

# *Cranial State of Mind*

**Does Cranial Osteopathy  
influence the patient's  
state of consciousness?**

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Master Thesis  
for the degree „Master of Science (Osteopathie)“  
at the Donau-Universität Krems  
submitted to the  
Wiener Schule für Osteopathie

Vienna, September 2006

# *abstract*

## **ENGEL, R.A.: "CRANIAL" STATE OF MIND - DOES CRANIAL OSTEOPATHY INFLUENCE THE PATIENT'S STATE OF CONSCIOUSNESS?**

Many patients - while or after a treatment with cranial osteopathy - report changes in awareness, perception or emotions. The project's aims were to find out, whether the described effect is measurable and whether there is a difference between an osteopathic technique and unspecific non-osteopathic touch. Then the phenomenon was related to the existing body of consciousness research .

An experimental design with three groups was used. Group E was treated by an osteopath using a cranial technique, group C1 was treated by a non-osteopath, using a sham technique, group C2 was lying still with eyes closed. During the experiment subjects' heart rate and heart rate variability (HRV) were measured to observe possible physiological concomitants of a shift in consciousness. After the experiment subjects filled out the Phenomenology of Consciousness Inventory (PCI) and the Dimensions of Attention Questionnaire (DAQ) to quantify their state of consciousness and attention.

46 healthy subjects were measured once by an osteopath or a non-osteopath.

The dimensions measured by the PCI are positive affect (joy, sexual excitement, love), negative affect (anger, sadness, fear), altered experience (altered body image, altered time sense, altered perception, altered meaning), visual imagery (amount, vividness), attention (direction, absorption), self awareness, altered state of awareness, internal dialogue, rationality, volitional control, memory and arousal. The DAQ more specifically measures 12 dimensions of attention. The HRV-system's measurements for heart rate (HR), low frequency domain (LF) and high frequency domain (HF) were analysed, then the variable LF-to-HF-ratio was computed.

An analysis of variance (ANOVA) and Duncan's multiple range test were used to detect significant differences between groups. Differences were found in the PCI's dimensions altered state of awareness ( $p < 0,01$ ), altered experience, perception, time sense, positive affect, joy, and internal dialogue ( $p < 0,05$ ). No significant differences could be detected in the DAQ results and the decrease of the LF-to-HF-ratio. The decrease in HR during the experiment was significantly higher in group E. No significant difference could be found in the decrease of the LF-to-HF-ratio.

The results indicate that the applied cranial technique induced an altered state of consciousness (ASC) associated with positive affect in the subjects. This ASC and the concomitant decrease in HR were significantly stronger than in groups C1 and C2. The results seem to back osteopathy's claim of being a holistic approach and bear several implications for patient handling while and after an osteopathic treatment. Further research is suggested in this new area, e.g. on long-term effects of the described ASC.

altered state of consciousness, cranial osteopathy, phenomenology of consciousness inventory (PCI), heart rate variability testing

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<http://www.osteopathicresearch.org/fulltext/2125.pdf>

### **OBJECTIVES**

### **DESIGN**

### **PARTICIPANTS**

### **MAIN OUTCOME MEASURES**

### **RESULTS**

### **CONCLUSIONS**

### **KEY WORDS**

### **AUTHOR**

### **FULL TEXT**

# *eidesstattliche erklärung*

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Alle Stellen, die wörtlich oder sinngemäß aus veröffentlichten oder nicht veröffentlichten Arbeiten anderer übernommen wurden, wurden als solche gekennzeichnet.

Sämtliche Quellen und Hilfsmittel, die ich für die Arbeit genützt habe, sind angegeben. Die Arbeit hat mit gleichem Inhalt noch keiner anderen Prüfungsbehörde vorgelegen.

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# *foreword*

I really enjoyed every stage of this project. It was a great experience to immerse myself in a subject for several months and learn so much on the way - not just about the subject itself, but about methodology, statistics and several great, new software programs as well. The project also provided a good excuse to buy and read a whole load of fascinating books - which happens to be one of my favorite pastimes.

It was just in the end that I had to finish the project under certain time constraints to be able to submit it as a Master thesis in osteopathy. I assume that this is quite a common experience among students and authors in general, however.

The huge appendix that was necessary to meet the "criteria for Master theses" was submitted to the jury, but not included in this hard cover version. The table of contents of this appendix, however, was kept and the listed documents can be provided on request.

Obviously topics like mine don't make best-sellers. Yet I hope, the occasional reader will find useful ideas and references and - hopefully - inspiration for further research!

Raimund Engel

# *1 introduction*



*“Science proceeds not through development of new ways to measure the dependent variables but through the careful analysis and reformulation of the independent variables.”*

*(Kenneth Hugdahl, 1995)*

## 1.1 Objectives of the Thesis

Many patients after treatment with cranial osteopathic techniques, especially on the fluid level will spontaneously report feelings of very deep relaxation, being “almost asleep”, feeling very much in their body, feeling very light, or sensations of “energy flowing” in the body. Others talk about seeing colors during the treatment or looking at emotional problems in a different way afterwards.

This suggests that the treatment can change the state of consciousness of the patient thus producing some of the following effects:

- Deep relaxation on a physical, mental and emotional level
- Improvement of awareness of the body, feeling more “inside” the body
- Transition into a dreamlike/altered state of consciousness enabling the patient to view worries and problems from a different perspective.
- Shift of consciousness towards more calmness and clarity

While, when asked, most osteopaths using cranial techniques will report similar experiences, this specific effect of Cranial Osteopathy is usually taken for granted and has not been researched so far.

The project aims to find out if the described effect is measurable and if there is a difference between an osteopathic technique and unspecific non-osteopathic touch. Then the phenomenon shall be related to the vast body of consciousness research.

## 1.2 The Hypotheses

The cranial fluid technique that is applied causes the induction of a mildly altered state of consciousness, which is bigger than in a control group with a sham technique (C1) or without any technique (C2). This is measured by the “Phenomenology of Consciousness Inventory (PCI)” and the DAQ “Dimensions of Attention Questionnaire” (see chapter 3)

### 1.2.1 PSYCHOLOGICAL EFFECT

The shift in consciousness caused by the osteopathic technique goes along with a shift to a more trophotropic state (Gellhorn & Kiely, 1972) that is bigger than in the two control groups. Indicators for this physiological shift are a decrease in heart rate and in the LF/HF (Low Frequency/High Frequency)-ratio, as measured by the means of “Heart Rate Variability”-testing (see chapter 3.7).

### 1.2.2 PHYSIOLOGICAL EFFECT

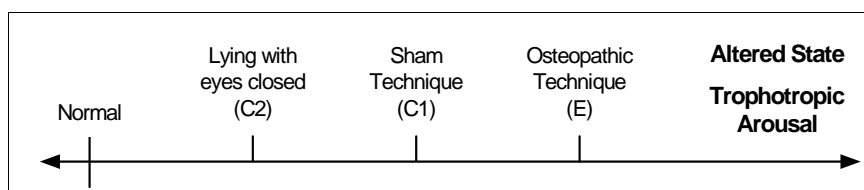


Figure 1: Hypotheses

# *2 fundamentals*

# 2.1 States of Consciousness

## 2.1.1 OVERVIEW

“Our normal waking consciousness, rational consciousness as we call it, is but one special type of consciousness, whilst all about it, parted from it by the filmiest of screens, there lie potential forms of consciousness entirely different. We may go through life without suspecting their existence; but apply the requisite stimulus, and at a touch they are there in all completeness, definite types of mentality which probably somewhere have their field of application and adaptation. No account of the universe in its totality can be final which leaves these other forms of consciousness quite disregarded. How to regard them is the question for they are so discontinuous with ordinary consciousness.”

(William James, 1902)

What William James, one of the great personalities in American psychology, wrote in his book “The Varieties of Religious Experience” is probably the single most quoted passage in consciousness research – and this is not just due to the later authors’ indolence or the nice words he put this in: James is also expressing a surprisingly *modern* point of view within a scientific surrounding which has regarded altered states of consciousness (ASCs) as something at least undesirable, potentially dangerous and possibly pathological – and sometimes still does nowadays (see chapter 2.1.7).

A diagram proposed by Dittrich (Dittrich, 1996) may serve to provide some system to the highly elusive topic of consciousness:

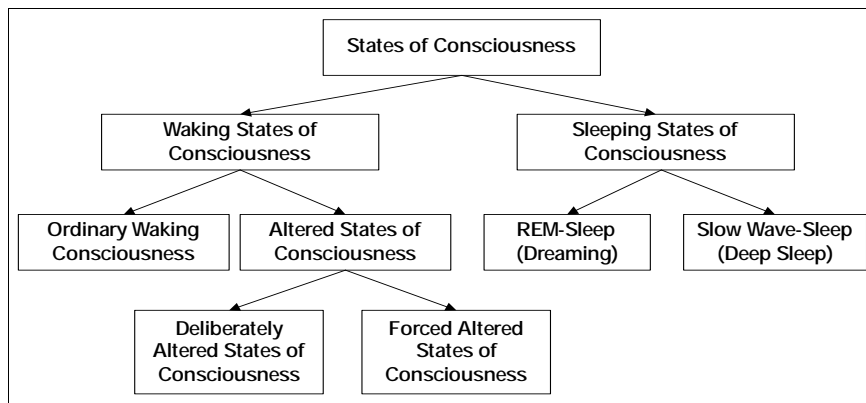


Figure 2: States of Consciousness

We spend most of our life in three states of consciousness (SoCs):

- “normal” waking consciousness
- slow wave sleep (aka deep sleep or delta sleep)
- desynchronized sleep (aka REM sleep or dreaming)

Although the psychology and physiology of sleep are highly fascinating topics the following presentation will be confined to the waking states and especially to altered states of consciousness (ASCs).

A multitude of these “altered” states of consciousness is known and many people aim to reach them by meditation, religion, taking drugs or various other procedures. It is safe to say that there is a strong need in mankind for this kind of experience. ASCs, however, are also known in the area of psychopathology – a subject that will be discussed in chapter 2.1.7.

All these states of consciousness can be examined by two means:

- first person reports of subjective experience (“introspection”)
- third person observation of a subjects behavior or measurement of various physiological parameters like heart rate, breathing, EEG, .... (“psychophysiology”).

Both approaches were used in this study and will be described in some detail.

Many different definitions of consciousness have been put forth by philosophers, psychologists and neuroscientists and to discuss and compare them would make up a study by itself. That’s why in this context we’ll confine ourselves to the definitions in Charles Tart’s “systems approach” to consciousness, which forms most of our methodology’s basis. Tart, one of the most renowned scientists in consciousness research, states that “Our ordinary state of consciousness is not something natural or given, but a highly complex construction, a specialized tool for coping with our environment and the people in it, a tool that is useful for doing some things but not very useful, and even dangerous, for doing other things.” (Tart, 1975)

In his view the terms *states of consciousness* and *altered state of consciousness* had come to be used too loosely, to mean whatever is on one's mind at the moment. Therefore he proposed a new terminology:

“The new term *discrete state of consciousness* (d-SoC) is proposed for greater precision. A d-SoC is a unique, dynamic pattern or configuration of psychological structures, an active system of psychological subsystems. Although the component structures/subsystems show some variation within a d-SoC, the overall pattern, the overall system properties remain recognizably the same.” (Tart, 1975)

“A *discrete altered state of consciousness* (d-ASC) refers to a d-SoC that is different from some *baseline state of consciousness* (b-SoC). Usually the ordinary state is taken as the baseline state. A d-ASC is a new system with unique properties of its own, a restructuring of consciousness. *Altered* is intended as a purely descriptive term, carrying no values.” (Tart, 1975)

The present study refers to Tart’s definitions of *discrete states of consciousness* (d-SoCs) and *discrete altered states of consciousness* (d-ASCs). For a better legibility, however, the simpler forms SoC and ASC are used.

An important notion about d-ASCs is to understand the word *altered* simply as a description for “importantly different” without adding the connotation of better or worse than any other SoC.

## 2.1.2 DEFINITIONS

## 2.1.3 TART'S SYSTEMS APPROACH

Tart's model regards SoCs as systems that are built together by specific combinations of subsystems/structures, which will be discussed in chapter 2.1.4. Ideally every SoC can be defined by describing each of these dimensions on a multi-dimensional map.

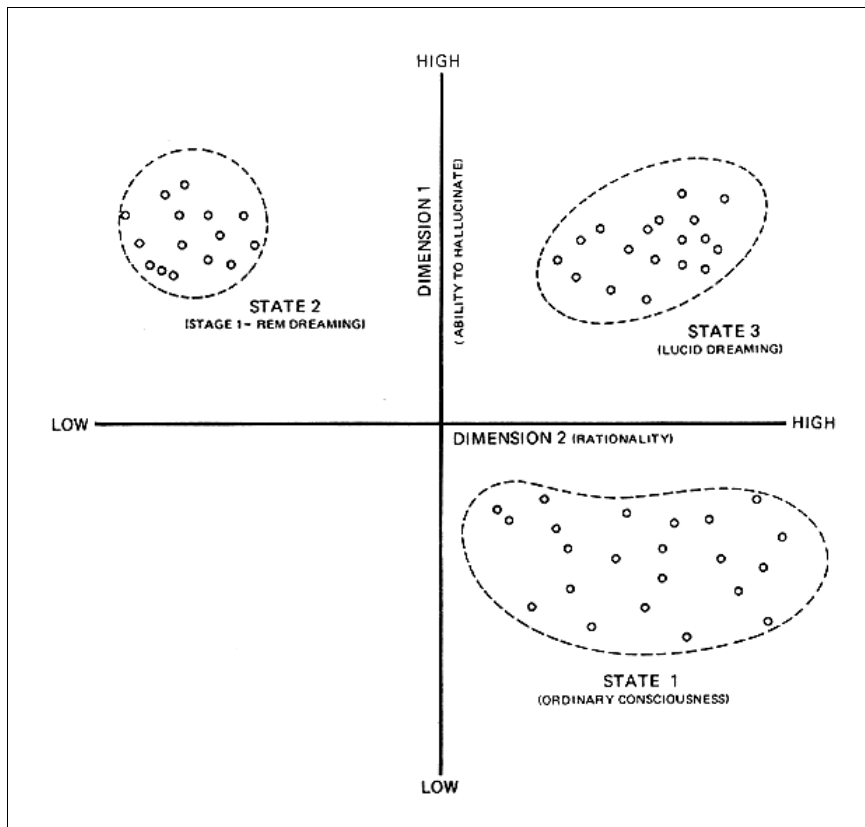


Figure 3: Mapping Experiences

Let's assume, as a simplified example, that everything we need to know about one person's experience could be mapped in a two-dimensional figure where we only know the degree of his rationality and of his ability to hallucinate. Each of the little circles represents the person's experience in a given moment. What is visible at first glance is that all these experiences seem to fall into three distinct clusters (marked with a dotted line). Within each of these clusters there is a certain amount of possible variability in the experience, but only up to a certain limit beyond which the existent SoC is left. In our example the individual can be either in ordinary waking consciousness (high rationality/few hallucinations) or in REM sleep (little rationality/lots of hallucinations) or in a third state of conscious "lucid" dreaming, but not anywhere in between.

There are transitional periods in between (see chapter 2.1.5) but these are not states that can be maintained for a longer period of time.

Tart examined the various experiences and behaviors reported in Altered States of Consciousness (ASCs) and classified the observed phenomena into several subsystems of consciousness. (Tart, 1975) The following chapter describes these subsystems and the way they can be affected by changes in consciousness.

## 2.1.4 SUBSYSTEMS OF CONSCIOUSNESS

## Attention/Awareness

He defines basic awareness as “... an ability to know or sense or cognize or recognize that something is happening.” (Tart, 1975) This basic attention/awareness is something we can to some degree direct voluntarily and we can experience it as distinct from the particular *content* of awareness most of the time.

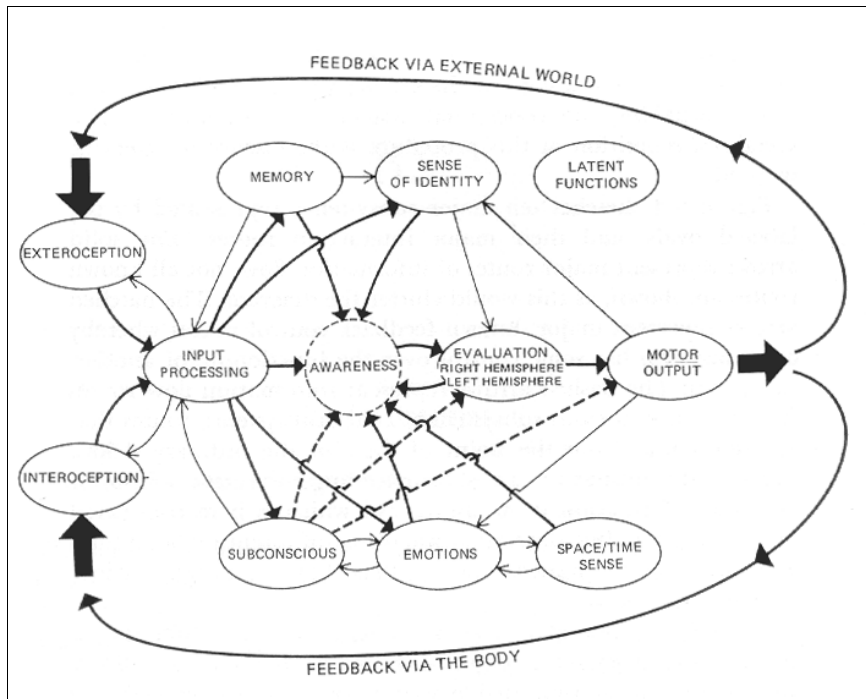


Figure 4: Subsystems of Consciousness

An important phenomenon in this area is *self-awareness* – our ability to be aware that we are aware. The degree of self awareness varies on a scale of being totally absorbed in what we are doing and “oblivious to the world” to a state when we are aware of a particular content and at the same time highly aware of our awareness process itself. Many meditation techniques like Zen meditation or Buddhist vipassana meditation strive for a high degree of self awareness.

To a certain extent Attention/Awareness can be volitionally directed to a certain information or subsystem in our consciousness. Like a searchlight it makes the area more clearly visible for our mind’s eye. At the same time our process of awareness also directs our psychological energy, thus activating and enforcing the information or subsystem it is focussing on. If we try to remember something we direct our awareness away from the present input of our senses and to our memory. This activates our memory subsystem and makes it easier to retrieve the needed information.

## Exteroception

The subsystem of exteroception comprises all the information we obtain through our classical sense organs eyes, ears, nose, taste organs and touch organs. When an ASC occurs this does usually not affect the functioning of our sense organs which are operating on “full volume” by default. (Some

drug-induced ASCs may be excluded from this rule of thumb.) Reported changes in perception of the external environment are more often related to changes in Input-Processing.

The input that is provided to our exteroception from a rather stable and constant environment serves as a stabilization of our “normal” baseline-state of consciousness (b-SoC). Consequently many methods of *inducing an ASC* use manipulation and patterning of exteroception. One way of doing this would be reducing sensory input by having someone floating in body-temperature water in the dark and quiet as in John Lilly’s floating tanks. (Lilly, 1972) Another way is patterning of input to the exteroceptors by rhythmic stimulation by means of drums or rattles in shamanic trance techniques, a third way would be sensory overload, e.g. by the loud music and light show during a rock concert (see chapter 2.4.8).

## Interoception

The subsystem Interoception includes all the information we gather about things that are going on within our body. Some of this information like proprioceptive input is processed consciously, some is measured, but not accessible to our conscious mind, e.g. the level of a certain hormone in our blood.

Reports of ASCs often describe huge changes in shape, size or functioning of their body. As in case with exteroception, however, most of these perceptions probably represent changes in Input-Processing rather than in interoception.

Changing the body image is a common technique for inducing ASCs: In sensory deprivation it is not just important to be in quiet and dark (reducing input from exteroception), but also to lie still (reducing interoception). This is used for example in meditation or hypnosis.

Overloading interoception can be achieved by unusual stimuli like a massage or sensory awareness exercises, but also by intense pain. Patterning the interoceptive input in unusual ways is another possibility of inducing ASCs. Examples are “mudras” (specific hand positions used in yoga) or whole body positions like the yogic “asanas” or the positions used in shamanic trance techniques (Goodman et.al., 1982; Goodman, 1988)

## Input-Processing

Before reaching awareness, all input data are going through various degrees of awareness. Our highly automated Input-Processing unit compares incoming data with material that is stored in memory, filters out most of it and selects only a minor part for further processing, transforms and processes these data and passes them on to awareness.

Rejection and then abstraction are the most important functions of Input-Processing: Our senses are continuously delivering a plethora of information most of which is not directly relevant for us. If all these data would reach awareness, we would be completely overwhelmed. That’s why our Input-Processing unit only passes on a small and abstracted part of our actual perception – from exteroceptors as well as from interoceptors.

While this selecting and filtering is highly automatic, it is a learned behaviour. Children usually have more options of perceiving any given object or event than teenagers or adults. The older we get the smoother and more efficient the process of recognition and filtering gets.

Large changes in Input-Processing occur in various ASCs: Probably all changes in perception of the outer or inner world are located here: Enhanced or decreased sensory intensity, as well as illusions or hallucinations.

Illusions are commonly defined as misinterpreting a sensory stimulus that is actually there (like entering a dimly lit room and mistaking a coat hanging on a rack for a person) while hallucinations are seen as the vision of something that is not there at all (like entering a dimly lit *empty* room and seeing a person).

Sensory input can be blocked partially or completely: In hypnosis for example one can suggest to a talented subject that he is blind or that he cannot feel pain and this is exactly what he will experience. On the other hand there are other ASCs (e.g. induced by psychedelics or meditation) which seem to be accompanied by less Input-Processing and less abstraction thus producing the feeling of being more in contact with the raw, unprocessed data of perception. This makes perceptions unusually beautiful, vibrant and alive.

## Memory

The Memory subsystem deals with the storage of residues of past experiences that we draw on in the present. We can think of Memory as structures in the brain (and perhaps also in the body) we can activate to produce certain kinds of information. Psychology divides memory into three domains: short-term (for a few seconds), mid-term memory (from minutes to a day) and long-term memory. Unless information is transferred into long-term memory it eventually gets lost.

These three different domains of memory can be affected differently by ASCs. As an example Marijuana users often report that they have forgotten the beginning of a conversation (loss of short term memory) while they are still able to speak English (intact long term memory).

Another interesting phenomenon is state-specific memory. Information that is gathered and stored in a certain d-ASC is sometimes not accessible in the normal SoC. While in many early studies this was interpreted as a loss of memory, it could be demonstrated later that in some cases seemingly lost information can be accessed again, when the person gets back into the same specific ASC where the information was acquired. (Goodwin et.al., 1969; Hill et.al., 1973)

Whenever we retrieve information from our memory we usually *know* that we are retrieving memories. There is a certain quality to it that helps us to distinguish between a memory and a present perception. This “memory-like” quality can get lost in certain d-ASCs. Then we experience a hallucination: We think that we are currently perceiving an event that actually comes from a past memory. Conversely, it is also possible that this “memory-like” quality gets attached to an incoming sensory perception triggering the experience of a *déjà-vu*, the feeling that we have seen this before.

Finally, we have to take into account that not everything stored in Memory is accessible in the ordinary SoC. Whenever a memory is too highly charged with unpleasant emotions, it becomes unacceptable and is repressed. In other d-ASCs like hypnosis or in dreams, however, this memory might become accessible again.



## Subconscious

The Subconsciousness contains mental processes or memories outside of our conscious awareness that usually cannot be made conscious. This includes the Freudian unconscious (sexual or aggressive instincts) but also other repressed emotions or intuitive processes. In addition to this *personal* Subconscious C.G. Jung described additional levels including a family Subconscious and a “*collective* Subconscious” shared by all mankind.

D-ASCs may alter the relationship between what is conscious and what is subconscious. LSD and similar drugs can lift contents out of the Subconscious into the conscious. While this was one of the major incentives for the use of LSD in psychotherapy it also is one of the dangers of experiencing a d-ASC: An unprepared person may be overwhelmed by emotions or memories that are usually subconscious and that he/she cannot handle.

The opposite effect can be observed in an alcohol blackout where previously conscious content becomes unavailable for conscious awareness.

An interesting example for altered functioning of the Subconsciousness is reported by the anthropologist Jeremy Narby who observed that d-ASCs induced by the South American plant ayahuasca typically contain hallucinations of snakes. He ascribes this to archetypal information (which is part of the Jungian “collective subconscious”) about the DNA contained in the plant. (Narby, 1998)

## Evaluation and Decision-Making

The Evaluation and Decision-Making subsystem processes the information that has entered our awareness, to find out what it means for us and what we should do about it. During this process it might be necessary to obtain more data through our senses and/or from our memory.

If we can't make sense of it, even after gathering additional data from our senses or our memory we don't act on the situation – at least for the moment. If we are able to make sense out of all this information, then we make a decision that eventually leads to an action. This action in turn leads to a new situation which is evaluated anew. (see fig. 4)

This continuous cycle makes up most of our thinking and action. It is largely automated and can hardly be stopped. This is why it also serves as a stabilizing factor for our SoC: “I think, therefore I am (in my SoC)”.

Other subsystems like Emotions and the Subconscious also make evaluations and decide if a situation is good or bad for us. In contrast to these two, however, the Evaluation and Decision-Making subsystem contains only intellectual, conscious processes.

The Evaluation and Decision-Making subsystem can work quite differently in d-ASCs. Some d-ASCs might for example cause a shift from a left-brain dominated style (analytical, sequential, logical) to a more right-brain dominated style of thinking (intuitive, simultaneous, in patterns, holistic).

Various other parameters of our Evaluation and Decision-Making can change in an ASC: the speed of our thought process can increase or diminish, the thinking can be dull or crystal clear, and our ability to solve problems may vary, too. People in hypnosis are usually much more tolerant of contradictions than in their ordinary SoC and the process of association is changed.

Lastly, the whole process is not only based on our personal system of logic but also heavily influenced by our emotions and subconscious processes.

The subsystem of evaluation and decision-making is represented in the PCI's dimensions "altered meaning, "internal dialogue" and "rationality".

## Emotions

We spend most of our life by *pursuing pleasant Emotions and avoiding unpleasant ones*, but still Emotions are not very well understood by science and are hard to define.

Many modern concepts of emotions are based on the works of Wilhelm Reich (1897-1957) a student of Freud who extended the purely verbal psychoanalysis to work on corporeal manifestations of suppressed emotions (see also chapter 2.4.9).

Volitional control over Emotions - a very high value in our culture - can change in d-ASCs as well as the intensity of perceived emotions. Another interesting phenomenon can be the dissociation from Emotions: a person in a d-ASC may report that a strong emotion is present without identifying with it.

In some d-ASCs like meditation even new emotions like serenity, tranquility or ecstasy may appear that are experienced in the ordinary SoC only rarely.

## Space/Time Sense

We usually think of time and space as things "out there" that we perceive. As Ornstein illustrates in great detail (Ornstein, 1971), our sense of time, however, is rather a construct that we created to organize sensory stimuli we receive.

Even in our ordinary SoC there are variations in our sense of time: a dull hour is perceived as two or three hours long, while an exciting hour goes by very quickly. In some d-ASCs these variations in the rate of time-flow are much bigger.

In the d-ASC of Marijuana intoxication, for example, our Input-Processing unit works differently allowing in remarkably more information. According to Ornstein (Ornstein, 1971) our sense of time also depends on how much has been happening during a certain time span, so time seems to last longer because much more is happening in the same hour.

A similar idea is expressed by Kurzweil (Kurzweil, 1999) who says that for children time seems to go by much slower than for adults, because the intervals between important events in life are very short at the beginning of life and gradually become longer.

In some d-ASCs people typically experience an unusually strong *focus on the present moment* up to the point of feeling timeless or even eternal.

In a similar way variations in space perception may occur during a d-ASC: objects seem to come closer or move away, distances walked may seem shorter or longer than ordinarily. Some people also report changes in depth when flat surfaces are experienced as three-dimensional. Empty space itself can start feeling less empty, but rather filled with vibrations or energy.

## Sense of Identity

Similar to the extra quality “This is a memory” that was described previously there is something like a “*this is me*”-tag we attach to certain qualities, experiences or parts of consciousness. This way we create a sense of ego, which adds a lot of energy to everything it is attached to. We will probably feel quite differently, if someone criticizes some facial features in general or if he says *our* face is ugly.

Conversely we also know a lot of characteristics we do *not* want to identify with, because we regard them as unpleasant and undesirable. And while denying that we have these features we might also project them onto others: “I am not quarrelsome, he is!”

Even in our ordinary SoC the Sense of Identity is varies greatly. Our social life puts us in various different roles during the course of a day some of which may demand behaviours and values that are very different or even contradictory to each other. Still we usually manage quite well to blend from one into the other.

In d-ASCs the sense of ego can be disengaged from various kinds of information it is usually attached to. This might allow someone to recover information from a traumatic event in the past or to disassociate from physical pain. The opposite can happen, too: In a d-ASC like drunkenness the Sense of Identity can be attached to a certain role that usually is not important and cause behaviour that is regretted later, when the person gets back into his SoC.

## Motor Output

The Motor Output system is defined by Tart as “those structures by which we physically affect the external world and our own body.” Usually Motor Output is directed by the Evaluation and Decision-Making subsystem, but this may also be bypassed, as it happens in reflexes or in direct subconscious influence on our movements. We may, for example, clench our fists without noticing, whenever another person we loathe is mentioned.

In d-ASCs various interesting phenomena in the Motor Output subsystem are sometimes reported: increased or decreased awareness of particular aspects, deautomatization of movements, as well as increased or decreased strength or skill.

## Representation in the PCI

Based on Tart's subsystems and additional work from Krippner, Ludwig and Silverman Pekala developed the "Phenomenology of Consciousness Inventory (PCI)" which was used for this project and will be described in chapter 3.4 (Pekala, 1991). The following table attempts to relate Tart's subsystems to their representative dimension in the PCI.

<i>consciousness subsystem</i>	<i>PCI dimension</i>
Attention/Awareness	Attention Volitional Control Self-Awareness Altered State of Awareness
Exteroception	Altered Perception Visual Imagery
Interoception	Altered Body Image Arousal
Input-Processing	Altered Body Image Altered Perception Visual Imagery.
Memory	Memory
Subconscious	per definition not accessible for introspection
Evaluation and Decision-Making	Altered Meaning Internal Dialogue Rationality
Emotions	Positive Affect (Joy, Sexual Excitement, Love) Negative Affect (Anger, Sadness, Fear)
Space/Time Sense	Altered Perception Time Sense
Sense of Identity	Self-Awareness Altered State of Awareness.
Motor Output	Arousal

Table 1: Subsystems of Consciousness and PCI-Dimensions

## Stabilizing Factors

As defined earlier an SoC is a tool that is used for a specific task. It would not be a good tool if it broke, when applied to a task. As an example it would produce quite a problem, if you drove on a highway and your SoC suddenly converted into a dream-state that is shutting down your senses.

To keep an ongoing SoC up and running – no matter if it is our normal, waking consciousness or an ASC – we use several types of stabilizing factors:

### LOADING STABILIZATION

The idea of loading stabilization can be compared with the strategy of giving someone a lot to do, so he doesn't have time and energy to do anything undesirable.

Psychologically this is done by our everyday routine activities and habits, but also by the constant input from our exteroception and interoception (see chapter 2.1.4). Another important stabilizing factor is our incessant, internal stream of thoughts.

## 2.1.5 IN AND OUT OF STATE

### FEEDBACK STABILIZATION

The second type of stabilization is feedback: Whenever one of the subsystems exceeds certain limits the whole SoC, which we have described as an artificial construction above, is in danger of falling apart and tilting into another one. To prevent this from happening certain mechanisms provide *negative feedback* to get the subsystem back into its normal range. As an example your thoughts might drift too far into an area that is considered a taboo by your values, then feelings of anxiety might set in at a certain point, keeping you from venturing further into this direction.

On the other hand, society educates us from childhood on with *positive feedback* reinforcing socially accepted behaviour, which probably arises from socially accepted thoughts and emotions.

### LIMITING STABILIZATION

Limiting stabilization means keeping one or several subsystems from functioning in a way that might destabilize the ongoing SoC. Tranquilizers provide such a limiting effect to the *Emotions Subsystem*: Extremely strong emotions, which might be disruptive to a normal SoC, are prevented and thereby the SoC is stabilized.

### Induction of ASCs

As a starting point for any shifts into an ASC we have a baseline state of consciousness (b-SoC) that is usually our ordinary Soc and that is stabilized by many different factors out of the categories we discussed in the chapter above. The first necessary step of induction is therefore the *disruption* of the b-SoC's stabilizing factors. Particular subsystems can be pushed beyond their limits by overloading them with stimuli, depriving them of stimuli or various other ways, which will be discussed in chapter 2.4.

The next step in the induction process is the *patterning* of the ASC: Stimuli must be applied that form our disrupted subsystems into a new way of functioning.

This is symbolized in Figure 5 where blocks of different shape and size symbolize our psychological subsystems that are arranged in a stable and specific way in a b-SoC. Then disrupting and patterning forces set in. They first cause changes within the b-SoC until it has reached its limit and is disrupted. Then the patterning forces form the “building blocks” into an ASC.

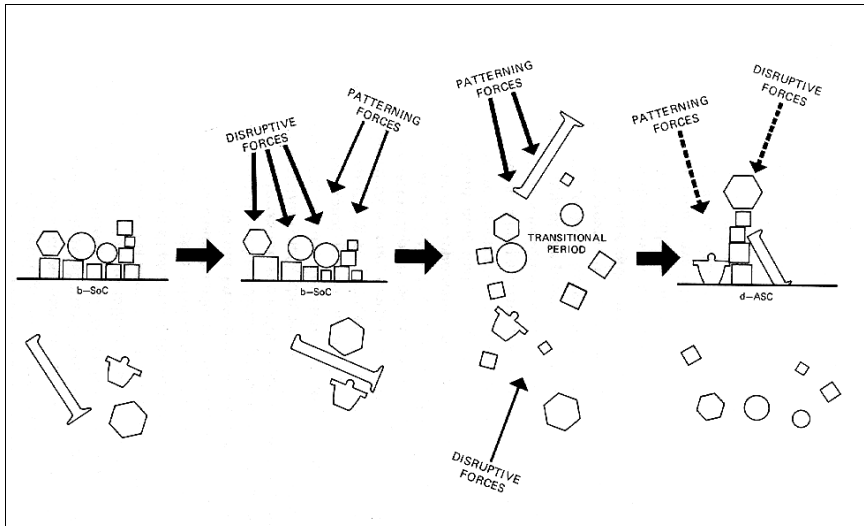


Figure 5: Induction of an ASC

“I find it difficult to accept, ..., that man’s ability to lapse into trance has been evolved just so he can be hypnotized onstage or in a clinical or laboratory setting. Moreover, the widespread occurrence and use of mystical and possession states or aesthetic and creative experiences indicates that these ASCs satisfy many needs both for man and society.” (Ludwig, 1990)

While Ludwig’s arguments for the usefulness of ASCs start quite teleologically, he later cites a lot more evidence in the areas of healing, ways to new knowledge or experience and social functions.

## Healing States

Throughout history and in many different parts of the world ASCs have played an important role in healing of psychological as well as of physical problems. In many traditions the shaman or healer will change into an ASC to gather information about the patient’s problem or ways he can be healed, but often also ASCs in the patient are induced to foster healing. Heightened suggestibility, increased meaning, a stronger need for emotional catharsis or the feeling of rejuvenation – all these traits associated with a ASCs can be used in healing. There is a long tradition from early examples like the Egyptian and Greek practice of “incubation” – the healing sleep in the temple – through to 20<sup>th</sup> century psychotherapy’s use of hypnotherapy, meditation or certain drugs.

A multitude of examples from different cultures and contexts can be found in “Healing States”, a book by Alberto Villoldo, practising shaman and psychotherapist, and Stanley Krippner, psychologist and recognized consciousness researcher (Villoldo & Krippner, 1987)

In contrast to those rather experiential reports Herbert Benson draws on dozens of studies when he describes the beneficial physiological and psychological changes caused by the “relaxation response” (Benson & Stark,

## 2.1.6 FUNCTIONS OF ASCS

1996). This relaxation response is a simplified meditation technique that is combining a mental device - like the repetition of a single word - a passive attitude and a muscular relaxation. Citing many studies on the effect of Placebo, he also strongly emphasizes the importance of suggestions to the patient, an aspect that we will get back to in chapter 6.1.1.

There is also a multitude of research on the psychological and physiological effects of other meditation techniques, which are described in chapter 2.4.6.

Apart from those specific healing applications, some of our everyday alterations in consciousness seem to be beneficial for our organism: Sleep has traditionally been known as The Great Healer and its importance has been recognized by modern sleep research (Dement & Vaughan, 1999). Likewise dreaming seems to have an important function in psychological stability (Jouvet, 1999).

*"If someone has visions, he needs a doctor."  
(allegedly said by former Austrian chancellor Franz Vranitzky)  
"Where there is no vision the people perish."  
(Proverbs, 29:18)*

In spite of influential authors like the previously quoted William James all ASCs were regarded as pathological disturbances, mostly associated with schizophrenia in the bigger part of the literature - a point of view that only started to change in the Mid-Sixties, when ASCs in healthy people become a subject of research. Thanks to this research today's psychologists and psychiatrists are provided with quite reliable distinctions between a healthy subject starting his spiritual development and someone mentally ill ((Wapnick, 1972) {Austin, 1998}).

Most authors agree that the most important distinction is the ability to enter and leave ASCs at will - which is obviously not possible for a schizophrenic patient - e.g. Fischer states: "When, however, a person gets stuck in a particular state or role, then we label him as abnormal." (Fischer, 1976) Besides in the mentally ill ASCs are often accompanied by strong negative emotions like rage or panic. If, on the other hand, we use meditation as an example for a beneficial ASC it is known to have a balancing and soothing effect on the emotions.

## 2.1.7 HEALTHY OR PATHOLOGICAL?

In the following table Austin compares two states that were often compared or confused in the literature: Mystical experience vs. Schizophrenic Psychosis (Austin, 1998):

	<i>Mystical Path</i>	<i>Schizophrenic Psychosis</i>
General nature and duration	An ongoing, more orderly development	May be compressed, disorderly and disorganized
Hallucinatory phenomena	In general, more visual; not threatening	In general, more auditory; can be threatening
Ideas of self-reference	Enlightenment cuts off the personal connotations of stimuli	Stimuli generate ideas of self-reference, especially in paranoid schizophrenia
A gap is experienced which splits outer social reality from inner personal reality	1	3
Inhabiting only the inner world and being fearful of it	0-1	3
Degree of tolerance for inner experiences	Trained for and well tolerated	May be overwhelmed by them
Simplification of lifestyle and renunciation of worldliness	More under conscious control	More under unconscious control
Dissolution of social attachments	1	3
Re-entry into society, improved by the experience	The usual goal	Less common
Subsequent ongoing, fruitful, well-integrated contacts with society	2	1 or 0
Sense of unity with the environment	2 (partially cultivated)	Less commonly perceived
Driving by cravings and aversions	Reduced	May be enhanced
Continued conscious control	Usual	Less effective

0 = none, 5 = maximal

Table 2: Mystical experience vs. Schizophrenic Psychosis (Austin, 1998)

While there obviously are criteria to differentiate between a spiritual and a pathological state, this distinction is not always easy to make. Many people who are starting to meditate or set off on a spiritual path can have unusual sensations of energy flow in the body, disturbed sleep, problems to concentrate and the like (Wilber, 1993). Christina and Stanislav Grof have introduced the term “Spiritual Emergency” to describe these symptoms (Grof & Grof, 1982).

Without proper guidance such a spiritual emergency can be very frightening for people and their surrounding and even lead to a non-adequate psychiatric treatment. To avoid that several psychiatrists and consciousness



researchers have formed the “Spiritual Emergency Network” of therapists who know how to support patients during a spiritual crisis. (Grof & Grof, 1982; Grof & Grof, 1990)

Pathological states as well as spiritual emergencies are definitely the domain of psychotherapy and psychiatry. Up to a certain point, however, it may also be necessary for an osteopath to give advice to his patients in this regard. In chapter 5.6 we describe a model that can be helpful doing that.

In this chapter’s title and beginning a dualism between healthy and pathological states is suggested. At the chapter’s end we’d like to describe a fascinating approach that is creating a synthesis of both: Dr. Eliezer Mendes, a physician and spiritual healer, treats epileptic patients in a clinic outside Sao Paulo. He regards epileptics as people who have a natural tendency towards mediumship but little control over their talent. By training them to become psychic mediums Dr. Mendes helps them to get free of epileptic seizures and he claims to have a success rate of 85%. (Krippner & Villoldo, 1986; Villoldo & Krippner, 1987).

## 2.2 Methods of Consciousness Research

In the early days of psychology the study of consciousness was a central issue in the work of structural and functional psychology. At the beginning of the 20<sup>th</sup> century however - with the rise of behaviourism - the exploration of consciousness quickly became unpopular: The introspective methods used in various laboratories had lead to different results, findings could not be verified from one laboratory to another and various disputes could not be resolved. This brought forth the rise of behaviourism who stated that introspection “forms no essential part of its method” and suggested the “elimination of states of consciousness as proper objects of investigation” (Watson, 1913). Only behaviour that could be observed from an outside, “third person”-point of view was regarded as scientific.

This was the prevalent opinion in psychology until the 1960s when consciousness again became a legitimate area of psychological research for several reasons:

During the 1960s many people in western countries’ subcultures started actively looking for ways to induce altered states of consciousness (ASCs) through the use of hallucinogenic drugs or meditation.

Anthropology had found that in many non-European cultures the ritual induction of ASCs for healing or various social occasions was a constantly recurring phenomenon.

Psychiatric research started to use the concept of ASCs to explain etiology and therapy of various psychiatric problems.

During the rise of cognitive psychology “various authors, e.g. (Kukla, 1983; Lieberman, 1979; Richardson, 1984) argued that consciousness can be reliably and validly investigated with perceptual, psychophysiological, and phenomenological research methods.” (Pekala & Cardeña, 2000).

In the 1960s and 1970s a lot of hope was put on *Neurophysiological Research Methods* especially EEG: It was expected to help to map consciousness neurophysiologically. Those high expectations soon had to be given up when it became obvious that brainwaves don’t equal consciousness but merely depict a small reflection of it. Neurophysiological research of consciousness, however, has continued until the present and added

### 2.2.1 HISTORY OF RESEARCH

new technologies like evoked potential, SPECT imaging and PET imaging, creating interested insights in our brain's state during meditation or other ASCs (Andresen, 2000; Austin, 1998; Newberg et.al., 2001).

Due to these early hopes in neurophysiological measurement only few researchers developed new methods for introspection using a “psychophenomenological” approach in consciousness research. The two most elaborate and widely used methods in this domain are the questionnaires “Außergewöhnliche Psychische Zustände - APZ” (Dittrich, 1996) and the “Phenomenology of Consciousness Inventory - PCI” (Pekala, 1991)

Research by first person reports of subjective experience is also called “phenomenological approach”, referring to the philosophy of the same name.

Phenomenology's founder Husserl postulated the “direct apprehension of reality through understanding and suspending (or bracketing) the various assumptions and presuppositions that distort one's apprehension of ‘the things themselves’ “ (Pekala & Cardena, 2000)

## 2.2.2 INTROSPECTIVE APPROACHES

### Concurrent Reports Approach

This section describes research methods that are probing for experiences or mental events *as they unfold*.

*Thinking out loud*: an ongoing verbal report of the contents of consciousness

*Event recording*: A particular event like a thought or an emotion is defined in advance. During the experiment its every occurrence is then registered by a counter or a similar device.

*Thought sampling*: During the experiment signals are given at random intervals, prompting the participants to report, what their mental activity was right before the signal.

*Depth Rating* provide quantitative ratings of a particular experiential dimension on a predefined scale. Depth rating is frequently used to assess the depth of a subject's hypnotic trance state.

### Retrospective Reports Approach

*Diaries*: narratives of individuals' lives

*Case Studies and Life Histories* have a long tradition in various areas of psychology and they are also a valuable tool in the study of ASCs

*Interviews*: one of the basic tools of clinical psychology, it probably provides the easiest way to find out about a subject's experience. Many other methods can be successfully complemented with a good interview.

*Content Analysis*: previously obtained – usually verbal - information is analyzed using *syntactic* (e.g. quality of verbal organisation in a dream report) or *semantic* (e.g. number of references to “unity” in a report of a mystical experience) criteria or *both*.

*Psychological Tests, Surveys and Questionnaires* are widely used in all areas of psychology. In consciousness research only few questionnaires have demonstrated to be reliable and valid. Among those are the “Phenomenology of Consciousness Inventory (PCI)” and the “Dimensions of Attention Questionnaire (DAQ)” by Ronald Pekala, which were used for this study and are described in chapter 3.

Another widely used model is Dittrich's "APZ" questionnaire. The APZ examines the three dimensions of "Oceanic Boundlessness (OSE)", "Dread of Ego Dissolution (AIA)" and "Visionary Restructuralisation (VUS)" (Dittrich, 1998).

This section will give an overview of the various parameters that are used to measure the physical response to psychological events, a domain of research named psychophysiology. More details about psychophysiological concepts and methods can be found in books by Schandry (Schandry, 1998) or Hugdahl (Hugdahl, 1996).

## 2.2.3 PSYCHO- PHYSIOLOGICAL APPROACHES

### Cardiovascular Activity

In this domain the measurement of *heart rate*, *heart rate variability* (see chapter 3.7), *blood pressure*, *pulse wave-speed* and *blood-volume reactions* are employed.

### Electro-dermal Activity

When the activity of our sympathetic nervous system increases, we begin to sweat, thus changing the electrical properties of our skin. Based on this effect the measurement of *skin conductance* and *skin potential* are used.

### Electrical Muscle-Activity

The contraction of striped muscles is triggered by a signal travelling from the medulla to the muscle along an axon. The frequency of signals in the axon can be measured by an electro-myogram. Psychophysiology uses only surface electrodes, in some medical examinations needle-electrodes are used, which allow a more specific localization of the area.

### EEG and Other Brain Imaging Techniques

#### ELECTRO-ENCEPHALOGRAPHY

records the difference in electrical potential between several points on the scalp. A standard full-scale EEG recording device usually consists of 19 EEG leads which are supplemented with two leads for the recording of eye movement, but many modern EEG laboratories use 32, 64 or even 128 channels.

The potentials recorded in EEG come from the cortex only, more specifically from large groups of neurons in the upper layers of the cortex. This makes the EEG insensitive to focused activity in narrow regions of the cortex and unable to detect activity in deeper parts of the brain.

It is very difficult to extrapolate from specific brainwaves to specific states of consciousness (SoCs). Nevertheless different ranges of brainwaves have been associated with certain SoCs and the following table provides an overview, before we proceed to the EEG frequencies that were measured during meditation:

<i>Freq. (Hz)</i>	<i>Name</i>	<i>State of Consciousness</i>
0 - 4	Delta	Slow wave sleep, deep meditation
4 - 8	Theta	Sleep, deep relaxation, meditation
8 - 13	Alpha	Usually with closed eyes and a calm mind, feelings of harmony
13 - 30	Beta	Conscious awareness, concentration, analytical thinking, sensory-motor activity
30-50+	Gamma	Mystical and transcendent experiences during meditation, healing, feelings of unity

Table 3: Brainwaves and States of Consciousness

During the past decades the use of the EEG has been complemented by various new imaging technologies. They usually work non-invasive and allow to study the brain “in action”. These new technologies are especially helpful in localizing mental functioning.

### **PET**

A *positron emission tomography* – or PET scan – is a “metabolic map” (Austin, 1998) of the brain. Our nerve cells burn glucose to get energy. By injecting a glucose “tagged” with a radioactive element that emits a positron, researchers can detect, where in the brain it is burned. This allows them to identify areas of heightened brain activity. The PET technique – while good for a general overview – tends to miss small details.

### **FUNCTIONAL MRI**

*Functional magnetic resonance imaging* (functional MRI, fMRI) uses the principle of following the patterns of blood flow, as the blood flow shifts to the most active areas of the brain. Strong magnets build up a magnetic field that forces all the hydrogen atoms in the body into the same orientation. When they switch back into their original position they produce measurable electromagnetic radiation. The distribution of this radiation allows to recognize active areas. It is faster than PET and can image the whole brain’s activity within a few seconds. Another advantage to PET and SPECT is that it doesn’t use radiation.

### **SPECT**

*Single photon emission computer tomography* (SPECT) detects radioactive emissions of radioactive tracers in a subject’s blood. The particular tracer that is used locks almost immediately into brain cells and remains there for several hours. This provides a “freeze-frame” of the blood flow in the brain at the moment of injection.

A common problem of all these three imaging techniques is that they are not able to detect, whether increased activity (deferred from increased metabolism or blood flow) is due to the firing of excitatory or inhibitory nerve cells. These two types of cells, however, will have opposite effects on brain activity.

## Other Body Functions

Apart from the systems listed above psychophysiology measures

- respiratory frequency and volume
- *eye movements* – the rapid eye movements (REM) led to the discovery of paradoxical sleep, one of the main SoCs
- *Pupil Reactions* – dilation or contraction of the pupil is “an objective physiological manifestation of psychological phenomena that occur during sensory, mental or emotional activity.” (Hess, 1972).

Important knowledge about the functioning of our brain has been gathered from methods, which will probably never be used in osteopathic research: In animals or patients undergoing brain surgery, a *direct stimulation* of certain areas of the brain was performed and then its effects on the animal’s or person’s behaviour or consciousness was studied. The methods of stimulation included electrical stimulation, surgical lesioning or anaesthesia of structures and the injection of various substances (e.g. neurotransmitters).

An example for this approach is Walter Hess’ pioneering work on the hypothalamus and the autonomic nervous system (ANS), which is described in more detail in chapter 2.3.2.

## Limits of Introspection

During the past decades introspection has regained its acceptance in psychological research. As with every other method, however, it is most useful to regard its limits before applying it in a project. Some of the described limits (Confabulation, Demand Characteristics) do not apply solely to consciousness research, but should also be considered in other areas of research, for example in an osteopathic research project using pain scales.

### FORGETTING

As every other part of acquired information, the personal experience of an ASC during an experiment is due to forgetting. In general, the subjects’ account will be more complete if they are questioned shortly after the experience.

The issue of forgetting is even more important for the research of ASCs because memories of these sometimes carry a very *elusive dream-like quality*. Memories of the experience may also be inaccessible due to “State-Specific” Memory (see also chapter 2.1.4).

### RECONSTRUCTION ERRORS, CONFABULATION, CENSORSHIP

There seems to be a strong tendency to “normalize” unusual experiences in recollection from memory. Schacter concluded that knowledge, beliefs and expectations can bias the process of storing and recollecting memories (Schacter, 1999).

## 2.2.4 OTHER METHODS OF BRAIN RESEARCH

## 2.2.5 METHODOLOGICAL CONSIDERATIONS

On the other hand some subjects may reconstruct their memories in a way that makes them more unusual and that way “more interesting”.

A part of a research participant’s experience may contain very private or sexual topics that he/she is not comfortable to share with the experimenter. In some cases this might not be relevant for the researched question, but the possibility of censorship should always be kept in mind. A possible remedy for this problem might be to guarantee the anonymity of the participant’s report.

#### **DISSEMBLING AND DEMAND CHARACTERISTICS**

To a certain extent it can also be possible that participants make up an experience completely or try to give answers that are “socially desirable”. This can formally be examined through “lie” and “social desirability” scales (Rorer, 1990)

Demand characteristics can be defined as the totality of cues “within the research context that guide or bias a subject’s behaviour” (Heiman, 1995). By implicit or explicit suggestions the experimenter might indicate to the subject which answers he should give thus invalidating the subject’s reports.

#### **DIFFICULTIES TO VERBALIZE**

Even some simple everyday experiences are very hard to put in words, for example describing the taste of an apple to someone who has never tasted one. This applies even more to ASCs.

#### **DISTORTION THROUGH OBSERVATION**

This phenomenon that is also known in research in other disciplines is highly important in the research of consciousness. Already Kant stated that the mind could not be regarded without distortion, and while any methodology always must strive to keep this distortion as minimal as possible, it must nevertheless also take into account that it does always exist.

An example of how this can be done in consciousness research is described in chapter 2.4.6: Meditators entered the depth of their meditative state in a neutral surrounding and were put into a SPECT-scanner directly afterwards. With the use of PET or fMRI (see chapter 2.2.3) they would have been forced to do the whole meditation inside the scanner, which would have made it much harder to reach deep meditation.

#### **LACK OF INDEPENDENT VERIFICATION**

An often cited argument against the study of consciousness is that whereas behaviour is “public”, consciousness is private and therefore not available to external verification. This is basically correct, but it does not solely apply to consciousness research but to virtually any other research discipline as well. As Varela stated, “the usual opposition of first-person vs. third-person accounts is misleading. It makes us forget that so-called third-person, objective accounts are done by a community of concrete people who are embodied in their social and natural world as much as first-person accounts.” (Varela et.al., 1991)

This aspect is also taken into account by Giorgi (Giorgi, 1990) who recommends that “researchers, at least initially, study the phenomenon of interest without theoretical assumptions, which may reveal more about their looking glasses than about the phenomenon itself.” {Pekala, 2000}

## Is there a type of individual more likely to experience ASCs?

Several studies tried to find out if certain personality traits make it more likely for an individual to experience an ASC. A study by Pekala et. al. (Pekala et.al., 1995) showed that those “individuals who are both highly hypnotizable and highly dissociative are more likely to report anomalous experiences.”

Another study compared the reactions of introverts and extroverts to the hallucinogenic drug psilocybin finding that extroverts showed significantly more changes in their EEG patterns than introverts and scored higher on a creativity test (Thatcher et.al., 1971). See also chapter 3.10.

## 2.3 Neurophysiology of Consciousness

*“The art of being wise is the art of knowing what to overlook.”  
(William James, 1918)*

### 2.3.1 OVERVIEW

During the inception phase of this study the author had planned a comprehensive chapter on the neurophysiology of consciousness. This idea was recognized as far too ambitious – not just in regard to the author’s limited understanding but also in regard to the upper limit of 100 pages that is prescribed for Master theses – and therefore dismissed.

A brilliant discussion of this very subject is provided by James H. Austin’s “Zen and the Brain” on almost 900 pages (including 112 pages of references). The following will be confined to a very short ‘top-down’ listing of those structures of the brain with the most important influence on consciousness.

### Cortex

The two hemispheres of our cortex contain four association areas that integrate neural activity from various other areas in the brain:

- Posterior superior parietal lobule (PSPL)
- Inferior temporal Lobe (ITL)
- Inferior parietal Lobule (IPL)
- Prefrontal Cortex (PFC)

The PSPL plays an important part in the integration of higher order sensory information. Within the PSPL this information is used to create a three-dimensional image of the body in space (Lynch, 1980). There seems to be some difference between the functions of the right and the left PSPL: While the right parietal lobe plays an important role in generalized localization and the sense of spatial co-ordinates the left PSPL is in charge of objects within arms reach that can be grasped and manipulated (Mountcastle, 1976). This differentiation seems to play an important role in the distinction between self and non-self, and during meditation major shifts seem to occur in the PSPL. (see chapter 2.4.6)

The ITL neurons are constantly scanning the visual field for objects of interest or importance to the organism. Whenever anything like that is detected they alert the brain by use of their connections to the limbic sys-

tem. Strong activity in the temporal lobes is associated with epilepsy as well as with mystical or paranormal experiences, e.g. (Persinger, 1984; Persinger, 1988).

The IPL lies at the junction of the temporal, parietal and occipital lobes. It is an association area strongly interconnected with the visual, auditory and somaesthetic association areas and generally regarded as the place where abstract concepts are created and put into words.

The PFC is the only area that receives afferent fibres from all the senses as well as from the other association areas (Fuster, 1997). It co-operates with the IPL in mediating abstract concepts and seems to contain the abilities to concentrate, to carry out complex tasks and to plan for the future. Left and right PFC are linked by direct nerve fibres (Frith et.al., 1991)

## **Limbic System**

The limbic system is in charge of the more complex aspects of emotion. It assigns emotional associations to objects or persons or experiences and coordinates the transformation of these emotions into behaviour. Medical students – when memorizing the functions of the limbic system – like to memorize them as “the four Ms and the three Fs”: mating, memory, mood, motivation; fear fighting, food. The limbic system is linked to the ANS via the hypothalamus.

### **HYPOTHALAMUS**

From an evolutionary perspective the hypothalamus is a very old part of the brain. Its function of governing the ANS will be regarded in more detail in chapter Consciousness and the Autonomic Nervous System (ANS). The other important function of the hypothalamus is the control of the endocrinal system.

### **THALAMUS**

The thalamus helps to resolve the incoming sensory messages, but it also creates a “sensory gate” permitting only a very small part of all sensory input to pass up into the cortex. Which of the messages are allowed to pass is highly dependent on our SoC (Grossman et.al., 1990). The mediodorsal part of the thalamus – together with the fornix and its related limbic regions – plays an important part in our sense of time.

### **AMYGDALA**

The amygdala is associated with the control of higher emotional and motivational functions, particularly arousal and fear. Besides it is also involved in attention, learning and memory.

### **HIPPOCAMPUS**

The hippocampus seems to play a major role in information processing, including learning and memory. In this regard, there is a close co-operation with the amygdala. While the amygdala usually facilitates the exchange of information between two regions of the brain the hippocampus tends to create the opposite effect. This inhibitory function can be carried out by the hippocampus, because it also takes part in controlling the thalamus, a structure linking the ANS to the brain.



## **CINGULATE GYRUS**

The cingulate gyrus can be described as interactive links in a larger integrated network that helps us to make our attention more lively and attach it to external objects. Stimulation of the anterior end of the CG elicits responses like relief from anxiety and tension, as well as feelings of well-being and relaxation.

## **SEPTUM**

Like many of the structures in the limbic system the septum has a huge amount of interconnections with its surrounding structures. This fact made it very difficult in early research to assign specific functions to it. In general however stimulation of the septum seems to evoke a pleasurable response and relief from pain as well as increased alertness and attentiveness.

## **Deafferentation**

An important function in the induction of ASCs seems to be carried out by the ability of certain brain structures to block input to other structures, a process called deafferentation. This was found out from research on lesions in certain areas of the brain that led to increased activity in other areas. Deafferentation of a brain structure can also function through the activity of inhibitory fibres. When a brain structure that normally processes sensory input is cut off from this input, it is required to function upon its own random neural activity (Lilly, 1972). As an example, a deafferented area of the brain that is normally occupied with the interpretation of visual signals tends to interpret any form of neural activity as visual input and create a visual hallucination.

An often cited example of deafferentation is the effect of curare-like drugs: These drugs relax the muscles and create a significant reduction of proprioceptive impulses. This reduces the discharges from hypothalamus to cortex and even produces behavioural sleep (Gellhorn, 1958).

This neurological finding seems to be consistent with Tart's postulate of loading stabilization (the continuous flow of sensory input helps to maintain an ongoing SoC, see chapter 2.1.5). And it is also of great interest, because the usual setting for an osteopathic treatment puts our patients into a state of mild sensory deprivation. In addition to that osteopathic techniques usually result in a reduced muscle tone and reduced proprioceptive input – all of those factors can make a patient more likely to shift into an ASC.

Yet another level below the limbic system and most of its fancy “higher” functions of consciousness, which mankind has acquired only recently in its evolution the Autonomic Nervous System governs our SoC and our behaviour on a more basic level.

## **Hess and Gellhorn**

*“...much exists and evolves in this world, which is not accessible to our comprehension, since our cerebral organization is primarily devised so that it secures survival of the individual in its natural surroundings. Over and above this, modest silence is the appropriate attitude.” (Hess & Fischer, 1973)*

## **2.3.2 CONSCIOUSNESS AND THE AUTONOMIC NERVOUS SYSTEM (ANS)**

Walter R. Hess discovered that he could change a cat's behaviour by electrical stimulation of its hypothalamus, a finding for which he received the Nobel price in 1949.

Whenever he stimulated the *lateral and posterior* parts of the hypothalamus he would activate an energy-expending state associated with the sympathetic nervous system (SNS) and generating the "fight-or-flight" reaction. Conversely, the stimulation of the more *medial and anterior* regions of the hypothalamus made Hess's cats relax. It activated the parasympathetic nervous system (PSNS), which is an energy-conserving system encouraging regeneration.

Gellhorn called those combined functions of ANS, organs, muscles and parts of the CNS (Hypothalamus, thalamus, limbic system) the "ergotropic" (work-preparing) system and the "trophotropic" (nourishment-providing) system and regarded them as strictly separated antagonists (Gellhorn, 1968) (During the last decade this view has been questioned more and more, as researchers discover areas where the SNS and the PSNS rather work complementarily than antagonistically.(Hugdahl, 1996))

In order to maintain homeostasis a balance between the two systems is needed and one way to establish this balance is the 'rebound' or 'spillover' phenomenon: Whenever one of the two systems is stimulated to its maximum capacity, it tends to activate the opposite system rather than inhibits it. The higher the initial level of arousal in one of the two systems, the more likely a 'rebound' happens.

Gellhorn also regarded the balance between ergotropic and trophotropic system as one of the major determinants for emotions: Thus sadness would be a concomitant of trophotropic dominance and joyous excitement of ergotropic preponderance. In a later article Gellhorn and Kiely tried to use these two systems to explain meditation and mystical states of consciousness. (Gellhorn & Kiely, 1972).

Newberg and d'Aquili, who are researching consciousness with state-of-the-art brain imaging techniques (Newberg et.al., 2001) propose five basic categories of ergotropic/trophotropic functioning which may occur during ASCs (Newberg & D'Aquili, 2000):

The *Hypertrophotropic* State, in which trophotropic activity is unusually high resulting in states of extraordinary quiescence. This may occur during normal sleep or during activities like meditation or prayer.

The *Hyperergotropic* State, occurring when ergotropic activity is unusually high. This produces a state of unblocked arousal and excitation associated with high alertness and concentration.

The *Hypertrophotropic* State with *Ergotropic Eruption*, when trophotropic activity is so high that the 'rebound' phenomenon occurs and activates the ergotropic system. (Gellhorn & Kiely, 1972) During certain kinds of meditation this can lead to hallucinations or even to the feeling of 'oceanic bliss'.

The *Hyperergotropic* State with *Trophotropic Eruption*, when ergotropic activity is so high that the 'rebound' phenomenon occurs and activates the trophotropic system. This can be associated with an orgasmic, ecstatic feeling resulting in a trance-like state.

The maximal stimulation of both the ergotropic and the trophotropic system, a state most likely associated with the most intense mystical experiences.

## Fischer

Based on Gellhorn's ideas an interesting model of states of consciousness has been proposed by Fischer in several publications since 1971 (Fischer, 1971; 1975; 1976; 1998). Starting with a zone of normal, ordinary waking consciousness he places other states on a circular scale according to their level of arousal. The area to the left is called the 'perception-hallucination continuum' and is associated with 'ergotropic arousal' (hyperarousal) associated with activity in the *sympathetic* nervous system. (Gellhorn & Kiely, 1972). With rising arousal - according to this model - a person's SoC changes from normal to slightly aroused states like creativity to hyperaroused states like catalepsy to a state of ecstasy or mystical rapture. As a physiological parameter to measure ergotropic arousal Fischer proposes the *Goldstein's coefficient of variation* specifying the decrease in variability of the EEG amplitude.

The area to the right presents states with an arousal level that is lower than in our everyday consciousness. Fischer calls this area the "perception-meditation continuum" or "trophotropic arousal" (hypoarousal) associated with activity in the *parasympathetic* nervous system. Parallel to the drop in the arousal level a person experiences various tranquil or hypoaroused states that are known from Zen or yogic meditation. The endpoint of the trophotropic scale is the yogic Samadhi.

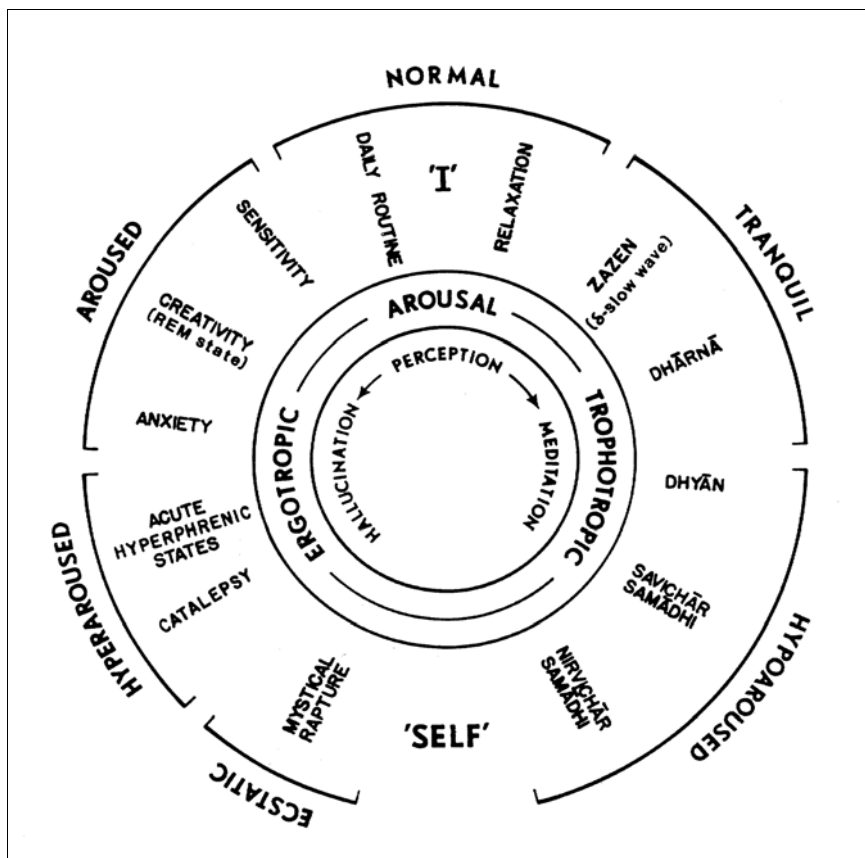


Figure 6: Fischer's Model of ASCs

The later versions of Fischer's model show a circular diagram of the two continua (see Figure 6): Fischer postulates that - due to the "rebound effect" - the extremes of both states are the same: Similar to Gellhorn's

model an excessive trophotropic state is supposed to rebound into an ergotropic 'Kundalini-experience' and 'yogic ecstasy'. Vice versa an excessive ergotropic state rebounds into a 'Nirvana-like hypo-arousal' (Fischer, 1998).

Fischer's model was criticized by Austin (Austin, 1998) for several reasons: In his model's first version (Fischer, 1971) he put pathological states like "acute schizophrenic states" on his scale as if this was a natural part of the progression to a state of mystical rapture. In later versions Fischer changed this by introducing the term "hyperphrenic" into his diagram and stating "Note that a labelling in terms of psychopathology has been omitted from this map. Hence it is perfectly normal to be *hyperphrenic* and ultimately ecstatic in response to increasing levels of ergotropic hyperarousal. When, however, a person gets stuck in a particular state or role, then we label him as abnormal." (Fischer, 1976) (Fischer's articles in 1975 in 1976 were published in „Confinia Psychiatrica“ and obviously were not accessible to Austin.)

The other important issue that was criticized by Austin is the fact that in his "perception-meditation-continuum" Fischer mixes states from Zen meditation with states from yogic meditation without respecting that these two disciplines do have completely different approaches and are also known to produce different physiological effects. In his book Austin – himself a highly experienced Zen practitioner – presents an alternative model of the meditative SoCs. (Austin, 1998)

While Gellhorn's and Fischer's models may not be perfect, they are, nevertheless, very useful and their attempt at linking experiential states to neurophysiological parameters seems promising. That is also why state-of-the-art brain researchers like Newberg and d'Aquili refer to Gellhorn's model from the 70s as a framework for their findings (Newberg & D'Aquili, 2000)

## 2.4 Research of Altered States

In 1925 William James published "Varieties of Religious Experience", a book that can be regarded as the first systematic listing of methods that may lead to an ASC.

More recently Dittrich gave an exhaustive overview of existing research on ASCs (Dittrich, 1996), which provided the outline for this following chapter. Dittrich demonstrated that the three dimensions of his APZ questionnaire

"Oceanic Boundlessness (OSE)",

"Dread of Ego Dissolution (AIA)" and

"Visionary Restructuralisation (VUS)"

are common denominators in ASCs *independently* of the way of induction. Different ways of inducing ASCs evoke different profiles of intensity in these dimensions, however (Dittrich, 1996).

Two other Dimensions "Vigilance Reduction (VIR)" and "Auditive Alteration (AVE) seem to be etiology-dependent.

The development of LSD in the 50s and the widespread subcultural use of LSD, hashish and marijuana was the trigger for a revival of consciousness research. Therefore those d-ASCs induced by hallucinogens are probably the best researched of all ASCs.

### 2.4.1 OVERVIEW

### 2.4.2 HALLUCINOGENIC DRUGS

In the context of this study, however the subject of hallucinogens only seems of marginal interest and is therefore not further elaborated. Books by Dittrich (Dittrich, 1996), Tart (Harman et.al., 1969), Grof (Grof, 1975) and others provide an excellent overview for anyone who is interested in further details.

Changes in consciousness caused by variations in sensorial stimulation resemble the experience of an osteopathic treatment to a much greater extent and are therefore more relevant for this project. Dittrich proposes a simple but useful model for categorizing of the different stimulus conditions (Dittrich, 1996).

### 2.4.3 PSYCHOLOGICAL STIMULI: OVERVIEW

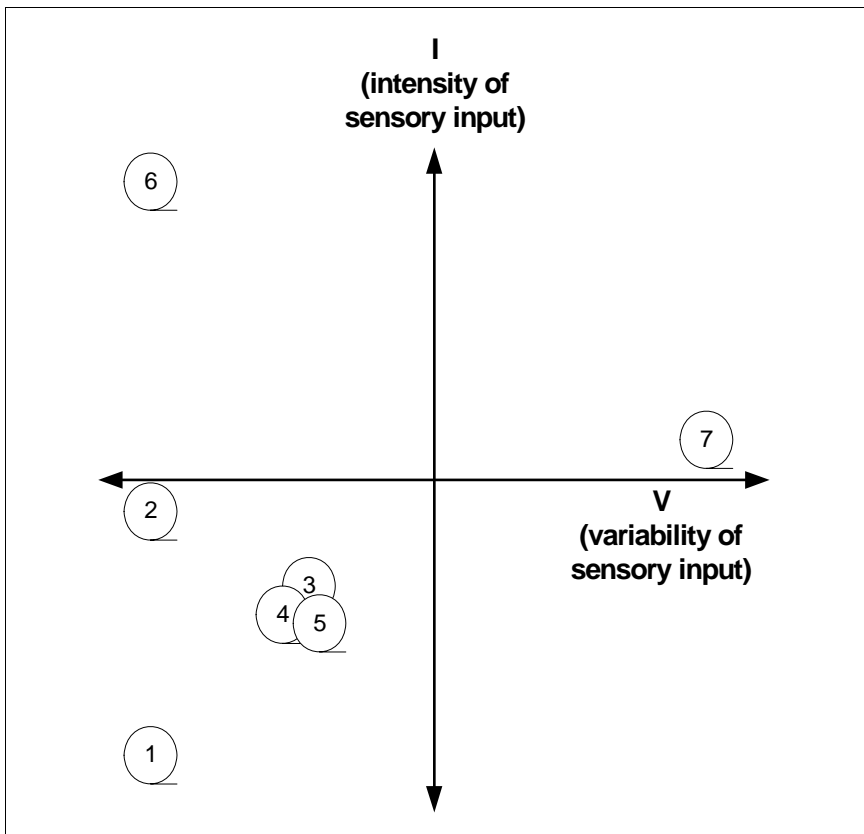


Figure 7: Two-dimensional taxonomy of psychological stimuli for the induction of ASCs (Dittrich)

1. *sensory deprivation*
2. *perceptive deprivation*
3. *hypnagogic and hypnopompic states*
4. *heterohypnotic procedures*
5. *autohypnotic procedures like meditation*
6. *sensory overflow through rhythmic-monotonous stimulation*
7. *sensory overflow through heightened variability*

In a two-dimensional system (see fig. 7) he places *Variability of Sensory Input* on the x-axis and *Intensity of Sensory Input* on the y-axis. Most stimuli for inducing ASCs are placed in the lower, left quadrant (-I/-V), meaning, that variability as well as intensity of sensory input are reduced. The extreme in this quadrant is complete Sensorimotor Deprivation (1). Perceptive Deprivation (2) consists of sensory input that is deprived of all

meaning: monotonous stimuli of normal or slightly reduced intensity are used. Intensity and variability of our perception is also reduced while we are falling asleep or waking up, resulting in hypnagogic and hypnopompic phenomena. (3) Most techniques to induce hypnosis (4) are located in this quadrant, too, as well as autohypnotic procedures (5) like meditation or relaxation techniques.

In the left, upper quadrant (+I,-V) we find sensory overload caused by rhythmic-monotonous stimulation (6). A practical everyday example might be an assembly line worker in a surrounding of loud noise, heat and maybe bright lights, all of those monotonous.

The right, upper quadrant contains sensory overflow through heightened variability (7), which exists only in artificial laboratory settings where optical or acoustical stimuli are presented in a very segmented way with each new impulse interrupting the previous one.

Dittrich (his book was first published in 1985) cites the situation in a discotheque as an example for the right, upper quadrant (+I, +V) using loud music, varying light effects and dancing as stimulants (Dittrich, 1996). In the author's opinion, however, the onset of techno and house music with its monotonous beats and melodies probably has moved this example to the left, upper quadrant and closer to the previously described assembly line experience.

Aristotle was the first to describe the occurrence of optical hallucinations during periods in darkness and silence, but the bible also mentions several situations of visions induced by a long stay in the desert. Hermits from different religions have been using a recluse settings for centuries in pursuit of meditative or spiritual states. Many tribes of Native Americans use an isolated period in the wilderness as a vision quest or an initiation.

Modern research of Sensory Deprivation started in 1951 and developed very quickly. In 1980 Suedfeld already listed more than 1500 studies in this area. (Suedfeld, 1980) This is due to the multitude of practical applications: The effects of Sensorimotor Deprivation cause problems for people with monotonous working environments like truck drivers or airline pilots, or for patients in certain medical settings (iron lung, plaster cast, isolated intensive care, ...) to name just a few of them.

In this area various definitions and categorizations have been made but most of the experimental settings can be divided in three groups:

- **Motor Deprivation:** subjects simply don't move
- **Perceptive Deprivation:** subjects stay in a very uniform surrounding of dim white light and white noise from loudspeakers
- **Sensory Deprivation:** subjects are in a completely darkened and acoustically isolated chamber, padded cuffs on arms and legs restrict their joint movement and tactile input. A special setting for sensory deprivation is the "isolation tank" that was developed by John Lilly: The body is floating in a 35° C warm fluid, in a tank with complete optical and acoustical isolation. (Lilly, 1972)

Many studies also used combinations of those three categories, which were termed **Sensorimotor Deprivation (SMD)**. (Austin, 1998)

Just to stop moving causes a big change in our organism: all the firing of our proprioception quietens down, causing the EEG to become more synchronized and the vigilance level to fall (Block et.al., 1965).

## 2.4.4 SENSORY DEPRIVATION

Sensorimotor Deprivation significantly reduces incoming stimuli *and* the patterns by which our brain usually reacts to them. This takes away a big part of our ordinary SoCs “loading stabilization” (see chapter 2.1.5) thus making it easier for the system to change into an ASC. Austin describes this as a “depatterning” (Austin, 1998). This concept is further developed in chapter 2.3.1.

Sensory deprivation and motor deprivation are interesting states for an osteopath, because in many respects a patient who is treated with cranial osteopathic techniques will be in a similar situation: Lying still, usually in a quiet surrounding, maybe with his eyes closed, and maybe with very little and uniform tactile stimulation.

The most common method for inducing hypnosis consists of a combination of optical stimuli with repetitive verbal suggestions of calmness, relaxation and tiredness. The hypnotic state is then used for suggestions of either general (relaxation, recovery) or specific nature (regarding the subjects problem).

Among the phenomena often associated with hypnotic trance are rigidity of the limbs and various physiological changes in the gastro-intestinal tract and the circulatory system. With respective suggestions it is also possible to evoke deafness, blindness, analgesia or hallucinations.

In experimental research of hypnosis various scales were developed to assess hypnotic susceptibility (Shor & Orne, 1962), depth of hypnosis (Shor, 1990) or dimensions of the hypnotic state (Pekala, 1991).

Patterson, an American osteopath and hypnotherapist described the use of the cranial technique CV4 as a means to induce hypnotic trance in his patients. (see chapter 2.5.3)

“There is little agreement on: how to define meditation, what should be measured, and what the most useful measuring instruments may be. Research on meditation is still in an embryonic state. No doubt, the slow process of data accretion will advance our knowledge of meditation so that some day we may better know what sort of data to collect. “ (Brown, 1977)

Ever since its beginnings in the late 1950s meditation research has been struggling for common grounds. It is not only that meditation is practised in very different contexts – usually in a more *spiritual* context in Asia and in a *health-related* one in the West. Meditation also comprises a wide field of different approaches and techniques. In yogic meditation, for example, the meditator focuses on a single object or idea, trying to exclude everything else. This is in sharp contrast with Zen meditation, which aims at keeping awareness open and receptive. These original differences also produce different results in research trying to measure the effects of meditation. During the first years of meditation research they were not respected, which led to a lot of contradictions and confusion.

Later Goleman (Goleman, 1992) and others proposed a distinction between at least two general groups of meditation: a *concentration* form of meditation and a form that emphasizes *detached awareness*. In general terms one could say that the former is represented by yoga and the latter by the Buddhist tradition.

## 2.4.5 HYPNOSIS

## 2.4.6 MEDITATION

Another difficulty in early meditation research was the fact that measurable variables like heart and respiration rate, or EEG have often been too “gross and tangential to the subtle transpersonal shifts in awareness, emotions and values that constitute the traditional goals of meditation.” (Walsh, 1993).

Despite all these problems several thousand studies on meditation have been performed up to date. A search on Medline alone counts 848 results, and that does not include all the projects in the psychological domain. Therefore the effects listed in the following are only a small selection of what has been researched. Most of these effects have been investigated by several independent studies, and that is why individual references are not cited. For a detailed bibliography of this area the author would like to refer to one of the existing meta-studies (Andresen, 2000; Engel, 1997; Murphy et.al., 1997; Shapiro & Walsh, 1984). Not as systematic as those, but unrivalled in details and depth is James Austin’s “Zen and the Brain” (Austin, 1998).

## Psychological Effects

Although the classification of meditation as “relaxation response” is a vast oversimplification, many reports describe greater calm, positive emotions of love and compassion, profound peace and a variety of ASCs up to the classical mystical experience.

Experimental studies include evidence for enhanced creativity, lucid dreaming, empathy, a positive sense of self control and marital satisfaction.

Therapeutic effects could be demonstrated in disorders like anxiety, phobias, stress insomnia and mild depression.

In chapter 5.3.5 the psychological effects measured in this project are compared to a study, which used the same questionnaire to measure the effects of Kundalini mediation (Venkatesh et al., 1997).

## Physiological Effects

Starting point for physiological research of meditation were several investigations of spectacular yogic abilities like altering body temperature or heart rate. When some of these claims could be validated, more systematic research was begun. Several physiological phenomena could experimentally be related to meditation:

- *reduction of the metabolic rate*, marked by reduced oxygen consumption, carbon dioxide production and blood lactate levels
- *cardiovascular effects*, like a slowing of the heart rate and a lowering of blood pressure
- *changes in blood chemistry*, like modified hormone levels, reduced lactate levels or reduced cholesterol
- *reduction in the severity* of asthma, migraine and chronic pain

## EEG and other brain-imaging devices

Early measurement of brain activity during meditation had to rely solely on electroencephalography (EEG). Contrary to the initial hopes in research by EEG the results proved interesting, but much too gross, leading Wulff to state: “However impressive the EEG may be, its application to meditation research is roughly akin to using half a dozen microphones to



assess life in New York city. In either case we can detect trends in general activity – the shift, say, from early evening to early morning- but the subtleties of the innumerable components that make up the global measures still lie beyond the capacities of these instruments.” (Wulff, 1991).

With most meditation techniques the EEG slows, showing an increased amount and amplitude of alpha waves. In advanced meditators a further slowing to the theta-range occurs. Brainwaves usually don't just slow down, but they also show a better synchronization between the right and left hemisphere.

In an especially interesting study the different responses to repeated external noises in Yogis and Zen practitioners could be shown: Yoga practitioners, whose practice involves withdrawing attention from the senses and internal focus, showed little or no EEG response to the repeated noises. Zen practitioners however showed a continued EEG responsiveness without any habituation to the clicks, which is consistent with the idea of an awareness open to all stimuli.

While the phenomena described above were originally thought to be unique for meditation, some could also be reproduced by relaxation techniques, biofeedback or self hypnosis.

During the past few years the use of EEG in meditation research has been complemented by several new brain imaging techniques:

In a very recent study (Newberg et.al., 2001) eight experienced meditators were asked to enter a meditative state and then indicate to the researchers, when they had reached the peak of this state. At that time the researchers injected a radioactive substance through a previously prepared intravenous line and the meditator was taken into a SPECT-scanner. In 8 out of 8 subjects the SPECT images showed a marked decrease in the activity of the left posterior superior parietal lobe (PSPL). Following this findings the authors concluded that the particular style of Tibetan meditation that was used lead to a deafferentation of the PSPL. Newberg and d'Aquili draw the conclusion that the feeling of non-separateness, which is experienced in meditation, is caused by the fact that the part of the brain that decides if something is self or non-self is simply turned off. (see also chapter 2.3.1 on the PSPL)

While they are falling asleep or waking up many people experience ASCs that are called *hypnagogic* (during falling asleep) respectively *hypnopompic* (during waking up) states.

Hypnagogic phenomena followed by sleep are usually forgotten. That is why it is hard to say how many people experience them. Among the various phenomena people most often report visual or acoustical hallucinations and alterations in body image or thought process.

Most people when awakened, are able to tell the difference between hypnagogic states and dreaming. This difference can be recognized by various criteria: Hypnagogic states are usually shorter than dreams, the subject shows no rapid eye movements (REM), and does not feel personally involved in the hallucinations.

Many of the author's patients are close to falling asleep or do fall asleep completely during a cranial treatment, suggesting that hypnagogic phenomena might contribute to the observed change in consciousness.

## 2.4.7 HYPNAGOGIC AND HYPNOPOMPIC STATES

## 2.4.8 SENSORY OVERFLOW

“In contrast to the abundance of research on sensory deprivation, sensory overload, which would appear to represent a natural corollary as “the other side of the coin”, is essentially nonexistent.” (Ludwig, 1971)

In contrast to this lack of experimental research as observed by Ludwig, there is a big amount of anthropological literature describing the use of sensory overload in non-European cultures. Examples can be found in the books of Michael Harner, Felicitas Goodman, Holger Kalweit, Alberto Villoldo and others.

In the anthropologic context the term “trance” is often used for shamanic states without further specification of the psychological and physiological concomitants of the individual trance state.

Most of the shamanic techniques, however, use intense ergotropic arousal (see chapter 2.3.2) and are therefore probably mechanisms completely different from Cranial Osteopathy.

Dittrich titles this chapter of his taxonomy more specifically “Increased rhythmicity or variability of the field of perception” and also describes research with rhythmic optical or acoustical stimulation. Rhythmic optical stimulation was first researched as a tool for diagnosing epileptic seizures.

During the early 1990s rhythmic optical and acoustic stimulation was popularized by the producers of “Mind Machines”, electronic consumer devices made for the induction of ASCs. The principle in most mind machines was derived from the research of Robert Monroe who had discovered the “Frequency Following Response”, the principle that the frequency of our brainwaves will tend to be entrained by the frequencies of acoustic stimulation. This was developed into a highly sophisticated method called Hemi-Sync (Atwater, 1997; Atwater, 1999).

Surprisingly enough there is no research regarding ASCs induced by touch or manual stimulation. Even Dittrich’s (apparently) all encompassing book does not mention this possibility although he even lists techniques like fasting, hyperventilation, excessive masturbation, absorption in the enjoyment of art or mountaineering.

Equally taciturn on the subject of touch is Tart. He just notes: “A good massage, for instance, or sensory awareness exercises ..... have been known to induce d-ASCs.” (Tart, 1975)

Apart from scientific research, however, various methods use stimulation of skin, muscles or other parts of the body and a few of them shall be discussed in the following.

### Therapeutic Touch

Therapeutic Touch, a method that was developed in 1972 by Dora Kunz and Dolores Krieger in a nursing environment, has rediscovered, what has been known for ages: That it is beneficial for someone to be touched due to an energetic exchange between people. The concept is based on the “assumptions that human beings are complex fields of energy, and that the ability to enhance healing in another is a natural potential.” (Website, 2002) and has strong similarities with the Japanese Reiki or traditional European Mesmerism.

While a literature review in 1984 had to conclude that “ .. empirical support for the practice of therapeutic touch is, at best, weak.” (Clark & Clark, 1984) quite a lot of research on the effects has been done during the past few years. Therapeutic Touch has been shown to be effective in decreasing

## 2.4.9 TOUCH/MANUAL STIMULATION

anxiety (Turner et.al., 1998), decreasing stress (Kramer, 1990), evoking the relaxation response, decreasing pain (Eckes, 1997), and other symptoms.

## **Acupuncture**

Acupuncture and Acupressure use the stimulation of certain points of the body surface to control and alter the flow of “Qi” a form of energy circulating in the body in specific channels. This Qi is regarded as the common source for physical as well as psychological phenomena, therefore it is common sense in traditional Chinese thinking, that a change in the flow of Qi will affect the state of consciousness. Several books have been published that focus on this specific aspect of acupuncture. (Eckert, 1998; Platsch, 2000)

Certain acupuncture points, however, do have a stronger effect on our psyche than others. One of the widest known combination of points is called “Windows to the Sky” and is known to increase the flow of Qi up into the head thus often creating interesting shifts in consciousness. These “Windows” – located around shoulders and neck – are further divided into greater (S9, LI18, TH16, UB10, Lu3) and lesser (RM22, SI16, SI17, DM16, P1) Windows.

A detailed description of the points and how and when to use them can be found in “The Heart of Listening”. (Milne & Society for the Study of Native Arts and Sciences, 1995). Milne also mentions the use of the “Windows” in inducing past life experiences, which – whatever else one may think about them – definitely must be regarded as a d-ASC.

## **Reichian Bodywork**

Wilhelm Reich a student of Sigmund Freud developed Freud’s psychoanalytic concept further by including the body in his analysis and therapy. In “The Function of the Orgasm” (Reich, 1942) he first described his new concept of a “muscular armour” that people use to suppress their unwanted emotions with the total of this armouring creating a person’s “character”. He developed the new technique of *Vegetotherapy* in which he combined verbal analysis of character structures with manual work on hypertonic muscles to re-establish a natural way of breathing and to free up blocked “orgone energy” in the body.

Reich’s work was taken further by many of his students leading to various styles of “Reichian Bodywork” including Bioenergetics (Lowen and Pierrakos), Orgonomy (Baker) and Radix (Kelly).

While focussing on emotions – one single subsystem of consciousness – Reich described a systematic relationship between mind and body that has been very influential to this day.

## **SomatoEmotional Release**

Negative emotion caused by a trauma can be stored in the body in “energy cysts” preventing complete healing. By mimicking the position that the patient went through during the trauma, a therapist can guide the patient to freeing the held-back emotions and restoring normal body functioning. (Upledger, 1990)

The concept of “*SomatoEmotional Release*” – including the energetic concept behind it – is obviously based on ideas and techniques developed by Wilhelm Reich in the 1930s and 1940s. However, Upledger doesn’t give anyone else credit for any of the ideas and techniques but claims to have invented them by himself. (In the same way he had claimed to have developed craniosacral therapy (Upledger & Vredevoogd, 1983) which is actually a derivative of Sutherland’s work.)

Sometimes in an osteopathic treatment old emotions can be mobilized and it is important to allow this to happen and to respect the process. Many therapists, however, almost seem to “squeeze” emotions out of a patient in an active and provocative way. In the author’s opinion this serves more often the purpose of feeding the therapist’s ego than promoting the patient’s wellbeing.

While it may be an important first step for a patient to accept and show negative emotions, it does not necessarily mean that such an emotional discharge can also be integrated. Integration, however, is indispensable if the aim is to promote the patient’s personal development. This is why the osteopath should practice a respectful attitude which is *allowing* emotions in a patient, but not pushing them.

### **Manipulative Technics in Hypnotic Trance Induction**

Only after this study’s experiments had been finished the author found that the American Academy of Osteopathy had released a CDROM with all the academy’s yearbooks from 1953 to 1999, providing an abundance of osteopathic literature in an easily searchable format. (AAO, 2001) This CD also contains an article from 1970 in which H.M. Patterson, an osteopath and hypnotherapist describes how he had systematically been using

Sutherland’s cranial technique of compressing the 4<sup>th</sup> ventricle (CV4) to induce a hypnotic trance in his patients. This trance state was then used to help the patient deal with psychological problems or to give suggestions to improve or restore health (Patterson, 1970). Although Patterson’s report is “only” experiential and not the outcome of a systematic research project it is an encouraging example of another osteopath who – based on similar experiences as the author with his patients – thought along similar lines.

## **2.5 Anatomy, Physiology and Osteopathic Approaches**

Basic knowledge about the area’s anatomy in the reader is taken for granted, so this chapter will describe just a few details of particular interest in relation to the experiment.

The deep suboccipital muscles - the target of the first technique that was used in this experiment (see chapter 3.3.2) - contain an extraordinary high number of muscle spindles (Richmond et.al., 1976; Richmond, 1977; Richmond et.al., 1999; Richmond & Abrahams, 1975; Richmond & Abrahams, 1979; Voss, 1958), which convey a large volume of information thus allowing a very fine-tuned regulation of the muscle length in this area. This also makes the suboccipital zone likely to become a “facilitated segment” (Korr et.al., 1982), that will react with contraction to even minimal stimuli.

### **2.5.1 SUBOCCIPITAL REGION**

Most of the afferences from the suboccipital region tend towards the cerebellum and the vestibular nuclei. However, there are also relationships to the trigeminal nerve (Skillern, 1954); (Schimek, 1988); (Ellis & Kosmorsky, 1995) and indications for connections to the vagus: Irritations in the area of the second cervical spinal ganglia caused repeated vagal responses like bradycardia and a drop in blood pressure (Jansen, 1993).

Osteopathic techniques in the cranial field can work on several different levels: bones, membranes, the central nervous system (CNS), or the cerebro-spinal fluid (CSF). Especially in fluid techniques the idea of an inherent intelligence in the body is used: The osteopath is guided by what he can sense in the fluid rather than actively imposing a technique on the patient's system. Most fluid techniques have a strong homeostatic effect on the body,

## 2.5.2 CRANIAL FLUID TECHNIQUES

### Ventricles and CSF

*"... the cerebro-spinal fluid is the highest known element that is contained in the human body, and unless the brain furnishes this fluid in abundance a disabled condition of the body will remain. He who is able to reason will see that this great river of life must be tapped and the withering field irrigated at once, or the harvest of health be forever lost." (A.T. Still)*

CSF is produced constantly in the plexus choroideus, mostly in the lateral ventricles, but also in the roof of the 3<sup>rd</sup> and 4<sup>th</sup> ventricle. The CSF circulates from the lateral ventricles through the interventricular foramen (or Monroi) into the 3<sup>rd</sup> ventricle, then through the aquaeductus mesencephali (or Silvii) into the fourth ventricle. From the 4<sup>th</sup> ventricle it continues through the lateral and medial openings (or foramina Luschkae and Magendii) into the cisternae and the intracranial and spinal subarachnoidal space. The CSF is reabsorbed in the arachnoid granulations.

An interesting detail is that there are sympathetic as well as parasympathetic fibres in the plexus choroideus: sympathetic activity causes a reduction of CSF production up to 30%, parasympathetic activity causes an increase up to 100% (Lindvall et.al., 1978); (Ando, 1996).

In neurology excessive pressure of the CSF is known as a reason for neural dysfunctions or even lesions, which demonstrates that there is a direct effect of CSF pressure on the CNS. This in turns allows us to speculate that even more subtle influences on the CSF fluctuation - like it is assumed to happen during certain cranial techniques - might influence the CNS and thus consciousness.

In the context of researching effects on consciousness, which presumably are mediated by the nervous system, it seems useful to review the neural structures adjacent to the ventricles:

- **Lateral ventricles:**
  - below:* caudate nucleus of the striate body, hippocampus, optic thalamus, fornix
  - above:* corpus callosum
  - lateral:* caudate nucleus of the striate body
  - medial:* pellucid septum, fornix and calcar avis
- **Third ventricle:**
  - below:* hypothalamus and optic chiasm
  - above:* plexus choroideus
  - lateral:* thalamus and hypothalamus

*anterior*: fornix, lamina terminalis, anterior commissure

*posterior*: pineal gland and posterior commissure

- *four appendices*: optic recess, infundibular recess, (into the stem of the pituitary gland), pineal recess, suprapineal recess.
- **Fourth ventricle:**
  - below*: tegmental part of the pons, medulla oblongata
  - above*: cerebellar peduncles, superior and inferior medullary velum, vermiform process
  - lateral*: N. facialis (VII), nuclei of the N. vestibulocochlearis (VIII)

An excellent overview of CSF and the ventricles can be found in Liem's "Kraniosakrale Osteopathie" (Liem, 1998).

Neither thorough literature research nor interviews with longstanding teachers of Cranial Osteopathy could bring forth any reference to changes in patients' consciousness in the writings of *Still, Sutherland or Becker*.

Nevertheless the idea of spirituality's importance is imminent in their teachings – it is just expressed within their own personal and historical context.

*Louisa Burns*, one of A.T. Still's students, wrote a book called "The physiology of Consciousness" as early as 1911, anticipating many ideas about the brain-consciousness relation that were developed by the psychiatry only much later. Unfortunately the book could not be obtained for a detailed review.

*Thomas F. Schooley* mentions that "...the mental activity of the patient is also changed from active to passive, or receptive, even to the point of sleep during reaction" and that a patient might prevent a CV4 technique from being successful by "... keeping his thought process going" too rapidly. (Schooley, 1953)

While not being exactly on the issue of consciousness *Edith E. Dovesmith's* observations are interesting in the context of our measuring of HRV: She suggests that cranial fluid techniques stimulating the longitudinal flow – like the CV4 – are also stimulating a sympathetic dominance in the patient. This is derived from reactions like "uneasiness, nervousness, great muscular tension, from the occiput to the mid dorsal area, an increase in the rate and intensity of the heart beat, a shortness of breath on walking or other accustomed activity, a lessening of appetite and an inability to sleep." Lateral fluctuation is described as stimulating a parasympathetic response, therefore being suited as a treatment for all spastic conditions, but also "...hypercortical activity, bordering on frenzied or maniacal states". In her article she also refers to Walter R. Hess's discoveries about the hypothalamus stating that "...instead of cutting out that behaviour area or electrically stimulating the hypothalamus it would appear that the management of the reciprocal tension membranes might be a more practical as well as a more physiological solution." (Dovesmith, 1953)

Dovesmith's ideas sound very interesting, but apparently no one has followed up on them so far. The technique that was used in this project (see chapter 3.3.3) only aimed to synchronize with the motion present and eventually bring the test subject to a Stillpoint. Neither longitudinal nor lateral fluctuation were induced specifically.

### 2.5.3 OSTEOPATHIC WRITINGS ON THE ISSUE OF CONSCIOUSNESS

In a case study J.B. Donovan writes about a patient with epilepsy being related to a cranial as well as a vertebral strain pattern and responding well to osteopathic treatment. (Donovan., 1953)

The only systematic study relating the subjects of Osteopathy and consciousness is “A Physical Finding Related to Psychiatric Disorders“. John M. Woods and Rachel H. Woods found an average “cranial rhythmic impulse” (CRI) of 12,47 per minute in 62 healthy subjects while the average rate of 102 psychiatric patients was 6,7 per minute. According to their paper “The usual rate for adults is from 10-14 impulses per minute” which is a popular point of view among osteopaths. Nevertheless, this is strongly opposed by James Jealous who regards the CRI as nothing but a compensatory rate, a “variable surface wave phenomena” reflecting ANS imbalance and disappearing early in treatment. Instead he proposes a slower rate of Primary Respiration at 2-3/min and even slower rates.

*Patterson’s* article on “The use of Manipulative Technics in Hypnotic Trance Induction” was already described above (see chapter 2.4.9)

*James Jealous* puts a lot of emphasis on *the osteopath’s* state of consciousness. (Jealous, 1999). According to Jealous an osteopath will perceive deeper levels of his patient’s being when he proceeds further towards a state that could be described as mystical.

## 2.6 Previous Research on Cranial Osteopathy

During literature research for this project the focus was to find studies or articles on the relationship of cranial techniques and consciousness or mental functioning, and the respective findings were listed above. This chapter will give a short description of five literature reviews on Cranial Osteopathy and/or Craniosacral Therapy.

### Cranial Academy

In 1999 the Cranial Academy published “A Bibliography of Research Related to Osteopathy in the Cranial Field”. Listed alphabetically by principal investigators the literature is categorized in ten main categories, some of which contain subcategories. The main categories are:

- The motile brain and central nervous system (histochemistry, microscopic anatomy, observations and measurements, related brain physiology)
- The dura mater of the brain and the spinal chord (molecular studies, gross anatomy and histology, embryology and aging, mechanical experiments, fascial connections to the cranium)
- The cerebrospinal fluid hydraulics (flow dynamics and pathways, pressure fluctuations and tidal movements, related cerebrospinal fluid physiology)
- The osseous-articular mechanism (suture structure and function, embryology, osteokinematics)
- Involvement of the sacrum in the craniosacral system

### 2.6.1 OVERVIEW

### 2.6.2 A REVIEW OF REVIEWS

- Clinical research in Cranial Osteopathy (paediatrics, palpation, trauma management, clinical effects of cranial dysfunction, new techniques)
- Pulsatile phenomena not related to arterial pulses, cardiac rhythm, or other known rhythmic activity (Instrumental detection and measurement, clinical correlations, palpation)
- Striated muscle anatomy and function related to the craniosacral system
- History of Cranial Osteopathy
- Bound volumes related to Cranial Osteopathy

The Cranial Academy's bibliography contains more than 300 entries, thus containing the biggest number of references of all the reviews. Unfortunately they are listed without any commentary, so it is not a big help in further literature research.

### **James Jones**

"This paper was intended to acquaint the reader with some of the current concepts of Osteopathy in the cranial field. " is what Jones tells about his motives and this author thinks, he succeeded. In a well legible article Jones addresses the most important cranial concepts, puts them in relation to findings from medical science and cites most of the important studies regarding Cranial Osteopathy directly. He closes his article stating that "...what the phenomena is, and its' applicability to treating the structural component of medical conditions remains to be more fully researched."

### **Upledger**

John Upledger provides a review of "Research and Observations that Support the Existence of a Craniosacral System". Upledger is structuring his paper by "... work in which I was not directly involved..." and "... some of the work in which I have been personally involved." (sic!) (Upledger J, 1995) In part 1 (non-Upledger) he lists 17 references without any further order, and then 3 "investigations by dentists" but he adds short abstracts, which were found helpful. Part 2 is an autobiographical narrative of Upledger's outstanding merits including unstructured descriptions of his studies, which makes it hard to extract useful information.

The terms "Osteopathy" or "osteopathic" are used only in the historical context of Upledger's first course with the Cranial Academy, in names (like "Academy of Applied Osteopathy") or in titles of cited literature. Otherwise it is all about "CranioSacral Therapy". Upledger's literature review is currently available on the internet at [http://www.cranio.org/JEU\\_Article\\_en.htm](http://www.cranio.org/JEU_Article_en.htm).

### **British Columbia Office of Health Technology Assessment (BCOHTA)**

In 1999 the "British Columbia Office of Health Technology Assessment", an agency at the University of British Columbia funded by of the Canadian government, charged a group of scientists with the "Systematic Review and Critical Appraisal of the Scientific Evidence on Craniosacral Therapy" (GREEN, 1999).



The introduction mentions Sutherland and uses a definition of *CranioSacral Therapy* with a quote by Greenman, that “*Craniosacral osteopathic manipulative techniques* attempt to restore motion to restrictions within individual sutures of the skull, ....” and many of the reviewed studies were done by osteopaths. Nevertheless the words “*Osteopathy*” or “*osteopathic*” are not used in the review outside the introduction or the bibliography. Another surprising detail is found in the list of organizations which were contacted for literature research: It contains naturopaths, nurses, massage-therapists and others, but not a single *osteopathic* association. These findings lead to the conclusion that the study’s subject is not regarded as a part of Osteopathy.

The article reviewed 35 studies that were categorized in the areas of

- Craniosacral treatment effectiveness (7)
- Agreement by practitioners on craniosacral assessment findings (5)
- Pathophysiology of craniosacral dysfunction:
- The potential association between health and craniosacral mobility restrictions(3)
- Motion/fusion between cranial bones (9)
- Cerebrospinal fluid rhythmic flow patterns (10)

Apart from well known studies doing *specific* research on Cranial Osteopathy, some studies from related fields (e.g. CSF fluctuation) were included. After a thorough methodological analysis the review come to a very critical résumé:

“The benefit of craniosacral therapy has not been demonstrated using well-designed research. The available studies are of low grade evidence ... and are of poor quality when judged using standard critical appraisal criteria. Inadequacies in the studies cited above preclude any statement attesting to craniosacral therapy effectiveness.” (GREEN, 1999)

Nevertheless everyone who plans to do research in the field of Cranial Osteopathy should read this article! It gives an outside opinion on Osteopathy from a rather objective point of view, applying scientific standards to the reviewed studies. The criteria applied are listed in the “Intervention Study Appraisal Form” and are perfectly suited to serve as a guideline for future research. Green’s literature is currently available on the internet at <http://www.chspr.ubc.ca/bcohta/pdf/cranio.PDF>.

## Jarvis

Having talked about fair and correct criticism in the chapter above, we now come to an example lacking correctness completely. On the website of the “National Council Against Health Fraud” William Jarvis has published an assault on Cranial Osteopathy based on badly informed judgement and one-sided polemics. As an example for his utter lack of knowledge on his subject, as well as for bad editing the following quote may serve: According to Jarvis cranial restrictions are freed up by “... tapping the skull [yes, that’s exactly the way it was published] with fingertips (the ‘tap’ is a solid, attention-getting, non-painful blow to the side of the head).” (Jarvis, 2001)

The unsystematic article further contains a dentist’s criticism of Viola Fryman’s statements during a course, a historical narrative on chiropractors claiming to have developed cranial work before Sutherland did and the

story of Ferreri, a chiropractor who allegedly was convicting for treating children during a research project with a forceful method called “Neural Organizational Technique”, causing long-term damages.

It is obvious that Jarvis is simply listing bits and pieces of completely different methods with the only common denominator that something is done to someone’s head. But he has his point, when he is able to cite the critical but reputable study by the BCOHTA (see above) or when he claims that he has written letters with questions on Cranial Osteopathy to the Michigan State University College of Osteopathic Medicine (MSUCOM) and the American Osteopathic Association (AOA) without ever receiving answers.

It probably will never be possible to avoid pamphlets like this one. Better research on Cranial Osteopathy, however, could make the work of people like Jarvis a lot harder.

An exceptionally well designed study about “Cranial rhythmic impulse related to the Traube-Hering-Mayer oscillation: Comparing laser-Doppler flowmetry and palpation” has been published in the JAOA in 2001, which is why it is not included in the reviews. Nelson, Sergueef et. al. developed a method for the simultaneous measurement of the cranial rhythm impulse (CRI) to the Traube-Hering-Mayer - oscillations and could demonstrate, that the two “bear a striking resemblance to each other.” (Nelson et.al., 2001) Traube-Hering-Mayer waves are oscillations in heart rate and blood pressure that will be described in more detail in the context of heart rate variability (see chapter 3.7). These oscillations were measured on twelve healthy subjects by laser-Doppler flowmetry, which provided measurement of the relative velocity of the blood. Simultaneously, the examiner palpated the subject’s CRI. The examiner then indicated to the second examiner whenever she was sensing flexion or extension in the subject’s head and these events were marked on the record. The study reached the conclusion that “...the PRM/CRI and the THM oscillation occur simultaneously, though they may not represent the exact same phenomenon.”

Many findings from medical or biological research seem to support parts of the cranial concept, e.g. brain and spinal chord motility studies. However, there is not enough research on Cranial Osteopathy itself, and most of it does not withstand a critical review by non-osteopathic scientists. Due to bad methodology even studies with big subject numbers (equalling big effort) like Viola Fryman’s study on 1250 children (FRYMAN, 1965) do not lend much credibility to the method.

Much of the research on Osteopathy in the cranial field has been preoccupied with the idea of demonstrating that Primary Respiration Movement does exist or that bones or other cranial structures do move (see the counts above). It is important for every method to have a scientifically acceptable model of how it works, and so all those efforts are justified. Still, the author would like to suggest that the scarce resources for osteopathic research should be directed more into the direction of *demonstrating the manifold effects* of Cranial Osteopathy, which are familiar for most osteopaths but have hardly ever been subject of research.

### 2.6.3 CRI RELATED TO THE TRAUBE-HERING-MAYER OSCILLATION

### 2.6.4 CONCLUSIONS

# 3 *methods*

## 3.1 Overall Study Design

*“An experiment is a ploy to make nature speak more understandably.”  
(Georg Wald, Nobel laureate for Physiology and Medicine 1967)*

As discussed before consciousness research has a long history of controversies about “the right” approach: subjective (first person) research methodology versus “objective” (third person) observations and measurements. The present study attempts to combine both sides with the idea in mind that - when venturing into unknown territory - it is better to be equipped with two tools instead of just one and that there might be interesting correlations between the two.

The study was designed as an experiment. Convenience sampling was used by sending a written invitation to about 200 people (including the author’s friends, acquaintances and patients, first year osteopathic students and students and graduates of the training in “Physioenergetik”). All subjects who applied in reaction to the mailing were accepted, then another three were found by “snowball sampling” to reach a total of 46 participants.

In the invitation the subjects were informed in detail about the procedure. The experiment’s aim, however, was only described in the general terms “...researching the subjective perceptions and effects on the autonomic nervous system during a cranial osteopathic technique”, to avoid any suggestions, which might have biased the subjects’ responses.

The subjects did not receive any compensation and participated voluntarily. They were first classified by the inclusion/exclusion criteria listed below. Then they were assigned to Experimental Group (E), Control group 1 (C1) or Control group 2 (C2) (see chapter 3.1.8 Criteria for Inclusion and Exclusion).

After HRV measurement data were analyzed, those subjects with either severely reduced HRV or a high number of extrasystoles were contacted and recommended to do a thorough ECG examination.

15 subjects were treated by an osteopath (operator 1) using the cranial technique of “synchronizing with the slow rhythm of 2-3 cycles per minute” as it is taught by James Jealous D.O..

The equally sized group C1 worked with a non-osteopath (operator 2) who was holding their head in a similar fashion for about 15 minutes conducting a sham technique.

The 15 subjects of C2, yet another control group, were lying still with eyes closed for about 15 minutes.

- During the experiment subjects’ heart rate variability (HRV) was measured using the PC-based system “Nerve-Express”.
- After the experiment subjects filled out 2 questionnaires: The “Phenomenology of Consciousness Inventory (PCI)” the “Dimensions of

### 3.1.1 BRIDGING THE GAP

### 3.1.2 SAMPLING

### 3.1.3 SUBJECTS

### 3.1.4 EXPERIMENTAL GROUP (E)

### 3.1.5 CONTROL GROUP 1 (C1)

### 3.1.6 CONTROL GROUP 2 (C2)

### 3.1.7 MEASUREMENT

Attention Questionnaire (DAQ)” by Ronald Pekala (see attachment) measuring shifts in consciousness/ attention.

- After completing the PCI and DAQ subjects completed a one-page questionnaire on personal data and previous experiences with ASCs. This inventory was placed *after* PCI and DAQ to avoid affecting their results by dropping hints to altered states of consciousness.

Eligible for the Experimental Group (E) and the Control Group 2 (C2) were all subjects who did not know more about the project’s aim than was stated in the “invitation for subjects” (see Appendix).

Additional criteria for Control Group 1 (C1), the “Placebo”-group were that

- subjects did not know enough about Cranial Osteopathy to be able to tell a fake technique from a real one (So osteopaths and osteopathic students after the second year of training were excluded.)
- subjects did not know the Control Group’s operator personally and thus did not know that he is not an osteopath (as was claimed in the explanation to the subjects.)

After completing the experiments 15 subjects had been tested in the groups E and C2 and 16 subjects in group C1. To ensure proper statistic evaluation one of the subjects (nr. 46) was chosen randomly and excluded from further analysis. As a tool for random number generation the respective function of MS-Excel was used (Microsoft, 2000)

The *numbering of subjects* could not be done continuously: The Nerve-Express software assigned the numbers from 7 to 13 to real patients, who were treated and measured in between the experiments. To avoid the danger of data loss the author did not try to undo this automatic assignment and close the gap, but preferred to continue with nr. 14.

The assignment to the Experimental Group (E), Control group 1 (C1) or Control group (C2) was done only semi-randomized for several practical reasons:

- There was only one system for HRV-measurement available
- The groups E and C1 needed different operators whose time had to be filled as efficiently as possible.

The first step was to find dates with a free treatment room in our clinic. Next these dates were assigned to the two operators. Then subjects were assigned to the dates according to *their* availability and the criteria described above.

## 3.2 Experimental Timeline

The overall time needed for one subject was about 45 minutes. The timeline of the actual experimentation phase was determined by the HRV measurement software, which chunks measurement data into phases of 192 heartbeats. Depending on the subjects’ heart rate these phases lasted between 2,25 and 3 minutes.

### 3.1.8 CRITERIA FOR INCLUSION AND EXCLUSION

### 3.1.9 ASSIGNMENT TO GROUPS

#### 3.2.1 OVERVIEW

Patients were welcomed, thanked for their coming and then the protocol was explained to them once again. (They had already read and approved it when applying.) The chest strap for HRV measurement was put on and the subject lay down on a treatment table. The HRV signal receiver was clipped to the subject's clothing and the measurement was started.

### **3.2.2 WELCOME, PREPARATIONS**

This phase was used to let the subjects settle down into their eventual position, check the HRV-measuring device for problems if necessary and for subject and operator to get ready. Subjects had their eyes open and were free to talk to the operator.

### **3.2.3 HRV PHASE 1**

The actual beginning of the experiment. From phase 2 to phase 6 subjects had their eyes closed. In group E operator 1 put his hands under the occiput and applied the inhibition technique to the subject's suboccipital muscles. In group C1 operator 2 put his hands under the atlanto-occipital junction without applying any specific technique. In group C2 subjects just closed their eyes.

### **3.2.4 HRV PHASE 2**

In group E operator 1 put his hands into a different position under the occiput into a "cradle hold" and started to synchronize with the subject's slow cranial rhythm. In group C1 operator 2 put his hands into a different position under the occiput into a "cradle hold", still without applying any specific technique. In group C2 subjects stayed lying on their back like before.

### **3.2.5 HRV PHASE 3**

same as phase 3.

### **3.2.6 HRV PHASE 4**

At the beginning the operator said: "Now the phase begins that the questionnaire will refer to afterwards." Everything else stayed as in phase 4.

### **3.2.7 HRV PHASE 5**

same as phase 3

### **3.2.8 HRV PHASE 6**

After the completion of phase 6 the operator terminated the measurement. The subject was told to sit up slowly, then stand up and move over to the table. The HRV system does not allow the termination of a measurement within a phase so subjects had to stay "wired" until the end of phase 7. However data from phase 7 were not included in the evaluation.

### **3.2.9 HRV PHASE 7**

The questionnaires were explained to the subject according to Dr. Pekala's instructions on side one of the PCI. Subjects were filling in the questionnaires without the operator's intervention. The operator did however answer questions regarding the questionnaire.

### **3.2.10 COMPLETING THE QUESTIONNAIRES**

## **3.3 Osteopathic Techniques**

As Tart points out, it is necessary to interrupt one state of consciousness before it is possible to enter another. (Tart, 1975) In complete osteopathic treatments HVT-techniques, especially in the upper dorsals or cervicals seem to produce a similar effect by first causing a sympathetic response (Kainz, 1999). Then a rebound according to Hess sets in and the body

### **3.3.1 GENERALITIES**

switches over to a parasympathetic “relaxation response”. This experiment uses an inhibitory technique on the deep suboccipital muscles to achieve the purpose of interrupting the subject’s b-SoC. This technique is also very helpful for inducing overall relaxation.

In the author’s as well as in other osteopaths’ clinical practice it seems that fluid techniques are more likely to cause shifts in patients’ consciousness than techniques on bones or membranes. In the same way, working with slower rhythms according to James Jealous (Jealous, 1999) seems to have more of this effect than working with the CRI of 10-14 cycles/minute.

This experiment uses an inhibitory technique on the deep suboccipital muscles to achieve the purpose of interrupting the subject’s b-SoC for one phase (about 3 minutes) of the HRV measurement.

The subject is supine with the osteopath sitting at the head of the table. The osteopath cradles the head in both hands with fingerpads on the insertion of cervical extensor muscles in the occiput. By flexing the metacarpophalangeal joints the osteopath exerts inhibitory pressure against the muscle insertions to produce a softening of muscle hypertonicity.

The subject is supine with the osteopath sitting at the head of the table. The osteopath used the “Becker Hold”, cradling the subject’s head in both hands without applying specific pressure on any structure. Then the osteopath synchronizes with the Primary Respiration Movement of 2-3 cycles/minute, focussing on the fluid level and trying to induce a Stillpoint in the subject. This technique is applied during 4 phases (about 11 minutes) of the HRV measurement.

If necessary it is maintained a little longer than that until the subject is balanced in a new, stable rhythm.

In Control group 1 (C1) the operator, who is not an osteopath, mimics the techniques described above by putting his hands into a similar position.

## **3.4 Phenomenology of Consciousness Inventory (PCI)**

The PCI is an instrument for retrospective phenomenological assessment. It was developed by Ronald J. Pekala over the course of more than a decade and across several generations of predecessors (Pekala, 1991). Ronald Pekala generously granted permission to use the PCI for this project and supplied the author with all the necessary materials for using it.

The PCI uses 53 items, each of them consisting of two statements separated by a seven-point Likert scale allowing the subject to indicate to which degree the statements reflect his experience. The items are arranged in a randomized block design so that no two items of similar content are adjacent.

### **3.3.2 SUBOCCIPITAL RELEASE**

### **3.3.3 SYNCHRONIZING WITH THE PRIMARY RESPIRATION**

### **3.3.4 CONTROL GROUP TECHNIQUES**

#### **3.4.1 OVERVIEW**

#### **3.4.2 ITEMS**

The 53 items assess 12 main dimensions of consciousness. Five dimensions have two or more subdimensions associated with them. The dimensions are:

- positive affect (joy, sexual excitement, love)
- negative affect (anger, sadness, fear)
- altered experience (altered body image, altered time sense, altered perception, altered meaning)
- visual imagery (amount, vividness)
- attention (direction, absorption)
- self awareness
- (altered) state of awareness
- internal dialogue
- rationality
- volitional control
- memory
- arousal

In several studies Pekala could demonstrate the PCI's validity, showing that different groups experienced the same phenomenological intensity and pattern parameters under the same stimulus conditions. These parameters were significantly different when the stimulus condition changed (Pekala, 1991).

The PCI contains five pairs of reliability items (identical or very similar statements with slightly different phrasing and inverted position of the two statements). These paired reliability items are used to monitor the consistency of participants' responses.

During the evaluation these pairs are compared and used to compute a "reliability index" (RI) score. This score would ideally be zero meaning a subject has indicated exactly identical answers on these five pairs of questions. Subjects answering in exactly opposite ways would generate a reliability index score of six. Marginal reliability was defined as an average RI score greater than 2.0. This allows the researcher to eliminate subjects with questionable reliability.

Given the small number of items per dimension the PCI will probably not be able to make very fine phenomenological discriminations. Besides the PCI's ability to make fine distinctions will also depend on the number of subjects assessed and the reliability of the subjects' answers.

Pekala used the PCI to assess periods from 2 to 4 minutes. Research with longer periods up to several hours has been carried out, but not published yet.

In pilot experiments subjects were asked to use the PCI to report on the complete experimental phase of about 15 minutes. While completing the PCI they complained that their subjective experience had changed remarkably within this time span so they found it difficult to answer certain questions. Taking this into account the time period assessed was reduced to about 5-6 minutes. (see chapter Experimental Timeline)

### 3.4.3 DIMENSIONS

### 3.4.4 VALIDITY

### 3.4.5 RELIABILITY

### 3.4.6 LIMITATIONS

### 3.4.7 TIME PERIOD LENGTH



For the use in this research project the PCI was translated into German by a psychologist. The translation was then validated by a medical doctor, a physiotherapist and the author himself.

## 3.4.8 TRANSLATION

# 3.5 Dimensions of Attention Questionnaire (DAQ)

Like the PCI, the DAQ is an instrument for retrospective phenomenological assessment. It was created to assess the dimension of attention – which already had been a part of the PCI - in more detail than this was possible with the PCI.

## 3.5.1 OVERVIEW

Like the PCI, the DAQ was developed by Ronald J. Pekala (Pekala, 1991) who generously granted permission to use the PCI for this project and supplied the author with all the necessary materials for using it.

The DAQ uses 40 items, each of them consisting of two statements separated by a seven-point Likert scale allowing the subject to indicate to which degree the statements reflect his experience. The items are arranged in a randomized block design so that no two items of similar content are adjacent.

## 3.5.2 ITEMS

The 40 items assess 12 dimensions of attention. The dimensions are:

## 3.5.3 DIMENSIONS

- simultaneity
- density
- locus
- perspicacity
- attentional control
- vigilance
- absorption
- direction of attention
- one-pointedness
- equanimity
- flexibility
- detachment

In several studies Pekala could demonstrate the PCI's validity, showing that different groups experienced the same phenomenological intensity and pattern parameters under the same stimulus conditions. These parameters were significantly different when the stimulus condition changed (Pekala, 1991).

## 3.5.4 VALIDITY

The DAQ contains six pairs of reliability items (identical or very similar statements with slightly different phrasing and inverted position of the two statements). These paired reliability items are used to monitor the consistency of participants' responses.

## 3.5.5 RELIABILITY

During the evaluation these pairs are compared and used to compute a "reliability index" (RI) score. This score would ideally be zero meaning a subject has indicated exactly identical answers on these five pairs of questions. Subjects answering in exactly opposite ways would generate a reliability index score of six. Marginal reliability was defined as an average RI score greater than 2,0. This allows the researcher to eliminate subjects with questionable reliability.

For the use in this research project the DAQ was translated into German by a psychologist. The translation was then validated by a medical doctor, a physiotherapist and the author himself.

### 3.5.6 TRANSLATION

## 3.6 Questionnaire on Previous Experiences with ASCs and Personal Data

On a one-page questionnaire subjects were assured that their data were processed anonymously and not handed over to third parties. Then they were asked their age, sex, the current level of distress in their lives, and if they had had previous experience with one of the following:

Cranial Osteopathy, relaxation training, meditation, ASC inducing drugs, Shamanic techniques, Mind-Machines, Hemi-Sync, Isolation-tank, spontaneous experiencing of ASCs.

## 3.7 Heart Rate Variability (HRV) Analysis

For many centuries physicians have auscultated their patients' hearts, observing beat-to beat rhythm shifts that were associated with their patients' age, illness or psychological state. In Traditional Chinese Medicine this became one of the central components of medical diagnostics. In-detail research, however, has only become possible with the development of technical measuring devices.

In 1847 Ludwig could observe the regular quickening of the heart rate with inspiration in a dog, a phenomenon that was later coined "respiratory sinus arrhythmia (RSA)".

According to recent neurophysiological research RSA is caused by inter-neural connections in the brainstem between the nuclei controlling the heart rate and the respiration. Ludwig's finding was soon confirmed by other researchers. Hering (1910) was the first to state that "... it is known with breathing that a demonstrable lowering of the heart rate is indicative of the function of the vagi."

In the 1960s interest in researching RSA was rekindled by researchers who emphasized the relationship between heart rate variability and the status of the nervous system. Eventually this led to the widespread use of HRV in several areas including psychophysiology

### 3.7.1 HISTORICAL OVERVIEW

### 3.7.2 BASIC PRINCIPLES

The analysis of HRV is based on a visual representation called “Method of Rhythmography” (developed by Dr. Zhemaitite in 1967). Rhythmography represents the time interval between each consecutive heartbeat (Regular-Regular or R-R-interval) as a straight vertical line. The length of the vertical line represents the length of the interval between heartbeats.

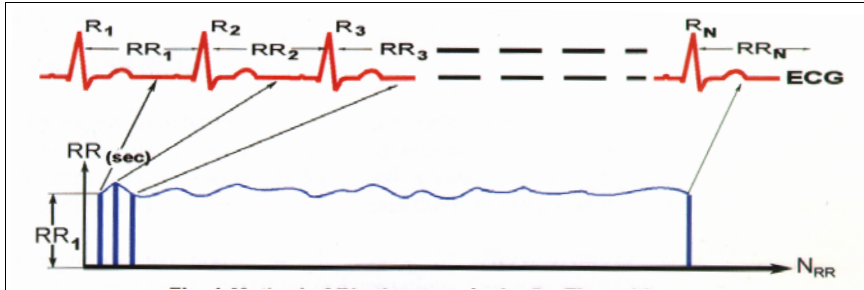


Figure 8: Rhythmography

When these lines are graphed sequentially they present a specific wave portrait of heart rhythm in form of a curve.

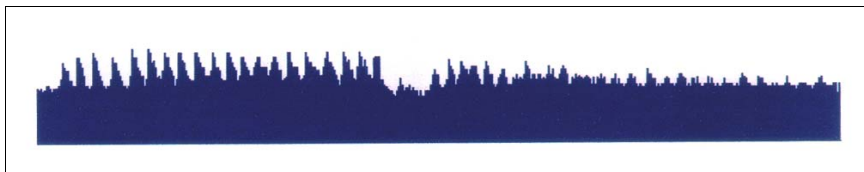


Figure 9: Rhythmogram

A spectral analysis of this curve allows to identify two main spectral components: high frequencies” (HF) and low frequencies” (LF). While this categorization is commonly used it is a little arbitrary because a spectral analysis (=frequency distribution of the various measured frequencies) shows a continuous transition between the two frequency domains. The HF domain contains frequencies between 0,15 and 0,4 Hz (9-24/min.), the LF domain frequencies between 0,04 and 0,15 Hz, (0-9/min.). This spectral analysis is graphically represented by a curve called periodogram. (Figure 10: Periodogram)

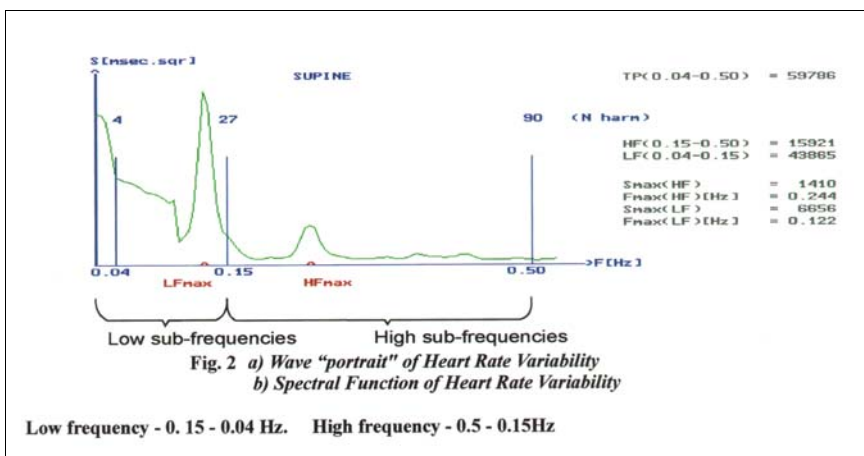


Figure 10: Periodogram (Spectral Analysis)

The RR intervals (the time between two R-spikes in the ECG) are graphically represented in the form of a rhythmogram and they are the basis for the calculation of HF and LF power. This is done by dividing the data in segments of 192 RR intervals, calculating the square of each interval and summing up all the values in a domain (unit: ms<sup>2</sup>). LF and HF values sum up to the value of “total power”.

The LF peak represents influences of both sympathetic and parasympathetic activity associated with baroreflexes while the HF peak represents the respiratory sinus arrhythmia modulated by the vagus.

In many previous studies the LF/HF ratio was shown to be a reliable index of autonomic balance: high values indicate a predominance of the sympathetic nervous system (SNS) and low values indicate parasympathetic (PSNS) prevalence (Bigger, Jr., 1996; Lombardi et.al., 1996; Malliani et.al., 1994; Pagani et.al., 1986)

(While this opinion is supported by a wide range of authors it is also questioned by others who state that due to the dual influences on LF variability “... the available data do not support the use of either LF variability or the ratio of LF-to-HF variability as a general index of sympathetic cardiac control or sympathovagal balance.” (Berntson et.al., 1997)

In clinical cardiology HRV is a reference for cardiovascular morbidity and mortality e.g. (Kleiger et.al., 1987) as well as for risk stratification for sudden cardiac death (Mulder, 1985).

In psychophysiology HRV is used as a marker for mental effort and workload (Mulder, 1985) as well as a measurement of general sympatho-vagal balance. (Malliani, 1994). Some groups also use HRV to test the efficiency of relaxation techniques e.g. (Sakakibara, 1994) or as output signal in bio-feedback techniques (Childre et.al., 1999).

Researchers in the domain of HRV agree that the measurement of HF variability or Respiratory Sinus Arrhythmia (RSA) can potentially be influenced by thoracic respiration. Regarding the conclusions from this fact, however, opinions diverge. While one group of researchers strongly recommends to control breathing during HRV measurement e.g. (Bianchi et.al., 1990; Grossman et.al., 1991) others have argued that the mental effort required for controlled respiration itself may reduce heart rate variability (Patwardhan et.al., 1995). One of the researchers, Thomas Bigger wrote an article dismissing the necessity of controlled breathing (Bigger, Jr., 1996) while co-authoring a paper that clearly advocates it (Grossman et.al., 1991).

(Hirsch & Bishop, 1981) compared HRV between spontaneous breathing and controlled breathing and found that the HR fluctuations during spontaneous breathing were within the 95% confidence limits of those measured during controlled breathing. Therefore they concluded that controlled breathing is not a prerequisite for correct HRV measurement.

The main objective of this project was to assess the influence of a cranial osteopathic technique on subjects' state of consciousness. Control of breathing – requiring outward directed attention and voluntary control - would very likely have prevented the occurrence of any ASCs. Therefore the concept of controlled breathing was dismissed.

### 3.7.3 APPLICATIONS OF HRV MEASUREMENT

### 3.7.4 THE INFLUENCE OF RESPIRATION

## Overview

Nerve-Express is a computer based system that provides a quantitative assessment of the state of the Autonomic Nervous System (ANS) combining simple heart rate measurement hardware with a software computing various parameters of heart rate, especially its variability.

The system was chosen because it was already available at the WSO enabling the author to add a second kind of measurement to the project without extra costs. Due to some flaws, however, it proved to be complicated in use. One of its drawbacks is the impossibility to export the computed results into other applications, which made it necessary to re-type them. More reliable and yet affordable alternatives for future projects are recommended in chapter 6.2.2.

## Hardware

Nerve Express Hardware consists of a chest electrodes belt (made by POLAR) that is applied to the subject's body and a receiver with a cable that plugs into the serial port and PS/2 keyboard jack of an IBM compatible computer. A hardware authorization key ("dongle") is used for copy protection.

This hardware was used in conjunction with an IBM Notebook computer (Pentium 133 processor, 40 MB RAM). It was difficult to find a notebook computer that worked with Nerve-Express because its "Nerve-Monitor" features require a screen resolution of 1024x768 pixels and the software runs only on Windows 95 or Windows 98.

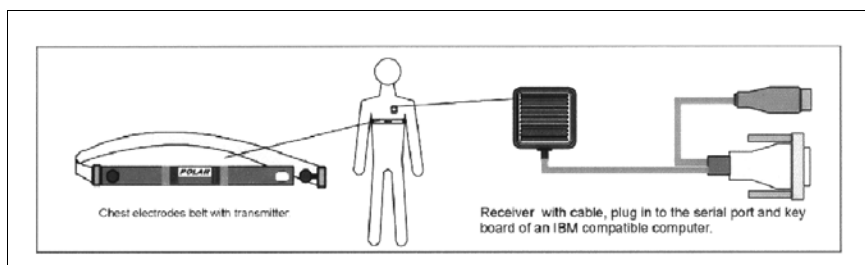


Figure 11: Nerve-Express Hardware

Older notebooks running one of these operating systems only have a screen resolution up to 800x600 pixels. Newer notebooks with the required screen resolution cannot run the old operating systems because the manufacturer does not provide screen drivers for those. The problem was solved by using a "virtual screen" feature on the old IBM Notebook computer running on Win 95 that computes an area of 1024x768 pixels although only a part of it can be shown on the 800x600 pixels screen. This makes the software quite clumsy to operate requiring a lot of scrolling, but it worked and was preferred to using a bulky desktop PC and monitor instead of a notebook.

## Software

The Nerve-Express software offers 2 possible tests:

- The Monitor Test provides ongoing measurement of heart rate variability and computes averages over phases of 192 heartbeats.

- The Orthotest combines a phase of 192 heartbeats in supine position, the process of standing up and a phase of 192 heartbeats in a standing position. The Orthotest provides the ANS status in the given moment of measurement and could be used for a before - after study design.

After trying both kinds of measurement in the pilot phase only the ongoing Nerve-Monitor measurement was used during the experiment.

The author was trained to use Nerve-Express by Dr. Riftine (who developed the system) personally. During the first phase of the project there was also support from Dr. Riftine. The operator for the control group was equally trained by the author and abided by a strict protocol (see appendix).

The algorithms used in Nerve-Express were compared with CHRONOS, the “gold standard” in HRV measurement in a study by Columbia University and showed “excellent agreement between the two algorithms” (Bigger, Jr., 1996).

The algorithms used in calculating HF and LF are sensitive to *ectopic beats*: Whenever more than 70% of the R-R intervals are ectopic beats, the Nerve-Express software will display the warning “Autonomic assessment may be wrong!” (Riftine, 1999). All subjects who showed this warning in more than one of the six phases were excluded from further statistical analysis of Heart Rate, HF and LF domain.

### 3.7.6 RELIABILITY

## 3.8 Statistical Procedures/Data Analysis

*“Get your facts first and then you can distort ‘em as you please.”*  
(Mark Twain about statistics)

### 3.8.1 OVERVIEW

In all the statistical procedures listed below results were regarded as significant if the null hypothesis could be rejected with a probability higher than 95% ( $p > 0,05$ ). The following graph shows an overview on the procedures that were used for data from PCI and DAQ as well as from HRV.

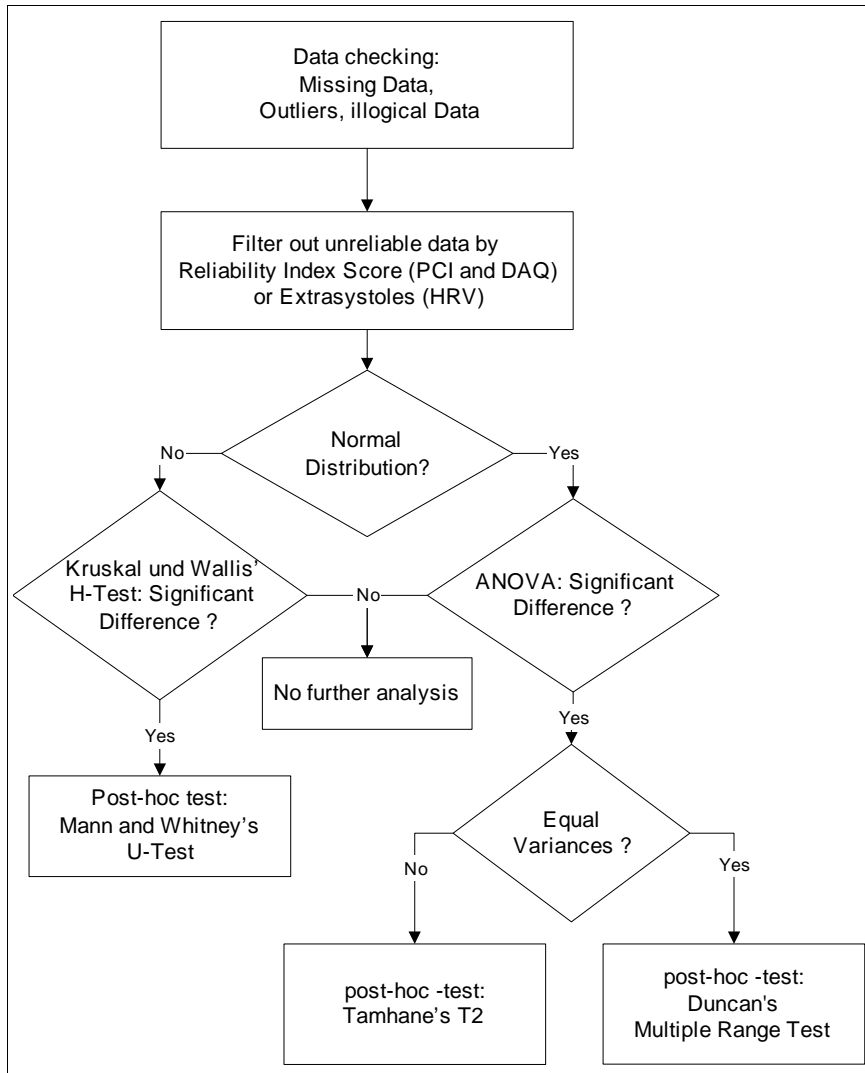


Figure 12: Statistical Procedures

#### Missing Data

Following advice by the statistician who was consulted, missing data due to skipped questions were replaced by the respective group's average score on that particular question.

#### General Procedures

PCI and DAQ raw data were typed into a spreadsheet in MS-Excel (Microsoft, 2000). Excel was also used to compute reliability and the score for each dimension according to Pekala's instructions (see appendix). These scores were then imported into SPSS (SPSS, 2002), where cases were selected for further analysis on the basis of sufficient reliability (reliability

### 3.8.2 PCI AND DAQ STATISTICS

index <2). Spot checks were carried out on several sample data tracing them back to the handwritten answers on the questionnaires to check data integrity through all transformations and conversions.

The next step was to perform a Kolmogorov-Smirnov-Test to check whether the acquired data were in a normal distribution. For normally distributed variables an analysis of variances (ANOVA) was performed to find out whether the differences between the groups were significant.

In case of equal variances “Duncan’s Multiple Range - test” was used as a post-hoc multiple-comparison test, otherwise “Tamhane’s-test”. These post-hoc tests serve the purpose of comparing each pair among the three groups to show which of the inter-group differences accounted for the significant difference between all three groups shown by the ANOVA. (In a comparison of more than 2 groups “post-hoc tests” are more specific than the t-test although serving the same purpose.)

For those variables that did not show a normal distribution the Kruskal-Wallis test was performed to find out whether the differences between the groups were significant. Then the Mann-Whitney U-test was performed as a post-hoc multiple-comparison test to compare each pair among the three groups to show which of the inter-group differences were significant. SPSS was also used to create all the statistical graphs.

Nerve-Express uses the RR-intervals of the HRV-measurement to compute a multitude of parameters. Among those the parameters for *Heart rate (HR)*, *Low Frequency (LF)* and *High Frequency (HF)* were chosen for further evaluation and typed into a spreadsheet in MS-Excel (Microsoft, 2000). (Nerve express only allows to export the raw data of RR-measurements, not the computed results.) Excel was also used to compute the *LF-to-HF-ratio*.

The data were transformed into a suitable table and imported into SPSS. Spot checks were carried out on several sample data comparing them with the original data in Nerve-Express to ensure data integrity through all transformations and conversions. In SPSS the difference of the variables HR and LF/HF-ratio between phase 1 (the baseline) and phase 6 (the last phase) of the experiment was calculated, resulting in the new variables HR\_diff and LHR\_diff.

The next step was to perform a Kolmogorov-Smirnov-Test to check whether the acquired data were in a normal distribution. Then the descriptive statistics on HR\_diff and LHR\_diff were calculated and an analysis of variances (ANOVA) was performed to find out if the differences between the groups were significant.

As a post-hoc multiple-comparison test “Duncan’s multiple range test” was used to compare each pair among the three groups to show which of the inter-group differences accounted for the significant difference between all three groups shown by the ANOVA. SPSS was again used to create the statistical graphs.

The main dimensions that contain subdimensions (e.g. altered experience with its subdimensions altered body image, altered time sense, altered perception, altered meaning) are calculated as the means of the subdimensions. Therefore a correlation between a main dimension and one of its subdimensions is necessarily high and does not convey any information. This is why – although contained in the matrix created by SPSS – these correlations are not interpreted.

### 3.8.3 HRV STATISTICS

### 3.8.4 CORRELATIONS



The correlation coefficient was calculated with Pearson's r - test. For all calculated correlations the following scaling was used:

<i>correlation coefficient</i>	<i>classification</i>
$ r  < 0,2$	very weak correlation
$0,2 <  r  \leq 0,5$	weak correlation
$0,5 <  r  \leq 0,7$	moderate correlation
$0,7 <  r  \leq 0,9$	strong correlation
$0,9 <  r  \leq 1$	very strong correlation

Table 4: Classification of correlations

## 3.9 Sources for literature research

The World Wide Web was searched using the search engine *Google* (www.google.com) and the search words

- “consciousness” AND “research”
- “cranial” AND “research”
- “craniosacral” AND “research”
- “osteopathy” AND “research”

and following interesting links on the pages within the search results.

Medline via Pubmed access at <http://www.ncbi.nlm.nih.gov/entrez>

OVID is a database provider offering online access to more than 80 medical, psychological and biological databases. OVID was used to access PsycInfo and Mantis.

a database specialized on manual therapies that was accessed through OVID.

PsycInfo is a database of psychological literature that was accessed through OVID and through the Library of the University of Vienna

The ZBMED located at the “Allgemeines Krankenhaus (AKH)” in Vienna was a valuable source for journal articles. Research was done in advance online at [aleph.univie.ac.at](http://aleph.univie.ac.at) and then the full text of the articles was retrieved directly at the library.

The literature service of the “Gesellschaft der Ärzte“ was used to access journal articles that are not available at the ZBMED.

### 3.9.1 EXTENSIVE INTERNET SEARCH

### 3.9.2 MEDLINE

### 3.9.3 OVID

### 3.9.4 MANTIS

### 3.9.5 PSYCFINFO

### 3.9.6 ZENTRAL-BIBLIOTHEK FÜR MEDIZIN

### 3.9.7 GESELLSCHAFT DER ÄRZTE

Charles Tart runs a website at <http://www.paradigm-sys.com/cttart/> providing access to all of his articles and selling copies of his books most of which are otherwise out of print.

### **3.9.8 CHARLES TART'S WEBSITE**

[www.sfb.at](http://www.sfb.at) is a meta-search-engine for second hand books. Most of the out-of-print classics on consciousness research were bought through this site.

### **3.9.9 WWW.SFB.AT**

Osteopathic literature could be purchased through the author's osteopathic bookstore [www.osteopathic-books.com](http://www.osteopathic-books.com).

### **3.9.10 OSTEOPATHIC LITERATURE**

A valuable source that deserves explicit mention here is a new CD that was issued by the American Academy of Osteopathy (AAO) only recently: All the AAO yearbooks from 1938 to 1998 are available in the searchable and indexed Adobe Acrobat format (AAO, 2001) providing easy access to a whole archive of osteopathic history, ideas and research.

## **3.10 Dismissed Methods**

Various additional or alternative procedures were considered in the concept and/or tried during the pilot phase of the project but then dismissed because of advice from jury or supervisors or because they turned out to be impractical or incompatible with other methods:

### **3.10.1 OVERVIEW**

In the concept phase the author considered to use the Myers-Briggs-type indicator as a personality profile before the experiment to be able to distinguish between introverted and extroverted personality types as it is recommended by several authors (Austin, 1998; Pekala, 1991). Following advice by a jury member this idea was dismissed because it would have divided the groups of 15 subjects into even smaller groups thus damaging the power of the study. For a follow-up study with a bigger population this approach should be considered, however.

### **3.10.2 PERSONALITY PROFILE**

During this study's preparation phase the APZ-questionnaire was found first and considered for use. A big advantage of the APZ is the fact that it has been used for research on a wide variety of ASCs (see chapter 2.4.1). This would have allowed the author to compare the outcome of this experiment, the assumed "cranial state of mind" c-SoC directly with all these other ASCs. If the c-SoC had shown a similar APZ profile like, for example, Zen meditation this would have opened up the possibility to infer from previous research about Zen meditation to the c-SoC.

### **3.10.3 APZ QUESTIONNAIRE**

Later during the preparatory phase the PCI was found and was chosen because its twelve dimensions (plus fourteen sub-dimensions) seemed to allow a greater differentiation of the subjects' experience than the APZ's three dimensions.

Additionally the phrasing of the PCI's items as well as the seven-point Likert scale that it uses seemed more appropriate for measuring the expected slight shifts in consciousness. In comparison, the phrasing of the APZ's items as well as the dichotomous Yes/No answering scheme seems to be constructed primarily for the measurement of strong shifts in consciousness in the way they occur in drug-induced ASCs.

Should the test person fill in the same questionnaire before and after the experiment? While this would have provided a baseline for a before-after comparison, it was also expected that reading the questions might be highly suggestive to the test subjects and “front-loading” the experience and thereby changing the results. Pekala and others used the questionnaire in most of their projects only after the experience and so did this project.

### **3.10.4 PCI AND DAQ BEFORE AND AFTER THE EXPERIMENT**

Pilot studies using the Orthotest showed that the second measurement after the experiment interfered with filling out the questionnaires: If the Orthotest was done first, it distracted subjects from their experience during the experiment before they could describe it in the questionnaires. If the questionnaires were filled in first, the Orthotest showed the distress that was caused by answering a number of complicated questions.

### **3.10.5 HRV ORTHOTEST**

Because of this interference and because it seemed more suitable to depict an ongoing process the Monitor Test was chosen for this project.

# *4 results*

## 4.1 PCI

After the results in distribution, reliability and missing data *those* dimensions are listed, in which significant differences between the groups could be detected. Then the results for the dimension “*body image*” are added, because they will be discussed in chapter 5. Statistical results for all the other dimensions are listed in the appendix.

For a better understanding of the PCI dimensions the respective items are listed after each dimension’s results.

Most of the PCI (sub)dimensions showed a normal distribution. Accordingly these dimensions were analyzed further by use of an ANOVA with post-hoc tests (Duncan’s and Tamhane’s). The dimensions of sexual excitement, negative affect, fear, anger, sadness, arousal and absorption did not show a normal distribution. They were treated further by using the Kruskal-Wallis test.

The scores for the reliability index (RI) were between 0 and 1,8, that means all subjects’ PCI data were reliable. This is an excellent reliability compared to Pekala’s experiments, which rendered back 10-15% of unreliable data (Pekala, 1991).

No significant differences of RI means between groups could be detected.

Following advice by the statistician who was consulted, missing data due to skipped items were replaced by the respective group’s average score on that particular question.

Missing Data occurred with subjects number 27 (Items 18, 23, 38, 39, 51), number 28 (items 2, 18, 20, 30, 48, 49, 50, 51, 52, 53) and number 30 (item 17).

Complete tables of all the descriptive statistics can be found in the appendix.

### 4.1.1 OVERVIEW

### 4.1.2 DISTRIBUTION

### 4.1.3 RELIABILITY

### 4.1.4 MISSING DATA

### 4.1.5 DESCRIPTIVE STATISTICS

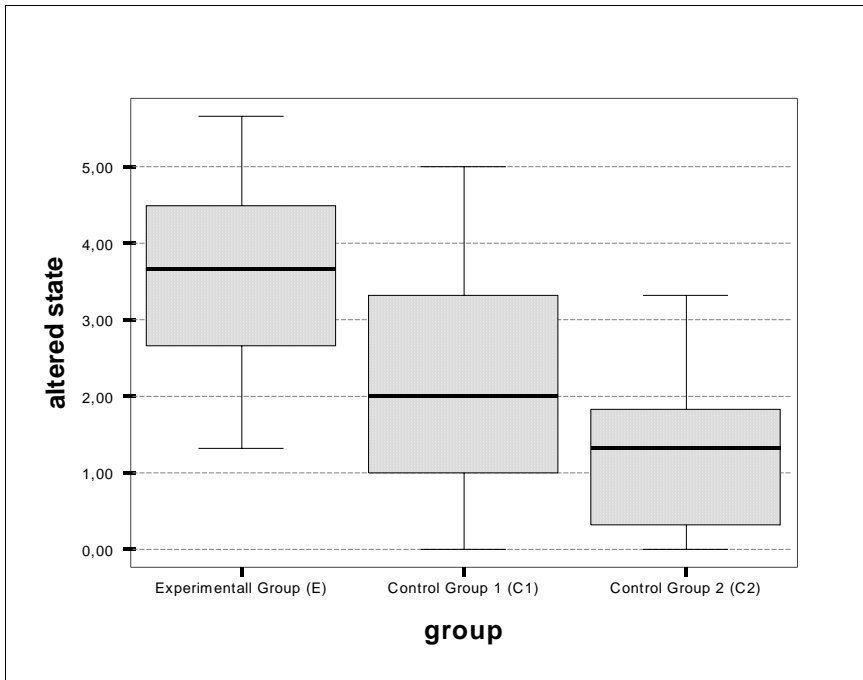


Figure 13: Altered State: Boxplot

**ANOVA and Post-Hoc Test**

The ANOVA showed a highly significant inter-group difference, with  $p=0,000$ .

E - C1	$p<0,01$	highly significant difference
E - C2	$p<0,01$	highly significant difference
C1 - C2	$p>0,05$	no significant difference

Table 5: Altered State: Multiple Comparisons between Groups (Duncan's)

**Items**

My state of consciousness was not different or unusual from what it ordinary is.

I felt an extremely different and unusual state of consciousness.

My state of awareness was very different from what I usually experience.

My state of awareness was no different than usual.

My state of awareness was not unusual or different from what it ordinarily is.

I felt an extraordinarily unusual and non-ordinary state of awareness.

**Overview**

**4.1.7 ALTERED EXPERIENCE**

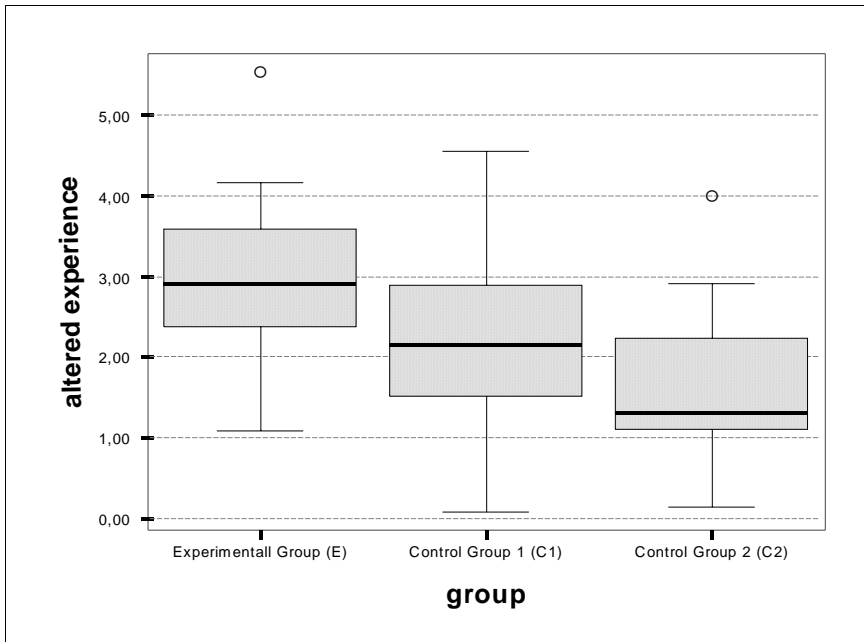


Figure 14: Altered Experience: Boxplot

**ANOVA and Post-Hoc Test**

The ANOVA showed a highly significant inter-group difference, with  $p=0,006$ .

E - C1	$p>0,05$	no significant difference
E - C2	$p<0,01$	highly significant difference
C1 - C2	$p>0,05$	no significant difference

Table 6: Altered Experience: Multiple Comparisons between Groups (Duncan's)

**Items**

The dimension of altered experience is computed from its subdimensions altered body image, altered time sense, altered perception and altered meaning.

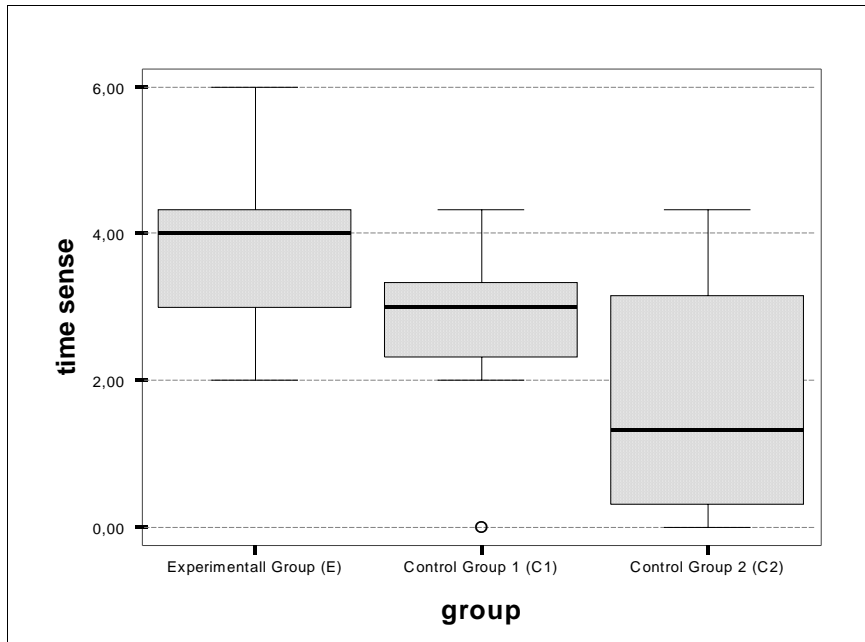


Figure 15: Time Sense: Boxplot

### ANOVA and Post-Hoc Test

The ANOVA showed a highly significant inter-group difference, with  $p=0,002$ .

E - C1	$p<0,05$	significant difference
E - C2	$p<0,01$	highly significant difference
C1 - C2	$p>0,05$	no significant difference

Table 7: Time Sense: Multiple Comparisons between Groups (Duncan's)

### Items

My perception of the flow of time changed drastically.	I noticed no changes in my perception of the flow of time.
I felt no sense of timelessness; time flowed as I usually experience it.	Time stood still; there was no movement of time at all.
Time seemed to greatly speed up or slow down.	Time was experienced with no changes in its rate of passage.



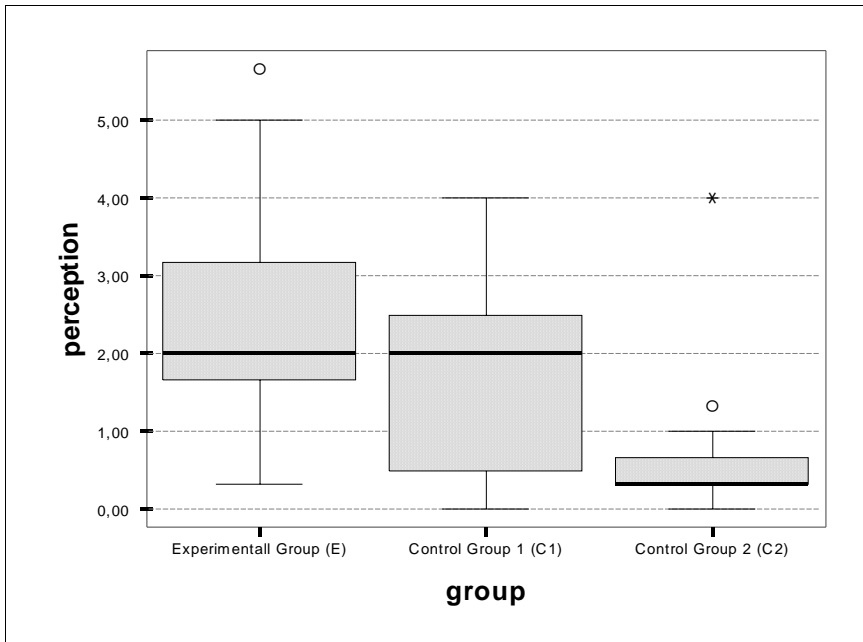


Figure 16: Perception: Boxplot

### ANOVA and Post-Hoc Test

The ANOVA showed a highly significant inter-group difference, with  $p=0,001$ .

E - C1	$p>0,05$	no significant difference
E - C2	$p<0,01$	highly significant difference
C1 - C2	$P<0,05$	significant difference

Table 8: Perception: Comparisons between Groups (Duncan's)

### Items

The world around me became extremely different in color or form.

I noticed no changes in the color or form of the world around me.

I noticed no changes in the size, shape, or perspective of the objects in the world around me.

Objects in the world around me changed in size, shape, or perspective.

My perception of the world changed drastically

I noticed no changes in my perception of the world.

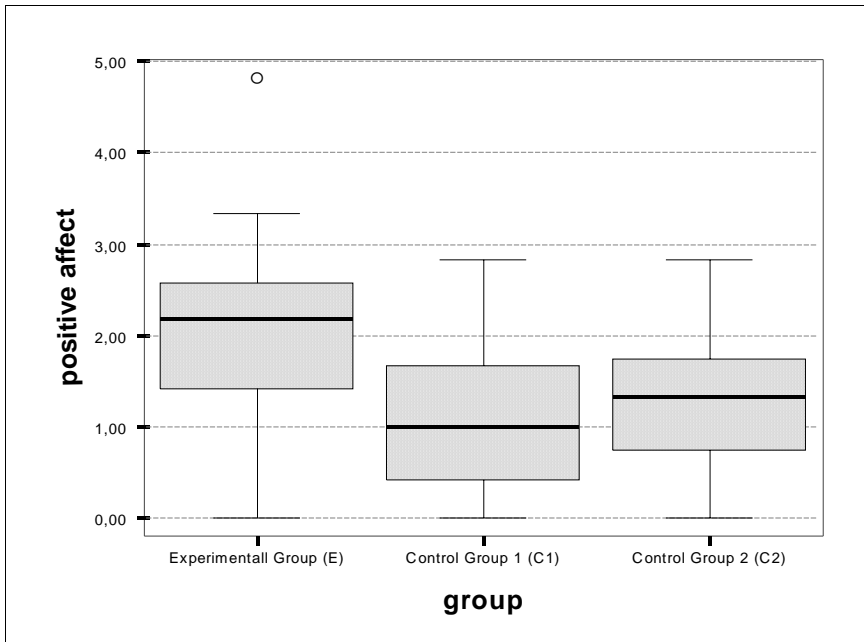


Figure 17: Positive Affect: Boxplot

**ANOVA and Post-Hoc Test**

The ANOVA showed a significant inter-group difference, with  $p=0,022$ .

E - C1	$p<0,05$	significant difference
E - C2	$p<0,05$	significant difference
C1 - C2	$p>0,05$	no significant difference

Table 9: Positive Affect: Comparisons between Groups (Duncan's)

**Items**

The dimension of positive affect is computed from its subdimensions joy, sexual excitement and love.

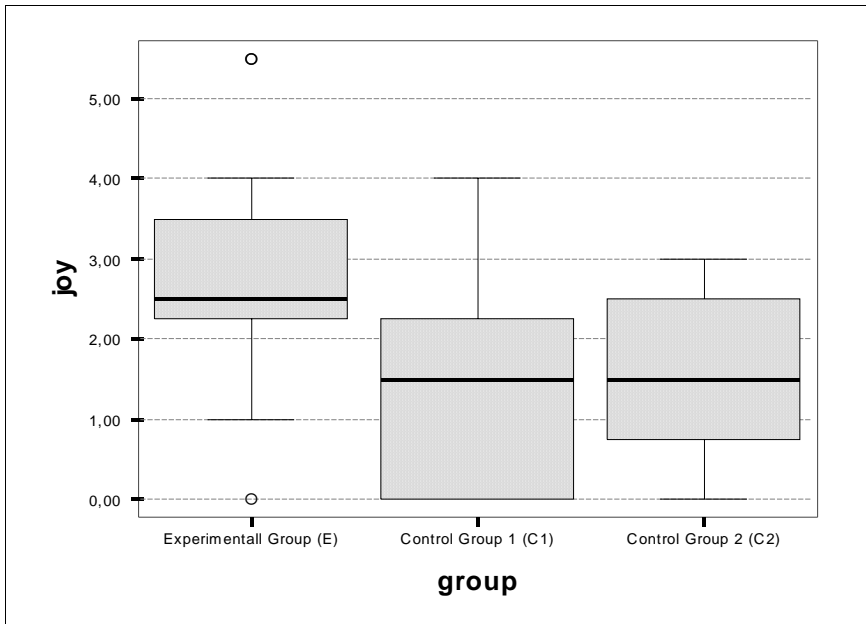


Figure 18: Joy: Boxplot

### ANOVA and Post-Hoc Test

The ANOVA showed a highly significant inter-group difference, with  $p=0,006$ .

E - C1	$p<0,01$	highly significant difference
E - C2	$p<0,01$	highly significant difference
C1 - C2	$p>0,05$	no significant difference

Table 10: Joy: Comparisons between Groups (Duncan's)

### Items

I felt ecstatic and joyful.

I felt no feelings of being ecstatic or joyful.

I experienced no feelings of ecstasy or extreme happiness beyond my usual feelings.

I felt feelings of ecstasy and extreme happiness.

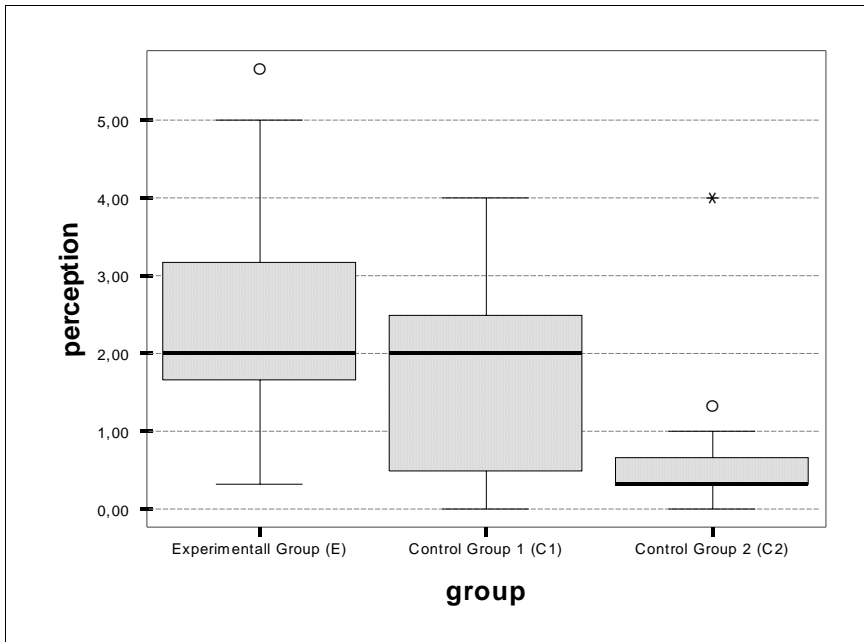


Figure 19: Internal Dialogue: Boxplot

**ANOVA and Post-Hoc Test**

The ANOVA showed a significant inter-group difference, with  $p=0,016$ .

E - C1	$p>0,05$	no significant difference
E - C2	$p<0,05$	significant difference
C1 - C2	$P<0,05$	significant difference

Table 11: Internal Dialogue: Comparisons between Groups (Duncan's)

**Items**

I did not engage in any silent talking to myself.

I was silently talking to myself a great deal.

I was silently talking to myself a great deal.

I did not engage in any silent talking to myself.

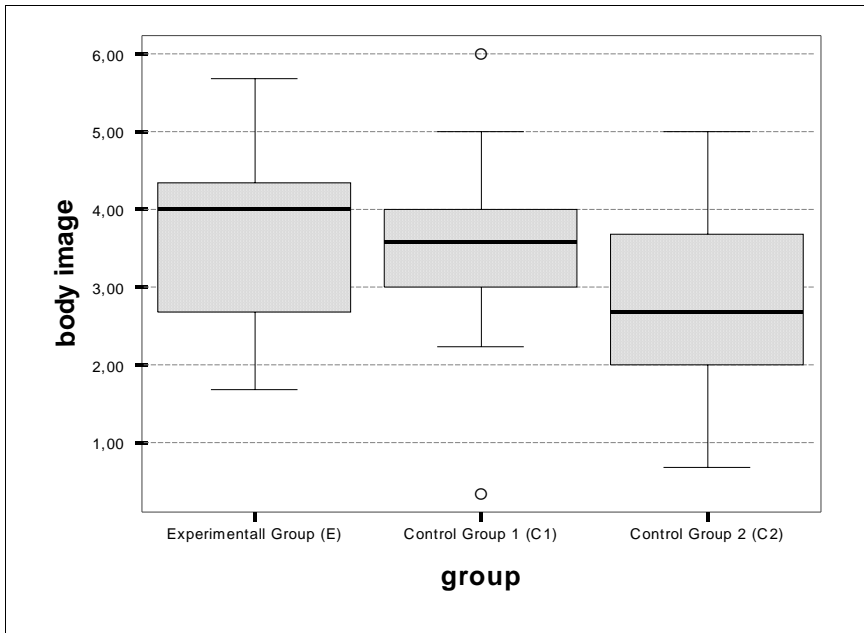


Figure 20: Body Image: Boxplot

**ANOVA**

The ANOVA showed no significant inter-group difference, with  $p=0,170$ .

**Items**

My body ended at the boundary between the skin and the world.

I felt my body greatly expanded beyond the boundaries of my skin.

My bodily feelings seemed to expand into the world around me.

My bodily feelings were confined to the area within my skin.

I continually maintained a very strong sense of separation between myself and the environment.

I experienced intense unity with the world: the boundaries between me and the environment dissolved away.

Men and women across all groups were compared using Student's t-test with a significance level of  $p < 0,05$ . In their answers women scored significantly higher in the dimensions perception, negative affect, anger, sadness, fear and arousal.

#### 4.1.14 M/F - COMPARISON

As described above (see chapter 3.1.9) Control Group 2 (rest only, no hands-on) was divided between the two operators. The author tested 12 out of the 15 subjects the non-osteopathic operator the remaining 3. A comparison of the two groups by Student's t-test showed no significant difference.

#### 4.1.15 INTER-OPERATOR COMPARISON WITHIN GROUP C2

#### within the main dimensions

The subdimensions of *altered experience* (altered body image, altered time sense, altered perception, altered meaning) correlate with each other with a correlation coefficient between 0,399 and 0,690, which is interpreted as a moderate correlation.

The subdimensions of positive affect (joy, sexual excitement, love) correlate with each other with a correlation coefficient between 0,401 and 0,503, which is interpreted as a moderate correlation.

The subdimensions of negative affect (anger, sadness, fear) correlate with each other with a correlation coefficient between 0,418 and 0,538, which is interpreted as a moderate correlation.

The subdimensions of visual imagery (amount, vividness) correlate with each other with a correlation coefficient of 0,375, which is interpreted as weak correlation.

The subdimensions of attention (direction [inward], absorption) correlate with each other with a correlation coefficient of 0,454, which is interpreted as a weak correlation.

#### 4.1.16 CORRELATIONS BETWEEN PCI- DIMENSIONS

#### across dimensions

In the following only moderate ( $r > 0,5$ ) or high ( $r > 0,7$ ) correlations will be listed. High correlations will be marked by an asterisk (\*). Correlations between two main dimensions will be marked with a (m).

#### Positive correlations

altered experience - positive affect (m)

altered experience - joy

altered experience - love

altered experience - altered state (\*) (m)

body image - perception

body image - meaning

body image - positive affect

body image - altered state

time sense - altered state (\*)

perception - time sense

perception - meaning

perception - positive affect

perception - joy

perception - altered state

meaning – positive affect  
meaning – joy  
meaning – love (\*)  
joy – love  
joy – altered state  
arousal – negative affect (m)  
arousal – anger  
arousal – fear  
self awareness – volitional control (m)  
self awareness – rationality (\*) (m)  
rationality – volitional control (m)

### **Negative correlations**

volitional control – altered experience  
volitional control – perception  
volitional control – altered state

These correlations can be roughly summarized by stating that the data tend to form three *clusters*:

- altered experience – altered state of awareness – positive affect
- self awareness – rationality – volitional control
- negative affect – arousal

with a negative correlation between 1 and 2.

## **4.2 DAQ**

Following advice by the statistician who was consulted, missing data due to skipped items were replaced by the respective group's average score on the particular question.

Missing Data occurred with subjects number 27 (items 7, 9, 19, 20) and number 28 (items 14, 23, 29, 33).

All the twelve DAQ Dimensions showed a normal distribution, therefore an ANOVA could be performed on all of them to calculate the significance of inter-group differences.

The scores for the reliability index (RI) were between 0,17 and 2,33. Two of the subjects (person nr. 23 and 33) showed a reliability index score  $RI > 2$  and were therefore excluded from further statistical analysis, which represents 4,44% of unreliable data. This is an excellent reliability compared to Pekala's experiments, which rendered back 12-20% of unreliable data (Pekala, 1991).

No significant differences of RI means between groups could be detected.

### **4.2.1 MISSING DATA**

### **4.2.2 DISTRIBUTION**

### **4.2.3 RELIABILITY**

No significant differences could be detected in any of the dimensions. This is consistent with the results of the dimension “attention” in the PCI, which is supposed to provide a general measurement of the same subsystem that the DAQ measures in detail.

As it was described above (see chapter 3.1.9) Control Group 2 (rest only, no hands-on) was divided between the two operators. The author tested 12 out of the 15 subjects the non-osteopathic operator the remaining 3. As with the PCI, a comparison of the two groups showed no significant difference.

#### **4.2.4 No SIGNIFICANT DIFFERENCES**

#### **4.2.5 INTER-OPERATOR COMPARISON WITHIN GROUP C2**



The one dimension, whose differences came closest to significance was “locus” ( $p=0,073$ ), concerning the question whether the subject’s attention was focussed inside or outside the body.

**Overview**

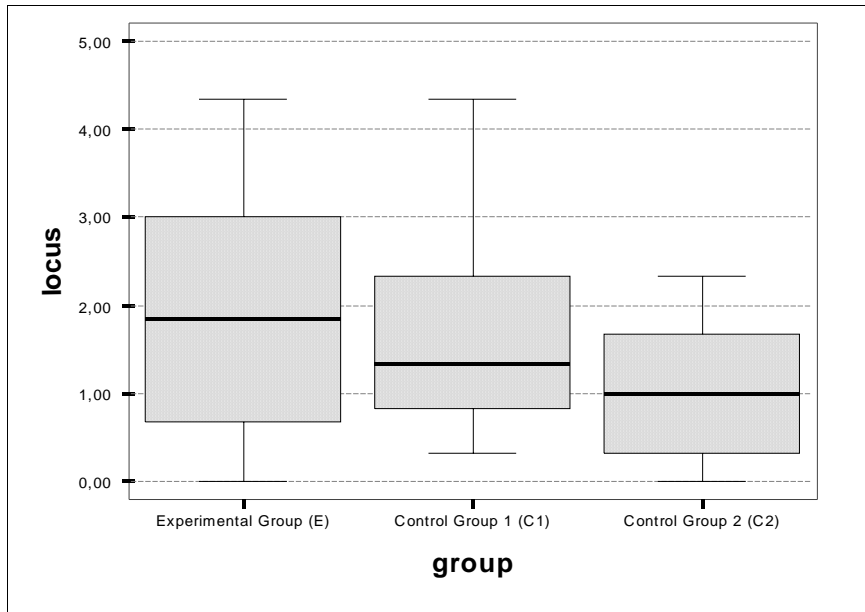


Figure 21: Locus: Boxplot

**ANOVA**

The ANOVA showed nosignificant inter-group difference, with  $p=0,073$ .

**Items**

I felt my consciousness to be very much within my body.

I felt my onsciousness to be “out of” and disconnected from my body.

I did not experience my consciousness to be outside of or separated from my physical body.

I actually experienced my consciousness to be outside of and separated from my physical body.

I felt my awareness completely separated and distant from my body.

I felt my awareness to be focused or centered within my body.

## 4.3 HRV

Both variables, HR\_diff and LHR\_diff, showed a normal distribution.

Eight subjects (person nr. 6, 14, 15, 21, 22, 33, 36, 42) showed more than 70% of ectopic beats, eliciting the Nerve-Express-warning “Autonomic assessment may be wrong!” in *more than one* of the six phases. These eight subjects were excluded from further statistical analysis of Heart Rate, HF and LF domain.

### Overview

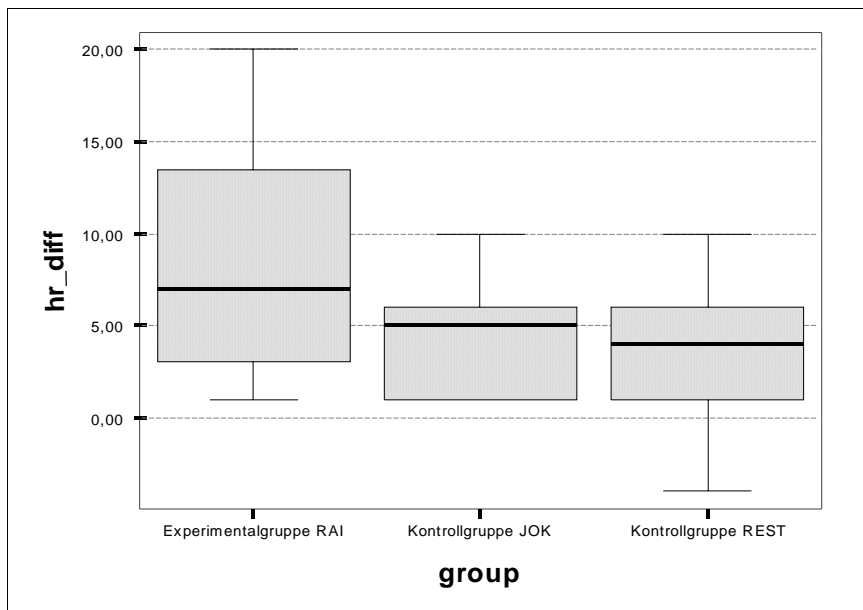


Figure 22: Difference in Heart Rate: Boxplot

### ANOVA and Post-Hoc Test

The ANOVA showed a significant inter-group difference, with  $p=0,045$ .

E - C1	$p<0,05$	significant difference
E - C2	$p<0,05$	significant difference
C1 - C2	$p>0,05$	no significant difference

Table 12: Difference in Heart Rate: Comparisons between groups (Duncan's)

### 4.3.1 DISTRIBUTION

### 4.3.2 RELIABILITY

### 4.3.3 DIFFERENCE IN HEART RATE

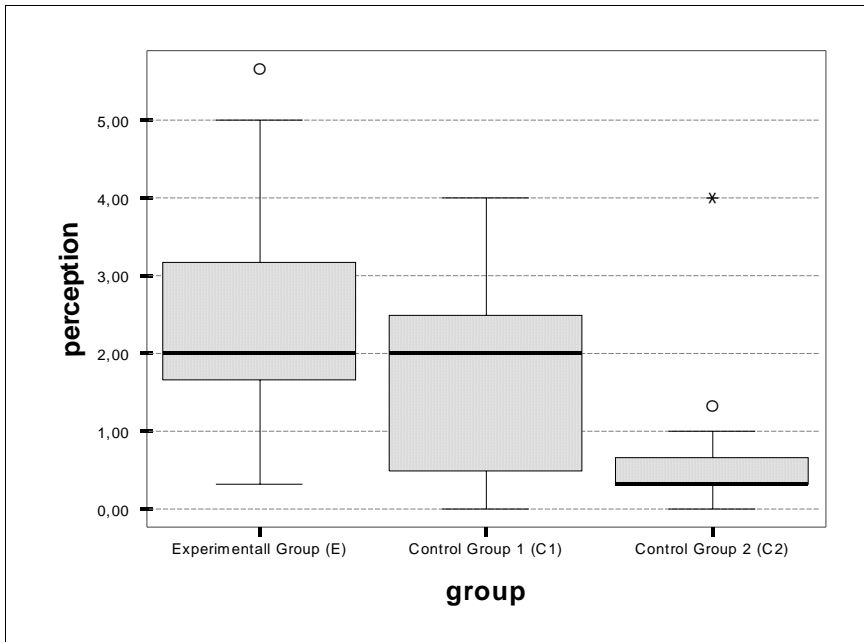


Figure 23: Difference in LF/HF-ratio: Boxplot

### ANOVA

The ANOVA showed a non-significant inter-group difference, with  $p=0,677$ .

## 4.4 Correlations

The variable HR\_diff shows weak correlations ( $r=0,346$ ) with LHR\_diff and the PCI subdimension of perception.

## 4.5 Correlations with Gender, Age or Previous Experiences

No correlation with gender, age or previous experiences with ASCs and PCI-dimensions or HRV-variables could be found, which exceeded the level of weak correlation ( $r=0,5$ ).

# 5 *discussion*

## 5.1 General

In chapter 1.1 we hypothesized that “The cranial ‘fluid technique’ that is applied causes the induction of a mildly altered state of consciousness, which is bigger than in the two control groups.”

The results in chapter 4 show that this hypothesis could be *confirmed*.

The second hypothesis was “The shift in consciousness caused by the osteopathic technique, goes along with a shift to a more trophotropic state (Gellhorn & Kiely, 1972) that is bigger than in the two control groups. Indicators for this physiological shift are a decrease in heart rate and in the LF/HF (Low Frequency/High Frequency)-ratio.”

This second hypothesis could be *confirmed in part*. A significant difference could be demonstrated in the decrease of heart rate, but not in the decrease of the LF/HF-ratio.

Is there a specific “Cranial State of Mind” as it is suggested in the title of this study?

In order to constitute a distinct SoC in the sense Charles Tart describes it (see chapter 2.1.2) it would be necessary to show that subjects in an experimental group report a specific and *reproducible correlation* of reactions. To calculate valid simultaneous correlations of multiple dimensions by a cluster analysis, it would take a group of at least 60 subjects, preferably 120 (Pekala, 1991).

So, due to lack of power of the present study, it is not possible to talk about a specific “Cranial-Osteopathy-SoC” or “Cranial State of Mind”, yet. The results indicate, however, that there might be such a distinct state, which is characterized by an altered state of awareness, an altered time sense and positive affect (predominantly joy).

## 5.2 The Differences One by One

The author surely is happy to cause positive affect and joy in his test subjects, but it also must be taken into account that these results may be biased. The subjects knew the author personally before the experiment, but not the second operator. They also had been invited by the author in a personal letter, so the difference between group E and group C1 might be due to the person of the operator. On the other hand there was no significant difference in any dimension between the two different operators within group C2.

In future projects it would be possible to avoid this cause of bias by using an osteopathic operator, who is not identical with the person or institution, who invites the subjects.

Another possible cause of the results in this dimension might be “I am glad that I am not in the control group, but get a treatment.” This might apply for the differences E-C2 and C1-C2.

Anecdotal evidence was supplied by two of the subjects some time after their experiments: One lady reported that she was “suspiciously” happy for several days after the experiment. Another one asked “Can’t you invite my husband to participate in your experiment a second time? Until Friday

### 5.1.1 WHAT ABOUT THE HYPOTHESES?

### 5.1.2 IS THERE ANYTHING LIKE A “CRANIAL STATE OF MIND”?

### 5.2.1 POSITIVE AFFECT/ JOY

morning he was very grumpy, but in the afternoon his mood had changed completely and he was cheerful for several days. I only found out later that he had come to participate in your experiment.”

The most significant statement that was made by group E, was that they felt really different from their usual state. The fact that none of the other dimensions - which are actually supposed to give a more detailed description of this general statement - showed an *equally significant* difference, allows two possible explanations: Either the altered state was experienced differently among individuals (e.g. for one subject time sense was altered more, for an other perception), or there was some important dimension of their experience, which is not depicted by the PCI. Interviews could help to make this clearer.

For the subjects in the experimental group the perception of time changed drastically. Due to the phrasing of the respective PCI items (see chapter 4.1.8) it is not completely clear, if subjects felt a slowing or a speeding up of time, but one of the items addresses the sensation of timelessness. This is another interesting parallel to many types of meditation, where timelessness is often experienced (Austin, 1999) - and it fits well with the osteopathic technique that was used in the experiment in order to induce a “Stillpoint” in the subjects - the state in which the whole system “is still and knows”.

In neuroscience the thalamus and the fornix, which are adjacent to the 3rd and the lateral ventricles, are associated with our sense of time -therefore the observed changes might be caused by changes in fluid fluctuation or pressure in the ventricles.

The author’s prediction in this dimension was a bigger amount of internal dialogue in group C2 than in the two hands-on groups. The results, however, showed just the opposite, with the most internal dialogue in group C1 and the least in group C2.

To explain this phenomenon it would be necessary to interview the subjects in regard to the content of their internal dialogue. Some of the subjects in group C1 mentioned later that they had been asking themselves, if what they were receiving was really an osteopathic treatment.

Another important factor, which unfortunately was not recorded, was the fact that some subjects took naps during the experiment and others did not. The lack of stimulation in group C2 might have caused more naps than in the other groups, resulting into less internal dialogue.

In the dimensions of volitional control, rationality, self awareness and memory the differences between groups were not significant, but they all matched the predicted sequence of group E being in the most altered and group C2 being in the most ordinary SoC. As an example, this means that rationality was the lowest in group E and the highest in group C2. Although the differences were not statistically significant, they are consistent among these four dimensions, which are typical for our ordinary SoC. This suggests that there is a trend that might be significant with a bigger sample size.

When volitional control, rationality, self awareness and memory are reduced, a patient is likely to be more prone to suggestions than in his ordinary SoC - an issue, which will be addressed in chapter

## 5.2.2 ALTERED STATE OF AWARENESS

## 5.2.3 TIME SENSE

## 5.2.4 INTERNAL DIALOGUE

## 5.2.5 NON-SIGNIFICANT DIFFERENCES

## 5.2.6 THE BIG SURPRISE: BODY IMAGE

“Altered body image” was one of the dimensions in which the author had expected significant differences, because this is often mentioned by patients. The PCI however showed no differences between groups. This gets more understandable when we take a look at the exact items that this dimension consists of:

My body ended at the boundary between the skin and the world.	I felt my body greatly expanded beyond the boundaries of my skin.
My bodily feelings seemed to expand into the world around me.	My bodily feelings were confined to the area within my skin.
I continually maintained a very strong sense of separation between myself and the environment.	I experienced intense unity with the world: the boundaries between me and the environment dissolved away.

Obviously all of these items only research the question of *boundaries*, leaving out all other physical sensations which may occur during a treatment. This was confirmed by some of the subjects in group E who – after filling in the questionnaires – spontaneously said things like

“ The most important thing I felt was not in these questionnaires: It was that the left side of my body, which had felt contracted before, became much longer.”

“I did not know where to put that on the questionnaire, but I felt a strong sensation of energy running through my spine.”

“While you held my head, it became much softer, almost liquid.”

While the PCI seems well suited for researching most of the differences in the SoC that are caused by cranial techniques, it is not specific enough in the dimension of “Altered Body Image”. A possible solution to this could be the development of a specific “Body Image Questionnaire” to supplement the PCI in this dimension – similar to the way Pekala developed the DAQ to get more specific information about attention.

*“One of the tragedies of life is the murder of a beautiful theory by a brutal gang of facts.” (unknown author)*

According to a traditional view of the ANS, stimulation of the vagus should result in a general trophotropic response of various parameters. Based on this view, an equal decrease in HR and LF/HR-ratio was predicted. The experimental group in this study, however, showed a *significantly* stronger decrease in heart rate, but only a *slightly* stronger decrease of the LF/HF-ratio of heart rate variability.

A possible explanation for this apparent contradiction is offered by Porges who proposes a “polyvagal theory” (Porges, 1995), based on the fact that “vagal efferent fibres do not originate in a common brainstem structure.” The branch originating in the nucleus ambiguus (NA) is *uniquely* responsible for respiratory sinus arrhythmia (RSA), which we have described as the source of heart rate variability in the HF domain (see chapter 3.7.2). In the regulation of bradycardia, however, the NA branch is joined by other vagal fibres originating from the dorsal motor nucleus (DMNX). “Thus the commonly used, but not interchangeable, measures of cardiac vagal tone may represent different dimensions of vagal tone.” (Porges, 1995).

## 5.2.7 DIFFERENCE HR – LF/HF-RATIO

## 5.3 Additional Reflections

The discussions above all focus on the dimensions that were unique in the “osteopathic” group E. It was very important to demonstrate the possibility of distinguishing an osteopathic technique from non-specific touch. In clinical reality, however, the sham treatment of group C1 is not used. Therefore the practically relevant differences are those between group E and C2, i.e. between osteopathic technique and no treatment at all. Taking this into account the differences discussed above as well as the significant differences (E-C2) in the dimensions of altered experience and perception even accentuate the results.

In other projects the osteopath tried to perform the real osteopathic technique as well as the sham technique in the control group. (e.g. Van Assche, 2000). These studies could not detect a significant difference between the groups. The fact that in this project it *was* possible to do so, allows to assume that it is not possible for an osteopath to put his hands on a subject and do nothing. Our hands are so much trained and conditioned to have a beneficial effect, that we cannot turn this off. For a non-osteopath this seems to be easier, although this and other projects have demonstrated that also non-specific touch does have profound effects on a subject.

In some of the dimensions (perception, internal dialogue) a significant difference between the groups C1 and C2 was demonstrated, which can be interpreted either as the effects of unspecific touch or of suggestion. A differentiation between those two causes would be possible in an experimental setting where two groups have an (non-osteopathic) operator holding their head in the same way. One group is told that an osteopathic treatment is tested, the other group is told that the effects of someone just holding their head are researched.

In 1967 Wilder proposed the *law of initial value (LIV)* for psychophysiological research. This law postulates that the magnitude of change in a response system is dependent on the prestimulus base level. The available “space” for stimulus-elicited changes is dependent on how close to the system’s “floor” or “ceiling” the prestimulus level is. Applied to this experiment this would mean that a person with a very fast heart rate (HR) in phase 1 is more likely to show a significant drop in HR than a person with a slow HR.

The groups’ mean initial heart rates showed differences, although these were not significant: group E: 69,08, group C1: 73,70 and group C2: 78,62. According to the LIV the strongest decrease in HR should have happened in group C2, the least decrease in group E. The results, however, were exactly the opposite, which confirms the the applied techniques’ influence.

In his book (Pekala, 1991) Pekala provides a multitude of data obtained by using the PCI. His results from a group that was sitting with closed eyes were compared with the results from group C2. A graph (see figure 24) shows two similar curves across the PCI’s dimensions, which underlines the basic reliability of the PCI. A Student’s t-test (that had to be calculated by hand, because only means and standard deviation of Pekala’s data were

### 5.3.1 COMPARING GROUPS

### 5.3.2 THE EFFECTS OF UNSPECIFIC TOUCH

### 5.3.3 LAW OF INITIAL VALUE (LIV)

### 5.3.4 PCI: COMPARING GROUP C2 WITH PEKALA’S DATA



available), however, revealed differences in the dimensions positive affect, joy, sexual excitement, love, negative affect, sadness, fear, attention, direction of attention, absorption, visual imagery, amount of imagery, self awareness, arousal, volitional control and internal dialogue. These differences seem to spread around the area of *affects* and *arousal* and can plausibly be explained by the different settings: Pekala got his data from classrooms full of college students while in our study people with the average age of 39 were lying in a room by themselves, just with the silent operator. Another important difference in the settings is the fact that Pekala's students were sitting, while our subjects were lying down - a fact that accounts for deeper relaxation, a lower score in *arousal* and higher score in *inward bound attention* and *absorption*..

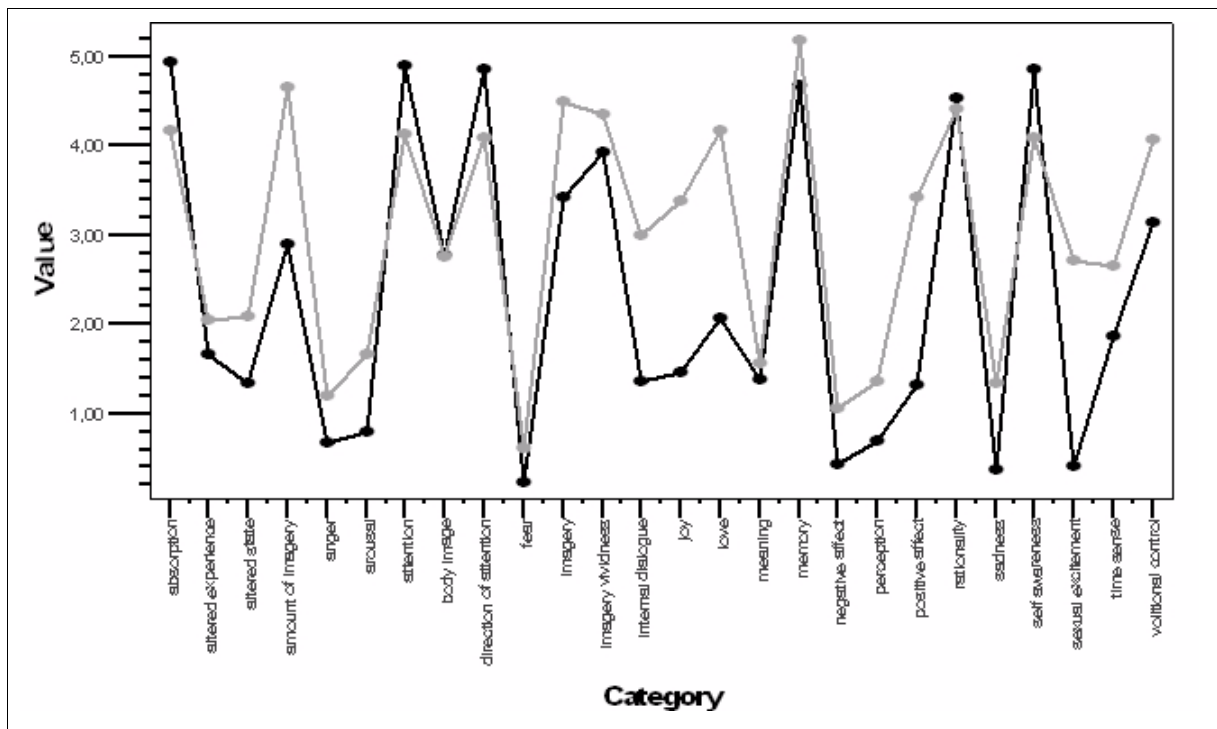


Figure 24: C2 compared to Pekala's data for eyes closed

## 5.3.5 SIMILARITIES WITH MEDITATION

An interesting study by Venkatesh et al. is using the Phenomenology of Consciousness Inventory (PCI) to measure the effect of Kundalini meditation (Venkatesh, 1997), by asking a group of 12 meditators to complete the PCI twice, after a meditation session and after a non-meditation session.

The results of his study seem very similar to the outcome of the experimental group in this project: “With regards to identity state meditative experience was found to produce statistically significant changes in terms of intensity in meaning ( $P < 0.06$ ), time sense ( $P < 0,05$ ), joy ( $P < 0.061$ ), love ( $P < 0.05$ ) and state of awareness ( $P < 0.01$ ).” (Venkatesh, 1997)

<i>PCI Dimension</i>	<i>Cranial Fluid Technique (Group E)</i>	<i>Kundalini meditation (Venkatesh, 1997)</i>
Time Sense	significant changes	significant changes
Joy	significant changes	significant changes
Love	significant changes	significant changes
State of Awareness	highly significant changes	highly significant changes
Meaning		significant changes
Perception	significant changes	*
Internal dialogue	significant changes	
Altered Experience	significant changes	**
Positive Affect	significant changes	**

*Table 13: PCI Dimensions in Cranial Fluid Technique and Kundalini meditation*

\* In a graph in Venkatesh’s paper perception is not listed as a dimension with significant changes, in the last paragraph however he writes that “Our results also indicate altered perception and meaning during the meditative state.”, so it is not clear how his results compare this study.

\*\* The combined dimensions of altered experience and positive affect are not listed in Venkatesh’s paper, therefore they cannot be compared here.

As shown in table 13 the resulting profile of the two experiments is very similar and suggests that the described Cranial technique might produce some of the beneficial effects of meditation.

## 5.4 Speculations: “How Does It Work?”

*“Something is happening but you don’t know what it is, do you Mr. Jones?”  
(Bob Dylan, 1965)*

When we look for the path that is connecting our osteopathic technique with shifts in consciousness, there’s two vast white spots on our map of *scientifically proven* knowledge: We do hardly know anything about the effects of our cranial technique on the CNS. And then we do know very little about the way our CNS is connected with consciousness. Most of all, we don’t even know if the effect of our technique on consciousness is mediated by the CNS at all. This leaves lots of room for interesting speculations.

This chapter will present several hypothetical possibilities on how the effects that could be observed during this experiment might have been caused. We will start out with the more mechanical models and work our way to rather energetic or mental points of view – in a similar way as Sutherland developed different models of cranial work during the course of his life. (Jealous, 1999)

A widely accepted model of the brain-consciousness relationship is that of computer hardware and software: Our mind running on our “brain machine”. We will restrict ourselves to this ‘conservative’ view of the mind (Tart, 1975) for the moment and explore various possible mechanisms of how osteopathic technique could change consciousness through effects on the CNS.

Pressure, movement, heat or other radiations off the osteopath’s hands are assumed as working agents in all of the following models

### 5.4.1 PHYSIOLOGICAL MODELS

#### Direct Effect on the CNS

Speculation: The osteopathic technique exerts a direct influence on the parts of the brain that induces the shifts in consciousness.

#### Circulation-Mediated Effect on the CNS

Speculation: The osteopathic technique exerts an influence on the blood circulation in certain parts of the brain which induces the shifts in consciousness.

A model that’s very much in tune with Still’s early ideas of the “law of the arteries”. The techniques that were performed during the experiment are likely to have influence on both: the arterial flow into the head (by loosening of the suboccipital muscles) and on the venous drainage (by influence on the jugular vein, occipital sinus, transverse sinus, straight sinus or further). And changes in blood circulation do have well known effects on the CNS.

#### CSF-Mediated Effect on the CNS

Speculation: The osteopathic technique exerts an effect on the CSF, and then changes in pressure and/or fluctuation of the CSF provoke an influence on the parts of the brain that induces the shifts in consciousness. Apart from those mechanical influences, the CSF also transports hormones, neurotransmitters and other substances which can affect neural structures.

This model corresponds to the working model for cranial fluid techniques, so. this is what is *supposed* to happen.

Medical science has been conducting many studies about CSF fluctuation, CSF flow or CSF pressure, but the system as a whole is still not very well understood and there are conflicting concepts about the CSF pulsation's origin (Liem, 1998). What we will do in the following, is look at various CNS structures which might be responsible for the observed changes in consciousness *as well as* accessible for CSF.

The *slowing of the heart rate* that was observed in the experiment indicates some sort of parasympathetic activity. Among the various areas that could have initiated this activity, the hypothalamus on the floor of the 3<sup>rd</sup> ventricle seems most prone to influence from CSF fluctuation.

*Time sense* is associated with the thalamus and the fornix (Austin, 1998) – in addition to several cortical regions. The thalamus forms the 3<sup>rd</sup> ventricle's lateral walls, and the fornix is adjacent to both 3<sup>rd</sup> and lateral ventricles.

In the literature the demonstrated *positive affect and joy* are related to the septum (Austin, 1998), which forms the medial wall of the lateral ventricles. The feeling of well-being might also be just a concomitant of the parasympathetic relaxation response.

The fluid – CNS – consciousness part of this model seems to work pretty well. What is left for further research is how we influence the fluid (if it is not physical pressure as in a CV4) and how exactly the fluid affects the CNS.

### **Specific or Unspecific Effect**

Independently from the way the effect is mediated, there could always be an effect through stimulation of *specific* parts of the CNS, or the osteopathic technique influences the brain in a rather *general* way. The brain uses this general impulse to create homeostasis, that would mean in the way that is the most useful for the person's system at that particular moment.

If we do exert a specific effect on CNS-structures: Would then another hand position cause a stimulation of *other* parts of the brain, thus causing a *different experience*?

Several possible mechanisms of psychological influence on the experiment's outcome were already discussed in chapter 5.2.1. In addition to that we would like to refer again to the extensive body of research on the issue of the "placebo-effect". (Benson & Stark, 1996).

## **5.4.2 PSYCHOLOGICAL MODELS**

*“Reality is what you can get away with.”*  
(Robert Anton Wilson)

Opposed to the “conservative view” of the mind that was described above, Tart proposed a “radical view” on the mind already in 1975: “... parapsychological data suggest that awareness is at least partially out of brain functioning, a condition that leads to very different views of human nature. The radical view of mind sees awareness as this something extra and postulates that physical reality can sometimes be directly affected by our belief systems.” (Tart, 1975)

To back up this postulate Tart wrote another book in 1977 in which he reviewed the literature on scientific research in the parapsychological domain and developed some highly interesting models (Tart, 1977). More than 25 years later the conservative view still constitutes mainstream thinking, but the “radical view” is backed up by more interesting concepts and research and doesn't seem quite as *radical* any more. (In 1986 Eccles even suggested that cause and effect might be reverse by suggesting that “... mental events cause neural events” (Eccles, 1986))

### Life Force

Speculation: There is a natural energy or life force that exists independently of the human body in the whole nature. In man this energy creates equally physiological and psychological phenomena. When the flow of this life force is blocked, both aspects of human health are affected.

An interesting concept that has historically shown up in various traditions.

The concept of “Qi” as it is used in *Traditional Chinese Medicine* was already mentioned before (chapter 2.4.9).

In the *Indian tradition* the life force is called “Prana”. It circulates through specific channels, the “Nadis” and is directed by postures and breathing.

In 18<sup>th</sup> century Europe the Austrian *Anton Mesmer* proposed the concept of “animal magnetism” a healing life force that can be transmitted through the hand of a “magnetic healer” into the patient. Mesmer's method was widespread under the names “magnetism”, “magnetic healing” or “mesmerism” and is still in use today. Since A.T. Still worked as “magnetic healer” before he developed Osteopathy, it must also be regarded as one of the major influences on Osteopathy.

*Wilhelm Reich* postulated the existence of an “Orgone” energy according to the definition above. (Reich, 1942)

*Dr. Randolph Stone*, an Austrian-born American osteopath, developed the concept of “Polarity Therapy” based on the energetic models of Chinese and Ayurvedic Medicine and many osteopathic ideas. His method became very influential in the development of new forms of body therapy in the 1960s and 1970s.

*W.G. Sutherland* in his later years used the concept of “Breath of Life” - again in accordance with the definition above - for his cranial work (Jealous, 1999). While those energetic concepts were included in the first edition of “Osteopathy in the Cranial Field” (Magoun, 1951) they were edited out in the third edition (Magoun, 1953), which served as a reference until 1998, when the first edition was released again.

Although the “Life-Force” model in its oldest forms is thousands of years old, the aspect of psycho-physiological integration that it contains is supported by very recent findings in psycho-neuro-immunology.

Modern physics during the past two decades has developed some interesting concepts which might become a scientific basis for the “Life-Force” Model. As pre-eminent examples we want to list “Biophotones” (Bischof, 1995), “Scalar Waves” and “Quantum Fields” (Pribram & Eccles, 1993). Many of these new scientific findings are documented in Oschman’s book “Energy Medicine – The Scientific Basis of Bioenergy Therapies” (Oschman, 2000)

## **Electromagnetism**

A well known and easily measurable form of „Life Force“ is electromagnetism - a wide field out of which we only want to cite the most relevant article: In an study from the HeartMath Institute McCraty and his colleagues demonstrated that the strong electrical field of the heart is transmitted through touch: If one person (A) touches another person (B) the ECG-signals of person A can be detected on the whole body surface of person B, also on electrodes placed on B's head to record an EEG. This effect, although much weaker, is also measurable if person A does not even touch, but is just close to person B (within about 3 feet). (McCraty et al., 1998)

McCraty cautiously adds that "that the appearance of the source's ECG signal in the receiver's EEG does not necessarily indicate that the signal has produced an alteration in the receiver's brainwaves.", but considers this as a possibility, since the signal is obviously present in the whole body of B. (McCraty et al., 1998)

Thus McCraty offers a possible explanation of two of this project's effects: The transfer of the electromagnetic waves from the osteopath's heart into the subject's body might influence the subject's heart rate, and those same waves - by passing through the subject's brain - might also induce a shift in consciousness.

## **Effects of Intention**

Speculation: In some way the osteopath’s intention has an effect on the patient’s state of consciousness and/or physiology.

Direct effects of intention on matter or living organisms sounds like a far-out concept, more appropriate in the context of science-fiction than of science. Nevertheless, many teachers and authors in cranial Osteopathy do stress the importance of the osteopath’s intention for the efficacy of the treatment. Jealous, for example, associates the level of the osteopath’s consciousness with access to certain levels in the patient’s system: The higher the level of consciousness, the deeper the impact on the patient. (Jealous, 1999)

In addition to the osteopaths’ experience there are also several interesting research projects in this domain:

### **GLOBAL CONSCIOUSNESS PROJECT**

The prestigious Princeton University runs the “Global Consciousness Project”: On 40 different locations all over the world computers with random number generators are set up, whose results are collected in a central database. Statistically an equal distribution of generated numbers would be predicted. In situations when a big part of the world’s population focuses on one single event, however, the generated “random” numbers deviate from the predicted results. As an example, there was a clearly

noticeable change in the generated numbers on September 11<sup>th</sup>, 2001, at a time when many people around the world were informed about the terror attacks in the USA.

Princeton researchers are very wary about explanations for this phenomenon, but they tend to interpret it as the effect of a possible global consciousness (Nelson, 1998)

#### **EFFECTS OF INTENTION ON REMOTE LIVING SYSTEMS**

Similar to the Life-Force-model, remote effects of intention have been common sense to primitive nations for centuries: sometimes in the beneficial form of remote healing or prayer, sometimes in the harmful form of bad spells. During the past decades this idea “spilled over” from anthropology into experimental psychology, yielding interesting results:

Schlitz reviewed 30 experiments of remote healing and comes to the following conclusion: “Results across the experiments showed a significant and characteristic variation during distant intentionality periods.” (Schlitz & Braud, 1997)

In a study done in New Jersey and replicated later in France and the Netherlands the researchers could measure significant changes in the “receiver” subject’s finger blood volume when another “sender” person was directing emotional thoughts toward the receiver. (Dean 1962, 1966)

Braud could demonstrate the effect of another person’s intention during an attentional task (Braud et.al., 1995).

A fair amount of evidence has also been produced for the efficacy of *prayer*. A Medline search for the term “prayer” gives back 237 results. One of the projects, a big-scale double-blind experiment was performed on almost 1000 cardiologic patients in a hospital in Kansas City: They were divided into a group that would receive prayer and an other that would not. Patients in the prayer group had a significantly better course of their disease, while the average duration of the stay in the hospital was the same in both groups. (Harris et.al., 1999)

Many more studies have demonstrated the possibility of purely mental effects on living systems in similar ways (see Radin 1997 for an overview).

Currently it is not possible to tell, which of the above models caused the observed effects. In the author’s opinion, however, it was a combination of some of them: Intention, Life Force, Fluid and maybe the CNS.

#### **5.4.4 CONCLUSIONS**

## **5.5 We Got an Altered State – So What?**

Osteopathy has always been claiming to be a truly holistic approach, encompassing a patient’s complete being rather than just cracking some joints. This study could demonstrate the effect of an osteopathic technique on consciousness, thus corroborating that Osteopathy affects more than the physical body. It would be a rewarding task for future research to find out if the demonstrated effects do have a beneficial influence on patients’ psychological or emotional problems.

#### **5.5.1 BACKING OSTEOPATHY’S CLAIMS OF BEING “HOLISTIC”**

In a next step it could be tried to compare the “Cranial State of Mind” with ASCs in other areas. We have already suggested before that there are similarities with light meditative states and therefore some of the beneficial effects of meditation (see chapters 2.1.6 and 5.3.5) might apply to Cranial Osteopathy as well.

As it was described before, there is hardly any research on the psychological effects of touch, let alone of specific manual techniques. Having demonstrated that these effects exist, the author hopes to stimulate the interest in further research.

## **5.5.2 BENEFICIAL PSYCHOLOGICAL EFFECTS**

## **5.5.3 STIMULATING FURTHER RESEARCH**



## 5.6 Excursus: What are our patients really looking for?

*“Without the transcendent and the transpersonal we get sick, violent and nihilistic, or hopeless and apathetic. We need something ‘bigger than we are’ to be awed by and commit ourselves to in a new naturalistic, empirical, non-churchly sense. Perhaps as Thoreau and Whitman, William James and John Dewey did.”*  
Abraham Maslow (1968)

What seems an obvious question at first (“Help me to get rid of my pain!”) might be more complex at second glance: Behind symptoms like a bad back and headaches we often find psychological or existential problems.

Some of them will require the professional help of a psychotherapist, but in many cases the effect of Osteopathy, to cause a temporal shift in the patient’s consciousness, might be able to help, too. In the same way as travelling to another country may help you to change your point of view on problems back home, an ASC may help you to put things in perspective, too.

The transmutation that is described as one of the goals of Osteopathy by Still and Sutherland must happen on a physical level, but in order to be complete, it must also happen on the consciousness level. A good way of looking at it might be, that Osteopathy – as it can improve a stiff joint – might be able to restore mobility to a rigid consciousness as well.

While the premise of a need for “spiritual wellness” may seem esoteric to some of the readers it is a fact that has been gaining recognition since the late 1960s when “Transpersonal Psychology” was founded, up to the point of being acknowledged by the World Health Organisation in several of its documents.

A brilliant treatise of man’s need for spirituality can be found in a paper by Chandler (Chandler et.al., 1992). After discussing the psychological literature about “Spiritual Wellness” she proposes a “Model of Spiritual Wellness” for counselling, which seems useful for the osteopathic practice, too. Chandler defines her goal of *spiritual development* as the “process of *incorporating* spiritual experience that results ultimately in spiritual transformations” (Chandler et.al., 1992) which implies, that isolated experiences don’t necessarily constitute a spiritual development.

This idea is developed further in the following diagram in figure 25. The x-axis of the diagram shows a midpoint of “spiritual wellness” which is defined as a “balanced state of openness to or pursuit of spiritual development” (Chandler et.al., 1992).

On the left side of the axis there is a state of “repression of the sublime” meaning the person denies the reality or importance of higher values or spiritual development. On the right side of the axis we find the state of “spiritual emergency /preoccupation” that was described above. On every level of spiritual development (y-axis) a person can shift anywhere on the scale between repression and preoccupation, therefore requiring different approaches to get to their point of balance.

### 5.6.1 ... GET RID OF THE PAIN

### 5.6.2 MODEL OF SPIRITUAL WELLNESS

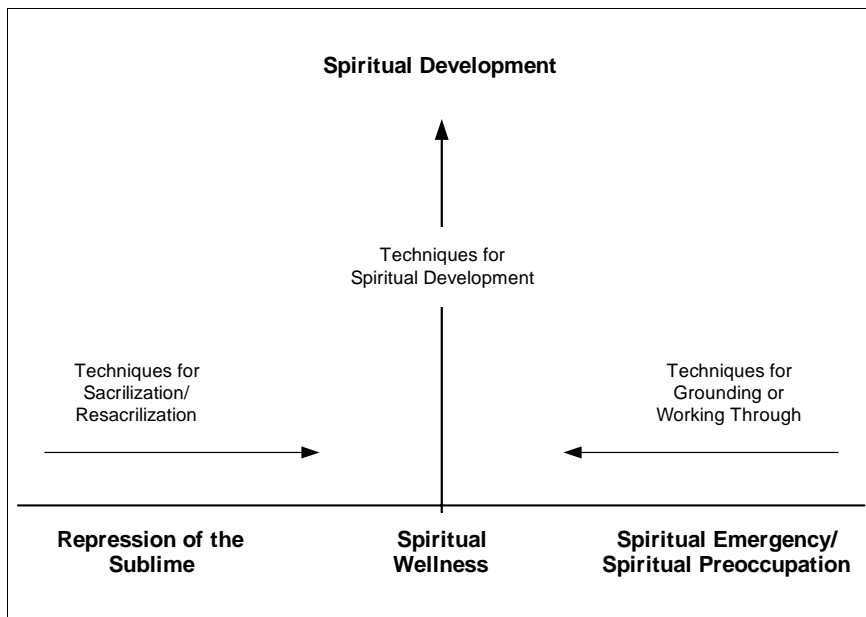


Figure 25: Spiritual wellness

For a patient who is repressing the need for spirituality techniques for *sacrilisation* (no, this is not about L5 fusing with the sacrum – that is *sacralisation*), for *sensitizing to the spiritual* (Maslow, 1971) will be needed and one might advise him to do relaxation techniques, meditation or spiritually oriented psychotherapy (e.g. Psychosynthesis).

Possible advice for patients in a spiritual emergency would conversely consist of reducing or stopping meditation for the moment and focussing on *grounding* instead. The term of grounding refers to slowing down the process of spiritual emergence and bring one back “down”. This might be achieved by physical movement like taking walks, by taking showers, getting a good massage, eating a normal diet or focussing on material tasks and necessities.

It would be an interesting task, to adapt osteopathic techniques to this model: Sacrilization might be achieved by ASC-inducing techniques like they were used in this experiment. For grounding it might be more efficient to use a technique like GOT that helps the patient to focus his attention inside his body rather than letting it drifting off.

# 6 *summary*

*“Now I feel very joyful  
and have a new sense of time -  
I’m in a Cranial state of mind”  
(To be sung to the tune of Billy Joel’s “New York State of Mind”)*

## 6.1 Clinical Relevance

Susceptibility to suggestions was not explicitly researched in this study. However its results (altered state of consciousness, altered experience, reduced volitional control) suggest that patients during or immediately after a treatment with Cranial Osteopathy might be highly susceptible to suggestions. While any doctor or therapist should always be highly conscious of the way he talks to his patients about their health or illness, this might be even more delicate when the patient is in a “cranial state”.

Remarks like “You got yourself a really bad lesion in your occiput!” might damage a patient’s health more than he might benefit from our treatment.

This idea is strongly supported by Patterson who used the CV4 to induce a – highly suggestible – hypnotic state in his patients (Patterson, 1970) as well as by many studies on the effect of placebo and nocebo (Benson & Stark, 1996).

Suggestion, when used consciously, can also be a highly efficacious tool in healing. Alan Becker reportedly tried to avoid for some time every bit of suggestion in his practice just to see what difference it would make. He later claimed that “he soon had to return to using suggestion, or starve.” (Patterson, 1970)

We quoted Tart in the beginning, who said that a distinct SoC is “a tool that is useful for doing some things but not very useful, and even dangerous, for doing other things.” The state of a patient after the treatment might not be suitable to jump into a car and rush to an important business meeting. Advice to the patient should be to take it slow, get some *grounding* (drinking water, walking a while before getting in a car or on a bus) or maybe sit down in the waiting room for another 15 minutes before leaving.

Based on this study’s results (especially the increased positive affect and joy) and prior osteopathic experience it seems justifiable to conclude that cranial fluid techniques might help patients with psychological or emotional problems. Further research is needed on this issue, however.

### 6.1.1 CAUTION WITH SUGGESTIVE STATEMENTS

### 6.1.2 ADVICE TO THE PATIENT

### 6.1.3 POSSIBLE EFFECTS ON PSYCHOLOGICAL PROBLEMS

## 6.2 Recommendations for further research

*“There are enough research projects here to keep squadrons of scientists busy for the next century.” (Maslow, 1971)*

Many future research projects have been proposed throughout this study. This chapter will pull them together and add a few more.

### **Do cranial fluid techniques create a long-term, beneficial psychological effect in patients?**

A repeated increase in positive affect and joy should be able to create long-term effects - similar to the psychological effects of meditation. Possible methods could include the PCI, scales of quality of life, or interviews.

### **Do patients look for help in achieving spiritual wellness?**

This was postulated in chapter 5.6. It would be interesting to find out if it is correct and, consequently, if Osteopathy can be of any help in this regard.

### **What happens to the osteopath’s SoC during a cranial treatment.**

Whatever the theory states, the author definitely feels, that he often is in an ASC *himself* while using cranial fluid techniques. Unfortunately time constraints did not allow to measure the author’s HRV while performing an osteopathic treatment and filling out the PCI afterwards - yet another future research project!

### **And Next: Is There Any Resonance?**

Does the osteopath’s consciousness influence the patient’s (as suggested by Jealous (Jealous, 1999) or vice versa?

### **Brain Imaging during/after Cranial Fluid Techniques**

Technically complicated, but highly interesting, this would be one way of finding answers to the question: “How does it work?”.

### **Development of a “Body Image Questionnaire”**

The PCI did not prove specific enough to bring forth any differences in body image, although the author is still convinced that they exist. A specific adjunct to the PCI for this dimension is suggested.

### **Single Subject Design or Qualitative Approach (In-depth Interviews)**

A possible consecutive research project could be to contact those subjects who experienced very distinct ASCs and interview them in depth to find out details about their experience beyond the scopes of a questionnaire.

## 6.2.1 NEW RESEARCH QUESTIONS

## 6.2.2 METHODOLOGICAL PROPOSITIONS

## **Naps During the Experiment**

In a study with a similar design it should be recorded if a subject presents any visible or audible signs of falling asleep during the experiment and the question should be included in the questionnaire. There might be interesting correlations with groups and/or certain dimensions of consciousness.

## **Neutral or Stillpoint During the Experiment**

In a study with a similar design it should be recorded if the osteopath in the experimental group perceives a neutral or Stillpoint in a subject. Then correlations between neutral and certain dimensions of consciousness could be researched.

## **Record Subjects' Spontaneous Comments**

Even if a quantitative approach is used, it would be useful to record the subjects' spontaneous comments during and after the experiment. These comments might indicate problems in the setup, possible explanations for otherwise puzzling results or possible areas for future research.

## **Get a Non-Osteopath for the Sham Treatment**

Obviously it is not possible for an osteopath to put his hands on a subject and do nothing. Our hands are so much trained and conditioned to have a beneficial effect, that we cannot turn this off. For a non-osteopath this seems to be easier (although still not entirely possible).

## **Osteopath Different from Researcher**

In this project a possible emotional bias of the subjects, based on the fact that the osteopathic operator was identical to the person they knew and who had invited them, could not be ruled out completely. In future projects it would be better to avoid this cause of bias by using an osteopathic operator, who is not identical with the person or institution, who invites the subjects.

## **Software für HRV measurement**

The "nerve express" system as it was used in the described trial can not be recommended for several reasons:

- In subjects with a high rate of ectopic beats the software "froze" during the measurement process, so the data could not be used.
- In the version that was used a PC with a serial port for the sensor and a parallel port for a dongle was needed, the more modern (and widespread) USB port could not be used
- The chest belt used by NerveExpress is more awkward for subjects than finger sensors or ear clips

As a low-cost yet reliable and flexible system the author currently recommends a combination of Freeze Framer (Quantum Intech, 2005) for the recording of the data and the free software "HRV Analysis" from the University of Helsinki (Karjalainen, 2003).

Measurement data out of Freeze Framer can easily be transformed and imported into "HRV analysis" which offers a wide range of possible analyses not just of the whole measurement period but also for any part of it.

### **German translation of PCI**

Only after this experiment had been finished the author discovered a German diploma thesis on translating the PCI into German language and testing it. (Rux, 2002) Future projects in German language might want to use Rux's translation rather than the author's, as it is thoroughly tested.

This study had Tart's spirit hovering over it, starting from page 1, so we might as well end our recommendations for further research with Tart's "strategies in using the systems approach" (Tart, 1975) for the research of a distinct ASC. He recommends a sequential strategy:

- Create a rough concept of the general components of a specific SoC, maybe through informal interviews with people who have experienced it or through pilot studies (like this one).
- Map the information, to see if there are common patterns of discrete experience that map an SoC.
- Proceed with the subjects who show this discreteness and find out why others don't. Map the state further, find out its main features, how the state is induced or deinduced, what its limits are and what it serves for.
- Then - based on good empirical maps of the "territory" and thoughtful considerations - more detailed studies on a bigger scale can be done on the nature of a particular state.

Dig On!

## **6.2.3 TART'S STRATEGIES**

# *7 acknowledgements*



## **I want to thank all the people who made this thesis possible:**

- my wife Monica and my wonderful children Manuela and Florian, for unconditional love and support and for interesting questions like “Daddy, why exactly do you want to write this thesis now?”
- my parents, for everything
- my friend Johann Kneihls, who coached me in methodology, showed me how to use SPSS, and pretended to be an osteopath for my control group
- Dr. Ronald J. Pekala who kindly provided his PCI and DAQ together with all the necessary information
- Peter Sommerfeld, and Dr. Paul Klein for support in methodological questions
- Dr. Barbara Schörner, who answered (almost) all my questions on statistics and SPSS
- Dr. Rudolf Kapellner for inspiring ideas and helpful books
- Gudrun Meddeb, for proof reading of the first half of the thesis. (Don't anybody blame her for errors in chapters 4 - 6!)
- all my research participants
- all my teachers in Osteopathy

# 8 *references*

"I quote no authors but God and experience." (A.T. Still)

"You should not ignore everything that is written in books." (René Descartes)

The author is usually not a great supporter of cartesian thinking, but when the argument is about books he is definitely taking sides with the french philosopher.

In the following list the most important references are printed **boldfaced**.

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# 12 abbr. (abbreviations)

ANOVA: analysis of variance

ANS: autonomic nervous system

APZ: Außergewöhnliche Psychische Zustände

ASC: altered state of consciousness

b-SoC:baseline state of consciousness

CNS:central nervous system

CSF:cerebro-spinal fluid

c-SoC:“cranial” state of consciousness

d-ASC:distinct altered state of consciousness

d-SoC:distinct state of consciousness

DAQ:dimensions of attention questionnaire

Duncan's:Duncan's multiple comparison test

EEG:Electro-Encephalography

fMRI:Functional magnetic resonance imaging

FFT: Fast Fourier Transformation

HF:high frequency domain of HRV

HR:heart rate

HRV:heart rate variability

HR\_diff:difference in HR between phase 1 and phase 6

LF/HF-ratio:ratio of LF to HF

LF:low frequency domain of HRV

LHR\_diff:difference in LF/HF-ratio between phase 1 and phase 6

PCI:phenomenology of consciousness inventory

PET: positron emission tomography

R-R:Regular-Regular (heartbeat -interval)

RSA: respiratory sinus arrhythmia

SoC:state of consciousness

SPECT:Single photon emission computer tomography

# *14 appendix*

(SUBMITTED TO THE JURY ON CD, AVAILABLE  
FROM THE AUTHOR ON REQUEST)

## **14.1 PCI**

**14.1.1 INVENTORY (ENGLISH ORIGINAL)**

**14.1.2 INVENTORY (GERMAN TRANSLATION)**

**14.1.3 SCORING SHEET AND INSTRUCTIONS**

**14.1.4 PCI ITEMS AS A FUNCTION OF  
PCI DIMENSIONS**

**14.1.5 RAW DATA AND STATISTICAL RESULTS**

## **14.2 DAQ**

**14.2.1 INVENTORY (ENGLISH ORIGINAL)**

**14.2.2 INVENTORY (GERMAN TRANSLATION)**

**14.2.3 SCORING SHEET AND INSTRUCTIONS**

**14.2.4 DAQ ITEMS AS A FUNCTION OF  
DAQ DIMENSIONS**

**14.2.5 RAW DATA AND STATISTICAL RESULTS**

## **14.3 HRV**

**14.3.1 STATISTICAL RESULTS**