximately 15-20cm and positioned parallel to the thorax or abdomen. In order to obtain measurement results that can be reproduced, one must always use the same distance.

A distance of 17cm is used for this experiment. Breathing sensor 1 is located at navel level, breathing sensor 2, the width of a hand lower than the sterno-clavicular joint. The same clothing should always be worn for different measurements as varying fabrics reflect light differently. Strong prints or black clothing should be covered by a white cloth. The clothing should be even and form-fitting so that body and cloth move together.

A precondition to an accurate breathing activity registration is that the subject be in a position that is as relaxed, comfortable and stable as possible.

4.2 Description of the techniques: CV4, EV4 and Placebo

Test subject positioning:

the subject is lying on a bed in a relaxed supine position

Practitioner

the practitioner sits in a relaxed position at the head of the bed.

4.2.1 CV4-technique = Compression of the fourth ventricle

Position of the hands:

- the underarms are lying on the bed
- hands are resting in each other
- the thenar eminences and thumbs parallel and pointing in caudal direction.
- the thenar eminences are located on the lateral angle of the occipital bone.

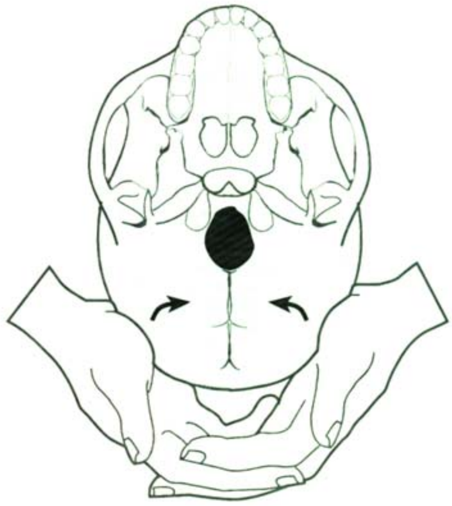


fig. 12 CV4

Performance:

In the cranial extension phase, the intent is to follow the shrinking of the occiput and to somewhat press together its anguli laterales. In the cranial flexion phase, the intent is to hinder the anguli's branching out laterally by using minimal compression whereby care must be taken not to block the cranial rhythm.
Movement amplitude gets smaller whereby the flexion and extension movement comes to a stop after several cycles. This is called the "**stillpoint"** and can last from a few seconds to several minutes while hands remain on the occiput.
At the end of the stillpoint, the practitioner feels a strong expansion force in the form of pressure on the balls of the thumbs which he passively observes. These cranial expiration and inspiration movements are observed for a few cycles to once again judge the quality of the cranial rhythm.

4.2.2 EV4 technique = Extension of the fourth ventricle (as per Jealous)

Hand positioning:

- Underarms rest on the bed
- The occiput rests in the hands
- Finger tips meet in the middle and are placed somewhat forward

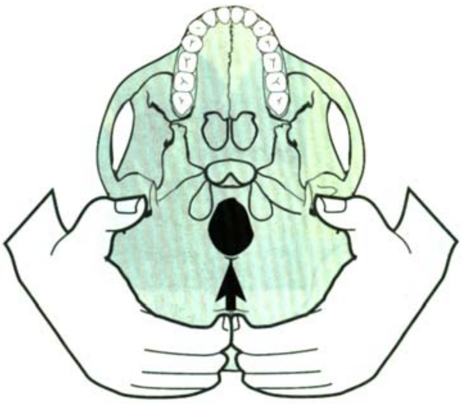


fig. 13 EV4

Performance:

In the cranial inspiration phase, the external rotation is observed with the intent to retard the expiration phase in its movement. The movements amplitude gets smaller and after a few cycles, the flexion and extension movement comes to a stop. This can last several seconds or minutes. Hands remain in this position until a warming and softening of the tissues located underneath them is felt. The renewed expiration and inspiration movements are further observed for a few cycles in order to evaluate their qualitative changes.

4.2.3 „Placebo“ technique

In this placebo technique, the positioning of the hands is almost identical to EV4 whereby here, the hands are located a bit more caudally so that only the little finger is in contact with the occiput. The intent is not to perceive any rhythm; the goal is to emotionally limit the subject by placing a fictivious separation layer between. There is no intention to perform a CV4 or EV4 technique.

4.3 Method

For this research, 12 subjects were used (N = 12, n = 7m, n = 4f) aged 21 to 43. The measurement occurred between 18.4.2001 and 22.6.2001.

Each was subjected to a CV4, EV4 and placebo technique at one week interval. The measurements were done via the Biofeedback-system before and during the techniques, to record the course.

The following parameters were captured:

- skin-conductivity
- skin-temperature
- pulse-rate
- breathing-rate
- breath-amplitude

The measurement on a subject occured on the same week day, at the same time (+/- ½ hour) in order to limit variations due to the time of day.

In order to minimize subject influence on the measurements, the techniques were made anonymous by initializing each technique. Test subjects were not informed of this process so that they did not know which technique was being performed.

The techniques' sequence order was determined prior to the beginning of the study. Each test subject picked a closed envelope in which his/her sequence was enclosed.

subject	technique / sequence	week 1	week 2	week 3
1	CBA	C	B	A
2	BCA	B	C	A
3	BAC	B	C	A
4	ACB	A	C	B
5	ABC	A	B	C
6	CAB	C	A	B
7	BCA	B	C	A
8	BAC	B	A	C
9	CBA	C	B	A
10	ABC	A	B	C
11	CAB	C	A	B
12	ACB	A	C	B

tab. 2 sequence / technique

A = CV4-technique

B = EV4-technique

C = placebo-technique

4.3.1 Points of criticism

As a consequence of the low number of subjects the statistical evidence must not be overestimated. Therefore, this study can only represent a "pilot project" suggesting tendencies.

Furthermore, the placebo-technique has to be seen from a critical point of view, because the border between a subtile craniosacral technique with minimal and focused pressure or movement and the placebo technique is very small. Unconscious and involuntary minimal pressure or movement of the hands cannot be totally excluded. Hence the practitioners experience and skill could influence the applied technique.

4.4 Conditions necessary for the room

Room temperature should be between 22° and 24°C in order to keep conditions constant for the test subject

Intensive sunlight falling on the test subject can render results inaccurate and needs to be filtered by drawn blinds

The test room's door should be shut in order to avoid disturbing noises that can have an influence on the measuring results. No telephones or mobiles are allowed in the room and a „do not disturb" sign is hung on the outside of the door.

These precautionary measures should ensure a homogeneous environment for all test subjects, without any acoustic or thermal disturbances.

4.5 Inclusion and exclusion criteria

The following pre-conditions were observed in order to ensure the most stable starting situation as possible.

Only people who had never undergone a cranio-sacral-osteopathetic treatment were used. This ensured an objective reaction on the part of the test subject that excluded any form of behavioral influence due to expectation.

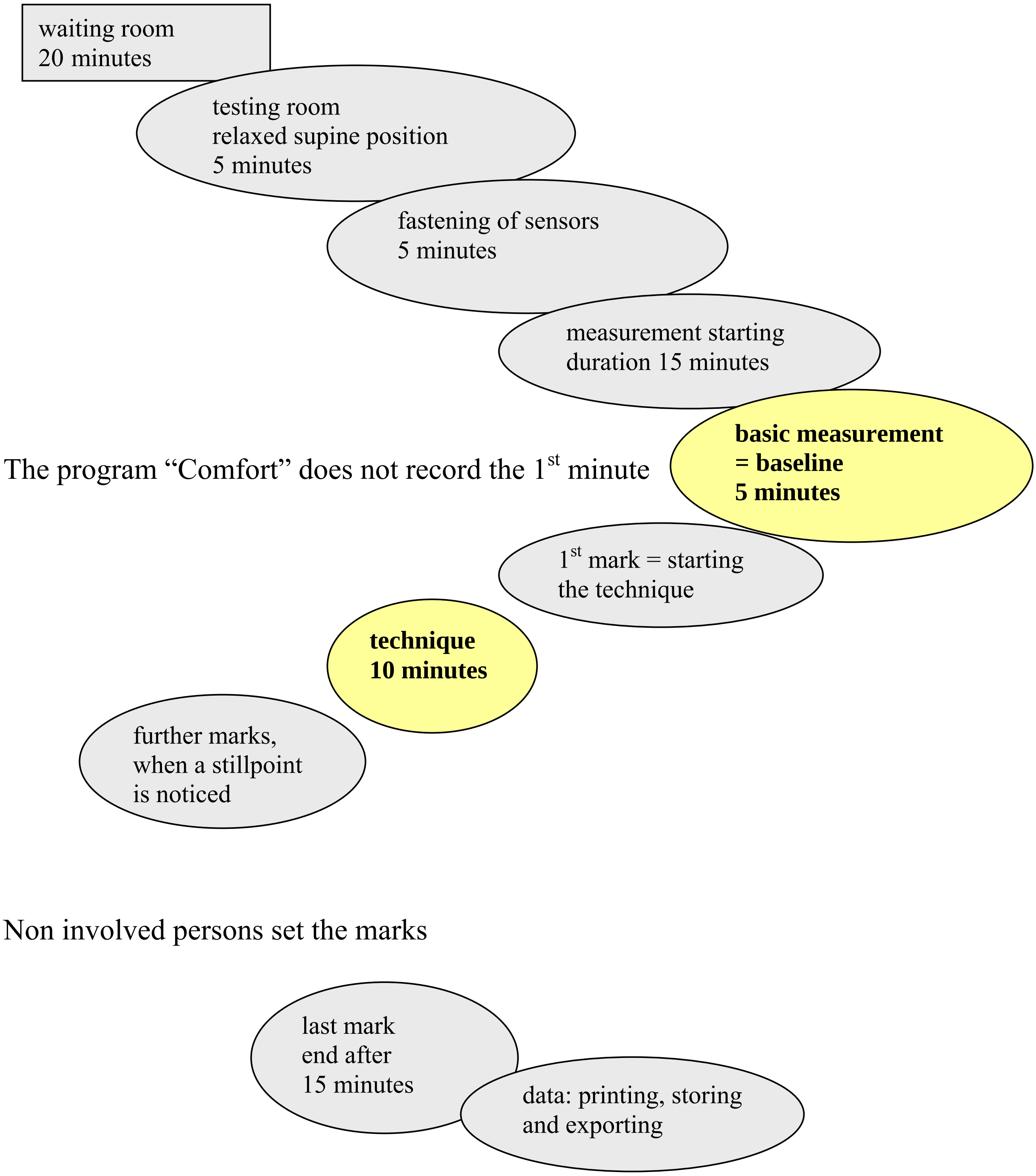
At the time of the study, test subjects should feel healthy, meaning that they are in generally good health, suffer from no acute or chronic disease necessitating regular medication such as febral infections, pneumonia, bladder infection, diabetes, asthma, known case of high blood pressure, thyroid disorder and so forth. People with recent post-traumatic wounds were also disqualified.

As the study explored the differences between the CV4 and EV4 techniques, special dysfunctions in the test subjects were not searched for. This is the goal of a further study. Test subjects could, however, feel slight aches, which they do not feel on a regular day, such as a temporary feeling of tenseness in the neck or in the lower spine.

The test subjects were not allowed to engage in any physical activity one hour prior to the measuring, such as sports, heavy physical work, etc., nor were they allowed to take any substances such as alcohol, nicotine, medicine, coffee, tea, etc., as this could have an effect on the thermo-regulation, the cardio- and metabolic systems as well as respiration.

Test subjects should try to relax and get rid of everyday stress in the waiting room for the 20 minutes preceding phase.

5 Procedure


waiting room
20 minutes
testing room
relaxed supine position
5 minutes
fastening of sensors
5 minutes
measurement starting
duration 15 minutes
The program "Comfort" does not record the 1st minute
basic measurement
= baseline
5 minutes
1st mark = starting
the technique
technique
10 minutes
further marks,
when a stillpoint
is noticed
Non involved persons set the marks
last mark
end after
15 minutes
data: printing, storing
and exporting

6 Results and statistical evaluation

The statistical evaluation was made by Benesch.

The measurements occured between: 18.4.2001 – 22.6.2001

For this study, 12 subjects (8 men and 4 women) aged 21 to 43 were used.

At the time of the measurement, they felt healthy and fulfilled the necessary inclusion and exclusion criteria.

The goal of this study was to determine whether there exists a measurable difference between the CV4 and EV4 techniques. The measurements were done via the Biofeedback-system.

The following parameters were captured:

- skin-conductivity
- skin-temperature
- pulse-rate
- breathing-rate 1
- breathing-amplitude 1

From these measurements, there were 57 measurements per test-subject over time, each showed mean-values, because the individual measurement-values were taken in very short intervals. These data were printed out with a graphical representation. (see appendix)

6.1 Profile of a single subject (subject 3)

To avoid confusion of the data, only one profile that seems interesting to me should be isolated and described in detail, because this study explores both cranial techniques and not single profiles.

The first markery, was set after the five minute base-measurement (baseline) at the beginning of the technique. It showed the point at which the practitioner set his hands on the subject's head, and the technique began. Further markings were set at noticed stillpoints and at the end of the measurement process after 15 minutes.

At the beginning, CV4 presented a clear rise of the pulse-rate and breath-amplitude with a simultaneous decrease of the breathing frequency.

On the other hand, the subject only reacted with a rise in temperature after the introduction of a stillpoint via CV4 or EV4, also skin-conductivity increased slightly after the stillpoint at EV4.

No change in the measuring data was noticed with the placebo-technique.

This example indicated that as of the **beginning of the technique, all the parameters were more or less influenced, but also that the stillpoint phase presented further changes, such as by CV4 in this case (= 2. stillpoint / marking 3).**

This subject showed almost no deviation in the measurement-data with the placebo-technique, but stronger changes during the CV4-technique and smaller reactions on the EV4-technique. During the complex evaluations of all the parameters, no parasympathetic or sympathetic effect could be firmly assessed for one of the two cranial techniques.

sequence subject 3	1.week / B	2.week/A	3.week/ C
	EV4	CV4	placebo
skin-conductivity ⇩	⇩ ⇧ after the stillpoint	⇩ minimal	⇩
skin-temperature ⇧	= ⇧ after the stillpoint	⇧ after the stillpoint	⇩
pulse-rate ⇩	⇩ minimal after the stillpoint	⇧ after the stillpoint	=
	mean value 89,9	mean value 84,59	mean value 73,54
breathing-amplitude 1	=	⇧	=
breathing-rate 1⇩	⇩ minimal	⇩	⇧ minimal in the last 1/3
	mean value 24,42	mean value 18,6	mean value 17,3

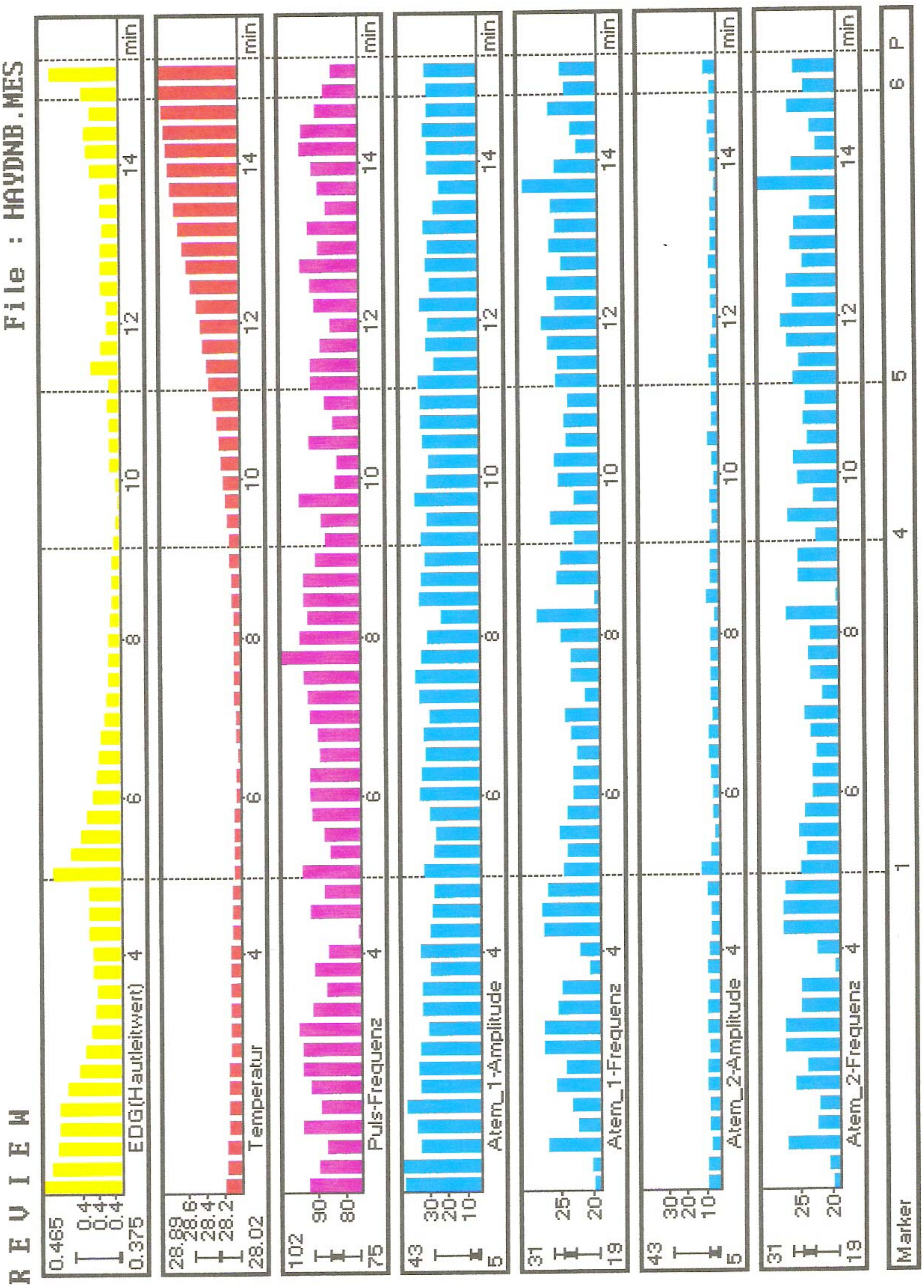
tab. 3 individual parameter / subject 3

red = parasympathetic

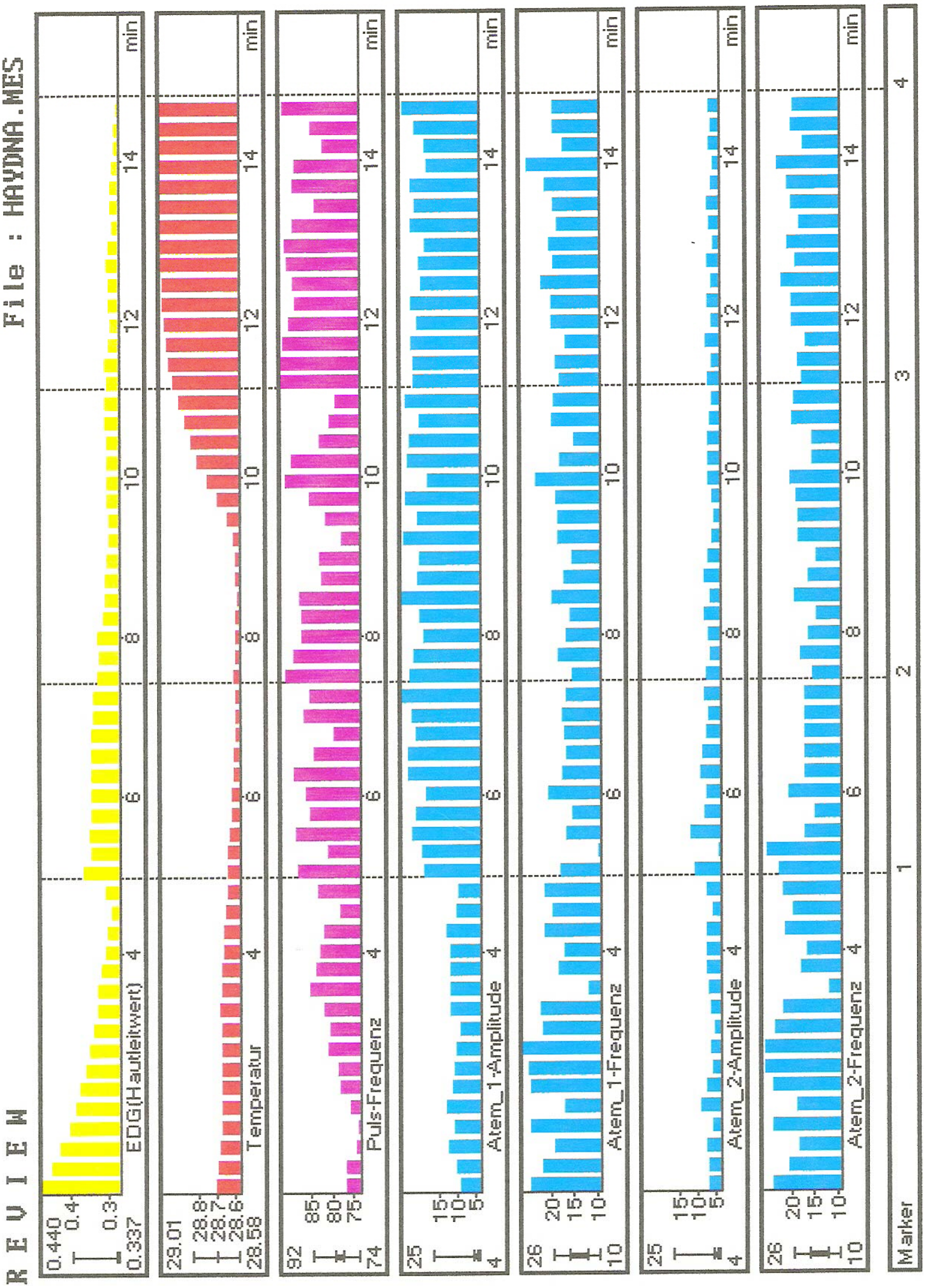
It was interesting that the pulse and breathing mean value decreased from the first to the third week especially after the CV4 technique. Conversely the pulse-mean-value was raised one week later during the next intervention for people who were trained (subject 12, 6 and 8).

Review - print-out / subject 3 following now

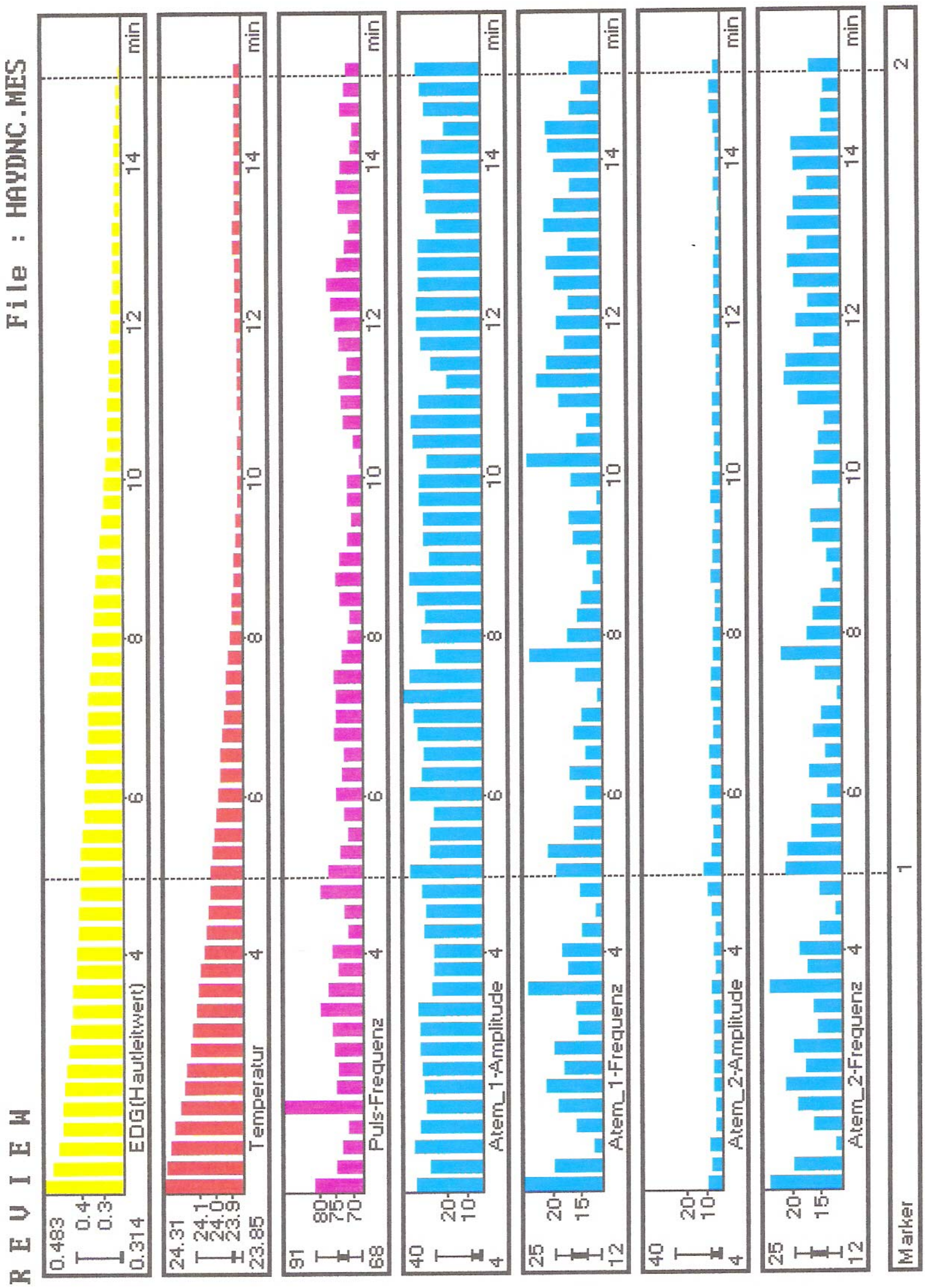
EV4


REVIEW
File : HAYDNB.MES
EDG(Hautleitwert)
Temperatur
Puls-Frequenz
Atem_1-Amplitude
Atem_1-Frequenz
Atem_2-Amplitude
Atem_2-Frequenz
Marker

CV4


REVIEW
File : HAYDNA.MES
EDG(Hautleitwert)
Temperatur
Puls-Frequenz
Atem_1-Amplitude
Atem_1-Frequenz
Atem_2-Amplitude
Atem_2-Frequenz
Marker
min

PLACEBO


REVIEW
File : HAYDNC.MES
EDG(Hautleitwert)
Temperatur
Puls-Frequenz
Atem_1-Amplitude
Atem_1-Frequenz
Atem_2-Amplitude
Atem_2-Frequenz
Marker

6.2 Descriptive statistic

see page 72-83 / appendix 10.4

To facilitate comparison, the raised data of the time-course were statistically processed.

6.2.1 Course measurement per subject

Following description: individual courses

- Comparison of the techniques for skin-conductivity
- Comparison of the techniques for skin-temperature
- Comparison of the techniques for pulse-rate
- Comparison of the techniques for breathing-frequency 1
- Comparison of the techniques for breathing-amplitude 1

CV4	*= A*	*= technique 1*	*= black*
EV4	*= B*	*= technique 2*	*= red*
Placebo	*= C*	*= technique 3*	*= green*

6.2.1.1 Results

From the description of the single courses one notices that the parameters changed at the beginning of the technique but every subject showed his own induvidual form of "profile".

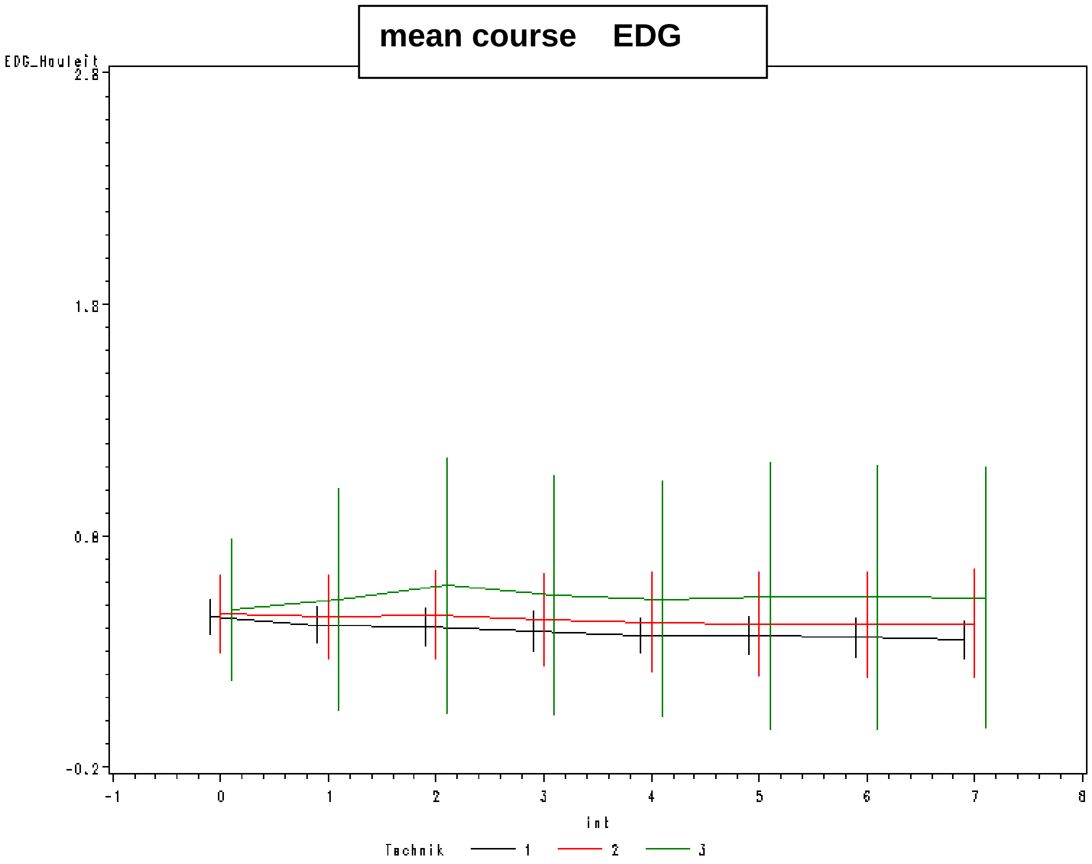
The result of the changes is to be seen as **"person-specific".**

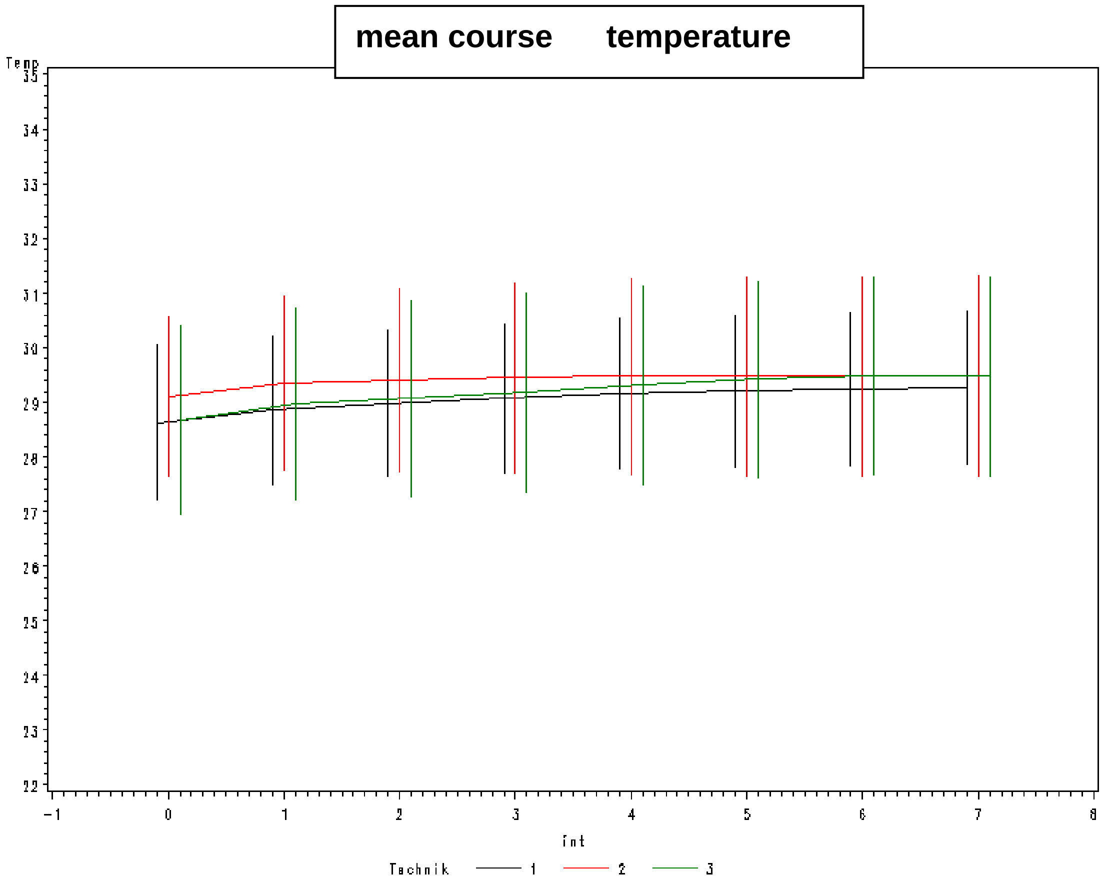
6.2.2 Technique comparison: description of the mean courses 8 intervals

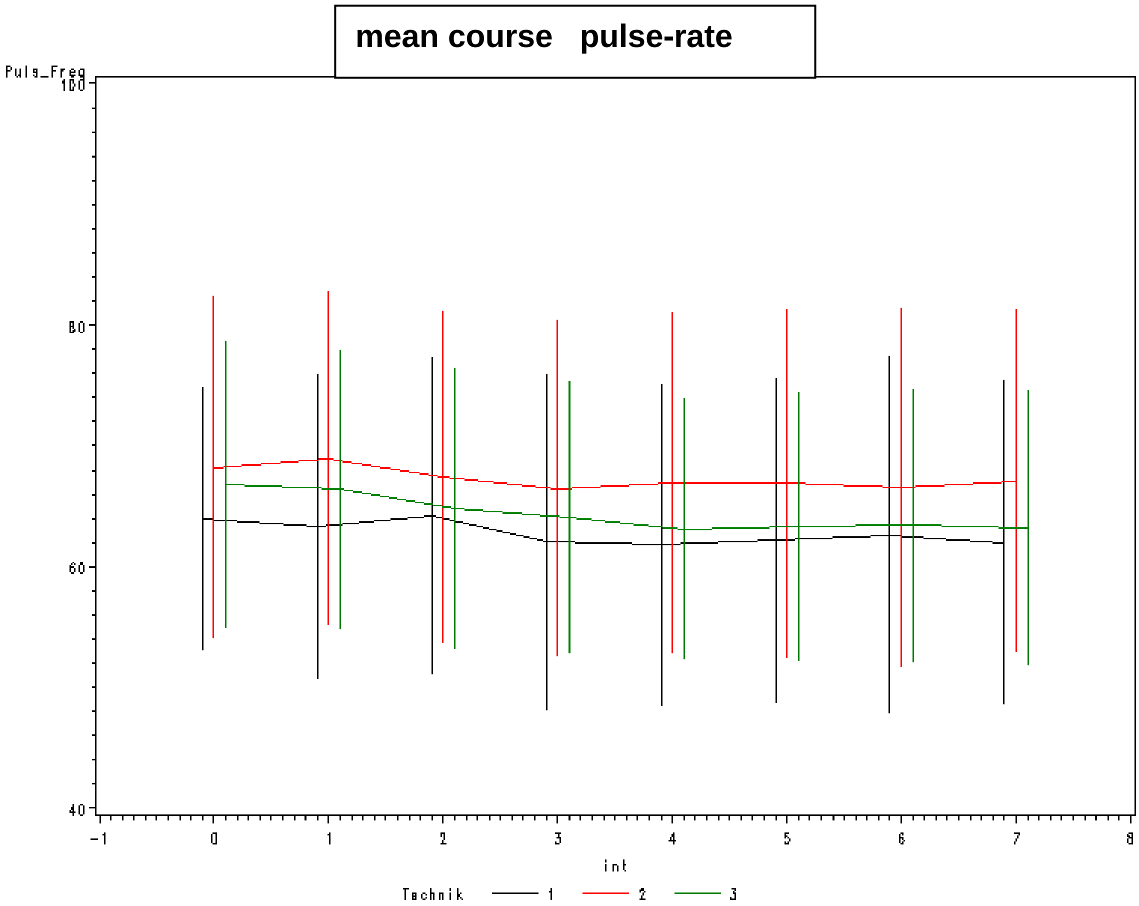
The parameter measurements were taken and compared at eight identical intervals.

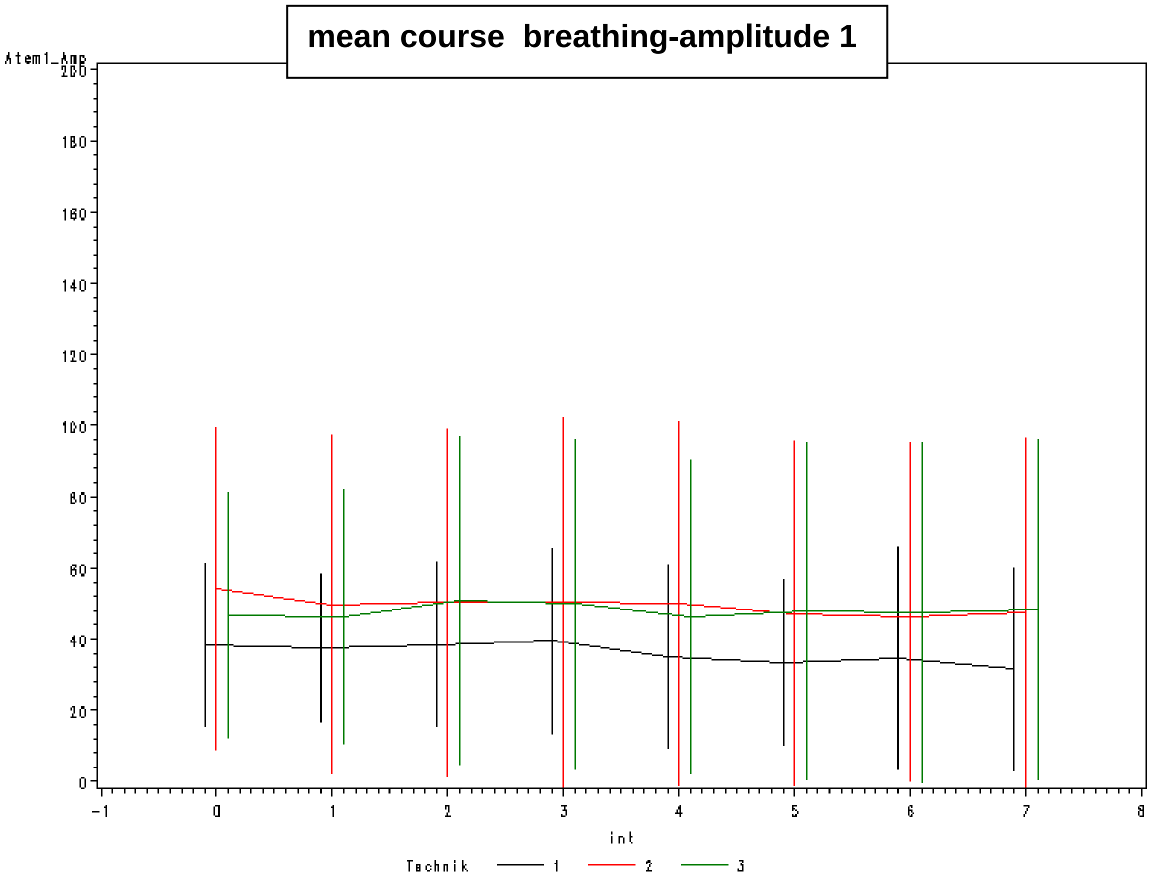
- Technique comparison for skin-conductivity - mean course
- Technique comparison for skin-temperature - mean course
- Technique comparison for pulse-rate - mean course
- Technique comparison for breathing-frequency 1 - mean course
- Technique comparison for breathing-amplitude 1 - mean course

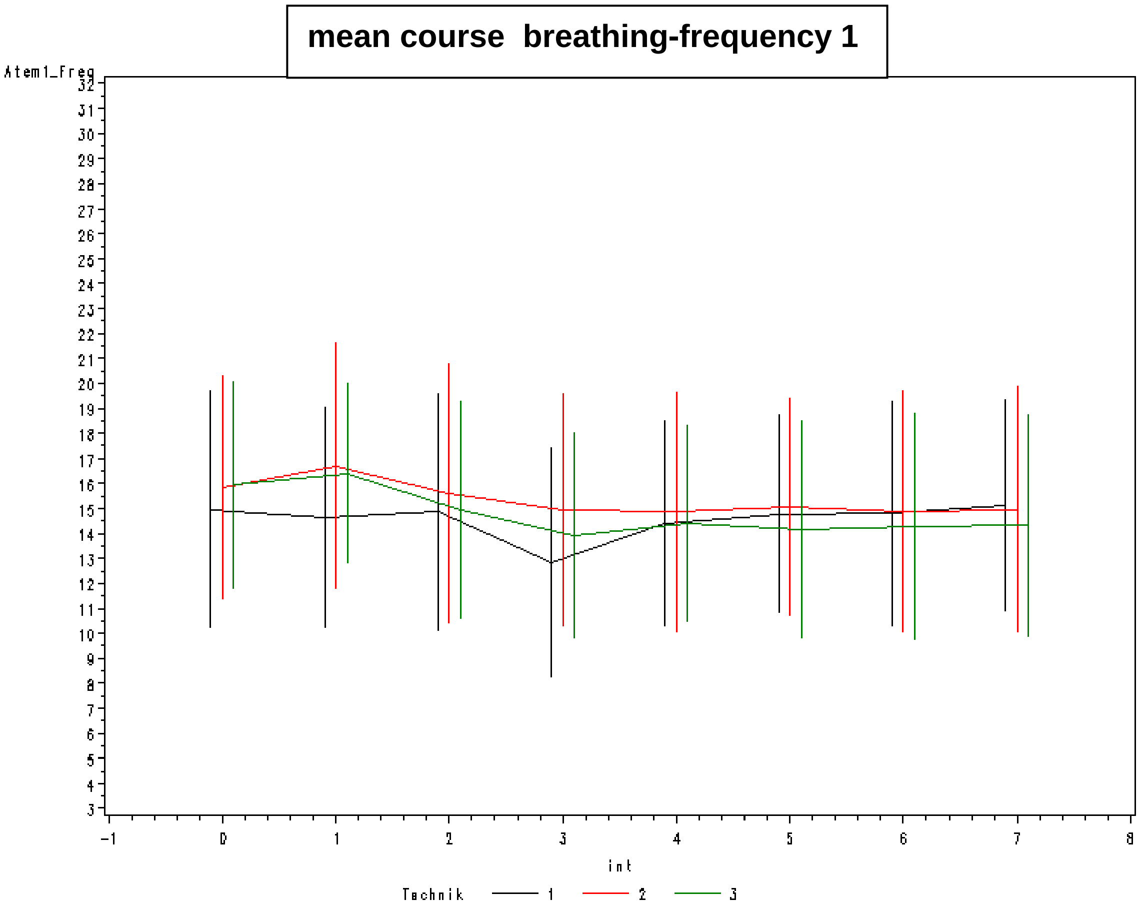
technique 1	=	CV4	=	black
technique 2	=	EV4	=	red
technique 3	=	placebo	=	green


mean course EDG
EDG_Haulelt
2.8
1.8
0.8
-0.2
-1
0
1
2
3
4
5
6
7
8
int
Technik
1
2
3


mean course temperature
Temp
35
34
33
32
31
30
29
28
27
26
25
24
23
22
-1
0
1
2
3
4
5
6
7
8
int
Technik
1
2
3


mean course pulse-rate
Puls_Freq
100
80
60
40
-1
0
1
2
3
4
5
6
7
8
int
Technik
1
2
3


mean course breathing-amplitude 1
Atem1_Amp
200
180
160
140
120
100
80
60
40
20
0
-1
0
1
2
3
4
5
6
7
8
int
Technik
1
2
3



6.2.2.1 Result

<u>Skin-conductivity :</u>

<u>CV4 and EV4:</u> both techniques indicated a decreasing tendency. **<u>CV4 had a low and placebo a high deviation.</u>**

<u>Placebo-technique:</u> interestingly, the skin-conductivity rose somewhat prior to the technique and decreased only minimally at the begin of the intervention.

<u>Skin-temperature:</u>

<u>CV4 and EV4:</u> in the first half, there was a rise in the temperature of approximately 0,5°C.

<u>Placebo</u>: the temperature rose similarly, but approximately by 1°C.

Pulse-rate:

The pulse-rate showed a very large deviation for all techniques.

CV4: The puls-rate sank more clearly at the beginning of the technique than with **EV4** and **placebo**.

Breathing-amplitude 1:

CV4: again presented the **smallest deviation** and the decrease in breathing-amplitude was more clearly recognized as in **EV4 and placebo.**

Breathing-frequence 1:

CV4: After the beginning of the technique, the breathing-frequence droped noticeably. After the **"drop"** it rose again up to the start-level.

EV4 and placebo: there was also a continued decrease, but it had started already before the technique and did not rise afterwards.

Summary:

CV4 showed a noticeably **small deviation** in the **skin-conductivity and breathing-amplitude 1**.

All of the CV4 parameters in the middle of the procedure lay among the lowest values (black linie), placebo in the middle (green line) and EV4 (red line) slightly higher.

The observation of the parameters and their interrelationship showed that all of the techniques had more or less a parasympathetic tendency. The breathing-frequency presented a clear marker for the **CV4** technique by going back to the starting level after the **"drop".**

6.3 Inference statistics

see page 84-88 / appendix 10.5.

As several of the measuring variables are “leftrise” (=linkssteil) and have extreme values, the data were transformed with logarithms. The measurements were split in 3 equal intervals (1. interval: values 1-17, 2. interval: values 18-38, 3. interval: values 39-57). For each measuring-value-variable the inference statistical analysis was made via the “General linear model with repeat-measurement” GLM-model – repeated; statistical program: SAS Realease 8.01), with sequence, technique and time as grouping-variables.

6.3.1 Result

Based on the inference statistics there was no significant difference between the CV4, EV4 and placebo-techniques. **Over the course of the three intervals, there were however significant, even highly-significant changes in all parameters**, meaning that the values over the course of the three intervals were more than by chance different.

p = probability

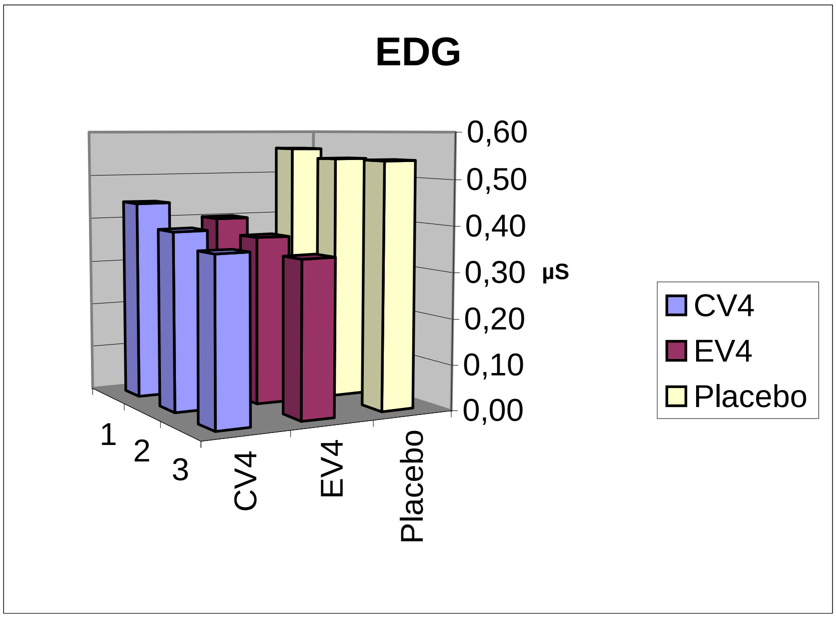
	time-course		technique
skin-conductivity	p = 0,0006	sign.	p = 0,21
skin-temperature	p < .0001	h. sign.	p = 0,8
pulse-rate	p = 0,0014	sign.	p = 0,21
breath-amplitude 1	p = 0,0119	sign.	p = 0,51
breath-frequency 1	p = 0,0278	sign.	p = 0,58

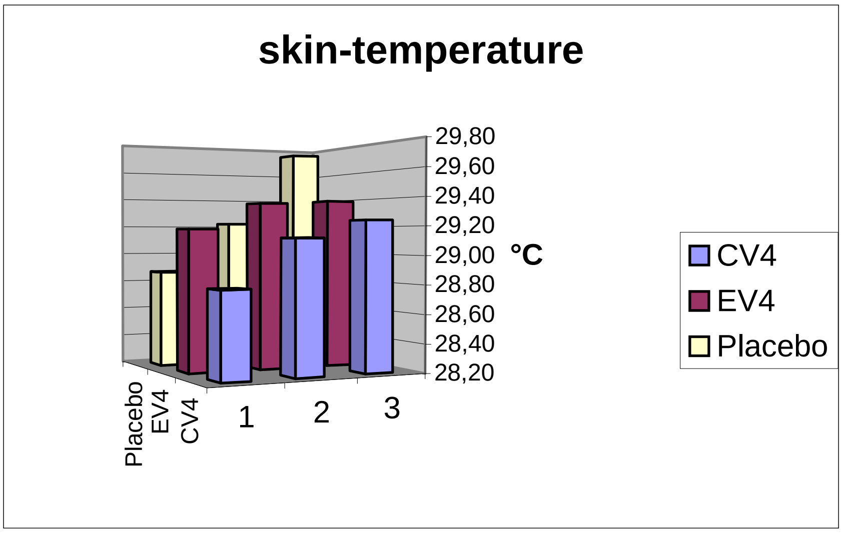
tab. 4 result / inference statistics

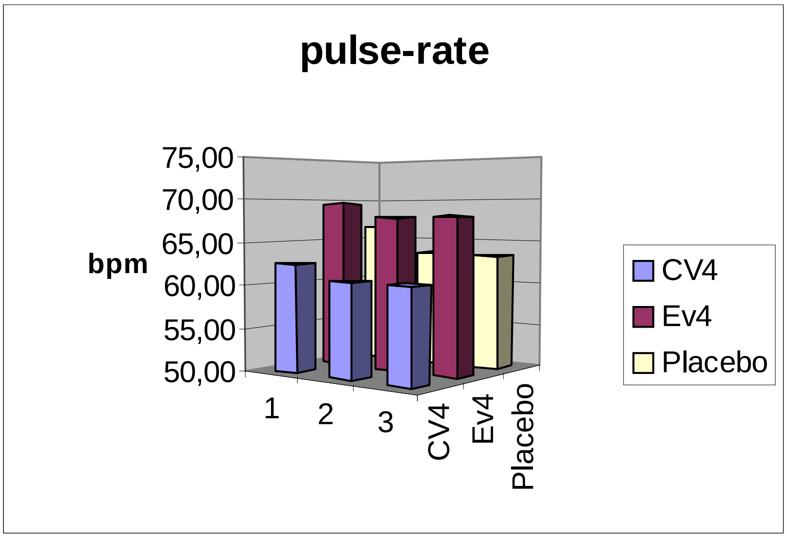
6.4 Description: mean values / 3 intervals

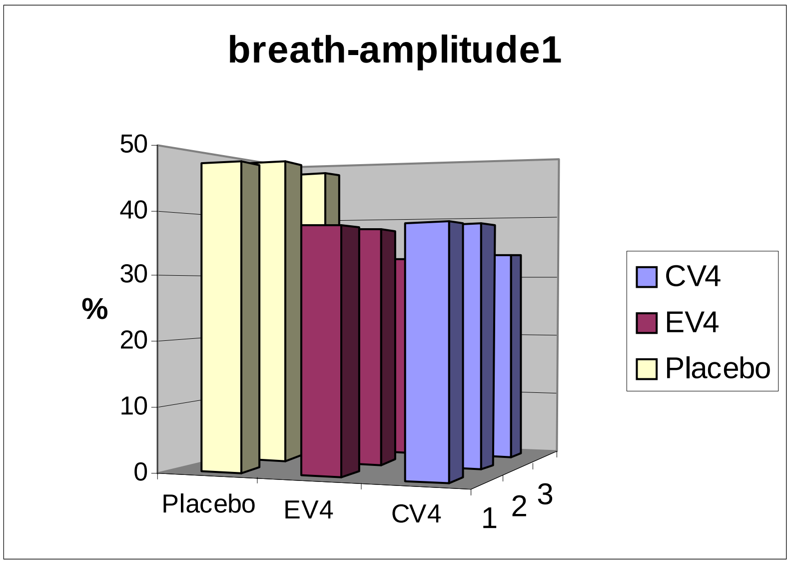
The charts below show the trends of the individual parameters.

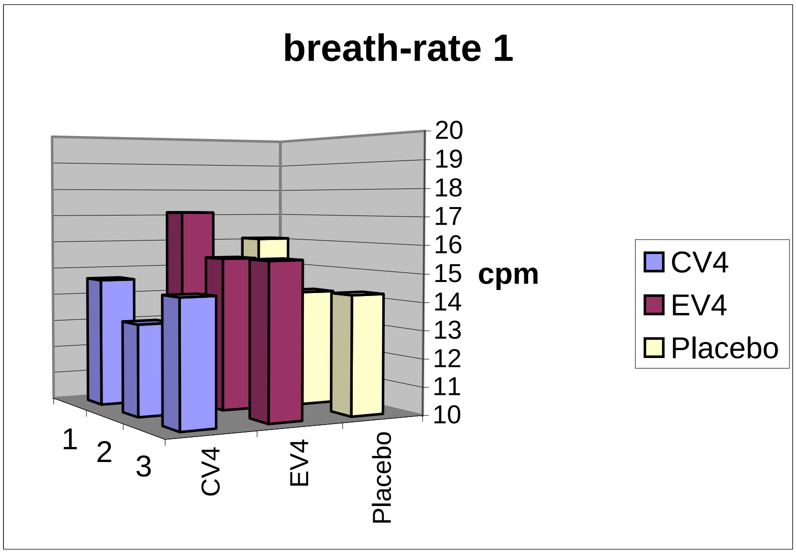
1. interval: measurement-value 1 - 17 Baseline
2. interval: measurement-value 18 - 38 0 - 5 minutes technique
3. interval: measurement-value 39 - 57 5 - 10 minutes technique






pulse-rate
bpm
75,00
70,00
65,00
60,00
55,00
50,00
1
2
3
CV4
Ev4
Placebo
CV4
Ev4
Placebo


breath-amplitude1
%
50
40
30
20
10
0
Placebo
EV4
CV4
1
2
3
CV4
EV4
Placebo


breath-rate 1
cpm
20
19
18
17
16
15
14
13
12
11
10
1
2
3
CV4
EV4
Placebo
CV4
EV4
Placebo

6.4.1 Diagram of tendencies

skin-conductivity	falling tendency	CV4 > EV4 > placebo
skin-temperature	rising tendency	placebo > CV4 > EV4
pulse-rate	falling tendency	CV4 / EV4 / placebo
breathing-amplitude 1	falling tendency	CV4 / EV4 > placebo
breathing-frequency 1	falling tendency rising	CV4 / EV4 / placebo CV4 after the “drop”

tab. 5 result / tendencies

6.4.2 Result:

The breathing-frequency showed a clear sign for the **CV4** technique by going back to the starting level after the **“drop”.**

All interventions had a more or less **parasympathetic tendency**.

7 Discussion

Concerning the question whether there is an identical or different effect using CV4, or EV4, the determining factor is the viewing angle and the observation method, because the changes in the parameters can be set in relation to the individual single-course of the subject, but also to the technique. The values of the parameters, as expression of the effect, can be interpreted individually or as a group.

7.1 Ad: “single-profile”

The course measurement of the **subjects** with their **individual reaction** sample shows that the techniques react more **“person-specifically”** as clearly “technique-specifically”. As the individual-profile shows, the pulse and breath-rate-mean-values sink from one intervention to the next, especially with CV4, if the subject has a higher pulse level. This effect cannot be verified for all subjects as this study does not explore any pathologies but the tendential characteristics of the techniques. The pulse-mean-rate of other subjects, who have through their fitness level a low pulse rate, rose. Immediate effects shall therefore be differentiated from mid-term effects. The course-measurement result and the mid-term changes are however an indication of the **harmonizing** respectively **homöostatic influence** of the techniques as reported by Jealous[35], and they have a say in the matter of indications as well as for the therapeutic process.

7.2 Ad: Technique

Because of the inclusion and exclusion criteria and the environment conditions the subjects are already prior to the techniques in a relaxed atmosphere. An important result of the study is that despite these preconditions there are **significant changes in the parameters via the CV4 , EV4 and placebo-techniques over the time (inference statistics).**

[35]JEALOUS James: WSO Seminar: Biodynamische Kranialosteopathie, notes, Pöttmes 2000

It seems that, globally seen there is no difference between all techniques. However, if one takes the statistically prepared parameters with their highly significant to significant reliabilities into account, then there are indeed **subtile differences** to be seen between all techniques in the course of the measurement.
In the **descriptive statistics**, the techniques show **"stimulus-specific"** responses in skin-conductivity, skin-temperature, breath-rate and breathing-amplitude.

7.3 Ad: parameter

The subject's psycho-physiological state is best reflected by **skin-conductivity** and delivers relevant information about the level of vegetative (sympathetic / parasympathetic) and psychic excitement and/or relaxation. As skin-conductivity reacts to outer and inner stimuli, it was tried to secure similar preconditions for the measurement, but environmental influences active on the subjects such as conflicts, resolutions, worries, mood, etc. cannot be completely eliminated. The beginning level shows for several subjects that there are important differences that can have been brought on by either positive or negative emotionally loaded thoughts. Several subjects show a small rise at the beginning of the technique as well as with two subjects (subject 8/placebo, subject 9/CV4) who fell asleep and dreamed towards the end of the intervention.
It is interesting to note that the **skin-conductivity level is higher in the placebo**-technique than in the CV4- and EV4-technique. The **CV4 deviation is very small** compared to the placebo's und EV4's. These facts can either be seen as indication of a deep relaxation or a decrease of sympathetic activity due to CV4. This trend can also be an indication that the placebo-technique does not influence the psycho-vegetative area as much as CV4 and EV4. Skin-conductivity as a factor of expectation that an intervention will be done, stays on the higher level of expectation, because no cranial technique is used.
The craniosacral concept works with very subtile, minimal but very precise techniques. It is therefore possible that this small difference is due to the technique's focus on the fourth ventricle.

A decrease in the sympathetic tone causes warming of the skin via a stronger blood-flow. Aside from thermoregulation, psycho-vegetative processes also play a role, especially in the hand area. In the placebo-technique, **temperature** rose higher as in CV4 or EV4. Temperature and skin-conductivity thus **differ** in their **course** and **intensity** in all three techniques. In the placebo-technique, the rise in temperature is possibly due to the breathing- or cardio-vascular-system.

Breathing sensor 1 and 2 show almost identical results, therefore only breathing sensor 1 was evaluated, to decrease the spread in measuring data of the **respiratory-system**.

The obvious breathing form (belly or breast-breathing) is a product of the usual breathing pattern and the current situation or level of activity. Calm breathing causes a CO_2 blood concentration rise which leads to venal stretching and a better blood supply as mentioned above.

Generally, the **breathing became** more **harmonious** or more **regular** and its rate decreased, like Magoun[36] and Wales[37] described. The CV4 breath-rate is to be handled differently. Of visible significance is the **"drop" occuring in CV4** in the middle and the subsequent rise as well as by far **smaller deviation.** The "drop" is comparable to the procedure of the technique, the breath-rate falls and rises simultaneously to the slowing down or acceleration of the longitudinal fluctuation. What is also noticeable is the approximately constant level of the breathing-amplitude in the placebo-technique.

This result is possibly an indication that CV4 has another influence on the respiratory system and to the autonomic centres than the EV4 or placebo-technique.

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[36] MAGOUN Harold: Osteopathy in the Cranial Field, Original Edition, 1951, 2nd Printing, Sutherland Cranial Teaching Foundation, Cincinnati, Ohio: The C. J. Krehbiel Company, 1997, p.83

[37] WALES Ann: "The management, reactions and systemic effects of fluctuation of the cerebrospinal fluid" in: Journal of the Osteopathic Cranial Association, p.46 published by The Osteopathic Cranial Association, 1953

A clear relationship exists between breathing and heart-rate. Deep calm breathing normally modulates the heart's rhythm (respiratory sinus arrhythmy = RSA: heart frequence rises through breathing in and falls when breathing out) and slows down the pulse-rate in her tendency.

As each person has a characteristic **pulse-rate** at rest that depends among others on his fitness level, a large value deviation is called forth. Active, vegetative and central nervous parts, physical performance, cognitive behavior as well as breathing activity all influence the heart-rate. Pulse- and breath-rate should occur in a synchronized manner due to their preconditions at rest, as calm relaxed breathing leads to a decrease in the pulse-rate. The descriptive statistics also shows here a minimally different picture for CV4 where the pulse-rate does not increase with the breath-rate in the last third.

The rise in breath-rate is noticeable from outside and could be the basis for Dovesmith's[38] observations that CV4 (extension of the occiput) has a sympathetic effect. For the other parameters a sympathetic effect is not to confirm. As each profile shows an individual reaction pattern, as described above, this fact can also be the basis for Dovesmith's thought model.

7.4 Ad: parameters combined action

The **parameters** taken are to be seen in their **combined action** as indicators of a person's relaxation level.

Relaxation is a process that comprises the simultaneous activation-changes of several systems. These include the muscular, cardiovascular, autonomic, endocrine and cognitive systems. Relaxation cannot be forced but is much more like a vegetative reaction that occurs by itself when the external and internal conditions allow it. A parameter alone therefore cannot prove a person's general relaxation level and it could cause wrong interpretation.

[38] DOVESMITH E.Edith: "Fluid fluctuation and the autonomic system", in: Journal of the Osteopathic Cranial Association, p.54-61, published by The Osteopathic Cranial Association, 1953, p.55

If one takes the measuring data of the individual parameters into account, a **general parasympathicotone tendency can be seen for CV4, EV4 and placebo.**

The changes are different for the individual parameters as well as for their combined effect. The immediate technique-specific parasympathetic tendencies are an expression of rest and regeneration through which the self-healing forces can be stimulated. As the placebo-technique moves in this direction as well, one has to wonder what causes could be responsible for this. Under certain circumstances the position of the hands in the occipital area may have an influence. A therapeutic process probably takes place, that one does not ackowledge on purpose as it is extreme difficult, almost impossible "not to feel anything and to do nothing".

Perhaps the reason for this effect is the touching of the head. *"Knowing by applied, respectful touching, that is targeted to the patient as a whole, always has an effect on the oldest parts of our sensory system. The person treated increasingly feels his decreasing muscle-tone, the deepening breathing and its regularity, his comfort. He feels his most primitive behavioral scheme, that is the one originating from man´s early developmental history"* writes Feldenkrais[39].

Another aspect is the placebo effect such as it is known in other medical fields (e.g. medication).

Interestingly, if one compares techniques, the beginning values of the individual parameters are on very different levels. Unfortunately I could not find any suitable model for this phenomenon, even after consulting colleagues. It is probably due to the insufficient members of subjects. It is also possible that already in the beginning phase or when attaching the sensors in nonverbal areas, a communicative exchange of information and therefore an influence on the part

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[39] LIEM Thorsten: Kraniosakrale Osteopathie, Stuttgart: Hippokrates Verlag, 1998, p.269

of the subjects could occur. Watzlawick[40]/quotation: *“One cannot **not** communicate”*.

7.5 Points of criticism

Unfortunately the marker could not be statistically valued at the time of the stillpoint as the **changing staff of the marking** often had insufficient PC experience and did not pay attention to the position of the cursor when clicking the mouse.

After the study was completed, it turned out in conversations with some subjects, that they could feel whether a cranial- or placebo-technique was being applied. An additional **questionnaire** would enrich this study but I thought it to far reaching at the point in time (planing stage) for this project. The level of agreement would be interesting to see.

[40] WATZLAWICK et al: Menschliche Kommunikation, Formen Störungen Paradoxien, 10. Auflage, Bern: Hans Huber Verlag, 2000

7.6 Consequence

The selection of time-intervals is decisive for the interpretation to show the techniques' immediate reactions on physiological functions and parameters. The inference statistics with mean values of three time-intervals show significant changes, but cannot show the techniques' characteristic signs. The descriptive statistics with mean values of eight time- and three time-intervals present a different way of responding and document the difference between placebo-EV4- and CV4- technique.

The inference statistics confirm hypothesis 1, whereas the descriptive statistics confirm hypothesis 2.
The results of this study seems to favour the classic CV4 technique, because EV4 reveals no technique-specific response.

- Regardless of the applied technique or placebo, the practitioners touch "affects" the person and thus has an effect on his physiological functions.
- The comparison with the placebo-technique underlines the existence of an **effect by the cranial techniques.**
- The comparison showes **"technique-specific" signs** such as the **"drop"** (breathing frequence) and a **small deviation** in skin-conductivity by CV4 and the high deviation of skin-conductivity by placebo.
- The results of this study strengthen the assumption of the harmonizing influence on the autonomic centres, especially through CV4.
- CV4, EV4 and placebo present **parasympathetic tendencies** with different characteristics.
- When CV4 was applied, healthy subjects generally showed more reactive responses during the course-measurement and after one week. This has to be seen as a **"person-specific"** response.

This study is a contribution to render craniosacral techniques objective and offers basic information on the changes in autonomous body functions during a CV4, EV4 and placebo-technique application, that could be used as comparison values for further studies with specific pathologies.

The unaspected rise of the pulse-rate's mean value in trained individuals one week after a CV4 could probably be of interest. The implications of this rise could be of significance in the treatment of athletics for their training in preparation of a competition.

8 Summary:

This study investigated whether there is a measurable difference between the two cranial techniques CV4 and EV4. Additionally a placebo-technique serves the purpose of comparision and objectivity. The cranial techniques focus on the fourth ventricle with the neighbouring autonomic centres. The measuring was taken via a Biofeedback-system and the following parameters of physiological bodyfunctions were registered: skin-conductivity, skin-temperature, pulse-rate, breath-rate and breathing-amplitude. After a one week interval and a preceding rest phase 12 healthy subjects got one of the two cranial techniques or placebo-technique. Inclusion and exclusion criteria concerning the subjects, but also conditions necessary for the room had to be met in advance.

The individual courses showed that the parameters changed at the beginning of the technique and each subject presented an individual profile of "person-specific" effects.

The inference statistic demonstrated over the period of time that all parameters showed significant even highly significant changes, but no significant differences between the techniques.

The descriptive statistics presented for the breath-rate subtile differences in form of a "technique-specific" "drop" when CV4 was used. Skin-conductivity showed a very small deviation in CV4 versus EV4 and especially placebo-technique. Skin-conductivity was generally at a markedly higher level with the placebo-technique.

The cranial techniques showed also a parasympathetic tendency for CV4, EV4 and placebo, with varying intensity.

The results of this study strengthen the assumption of the harmonizing influence on the autonomic centres, especially through CV4. The comparison with the placebo-technique underlined the existence of an effect by the cranial techniques. The conclusion of this research tend to support the application of CV4 as EV4 does not show any technique-specific signs.

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10 Appendix

10.1 Index of illustrations

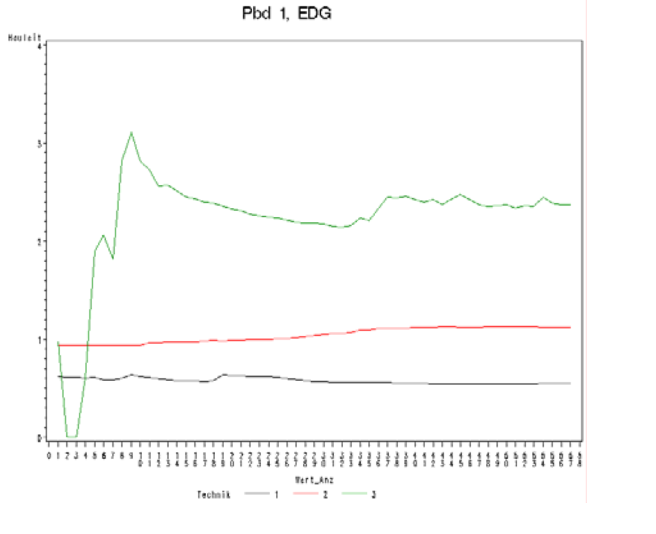
10.2 Index of tables

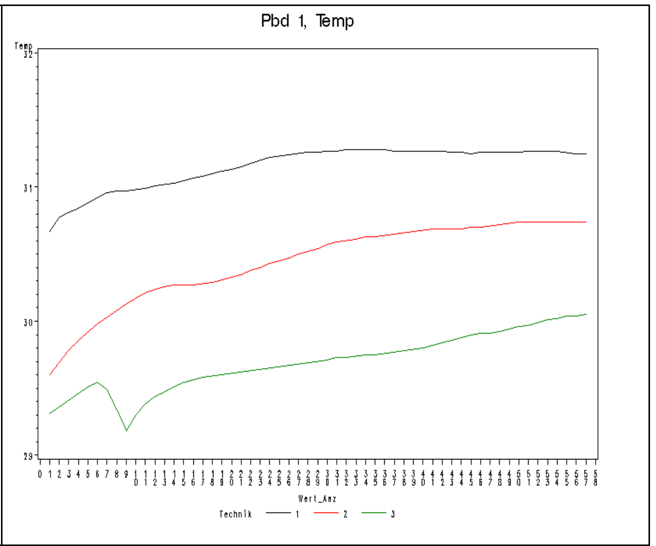
10.3 Abreviations

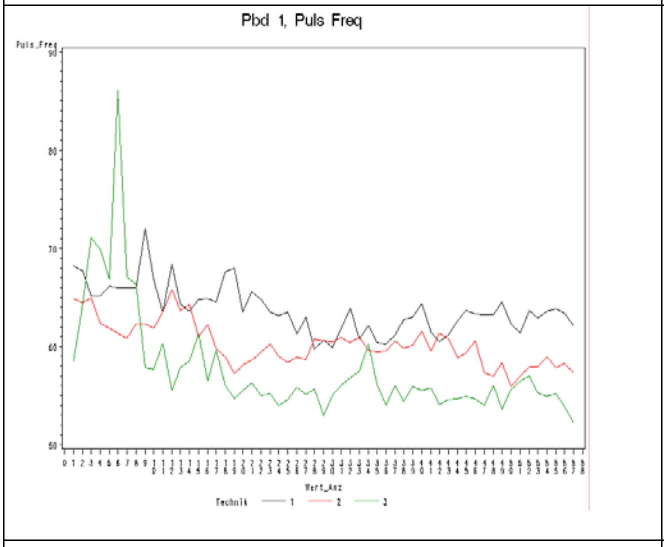
ANS	Autonomic Nervous System
BFB	Biofeedback
bpm	beats per minute
CI	contraindication
CNS	Central Nervous System
cpm	cycles per minute
CRI	Cranial Rhythmic Impulse
CSF	Cerebro-Spinal-Fluid
CV4	Compression of the Fourth Ventricle
EDG	Electrodermography
EV4	Expansion of the Fourth Ventricle
µS	micro-Siemens
p	probability
Pbd	Proband (engl.: subject)
PPG	Pulsplethysmography
SBS	Spheno-Basilar-Symphysis
sign.	significant
TEM	Thermistor-measurement

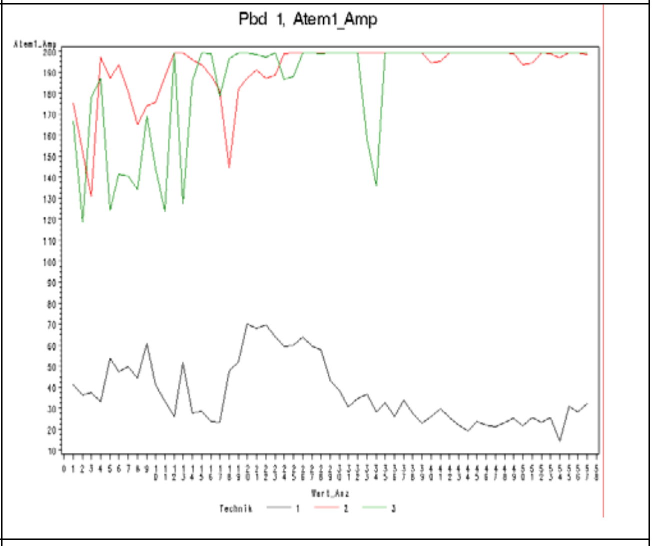
10.4 Descriptiv statistics

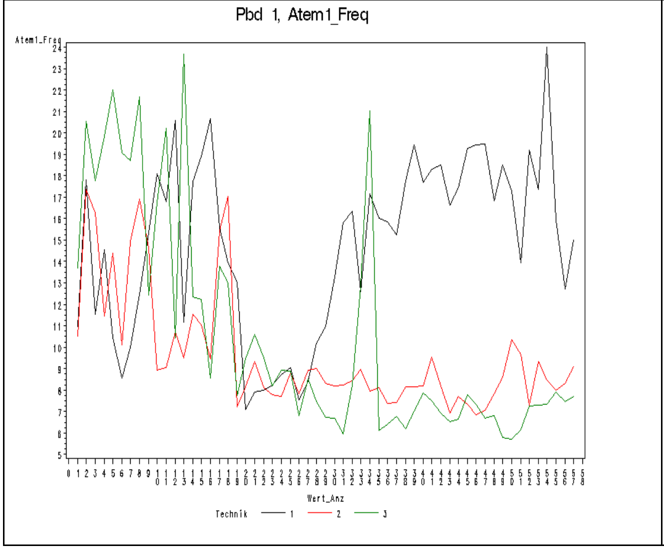
Made by Michael Benesch, Wien, 2001











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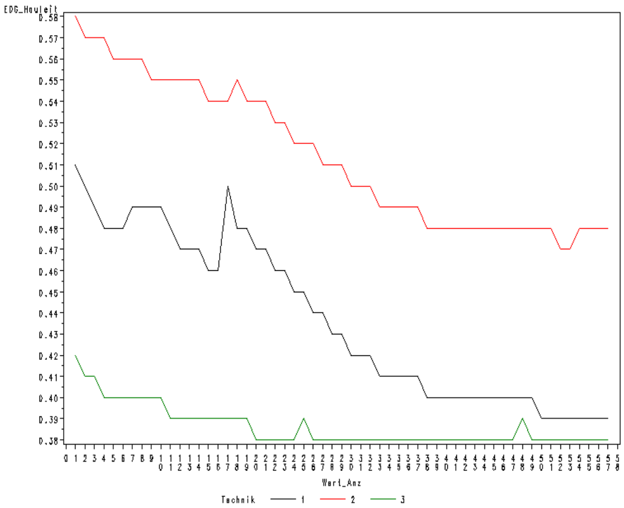

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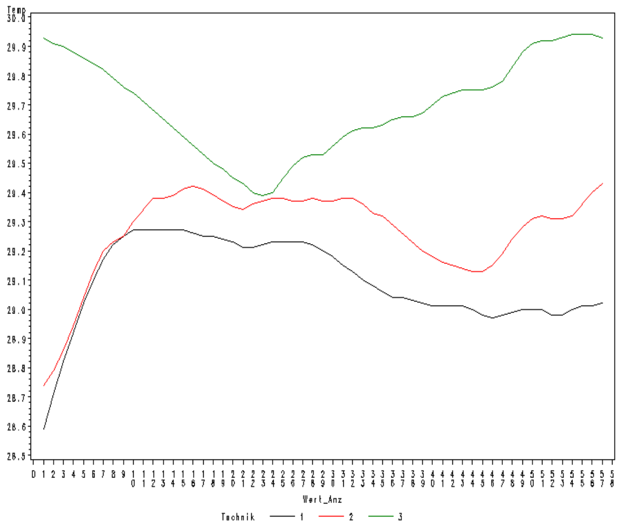

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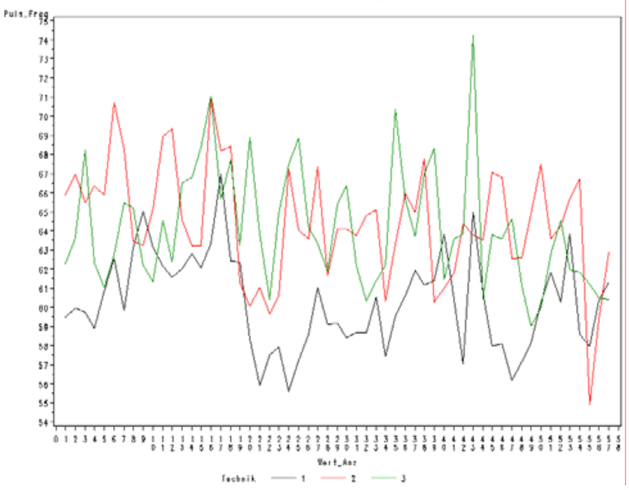

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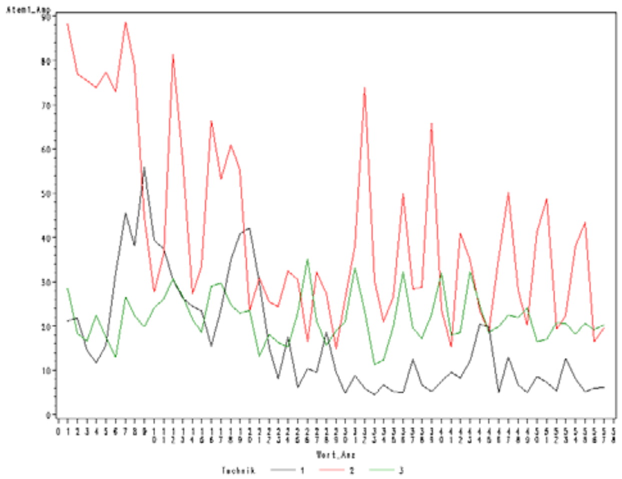

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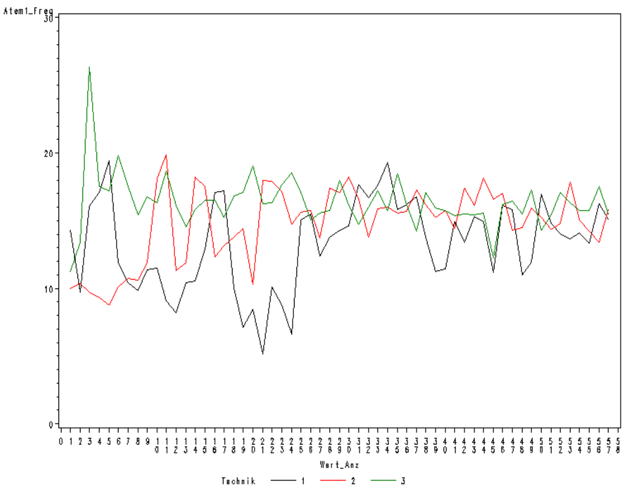

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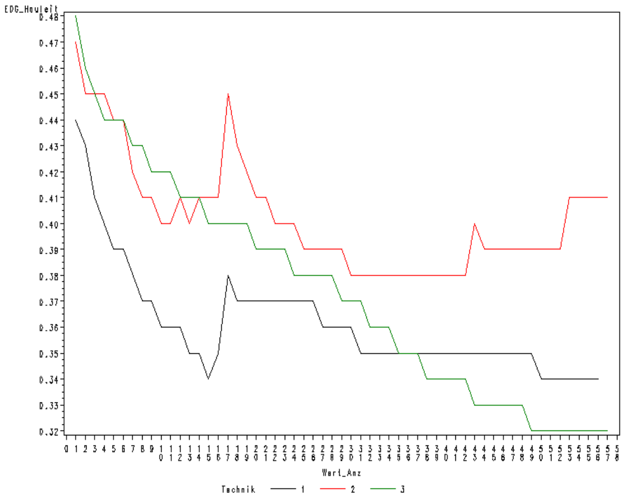

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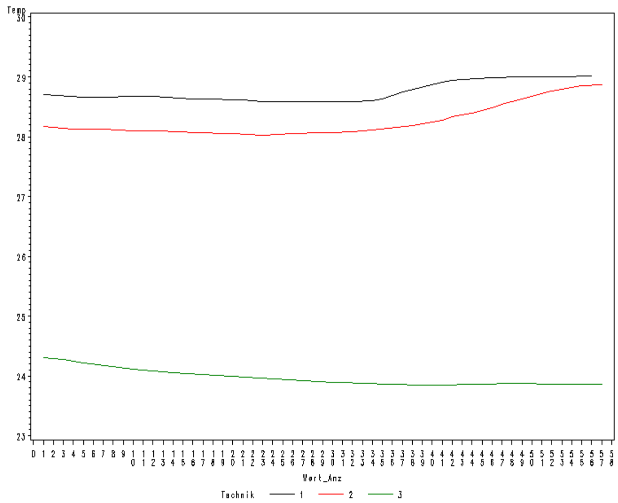

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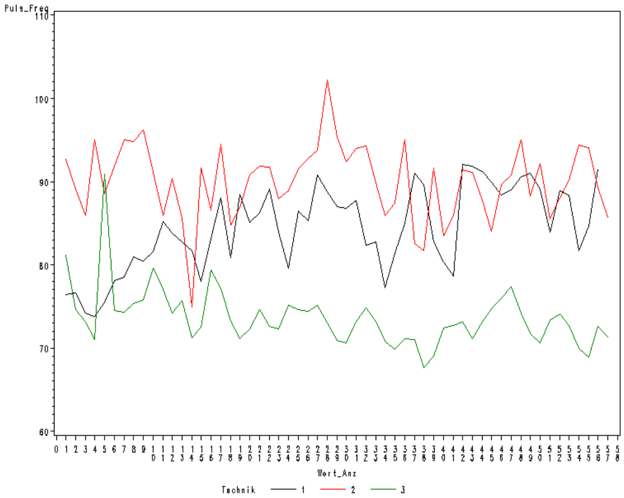

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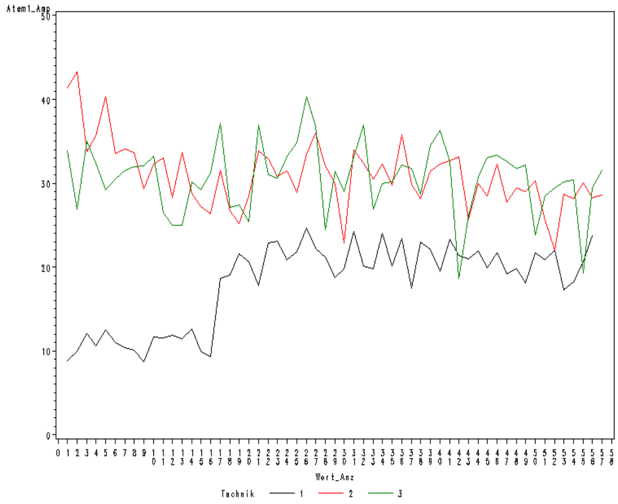

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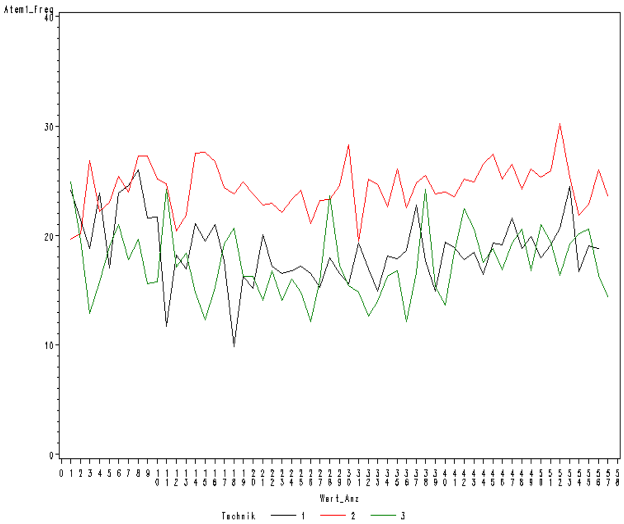

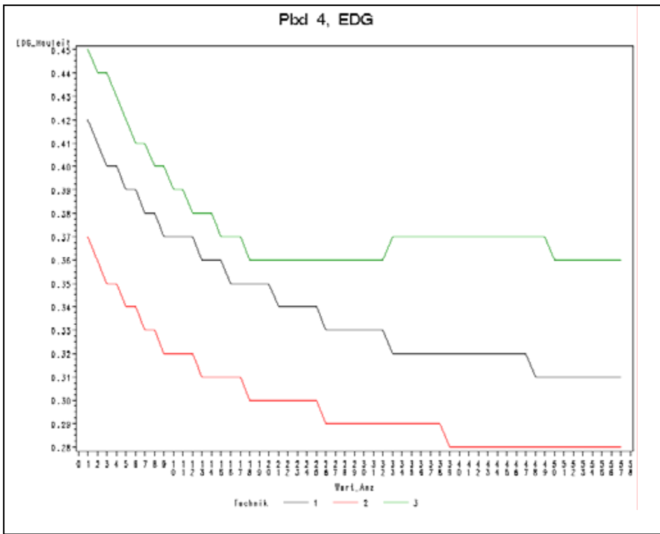
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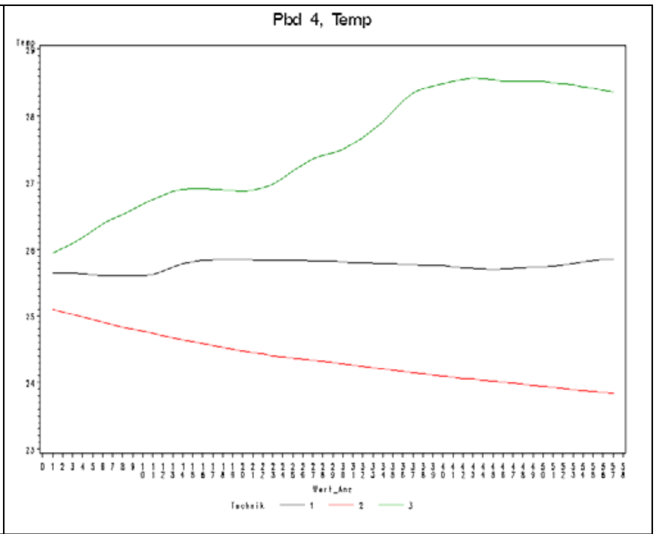
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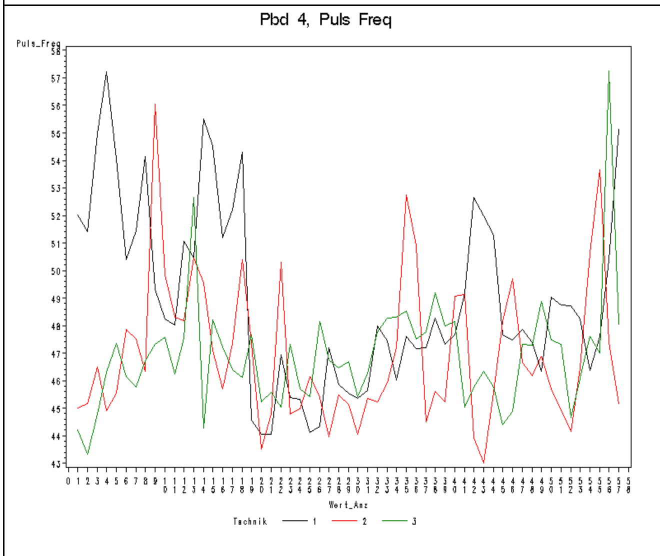
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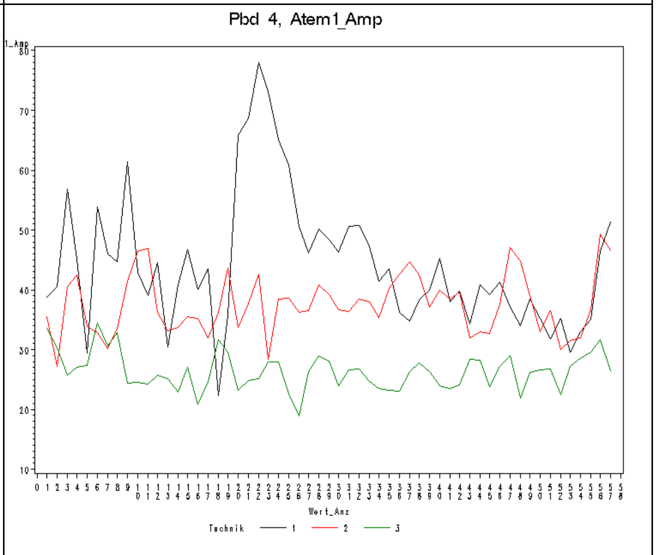
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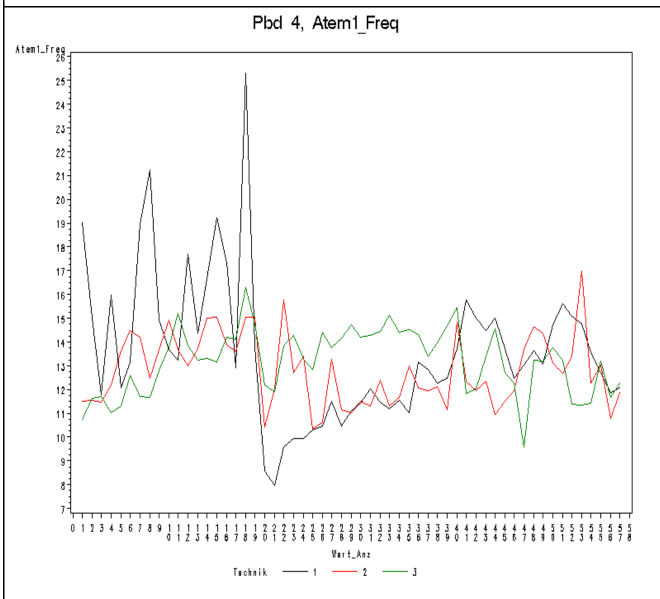
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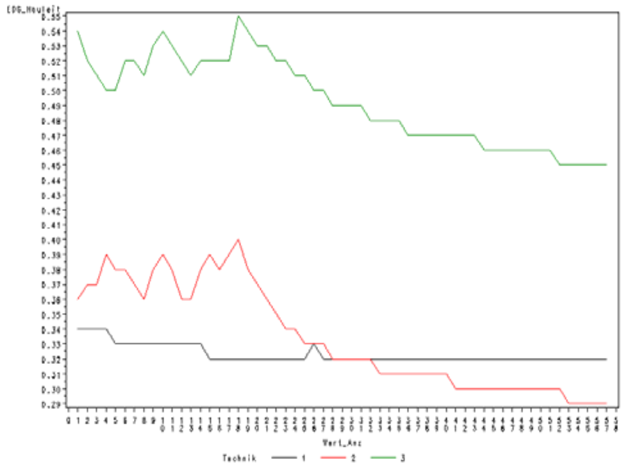

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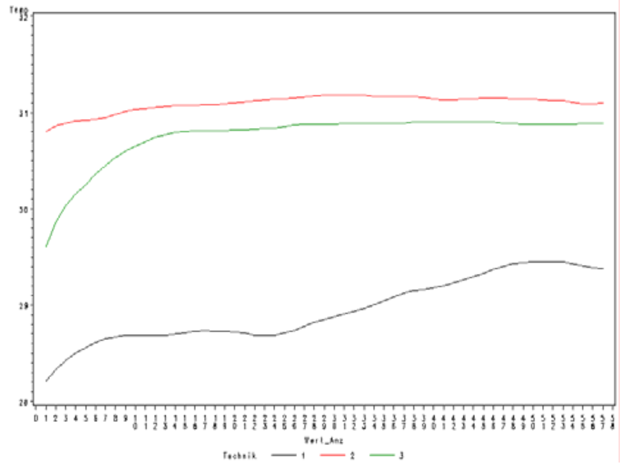
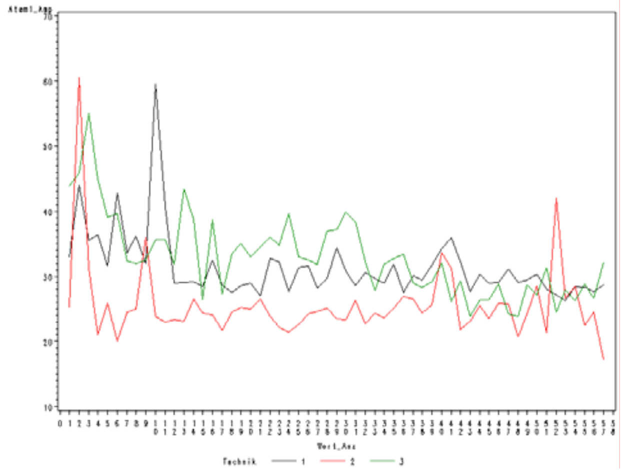
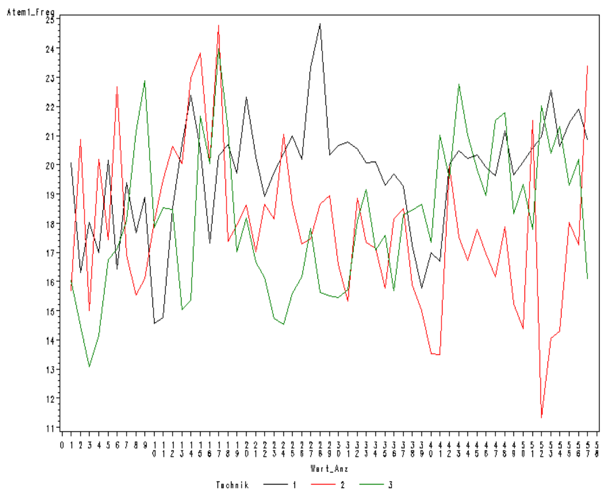


Pbd 5, Puls Freq

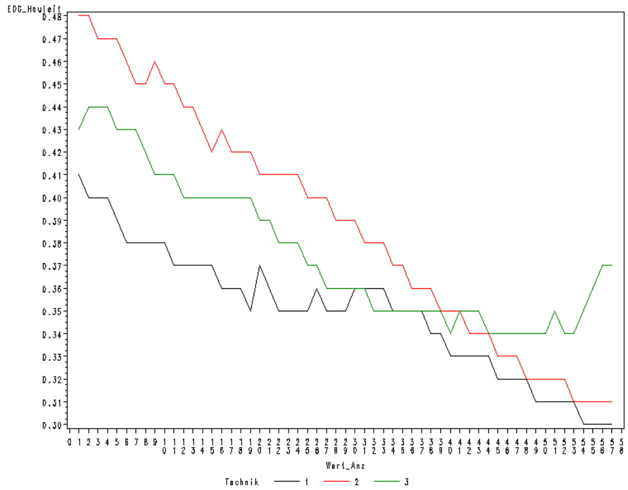
Pbd 5, Atem1_Amp



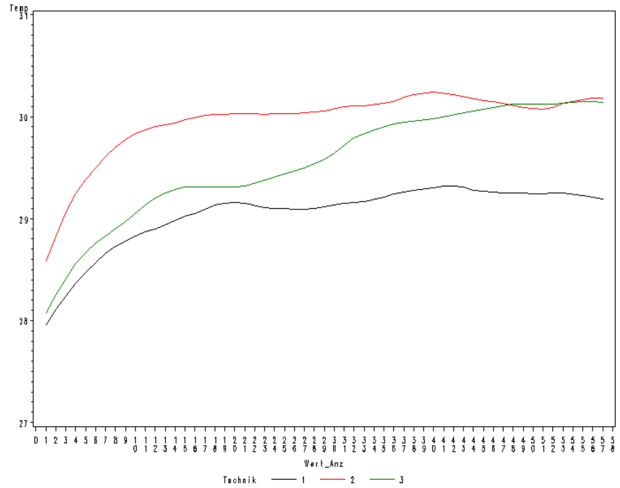
Pbd 5, Atem1_Freq



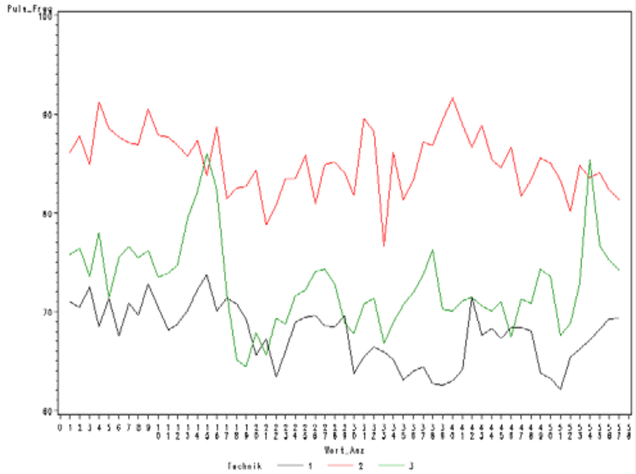
Pbd 6, EDG



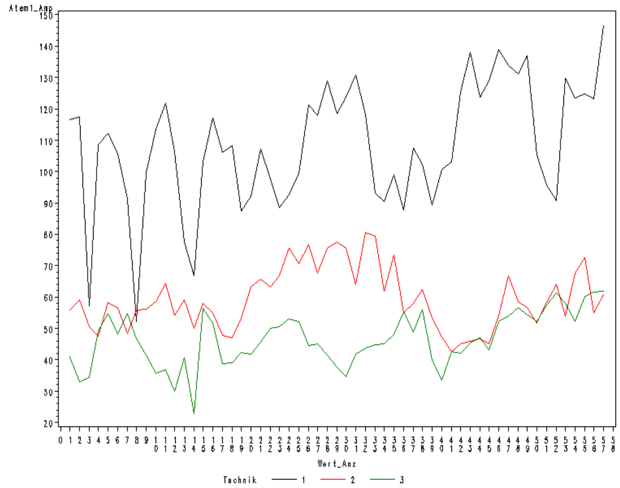
Pbd 6, Temp



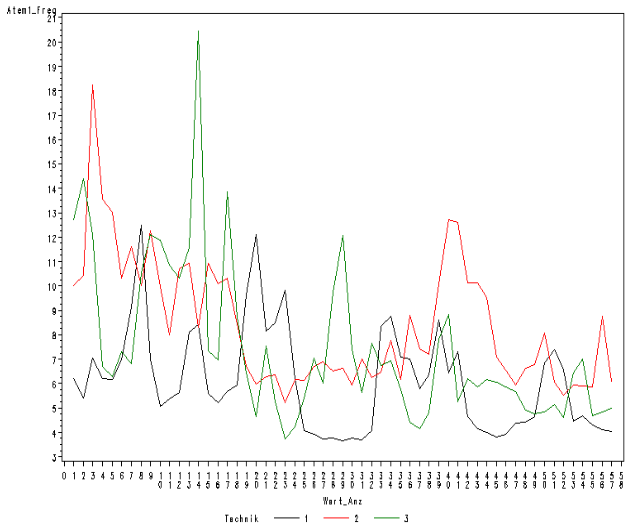
Pbd 6, Puls Freq



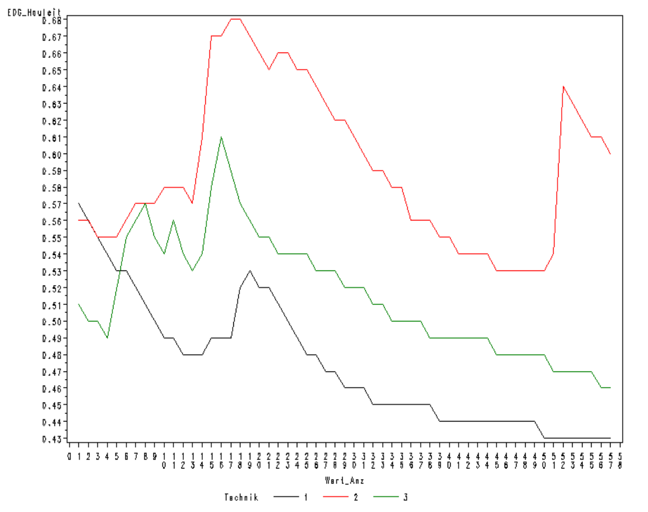
Pbd 6, Atem1_Amp



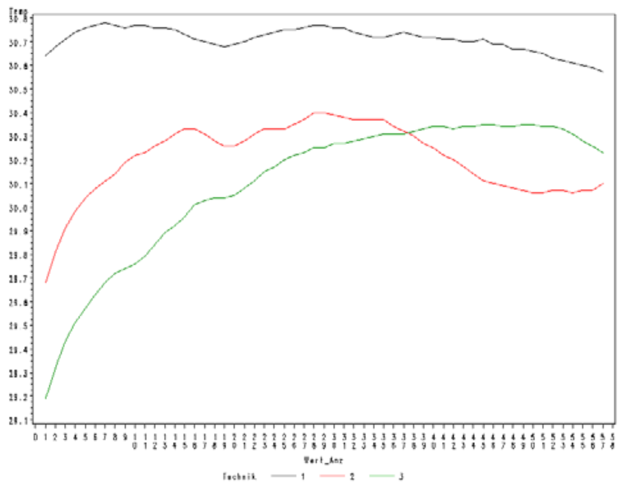
Pbd 6, Atem1_Freq



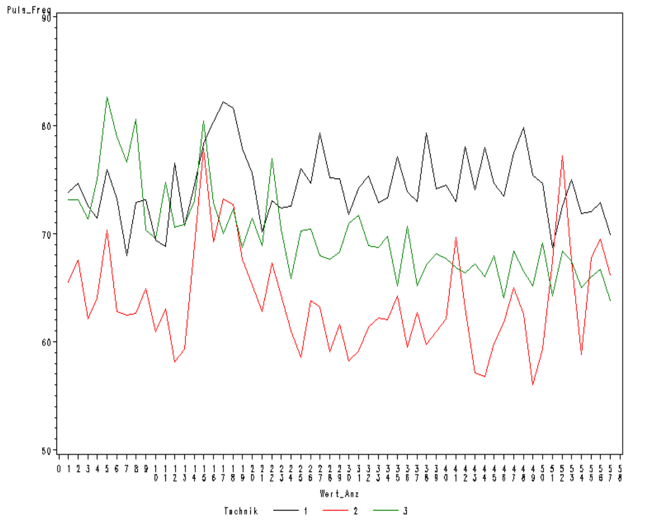
Pbd 7, EDG



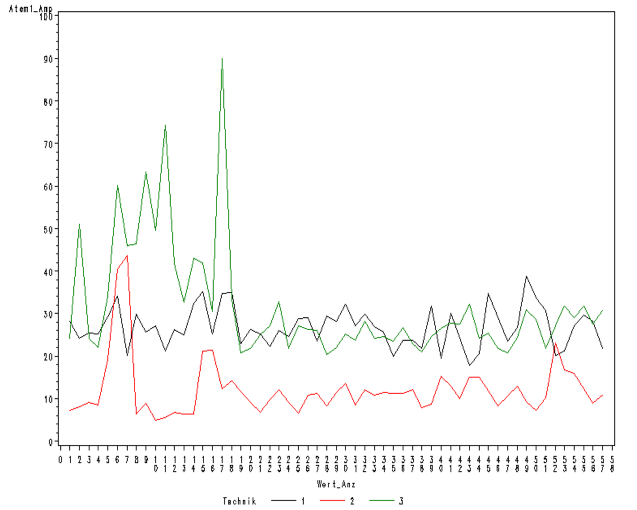
Pbd 7, Temp



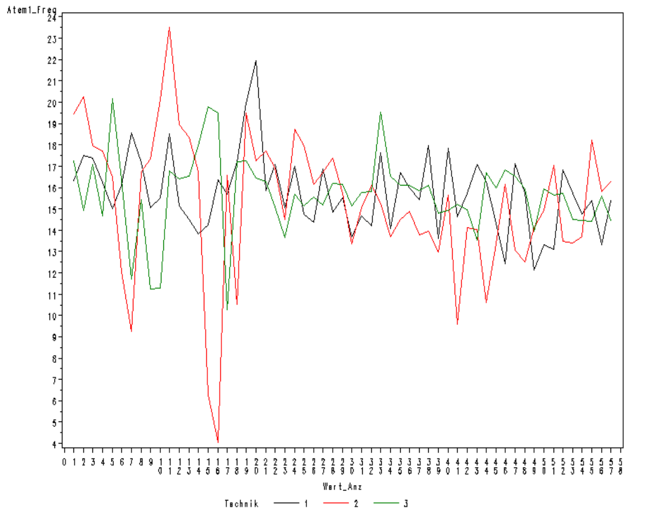
Pbd 7, Puls Freq



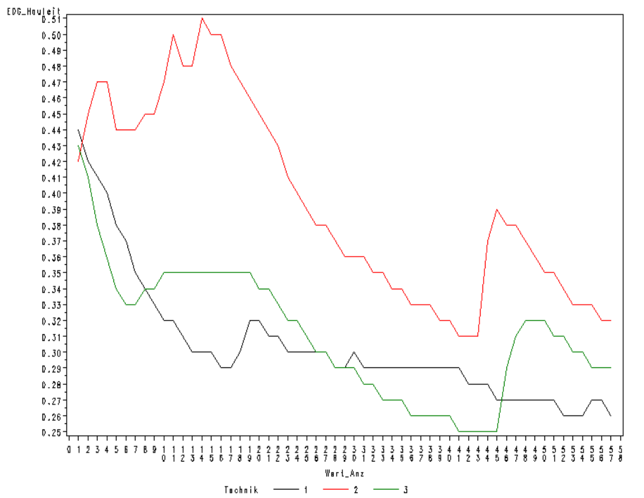
Pbd 7, Atem1_Amp



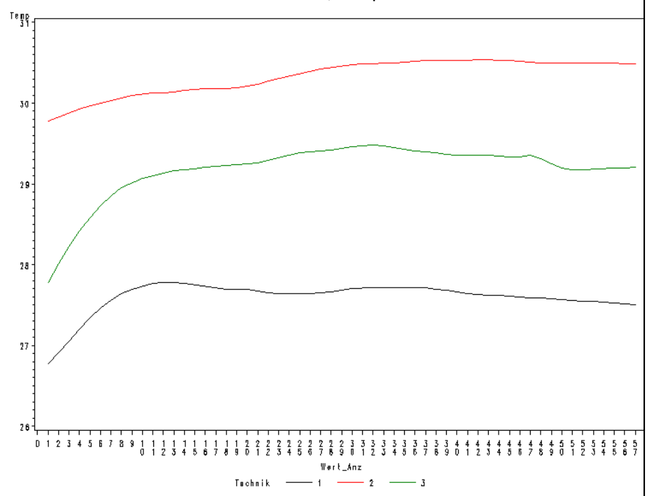
Pbd 7, Atem1_Freq



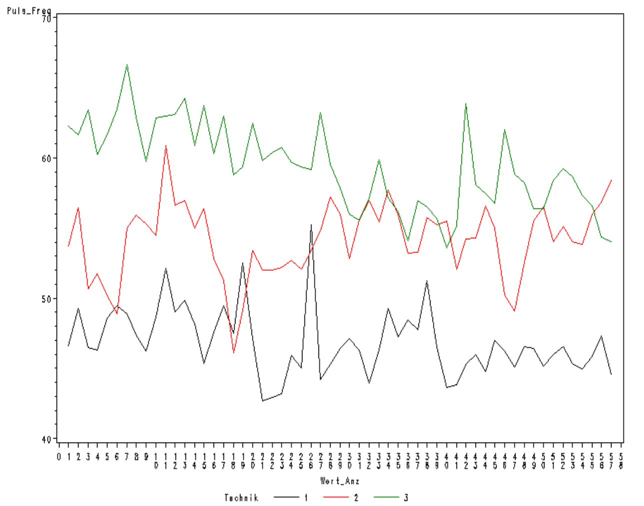
Pbd 8, EDG



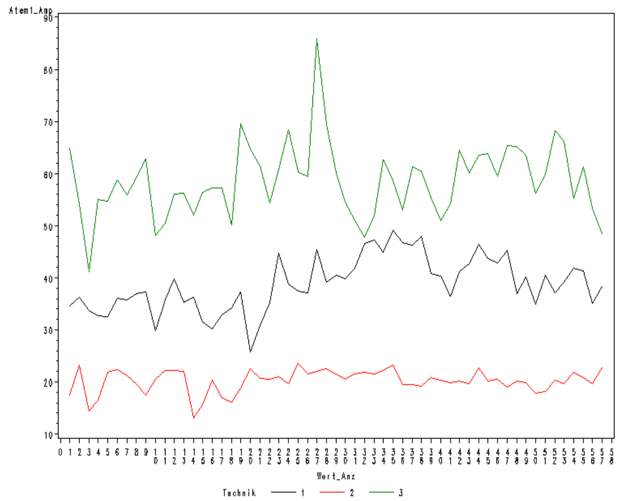
Pbd 8, Temp



Pbd 8, Puls Freq

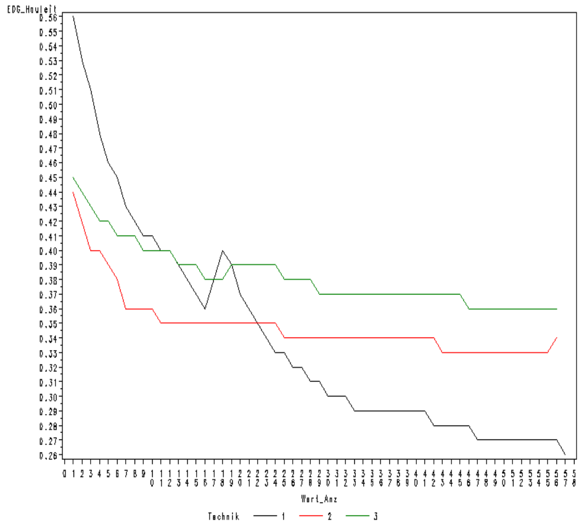


Pbd 8, Atem1_Amp

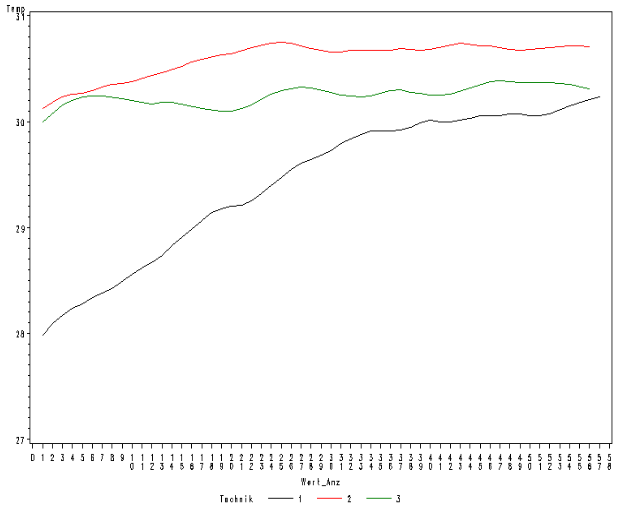


Pbd 8, Atem1_Freq

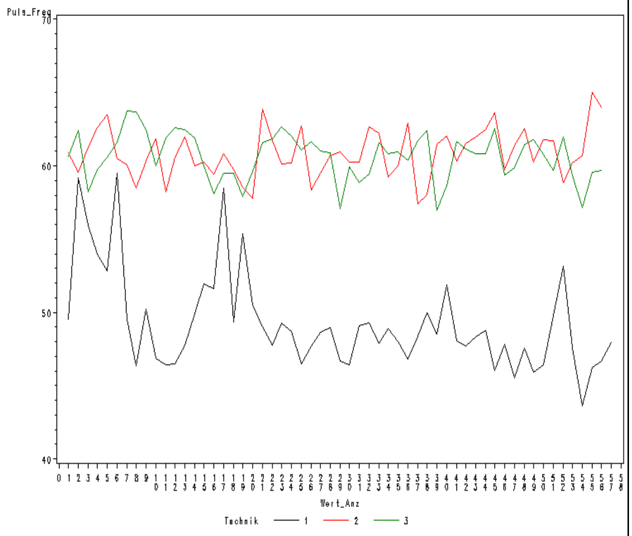
Pbd 9, EDG



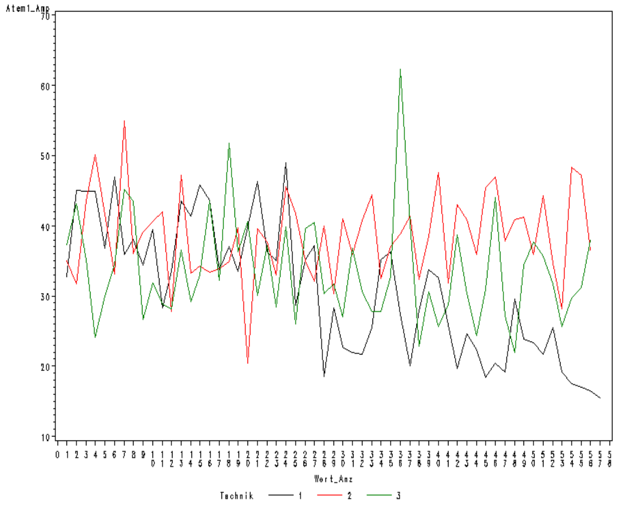
Pbd 9, Temp



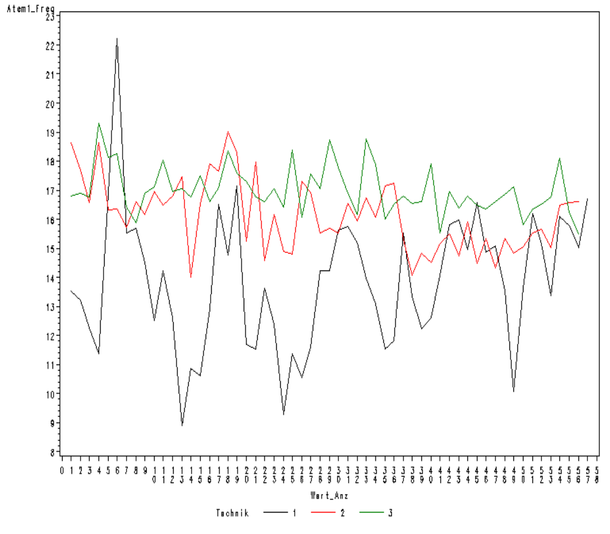
Pbd 9, Puls Freq

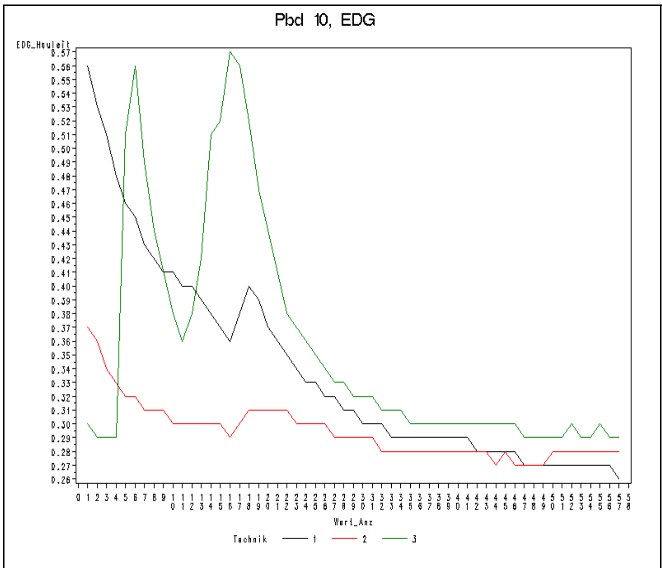


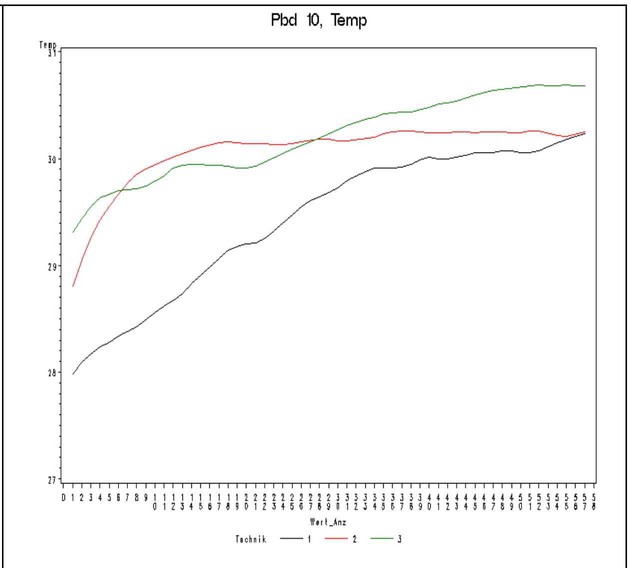
Pbd 9, Atem1_Amp

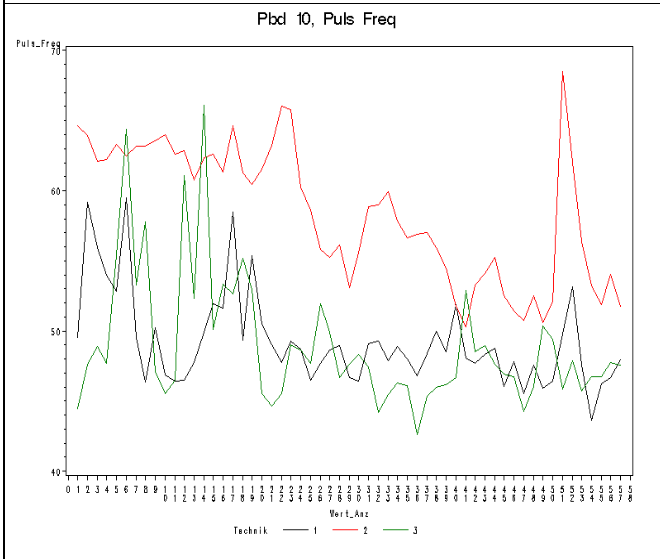


Pbd 9, Atem1_Freq




Pbd 10, EDG
EDG_Houlelt
Wert_Anz
Technik 1 2 3


Pbd 10, Temp
Temp
Wert_Anz
Technik 1 2 3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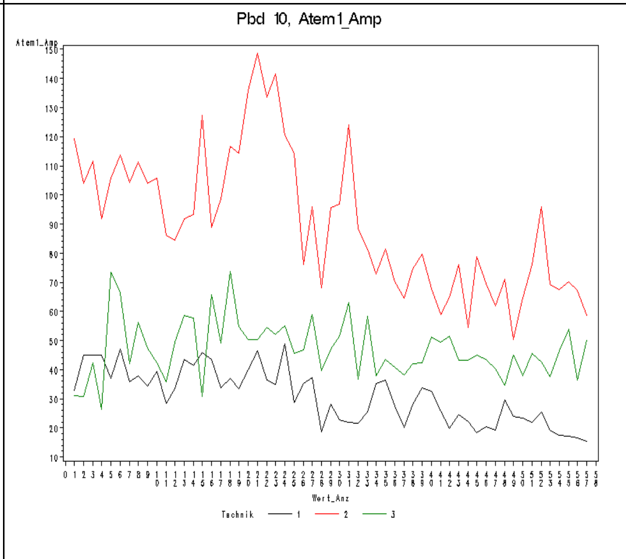
Puls_Freq
Wert_Anz
Technik 1 2 3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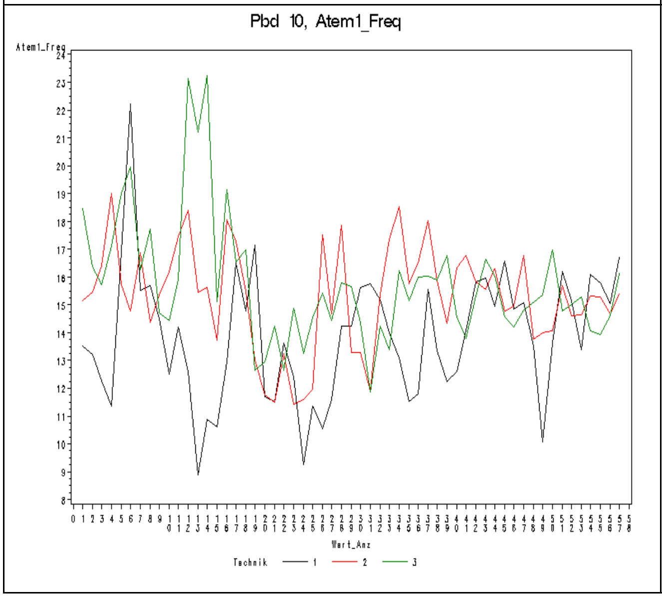
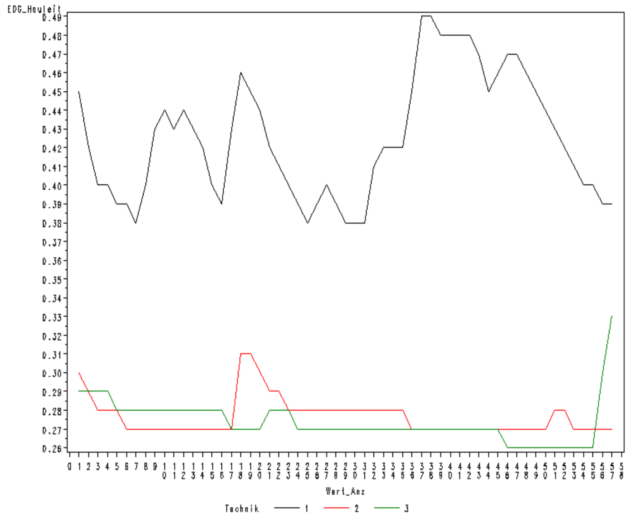
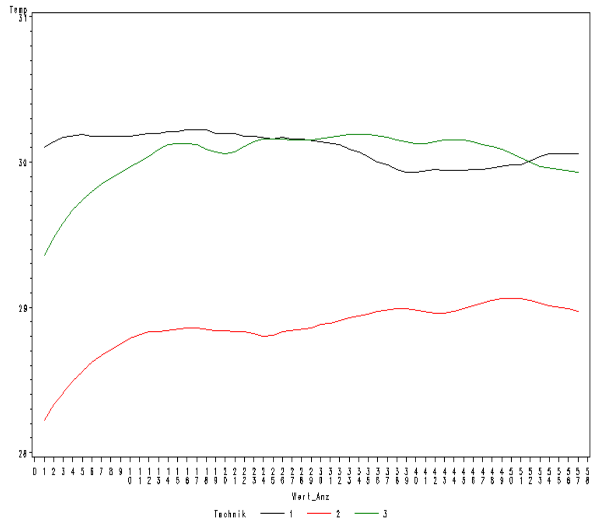
Technik 1 2 3


Pbd 10, Atem1_Freq
Atem1_Freq
Wert_Anz
Technik 1 2 3

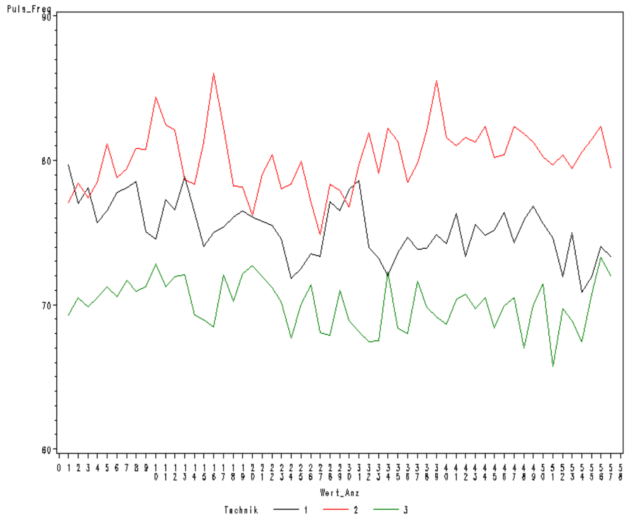
Pbd 11, EDG



Pbd 11, Temp



Pbd 11, Puls Freq



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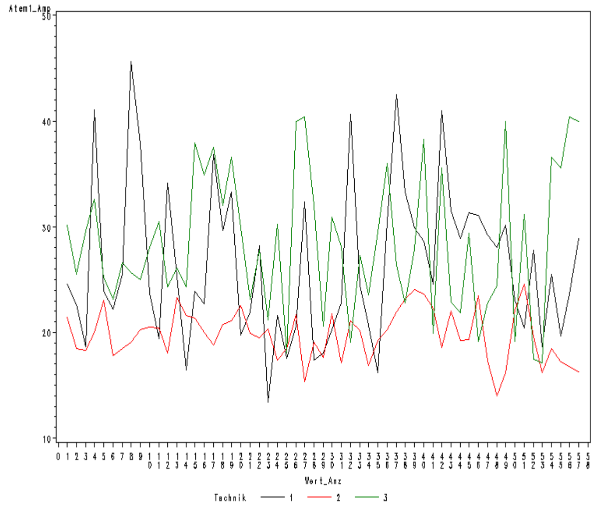
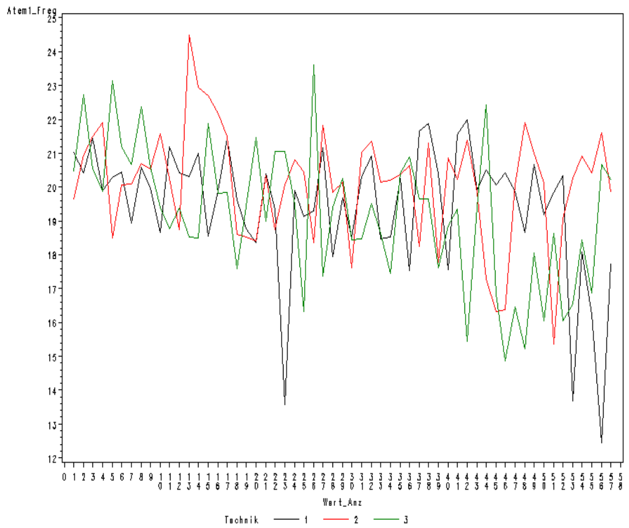
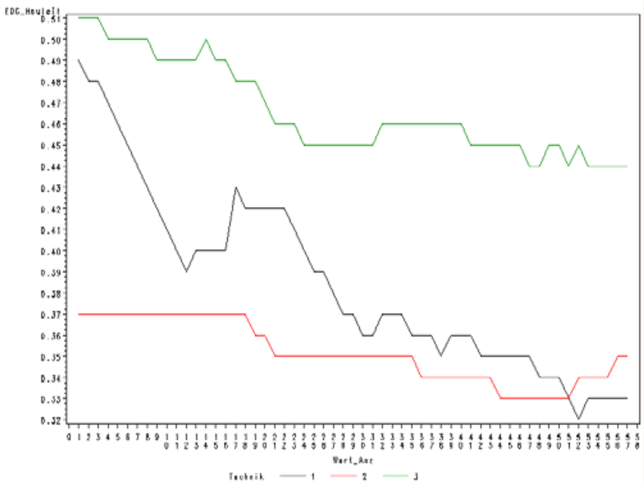


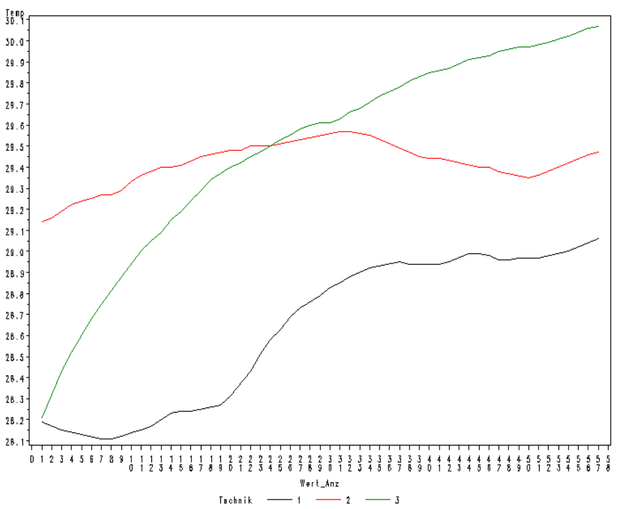
Pbd 11, Atem1_Freq



Pbd 12, EDG



Pbd 12, Temp



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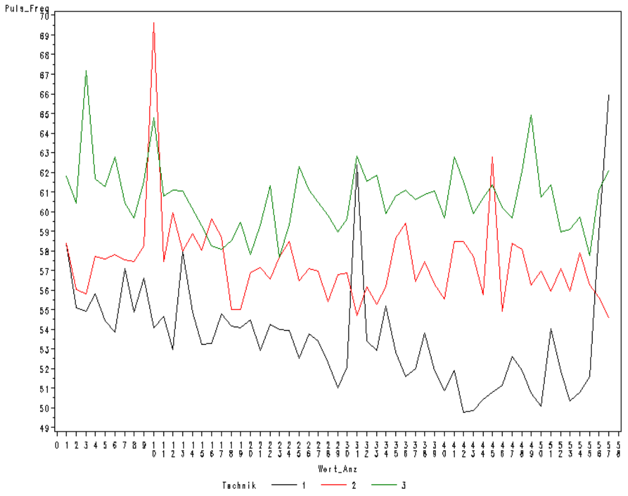

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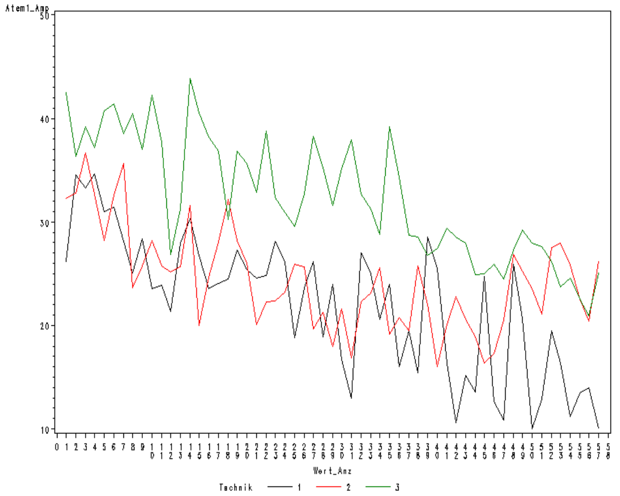

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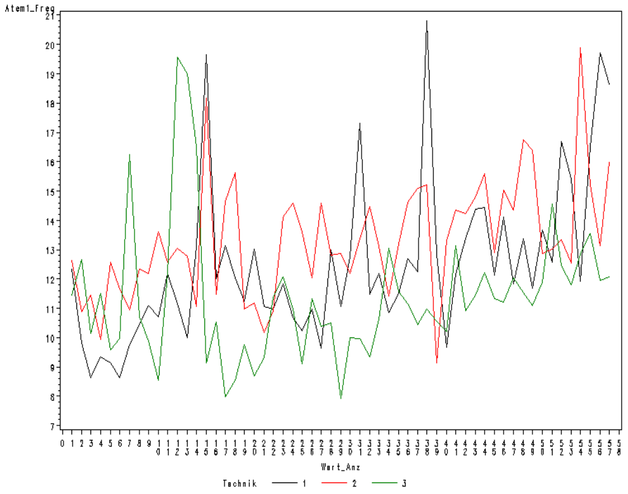

10.5 Inference statistics

Made by Michael Benesch, Wien, 2001

Skin-conductivity

Source	DF	Type III SS	Mean Square	F Value	Pr > F
sequenz	5	5.23609332	1.04721866	1.01	0.4842
Error	6	6.20919129	1.03486522		

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik	2	0.45357904	0.22678952	1.76	0.2144	0.2317	0.2144
technik*sequenz	10	2.05080222	0.20508022	1.59	0.2217	0.2808	0.2217
Error(technik)	12	1.55021844	0.12918487				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
zeiten	2	0.38326947	0.19163473	14.58	0.0006	0.0075	0.0006
zeiten*sequenz	10	0.05506752	0.00550675	0.42	0.9111	0.8287	0.9111
Error(zeiten)	12	0.15767255	0.01313938				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik*zeiten	4	0.01659641	0.00414910	1.66	0.1920	0.2379	0.1924
technik*zeiten*sequenz	20	0.07610961	0.00380548	1.52	0.1619	0.2644	0.1626
Error(technik*zeiten)	24	0.05997969	0.00249915				

Temperature

Source	DF	Type III SS	Mean Square	F Value	Pr > F
sequenz	5	0.15284728	0.03056946	1.88	0.2313
Error	6	0.09733275	0.01622212		

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik	2	0.00241255	0.00120628	0.22	0.8058	0.7564	0.8058
technik*sequenz	10	0.05130807	0.00513081	0.94	0.5356	0.5297	0.5356
Error(technik)	12	0.06583586	0.00548632				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
zeiten	2	0.00406957	0.00203478	23.08	<.0001	0.0009	<.0001
zeiten*sequenz	10	0.00093548	0.00009355	1.06	0.4546	0.4604	0.4546
Error(zeiten)	12	0.00105815	0.00008818				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik*zeiten	4	0.00056541	0.00014135	1.96	0.1331	0.1838	0.1331
technik*zeiten*sequenz	20	0.00301867	0.00015093	2.09	0.0429	0.1137	0.0429
Error(technik*zeiten)	24	0.00173130	0.00007214				

Pulse-rate

Source	DF	Type III SS	Mean Square	F Value	Pr > F
sequenz	5	1.40255755	0.28051151	0.79	0.5924
Error	6	2.12706888	0.35451148		

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik	2	0.09074375	0.04537187	1.79	0.2095	0.2192	0.2095
technik*sequenz	10	0.10877184	0.01087718	0.43	0.9059	0.8772	0.9059
Error(technik)	12	0.30496727	0.02541394				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
zeiten	2	0.03270476	0.01635238	12.00	0.0014	0.0090	0.0014
zeiten*sequenz	10	0.00548884	0.00054888	0.40	0.9204	0.8533	0.9204
Error(zeiten)	12	0.01635834	0.00136320				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik*zeiten	4	0.00192878	0.00048220	0.85	0.5052	0.4532	0.5052
technik*zeiten*sequenz	20	0.01192902	0.00059645	1.06	0.4441	0.4565	0.4441
Error(technik*zeiten)	24	0.01354666	0.00056444				

Breath-rate 1

Source	DF	Type III SS	Mean Square	F Value	Pr > F
sequenz	5	2.03332059	0.40666412	0.43	0.8111
Error	6	5.62283264	0.93713877		

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik	2	0.05172495	0.02586247	0.56	0.5859	0.5290	0.5859
technik*sequenz	10	0.34837663	0.03483766	0.75	0.6686	0.6368	0.6686
Error(technik)	12	0.55497800	0.04624817				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
zeiten	2	0.25377634	0.12688817	4.90	0.0278	0.0625	0.0278
zeiten*sequenz	10	0.26141841	0.02614184	1.01	0.4863	0.4854	0.4863
Error(zeiten)	12	0.31064808	0.02588734				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik*zeiten	4	0.06623399	0.01655850	1.53	0.2257	0.2538	0.2257
technik*zeiten*sequenz	20	0.21626069	0.01081303	1.00	0.4967	0.4943	0.4967
Error(technik*zeiten)	24	0.26004607	0.01083525				

Breath-amplitude

Source	DF	Type III SS	Mean Square	F Value	Pr > F
sequenz	5	10.12585608	2.02517122	0.96	0.5058
Error	6	12.60506442	2.10084407		

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik	2	1.05479597	0.52739798	0.71	0.5127	0.4923	0.5127
technik*sequenz	10	4.86563657	0.48656366	0.65	0.7470	0.7268	0.7470
Error(technik)	12	8.95584342	0.74632028				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
zeiten	2	0.36390318	0.18195159	6.57	0.0119	0.0242	0.0119
zeiten*sequenz	10	0.83498862	0.08349886	3.01	0.0371	0.0658	0.0371
Error(zeiten)	12	0.33254751	0.02771229				

Source	DF	Type III SS	Mean Square	F Value	Pr > F	Adj Pr > F	
						G - G	H - F
technik*zeiten	4	0.10051795	0.02512949	1.09	0.3834	0.3599	0.3834
technik*zeiten*sequenz	20	0.46641507	0.02332075	1.01	0.4835	0.4847	0.4835
Error(technik*zeiten)	24	0.55288584	0.02303691				

10.6 Measurement results

CD – ROM