The Experience of flotation-REST (Restricted Environmental Stimulation Technique): Consciousness, Creativity, Subjective Stress and Pain.

Anette Kjellgren

Department of Psychology
Göteborg University
Sweden 2003
Doctorial dissertation

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Printed in Sweden
Elanders Graphic Systems AB
Göteborg
ISSN 1101-718X
ISRN PSYK/AVH/--124--SE
ISBN 91-628-5872-6

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Anette Kjellgren
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Abstract. The purpose of the presented investigations was to study the influence and effects of altered states of consciousness (ASC) induced through the flotation tank restricted environmental stimulation technique (flotation-REST) in a laboratory setting. The results from the present investigations indicate that flotation-REST may offer a safe and practical method of inducing altered states of consciousness in a controlled laboratory setting. Throughout, flotation-REST was experienced as a positive event by the participants. In order to optimize the conditions of flotation-REST, possible differences in the type of experiences due to different settings (strict/fantasy) applied in the laboratory were examined; no such differences were obtained. Nor were experiences in the flotation tank affected by participants' earlier experiences of altered states of consciousness. Mental experiences reported from flotation-REST include deep relaxation, experiences of leaving or losing contact with the body, visual and auditory pseudo-hallucinations and transpersonal experiences. Comparisons between chamber-REST and flotation-REST indicated that the flotation-REST group experienced a significantly higher degree of ASC as compared to the chamber-REST group. The instrument, EDN-scale, was developed to allow these measures. Investigations of creativity indicated that flotation-REST induced more originality and impaired deductive thinking, in comparison to chamber-REST. Chamber-REST induced more realistic and elaborated thinking compared to flotation-REST. Comparison of these two conditions indicated that both flotation-REST and chamber-REST were equally effective in reducing subjectively experienced stress. An experimental pain procedure was arranged in order to study the experience of pain in connection with individuals experiencing ASC (induced by flotation-REST). A higher level of pain and stress was obtained in those individuals with high ASC in the flotation-group compared with those with low ASC (as measured with the EDN-scale). The individuals presenting high ASC also experienced duration of experimental pain as shorter compared with low ASC individuals, within the flotation-REST condition. Within the chamber-REST condition, there were no differences between the low ASC and high ASC individuals. To study the possible pain-alleviating effects of flotation-REST upon existing, chronic pain, a series of flotation-REST treatments over a three-week period was carried out. It was found that the participants most severe perceived pain intensity was significantly reduced, whereas low perceived pain intensity was not influenced by the floating technique. Further, the results indicated that the circulating levels of noradrenaline metabolite MHPG (3-methoxy-4-hydroxy-phenylethyleneglycol) were reduced significantly in the experimental group but not in the control group following treatment, whereas endorphin levels were not affected by flotation. Flotatation-REST treatment also elevated the participants' optimism and reduced the degree of anxiety or depression; at nighttime, patients who underwent flotation fell asleep more easily. These findings describe possible alleviations in patients presenting with chronic pain complaints. Taken together, these studies on the flotation-REST technique offer a promising avenue of future research on stress reduction, pain treatment and personal development, hopefully elucidating regional brain implicit and explicit processes.

Key words: *Altered states of consciousness, ASC, Floating, Flotation, REST, Pain, Creativity, Stress, setting.*

This thesis is based on the following four research papers, which will be referred to in the text by their Roman numericals:

I Norlander, T., Kjellgren, A., & Archer, T. (2001). The Experience of Floatation-REST as a Function of Setting and Previous Experience of Altered States of Consciousness. *Imagination, Cognition and Personality, 20*, 161 - 178.

II Norlander, T., Kjellgren, A., & Archer, T. (in press). Effects of Floatation- versus Chamber-restricted environmental stimulation technique (REST) on creativity and realism under Stress and Non-stress condition. *Imagination, Cognition and Personality.*

III Kjellgren, A., Sundequist, U., Sundholm, U., Norlander, T., & Archer, T. (2003). Altered consciousness in flotation-REST and chamber-REST: Experience of Experimental Pain and Subjective Stress. *Social Behaviour and Personality, 8,* 000 - 000.

IV Kjellgren, A., Sundequist, U., Norlander, T., & Archer, T. (2001). Effects of flotation-REST of muscle tension pain. *Pain Research and Management, 6*, 181 - 189.

ACKNOWLEDGMENTS

First and foremost, I would like to thank Sigrid for her constant loving presence in my life.

I would like to extend my deepest gratitude to my supervisor and examiner Professor Trevor Archer, University of Gothenburg, for his kind and patient guidance and heartfelt enthusiasm and understanding during the planning and preparation of this work. I am grateful too for his scientific knowledge and valuable and constructive advice during the course of these enterprises. Likewise, thankfulness and respect are due to my second supervisor, Associate Professor Torsten Norlander, Head of the Department of Psychology, University of Karlstad, who skillfully guided me within the field of experimental psychology. He always encouraged my ideas and taught me many things about the scientific world.

Further I would like to thank all my colleagues and friends at the Department of Psychology, University of Karlstad for the heart-warming atmosphere and all valuable support.
Also thanks are due to Associate Professor Annika Dahlgren-Sandberg, University of Gothenburg and Professor Georg Stenberg, University of Växjö for valuable and constructive comments of the manuscript.

I want to extend my gratitude to all the participants in the experiments, without whose time and patience this work would not have been possible to achieve.

I also want to thank my parents Emy and Knut and their lifepartners Lennart and Helena for all their love and warmth. A very special expression of gratitude is due to Anders Eriksson, for his love, his kind support, encouragement and rewarding discussions.

And finally, I also would like to thank Dr. Ralph Parnefjord for his love, for valuable help with translation into English, for our time together – and his excellent cooking!

Contents

The investigations have received ethical approval from the Ethical Board on Experimentation on Human Subjects at University of Karlstad and University of Örebro, Sweden.

1. INTRODUCTION

"Our normal waking consciousness 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 their completeness... No account of the universe in its totality can be final which leaves these other forms of consciousness quite disregarded." ***(William James, 1901).***

1.1. Altered states of consciousness

Is it possible or even fruitful for the (conscious) unhindered workings of the mind to understand what is implied by the term "consciousness"? Consciousness is a phenomenon, which has been discussed in several areas, from religion to neuroscience. The concept of consciousness is difficult to define and has by some researchers even been seen as an entirely subjective experience, thereby not of relevance for scientific research (Tassi & Muzet, 2001). Several attempts towards definitions of consciousness have been made, but for the purpose of this treatise the following definition applies: "Consciousness is an individual's current awareness of external and internal stimuli" (Atkinson, Atkinson, Smith, Bem, & Nolen-Hoeksema, 2000, p. 193).
Another, quite similar, definition av consciousness formulated by Farthing (1992, p. 6) is: "Consciousness is the subjective state of being currently aware of something, either within oneself or outside oneself". According to Encyclopædia Britannica Dictionary (2002) the term "consciousness is defined as "The perception of what passes in a man's own mind". In Merriam-Webster's Collegiate Dictionary (2002) the term is defined, among others, as:
(1) "The quality or state of being aware especially of something within oneself "
(2) "The state or fact of being conscious of an external object, state, or fact "
(3) "The totality of conscious states of an individual"

Other terms, too, are used to denote different aspects of "consciousness", one such being awareness. Certain languages e.g. French, Italian and Spanish, make no distinction between consciousness and awareness (Tass & Muzet, 2001). Tart (1990, p. 3) points out that in Sanskrit there are about twenty terms used to differentiate states of consciousness.

Sometimes, other components are supplied to the definition of consciousness, for example : vigilance ("I am awake"), mental states ("I am thinking") and selective attentiveness ("I do attend to") (Nidermeyer, 1994). It is useful to consider that there exists a curious disunity in the definitions of consciousness and it is neither the intention nor any pretension of this thesis to become embedded in that conceptual quagmire. Also, many hypotheses have been made to determine what may contribute to the neuroanatomical basis for consciousness in the brain. Many candidates have been suggested eg. thalamus (Bogen, 1995), limbic structures (Gray, 1993) and anterior cingulate cortex (Benes, McSparren, Bird, San Giovanni & Vincent, 1991; Devinsky, Morrell & Vogt, 1995). The anterior cingulate cortex plays an important role in attentional processing. The so called "anterior cingulate cognitive division" serves to 1) modulate stimulus selection (i.e. focused attention) and 2) mediate response selection (Bush, Frazier, Rauch, Seidman, Whalen, Jenike, Rosen & Biederman, 1999; Whalen, Bush,

McNally, Wilhelm, McInerney, Jenike & and Rauch, 1998). There is also suggestions that consciousness might not be a function of a unique centre. Many structures, playing different roles, are involved (Delacour, 1995) and its basis is likely to be interactions between different neural structures (Tassi & Muzet, 2001). Delacour (1997, p. 127) points out: "..the main factor limiting advances in the neurobiology of consciousness is methodological: the lack of a comprehensive description of consciousness as a vital lead".

An even more elusive, but challenging, operational term is "altered states of consciousness" (ASC). From the state of consciousness called "normal waking state of consciousness", we constantly move in and out of different, alternative states of consciousness (Setterlind, 1990; Zinberg, 1977) that are generally referred to as alterations of ongoing states of consciousness. The most frequently experienced ASC by far is sleep, wherein a normal person spends about one third of his/her whole life. Even within this single altered state called sleep, distinct sub-states can be described and defined, such as Rapid Eye Movement (REM)-sleep, non-REM-sleep, dream-sleep and deep sleep, depending on definitions and techniques of observation.

Apart from the altered states within sleep, several altered states of consciousness have been described during daydreaming, relaxation, meditation, sensory deprivation, drug-induced states, etc. There are obvious differences in the degree and intensity of the experiences, depending on which condition one studies. A mildly relaxation-state implies naturally other experiences than a more dramatic ASC during e.g. a drug-induced state, but there may exist some common hall-marks. A multitude of overviews, synopsis and models of description to encompass the different altered states of consciousness have been suggested.
Despite many attempts there as yet exists no scientifically comprehensive or generally accepted theory concerning the phenomenon altered states of consciousness. Kokoszka (1992) indicates that "researchers studying altered states of consciousness are not interested in the whole range of states of consciousness in relaxation, but only on the most altered ones".
It is possible that the research focus upon the more extreme conditions has resulted in the absence of an all-encompassing theory. Even for those interested in less dramatic ASC, as induced by eg. relaxation or mild sensory deprivation it is necessary to acknowledge the research and notions from the more "dramatically-" focussed research.

Altered states of consciousness may induce experiences of transcendence and transpersonal states, implying access to thoughts and experiences transcending the normal span of the individual's different states of consciousness, thus releasing thought content, intuitive insights and emotional experiences that apparently seem to exceed the individual's biographic experiences and thought-forms (thus the expression "transpersonal"). During ASCs like those induced by e.g. relaxation, daydreaming or meditation are transpersonal experiences not so frequent. Most common during such less dramatic ASC are feelings of peacefulness and a slightly distorted time-perception.

Altered states of consciousness may be induced or provoked by a number of techniques or manipulations (e.g. Bundzen, Korotkov & Unestahl, 2002; Dietrich, 2003; Dittrich, 1996; Scheiffele, 2001), for example meditation, sensory deprivation, sensory overload, psychedelic drugs, fasting, sleep deprivation etc. ASC may also appear in a seemingly spontaneous manner, where the inductive factor cannot be clearly identified. The effects of ASC are mainly psychological and may include subjectively experienced changes in formal thinking, changes in time- and space perception, perceptual and sensory changes as such, experiences of changes in body-image and emotions of profound insights or experiences of a spiritual character (Ludwig, 1990). Transpersonal experiences are usually pleasant, but can also

contain negative or threatening components. The emotional baseline during a more dramatic ASC is unstable and may quickly change from euphoric to fearful. Particularly during drug-induced ASC, the impact of "set" (expectations, quality of emotional baseline prior to intake) and "setting" (the outer conditions and surroundings during the intoxication) are of vital importance in molding the characteristics of the experience.

1.2. General characteristics of ASC

Many attempts have been made to describe the general characteristics of ASC. For example Ludwig (1990, p. 18 - 33) gives the following:

> *..any mental state(s), induced by various physiological, psychological, or pharmacological maneuvers or agents, which can be recognized subjectively by the individual himself (or by an objective observer of the individual) as representing a sufficient deviation in subjective experience or psychological functioning from certain general norms for that individual during alert, waking consciousness. This sufficient deviation may be represented by a greater preoccupation than usual with internal sensations or mental processes, changes in the formal characteristics of thought, and impairment of reality testing to various degrees.*

Metzner (1992) defines an ASC as a change in thinking, feeling, and perception, in relation to one's ordinary baseline consciousness, that has a beginning, duration, and ending.

Another definition of ASC is proposed by Charles Tart (1972, p. 1203), who also often are given credit for coining the term altered states of consciousness, is "a qualitative alteration in the overall pattern of mental functioning, such that the experiencer feels his consciousness is radically different from the way it functions ordinarly".

Dittrich (1998) points out the difficulty of conducting research on ASC due to the lack of sufficient operationalization of the term. In order to describe the experiences that can ensue from an ASC, the following general characteristics, formulated by Weber (1920) have been adopted by Dittrich, in order to further differentiate the term ASC:

> *1. ASC represents a marked deviation in the subjective experience or psychological functioning of a normal individual from her/his normal usual waking consciousness.*
>
> *2. This deviation represents not only changes in mood or motor activity (as under alcohol or tranquilizers) but also unusual experience of oneself and surroundings. Time and space as fundamental categories of human experience are changed.*
>
> 3. *As opposed to psychiatric disease, ASCs normally last only a few hours.*
>
> 4. *ASCs are self-induced or may occur in the "normal way of life". They are not the result of illness or adverse social circumstances.*
>
> *5. ASCs are considered "irrational", "abnormal", "exotic", or "pathological" by the social norms of the mainstream of present western society.*

Another definition is made by Farthing (1992): "*An altered state of consciousness (ASC) may be defined as a temporary change in the overall pattern of subjective experience, such that the individual believes that his or her mental functioning is distinctly different from certain general norms for his or hers normal waking state of consciousness*".

The subjective experience of an ASC is a common feature in most of definitions. There is no objective way to determine if someone is in an ASC or measuring the degree of an ASC.

The psychological changes that can be noted during an ASC may be seen as independent of the means by which the ASC was attained. As described earlier, changes usually reported are alterations in thinking, disturbed time sense, loss of control, change in emotional expression, body image change, and perceptual distortions (Ludwig, 1990). These changes will be described in more detail below.

Alterations in thinking. It is common that the thought processes and thought contents are changed in their formal structure and content. Associations are abundant and it is not uncommon that "magical thinking" develops (impression of deep, arcane meanings of profane objects and concepts, with a strong symbolism) (Grof, 1980). It is implied that during ASC primary-process thinking predominates at the expense of secondary-process thinking, impairing reality testing to varying degrees.

Primary process is often considered the mental functioning of early childhood, before reality-orientation, language and the ability to delay immediate satisfaction have developed (Fromm, 1978). The primary process is an unconventional, instinctive thinking that tends to operate on concrete images rather than abstract concepts, while secondary processes is associated with logical, analytical, abstract, and reality-oriented thought (Norlander, Bergman & Archer, 1999). In traditional psychological terms the effect may be described as a cognitive shift from a more secondary process oriented thinking to a more primary process-oriented thinking (Neisser, 1967).

Psychotherapy may be augmented by ASC-techniques such as hypnosis, guided imagery and flotation tank experiences (e.g. Jessen, 1990; Suedfeld, 1975). During the 1950's and 60's psychedelic and psycholytic therapies were used by several mainstream therapeutical institutions in order to facilitate and shorten the time of precipitation of the psychotherapeutic process (e.g. Grof, Soskin, Richards, & Kurland 1973; Grof, 1980; Soskin, Grof, & Richards, 1973). Today, a renewed interest in these techniques can be noted. The use of the so-called "psychoactive" substances is also being investigated, for example the uncompetitive N-methyl-D-aspartate receptor antagonist ketamine (Krupitsky & Grinenko, 1997) and MDMA (methylenedioxymethylamphetamine, "ecstasy") (Gasser, 1994; Greer & Tolbert, 1998; Nasmyth, 1989).

Disturbed time sense. Often reported is a subjective feeling of timelessness or acceleration or slowing of time (Mee, 1995; Raab & Gruzelier, 1994). Sometimes the experience is reported as if the "time is standing still" (Ludwig, 1990).

Loss of control. Mostly, people enjoy and value a self-chosen and limited period of losing control and responsibility, commonly referred to as "relaxing". It is not to be forgotten that certain personality types and especially persons with experiences of strong depressive reactions and psychotic episodes may react in an intensely negative way to this condition, struggling to the utmost to maintain the needed amount of control (Strassman, 1984). For these persons, intense forms of ASC is likely to precipitate panic reactions, existential crises and additional tension. This consideration is a practical reason for screening participants of experimentally induced ASC for traits of this character (Greer & Tolbert, 1998; Delgado & Moreno, 1998).

A person entering an intense ASC-state may easily become imprisoned in a condition where he/she fears losing control and his/her grip on reality (Hollister, 1988). Here, a real risk for accidents can appear based on misinterpretations of reality resulting in erroneous or irrational actions.

Change in emotional expression. Emotional state particularly is influenced under ASC conditions. Usually, the emotional baseline is highly unstable and may, especially during psychedelic drug induced ASC, quickly change (Grof, 1980; Ludwig, 1990). This observation has been noted with interest during psychotherapeutic sessions, where introspection and exploration of subjective inner worlds and thought-patterns are encouraged (Delgado & Moreno, 1998). During less intense ASCs, like those induced by eg. meditation, guided imagery or mild sensory deprivation, which are induced not as unstable emotional condition but rather as feelings of calm tranquility and peacefulness (eg. Forgays, Forgays, Pudvah & Wright, 1991; Schulz & Kaspar, 1994) that are considered to facilitate the subsequent psychotherapy (e.g. Jessen, 1990; Suedfeld, 1975).

Body Image Changes. The inner representation of the body-image and the experience of the boundaries of the body may be markedly changed or experienced as unclear (Ludwig, 1990). Apart from experiencing an expansion or a miniaturization of the body as such - well described in the "Alice in Wonderland Syndrome" (Golden, 1979; Rolak, 1991) - sensations of floating and experiencing the body-boundaries dissolved and bizarre experiences of distorted parts of the body-scheme may appear. Although the descriptions usually sound quite disturbing, in general subjects describe the experience as pleasant (Golden, 1979; Rolak, 1991; Spitzer, 1988).

Perceptual distortions. Perceptual distortions are a hallmark of ASC induced by psychedelic substances. Most prevalent are visual disturbances such as perceiving vivid colors, organic or interwoven patterns and fleeting glimpses of complex imagery. Sensory modalities can be mixed such as "seeing noises and hearing colours", involving both sensory and motor (reporting) disturbance (Delgado & Moreno, 1998; Pahnke & Richards, 1993). Although less common, all sensory modalities may be distorted during an ASC (for a good classical description, see Beringer, 1927).

The term "hallucination" (from the Latin alucinare, "to wander in mind") has been defined as "an apparent perception of an external object when no such object is present" (Hinsie & Campbell, 1970). Since the terms "hallucinations" and "hallucinogens" are often used in ambiguous ways, it might be of value to define the terms "hallucination" and "pseudo-hallucination" as used in this text. The definition is based on the clinical psychiatric use of the terms stating that a hallucination is a sensory perception without external stimulus. The perceiver cannot differentiate this perception from the objects of the reality that are perceived

by other people. A hallucinating person is thus not immediately aware of that the perception is not part of the reality as defined by others. It is important to note that the hallucinations are maintained in the face of all evidence to the contrary. In contrast hereto, a pseudo-hallucination is a sensory perception, where the perceiver is able to categorize the impression as a "pathological" sensory impression, or sensory perception not perceived as "real" by others (cf. Spitzer, 1988). Most "hallucinations" experienced under the influence of psychedelics or during ASC induced by other techniques, are in effect pseudo-hallucinations. The extent to which vivid visual imagery during dream-sleep skall klassificeras som true hallucinations or pseudo-hallucinations may be discussed. Sometimes these images that come during sleep-onset are called hypnagogic imagery. Blackmore (2003, p. 307) points out "rather than try too hard to delimit these categories, some prefer to think of a continuum with true hallucinations at one end and imagery at the other".

The perceptual distortions appearing during mild forms of ASC are usually in the form of pseudo-hallucinations, i.e. the person in question experiences sensory impressions, but knows that they are not "for real". An actual confusion with the mutually experienced reality is thus not present. Ample descriptions are available from studies of mild sensory deprivation (e.g. Goodman, 1982; Raab & Gruzelier, 1994; Spitzer, 1988), where vivid visual imagery can be observed, fulfilling the criteria of pseudo-hallucinations. Also acustic pseudo-hallucinations are documented during sensory deprivation, but olfactoric and tactile are rarely seen (e.g. Goodman, 1982).

During intense ASC (for example with adequate dosages of psychedelic drugs, during psychotic episodes in schizophrenic patients or addicts suffering from amphetamine psychosis etc. and strong spiritual episodes), the pseudo-hallucinations can gradually evolve into true hallucinations, thus disabling a reality control based on sensory perceptions (Bowers & Freedman, 1993). Processing of those perceptions are performed by brain regions responsible for "executive functioning" e.g. prefrontal cortex, amygdala and hippocampus (Bechara, Damasio, Damasio & Lee, 1999; Elliott, Sahakian, Matthews, Banerjee, Rimmer & Robbins, 1997; Rubia, Overmeyer, Taylor, Brammer, Williams, Simmons & Bullmore, 1999).

It must be indicated that a comprehensive review of the possible neurobiological models and factors involving (pseudo) hallucinatory states falls outside the scope and purpose of this dissertation.

Changes of quality of life. Other, more profound psychological changes than the above mentioned can appear during ASC, such as a major change in meaning and significance, a sense of the ineffable, feelings of rejuvenation, and an intense spiritual awakening (i.e. Metzner, 1999; Stafford, 1992; Strassman, 2001). Also, in the literature, reports of drastic turning points in life after ASC are abundant (e.g. Huxley, 1954; Stolaroff, 1994; Strassman, 2001; Trueheart, 1992). As indicated previously, amongst others by Dittrich (1998) are ASC sometimes considered "abnormal" or "pathological" by the social norms of the mainstream current western society. It ought to be indicated that anthropological descriptions from 'native peoples' and cultures are considered too as powerful methods for healing and growth.

1.3. Comparison between ASC induced in different ways

Independent of the method used to induce an ASC, such as sensory deprivation, psychedelic drugs and meditation, there seems to be similarities between the experiences that result

(Dittrich, 1996). The first modern scientist in the western culture that noted similarities between different altered states of consciousness was Moreau (1845) who, based on his self-experiments with cannabis, suggested that hallucinations and mental illnesses were virtually identical psychic states.

A comparison between drug-induced ASC initiated by the chemically widely different substances of Δ^9-tetrahydrocannabinnol (THC) and N,N-dimethyltryptamine (DMT) showed no significant difference between the two substances relating to the individual's experience of visual and acoustic hallucinations, impairment of memory and attention, depersonalization syndrome, changes of body image, euphoric states or anxious-depressive state (Dittrich, Bickel, Schopf & Zimmer, 1976). The class of drugs, generally referred to as hallucinogens, may alter consciousness in profound and bizarre ways, but confusingly enough many drugs can act in a variety of ways as hallucinogens. The term 'hallucinogen' is more than a little misleading. It focuses attention upon attention and alterations of perception (sensory disturbances) but these are far from the only effects produced by these drugs which may induce profound effects on mood, cognition and thought processes, and physiology. Hallucinogens alter nearly all aspects of psychological function and the expression "altered state of consciousness" is singularly adept (Maisto, Galizio and Connors, 1999).

Subjective psychological effects of sub-anesthetic doses of ketamine revealed changes in all sensory modalities and in the subject's sense of identity, emotions and existence, in a similar way as for LSD and other psychedelic drugs (Hansen, Jensen, Chandressh & Hilden, 1988). Furthermore, analysis of ketamine effects in healthy volunteers demonstrate that the effects of the compound mimic both the positive and negative symptoms of clinical schizophrenia (cf. Krystal, Kasper, Seibyl, Freeman, Delaney, Bremner, Heninger, Bowers & Charney, 1994; Krystal, Karper, Bennett, Abi-Saab, D'Souza, Abi-Dargham & Charney, 1995; Krystal, Karper, Bennett, D'Souza, Abi-Dargham, Morrisey, Abi-Saab, Bremner, Bowers, Suckow, Stetson, Heninger & Charney, 1998; Moghaddam, Charney & Krystal, 1996).

Although these suggestions of equivalence of different psychedelic substances are reported, several attempts have been made to differentiate between certain mystical states and drug induced altered states of consciousness (e.g. Fischman, 1983). An attempt to differentiate various states using a verbal computerized content analysis (Oxman, Rosenberg, Schnurr, Tucker & Gala, 1988) showed that the subjective experience of schizophrenia, psychedelic drug-induced states and "mystical ecstasy" are more likely to be different than alike.

Episodes of paranoid-hallucinatory schizophrenia are characterized by mostly threatening and paranoid delusions, many times with a mystical or sexual overtone. Hallucinations are often prevalent in the acute phases and/or the acute debut, but include tactical and acoustic perceptions to a greater extent than pharmacologically or physiologically induced ASC. Although visual hallucinations are described, they are not as usual in schizophrenia, whereas commenting voices, whispers and perception of music are present to a lesser extent in pharmacologically or physiologically induced ASC. For further descriptions on positive symptoms in schizophrenia, see the Diagnostic and Statistic Manual IV (DSM IV) by the American Psychiatric Association (1994). To a large extent, the above distinctions may be transferred to other psychotic reactions as well, such as organic psychoses and delirium tremens.

The concept of a model psychosis, comparing effects of psychedelic drugs with symptoms of psychotic reactions (for a review, see Gouzoulis-Mayfrank, Hermle, Thelen & Sass, 1998)

may be used for limited areas in order to understand the basic function of isolated symptoms of schizophrenia and their neurohumoral correlates. Nevertheless, it seems prudent to exclude psychotic symptoms, based on endogenous psychiatric illnesses or long-term organic damage to the central nervous system from the rest of the ASC.

A comparison between less dramatic ASC (induced by e.g. mild sensory deprivation, endurance running or meditation) and more dramatic ASC (e.g. drug induced or dreams) also reveals some similarities, but with different intensities. Such similarities can be for example: visual imagery, distorted time perception, euphoria, diminished awareness of the surroundings, intensified understanding of one's sense of identity, atypical thought pattern, feelings of unity with one's self and/or nature, peacefulness and inner harmony (e.g. Dietrich, 2003; Goodman, 1982). More discomforting or frightening experiences (e.g. traumatic fear) may hardly occur during the mild and more manageable ASC.

1.3.1. Measuring Altered states of consciousness.

No objective measurement exists for the subjective psychological experiences during ASCs. Several neuroendocrine and neurophysiological measures have been tested, but no reliable unique biological measures are available.

Qualitative methods, analyzing written texts or transcribed interwievs exist, based on the theis that language content mirrors the degree of ASC (e.g. Martindale, 1975; Martindale, 1990; Martindale & Dailey, 1996; Oxman, Rosenberg, Schnurr, Tucker & Gala, 1988).
Psychometric research tools have also been designed to quantify effects on mood-, perception- and cognition-altering effects during ASCs. These psychometric scales are mainly designed for research with drug induced states. One wellknown such scale is the Hallucinogen Rating Scale (HRS), which was originally designed for research with DMT (N, N-dimethyltryptamine), and later modified as the standard questionnaire used in most studies involving psychoactive drugs (Riba, Rodríguez-Fornells, Strassman & Barbanoj, 2001).

Another psychometric self-rating scale, first developed by Dittrich (1975) is the APZ-questionnaire (**A**ussergewöhnliche **P**sychische **Z**ustande), and a later psychometrically improved version called OAV-qustionnaire (Dittrich, 1998). The APZ-qustionnaire consists of 158 items, the respons to which is either "yes" or "no". The OAV-questionnaire uses visual analog scales (VAS-scale) instead of "yes" and "no"-answers. The APZ-qustionnaire has become the international standard for assessment of ASCs (Dittrich, 1998), and has among other been used for testing the hypothesis that "irrespective of their mode of induction, ASCs have invariant features in common, which at the same time differentiate them from normal state of consciousness" (Dittrich, 1998, p. 81). Agents used for ASC-induction were both pharmacological (DMT, psilocybin, THC and nitrous oxide) and psychological agents (sensory deprivation, hypnagogic states and sensory overload). The results revealed three oblique dimensions as common denominators in ASCs, which are further commented upon in detail by Dittrich (1998). This questionnaire has also been tested for measuring endogenous psychosis (Habermeyer, Gouzoulis-Mayfrank, Steinmeyer, Hermle & Sass, 1996).

A modified and shortened version of this test has been constructed by us, for use in studies involving research with flotation-REST. Out of the original 158 item, 29 item were selected and modified for their apparent relevance for experiences induced by flotation-REST (e.g. "the boundary between myself and my surrondings seemed to blur", "I saw light or flashes of light in total darkness or with eyes closed", "I saw scenes rolling by like in a film, feeling of deep peace within me", "I believed I heard voices although no one was in my vicinity", "my

"I" seemed to leave the body"). Questions not of relevance for the dark, quiet environment in the flotation tank were excluded (e.g. "sounds and noises sounded different than normal", "the ground I was standing on seemed to be swaying", "things around me appeared to be bigger than usual"). For all the 29 items a visual analog scale 0 - 100 were used. Every item measuring the persons subjective experience of deviation from his/her "normal state"of consciousness. The items can be cathegorized as belonging to the following clusters:
-Perceptual effects: 8 items (Visual: 4; Auditory: 4),
-Time perception: 4 items,
-Alterations in thinking: 8 items,
-Bodily/Body image changes: 6 items,
-Emotional/Quality of life: 3 items.

All points from the 29 items are averaged to form a measurement of "experienced deviation from normal state". This questionnaire, EDN (**E**xperienced **D**eviation from **N**ormal state) offers a measure of each individual own judgement of deviation from the day-to-day 'normal' state of consciousness. For further discussion regarding EDN, see 3.2.

1.4. Theoretical models of ASC

Several attempts have been made to organize the scattered notions of ASC into a consistent theoretical system, enabling the eventual construction of a model. These models (e.g. Fischer, 1971; Fromm, 1978; Grof, 1980) ought not to be seen as mutually exclusive to each other. Far from claiming to be a complete description of altered human states of mind it may well be that what is conceived here is some neural "terra incognita". Some well-known models are presented below.

1.4.1. Primary-secondary process model

The concepts, primary and secondary process, originate from psychoanalytic theory but in this context are used in accordance with the notions of Neisser (1967). Primary process implies originality, instinctiveness, unconventionality and "here-and-now" thinking, whereas the concept secondary process is associated with logical, analytical, and conventional and reality oriented thought.

One way of organizing or describing ASC is in terms of primary and secondary processes. As Noy (1969) suggest, with the support of Goldberger's experiments in sensory isolation (Goldberger, 1961), there is a weakening of the secondary processes (eg. logical, analytical, abstract and reality oriented thought) to the advantage of primary processes (e.g. dreamlike state, instinctive thinking, concrete imaging rather than abstract concept) during ASC. Noy (1969) suggests that the term "feedback" may be used as a criterion to define the two processes. This reasoning leads up to the definition: "Secondary processes are all mental processes dependent on feedback for their maintenance; primary processes are all mental processes not dependent on feedback for their maintenance" (Noy, 1969, p. 166).

The balance between primary and secondary processes plays a critical role in an individual's state of consciousness or way of thinking, and is reflected in his/hers language contents (Martindale, 1975; Martindale, 1990; Martindale & Dailey, 1996). Other evidence for this balance may be derived from studies on the creative process (e.g. Norlander, 1999). Furthermore it has been argued also that a hemispheric balance in conjunction with cortical-subcortical tone may underlie the primary-secondary process shifts (Norlander, 2000). Studies

administering psychoactive drugs, e.g. psilocybin (Martindale & Fischer, 1977) and marijuana (West, Martindale, Hines & Roth, 1983) show an elevation of the primary process content of verbal production. ASC may according to these notions be seen as a condition where the degree of secondary processing is attenuated to the benefit of primary processing. Neisser (1967) points out that in the concept of "cognition", both secondary and primary processes should be included. According to Neisser (1967, p. 4), the term cognition is included in "all processes by which the sensory input is transformed, reduced, elaborated, stored, recovered, and used. It is concerned with these processes even when they operate in the absence of relevant stimulation, as in images and hallucinations".

Fromm (1978) goes further by listing various states of consciousness according to their relative amount of primary with respect to secondary processes. As a basic condition involving the highest amount of secondary processing, the normal waking state is assumed, following which, in descending order: states such as "waking entranced", free association, daydreaming, several meditation techniques, light hypnosis, inspirational phase of creativity, minor psychedelic states, medium and deep hypnosis, major psychedelic states, nocturnal dreams and finally psychoses are emergent (see Figure 1).

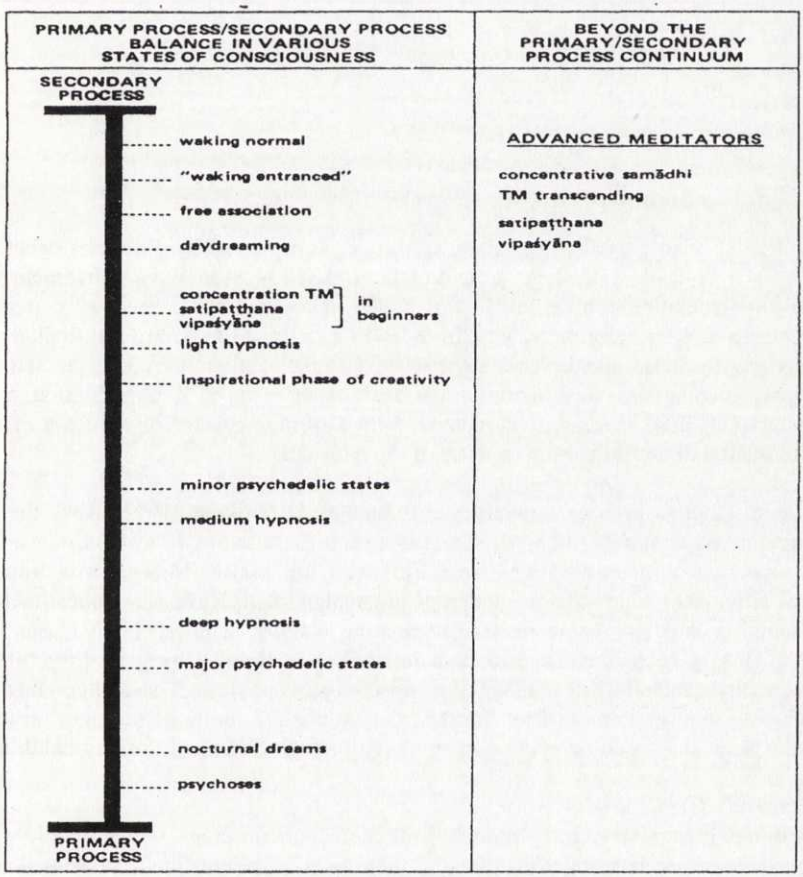

Fig 1.
From Fromm, 1978.

1.4.2. Diverse other models

Girdano and Everly (1979) have presented a further application of the results of Goldberger (1961) and sensory restriction as a means to achieve ASC. Here, different ASC are outlined along a "hypoarousal - hyperarousal" continuum, related to the amount of stimulus input (see Figure 2) that may arise. Although widely applicable, paradoxical states such as experience of strong tranquillity during high stimulus input, are difficult to correlate with this model.

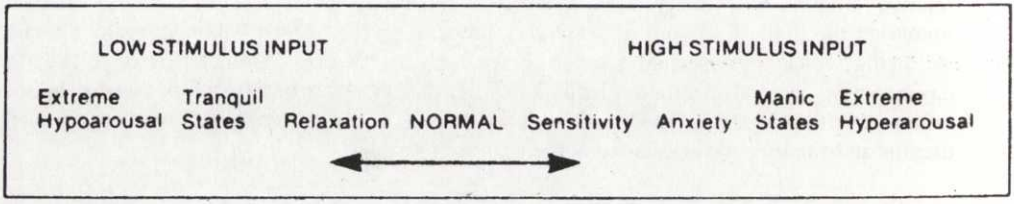

Fig. 2
From Girdano & Everly, 1979.

Another model, also partially including arousal is constructed by Fischer (1971). He has postulated a "psychological" cartography where ASC is seen as a movement along a perception-hallucination continuum. In this model, there are two avenues of experience for the normal waking consciousness: One may lead to increased hyperarousal, including states of creativity, psychotic and ecstatic experiences, and the other one along a "staircase" of hypoaroused meditative states, including the peak experiences of Zen-meditation, as well as Yoga Samadhi. These states are characterized by a turning inward of the span of attention towards a mental dimension at the expense of the physical.

Other models include that of Kokoszka and Zinberg. Kokoszka (1992) who, for example present an integrated model of consciousness states, differentiating four main states: Ordinary waking state, differentiated waking state, REM-sleep, and non-REM sleep. According to this model, differentiated states of consciousness are analogous to REM sleep phenomena due to their inherent content of spontaneous imaginative activity. Zinberg (1977) uses the term alternating state of consciousness to denote a condition, naturally-changing different levels of alertness, without including normal waking consciousness or sleep. These alternating states of consciousness involve transcending borders, expanding the limits of the ego, presence and change the time- and space-perception in combination with its absence of rational thinking.

1.4.3. Stanislav Grof's model

Another model is Stanislav Grof's model of the human unconscious, which mainly was based on psychedelic research conducted in several thousands of patients in Czechoslovakia and the USA during the 1950s and 60s (Grof, 1975). Grof's model is not limited to drug induced ASC only, but is directly applicable to other ASC, independent of their origin (Grof, 1975; Grof,

1980). During the latest decades, Grof has developed a breathing technique, referred to as holotropic breathwork, whereby individuals, through deep and intensive breathing to suggestive music are induced to ASC-conditions.

The psychological levels in Grof's model are: (a) Sensory barrier, (b) The individual's unconscious, (c) The level of birth and death (perinatal level), and (d) The transpersonal level.

Nearly all persons, participating in experimental psychotherapy using breathing techniques, music, dance or body-work may experience these levels, according to Grof. Even many other techniques such as biofeedback, sensory deprivation, sensory overload or meditation can induce many of these psychological levels. They can in rare cases even arise spontaneously.

(a) Sensory barrier
This level involves the perceptual senses, especially the visual and auditory system. Abstract and often aesthetically appealing images are perceived, which can be experienced with open or closed eyes. Changes in the acoustic sense often involve new dimensions of music. Many subjects say that they truly experienced music for the first time in their life. Changes and intensification of smelling, tasting and the tactile sense may also occur. Characteristic is also the phenomena of synesthesia (crossing over among sensory modalities) where e.g. colors can be heard or sounds can be seen (Ludwig, 1990).

(b) The individual's unconscious
This level includes experiences that are found in traditional psychotherapy or psychoanalysis. These experiences have their origin in important memories, events and circumstances in the individual's personal life from birth to date. Most of that which emerges here conforms with prevalent psychodynamic models and theories. The prerequisite for the emergence of the state is that it has sufficiently great emotional charge for the person.

Grof has noticed that relevant memories do not appear randomly, but instead in thematic clusters. The recollection of single memories with equally strong emotional charge in a thematic cluster can be separated in time by several years or decennia, but appear together during an ASC. Grof's term for these phenomena of clusters of recollected memories is COEX System ("system of COndensed EXperiences"). The COEX System is a general principle and is not restricted to this level.

(c) The level of birth and death (perinatal level)
This level links together the ASC experience with the different phases of the individual's own deliverance/birth. The Greek prefix *peri-* means "around" or "near" and the Latin root *natalis* translates as "pertaining to childbirth". Birth is a potentially life-threating event involving extremely powerful emotions and physical sensations. According to Grof (1975, 1980), experiences may occur during the ASC condition that are directly related to those during childbirth. Grof (1996, pp. 46-47) considers that "the perinatal reservoir of difficult emotions and physical sensations is an important potential source of future psychopathology".

(d) The transpersonal level
Experiences of this level seem to transcend time and space. The individual's consciousness expands beyond the usual boundaries of the ego and may encompass

earlier ancestral or past-incarnation experiences. The experiences may show also a paranormal character, involving such apparent phenomena as telepathy, precognition, space travels or out-of-body experiences. Archetypal experiences, encounters with various deities, identification with the cosmic void or significant religious experiences have been attributed also to this level.

1.4.4. The transient hypofrontality hypothesis model

This model is based on neurobiology and not on psychological descriptions. The central thesis is based on functional neroanatomy, proposing that altered states of consciousness are principally due to transient prefrontal cortex deregulation (Dietrich, 2003). Consciousness is conceptualized as hierarchically ordered cognitive functions. All altered states of consciousness involve subtle modification of cognitive and behavioural functions (eg. time-distortions, change in focused attention and impaired social funtioning) that are typically ascribed the prefrontal cortex. The fenomenological uniqueness of all different kinds of ASCs that can be evoked, are a result of different viability of various frontal circuits. A transient hypofrontality (transient decrease in prefrontal cortex activity) is proposed as the unifying feature of all altered states, independant of their origin or methods of induction. Unlike most cases of mental illness and damages to the brain, ASC are transient in nature. For a thorough review of the transient hypofrontality hypothesis, see e.g. Dietrich (2003).

1.5. Methods for inducing ASC

1.5.1. Introduction

Several methods to induce ASC are available, for example sensory deprivation, psychedelic drugs and meditation. Many of these methods have an old historical tradition and have been used by many cultures all over the world for ritual ceremonies, spiritual practice, shamanic healing and transformation. Several chemical substances with properties to induce ASC are known. Some have their origin in plants or fungi (e.g. psilocybin, dimethyltryptamine, tetrahydrocannabinol, and mescaline), while others are partly or totally synthetic, such as LSD (lysergic diethylamide acid), MDMA (methylenedioxymethamphetamine), 2C-B (4-Bromo-2, 5-dimethoxyphenetylamine). Meditation techniques have a long historical tradition, with main branches such as Zen, Transcendental Meditation, and various forms of Yoga and dynamic meditation forms. Some of these are characterized by a regular practice of openness, while others are specifically aiming at producing certain states of mind or inducing a state of minimal internal dialogue through attentive movement. There are also a multitude of traditions combining different techniques such as fasting, breathing exercises, intense prayer, trance, sensory isolation, sensory overload or use of psychoactive compounds (Ludwig, 1990; Migály, 1993).

1.5.2. Sensory deprivation

Sensory deprivation has been defined as an experimental condition designed to *"provide a reduction of either patterning or, more commonly, intensity of exteroceptive stimuli"* (Goodman, 1982 p. 96)

The initial scientific experiments on sensory deprivation started during the 1950's at the McGill-University of Montreal. At this period, the Korean war had just finished and terrible rumours were spread over the United States the US prisoners had been "brain-washed"

through application of sensory deprivation techniques. There was an increased research interest to investigate some of the processes underlying sensory deprivation. At McGill University, Ontario, Canada, experiments were underway to examine how monotonous stimulation affected humans; it must be remembered that the great neuropsychologist Donald Hebb, at McGill, was highly productive at this time. It was of general concern that this knowledge was required, amongst other reasons for the military, for many tasks, such as radar monitoring, where subjects needed to sit long hours studying a relatively monotonous screen. Another problem area was provided pilots flying very high altitudes in jetplanes who, seemingly without warning, could lose interest in controlling the plane or reporting to homebase, but instead sank into mysterious euphoric conditions that led to a complete loss of interest in flying. Since the space age was in its embryo, questions were posed regarding how these effects would influence forthcoming astronauts as it was planned to send out into space, given the unwanted effects at high altitude flying.

A wealth of information is available concerning the reaction of people being exposed involuntarily to isolation, such as being shipwrecked, members of polar expeditions, solitude sailors, locked-in mine-workers and prisoners of war (Spitzer, 1988). The mutual theme of experience is the passing of periods of vivid hallucinations (mostly visual, but also acoustic), combined with a changed perception of reality. Other phenomena noted in the context of scientific research with sensory deprivation are a changed perception of time, confusion, restlessness, emotional instability, paranoid reactions and distorted body images (Spitzer, 1988). Other negative effects of sensory deprivation are problems with logical thinking, lack of concentration, anxiety and hallucinations (Goodman, 1982; Zubeck, 1973). Sensory deprivation or, to apply a contemporary conceptualization, Restricted Environmental Stimulation Technique (REST) is thought to result in a weakening of the secondary process, in its turn leading to a cognitive balance with a mainly primary process-orientation (e.g. Norlander, Bergman & Archer, 1998). During the latest decades, much attention has been paid to the positive effects of sensory deprivation, as for example increased well-being and relaxation (Mahoney, 1990), mild euphoria (Schulz & Kaspar, 1994), greater production of ideas (Forgays & Forgays, 1992; Suedfeld, Metcalfe, & Bluck, 1987), increased originality (Norlander, Bergman & Archer, 1999), improved sleep at night (Ballard, 1993), reduced stress, tension and anxiety (Fine & Turner, 1982; Schulz & Kaspar, 1994; Suedfeld, 1983; Suedfeld & Borrie, 1995; Turner & Fine, 1984), reduced pain (Mereday, Lehmann, & Borrie, 1990), reduced headache (Wallbaum, Rzewnicki, Steele & Suedfeld, 1992), lowered blood pressure (Fine & Turner, 1982), less muscle tension (Norlander, Bergman & Archer, 1999) as well as proving to be a suitable complement to psychotherapy (Jessen, 1990; Mahoney 1990).

Characteristically, modern research applies a milder form of sensory deprivation, the so-called Restricted Environmental Stimulation Technique (REST). Two forms of REST are presently used, chamber-REST and flotation-REST. In chamber-REST the person is allowed to lie in solitude on a couch in a silent, dark chamber. In flotation-REST the person is instead floating on his/her back in a dark, soundproof tank of saturated salt solution. Typically for these current methods it should be noted that the session time seldom extends more than over a 60-minute duration. The aspect of voluntary choice is also not to be neglected as it is assumed to contribute more to a positive experience than the procedure of being forced into an isolated confinement.

It also ought to be mentioned that the method of REST is in general experienced as pleasant and that participants are often prepared, invariably, to repeat the experience on further occasions (Suedfeld & Borrie, 1999).

1.5.3. The modern flotation-tank

Flotation-REST as a method was developed by Lilly (1977) in the 1950s. In 1954 he studied a soundproof waterfilled tank at the National Institute of Health, constructed during World War II for experiments of underwater swimmer. Lilly's first tank was so constructed that the subject was meant to float in a standing position wearing a breathing-mask while sea-water was pumped into the tank from underneath in order to provide the necessary supporting capacity. Lilly experimented himself by floating in his tank despite the contemporary general assumption in the scientific community that sensory deprivation was a road to madness. He discovered that instead of 'presumed madness' he experienced richly elaborate states of inner experience (Lilly, 1972). His experimentation with flotation continued and he constructed a tank allowing the participant to float relaxed in a supine position with the face and ventral parts of the body above the waterline. This development made it possible for the water to be saturated with magnesium sulphate-salt (Epsom salts) resulting in high buoyancy. Gradually, adequate systems for warming the water and filtering it for cleanliness were specialized.

Since then, the technique has been developed further and has undergone more trials. From being an experimental construction of high complexity, REST-tanks are now available as commercial solutions to be installed in a small-ventilated room. The maintenance is reduced to a minimum in the present commercial versions, as compared to the original tanks. Modern contemporary flotation tanks maintain the salt solution in the tank heated to 34.4 °C, being the approximate outer skin temperature. Each participant wears earplugs to minimize acoustic stimulation. When the entrance lid is closed, the surroundings are completely dark. Some flotation tanks have inside lights that can be activated by the participant. The depth of the salt solution is approximately 200 - 300 mm. In this surrounding the participant can lie down and float comfortably and relaxed. Since sensory stimulation is reduced to a minimum (earplugs, darkness, and skin tempered water), this method induces a profound relaxation. The participant can terminate the floating session at any moment, but a common treatment period is about 45 minutes. Very few participants terminate the flotation prematurely. Suedfeld and Borrie (1999) reported a rate of premature termination less than 5%. After each session, the salt solution is filtered and sterilized, mostly by UV radiation and/or hydrogen peroxide. Many of the current flotation-tanks have even been formed so as to present an attractive design some have installed a two-way intercom system, in-tank lightning and even video-screen is optional.

Recently, yet another method has been used, called dry-REST (Suedfeld & Borrie, 1999), being a compromise between chamber-REST and flotation-REST. Here, the equipment of a flotation tank is used, but the difference lies in the fact that the participant is placed on a plastic membrane, hindering direct contact with the salt solution. The advantage of this method is the avoidance of showering after each session and the reduction of demands on sterilization of the salt solution (Suedfeld & Borrie, 1999). Nor is it always necessary to use the ear-plugs for dry-REST.

1.6. Possible positive effects of ASC induced by REST.

1.6.1. Relaxation and stress reduction

The term "relaxation" is usually left undefined and "denotes implicit unspecified states of psychophysical easing of tension or resting" (Kokoszka, 1992, p. 4). When "Relaxation" is applied as a concept it is done so in the absence of physiological stress reactions (e.g. Benson,

1975). A multitude of techniques for relaxation and stress-reduction are described, as well as for example, meditation, autogen training and hypnosis. Since the focus of the present work is flotation-REST it remains outside the scope of the present treatise to describe these methods to any great extent.

There are some studies that indicate a stress reducing and/or relaxation effect of treatment in the flotation-tank. Flotation-REST induces relaxation both within comparison before and after a flotation-session, and across repeated flotation-sessions, which may be measured over several parameters. Self-estimations of relaxation utilizing psychometric scales or open questions demonstrate intensive relaxation-effects of flotation-REST (eg. Forgays, Forgays, Pudvah & Wright, 1991; Schulz & Kaspar, 1994). There are also investigations with flotation-REST whereby physiological stress markers (e.g. heart-rate, blood-pressure, plasma cortisol) have been studied, see section 1.6.2.

1.6.2. Pain reduction

Several studies have been performed that apply flotation-REST as a method to alleviate different types of pain conditions. Patients suffering from chronic headache experienced significant improvements after flotation-REST treatment, and these improvements were maintained during follow-up six months later (Wallbaum, Rzewnicki, Steele & Suedfeld. (1992). Notable improvements in patients with rheumatic aches were observed by Mereday, Lehmann och Borrie (1990). Alleviations of premenstrual pain were noted by Goldstein and Jessen (1990). Other studies indicating analgesic effects associated with flotation-REST have been reported by e.g Fine & Turner (1985) and Suedfeld & Borrie (1999).

Certain attempts have been made to identify the physiological markers for the subjectively experienced pain alleviation so often reported with flotation-REST. Thus, significant reductions of adrenocorticotropic hormone (ACTH) and plasma cortisol levels have been found after REST-treatment (Turner & Fine, 1983; Turner & Fine, 1990). One study (Turner, Fine, Ewy, & Sershon, 1989) showed that REST as treatment method in a series of eight sessions was followed by a decrease in plasma cortisol and a reduction in arterial blood pressure compared with the initial treatment occasion, although Schulz and Kaspar (1994) did not find any changes in plasma cortisol and other endogenous substances 60 min after floating compared with lying on a mattress for an equivalent interval.

There is some degree of uncertainty about the duration of any eventual pain-reduction. Suedfeld and Borrie (1999) discuss several factors that influence the duration of pain-relief, including: type of pain, whether or not the patient achieves deep-relaxation, the number of treatment sessions, as well as whether or not the patient is able to maintain the relaxed condition after the treatment.

1.6.3. Enhanced creativity

The term creativity was coined 1950 by J.P Guilford. He made no attempt to define the concept but presented (Guilford, 1967) a number of characteristics:

1. Creative thinking culminates in novel ideas which may or may not emerge in the form of tangible products.
2. Novelty need apply only within the frame of reference of the thinking person himself/herself.
3. Creative productivity means quantity of output, namely number of responses of a certain kind, e.g. number of words, ideas, sentences in the writers' context.

With Guilford's three distinction as starting-point, Ekvall formulated the following definition of the concept creativity: *"Creative thinking is characterized by the content of something new – new to the thinking individual himself. The level of creativity is linked to the level of novelty"* (Ekvall, 1983, p. 11). A series of other definitions of creativity by different theorists have been forthcoming but characteristic for most of them is that the newsworthiness criterion plays a central role (Norlander, 1997). For this reason, the present dissertation will maintain Ekvall's notion (1983) of Guilford's three characteristics.

The primary-secondary process model (Noy, 1969) in connection with ASC has been touched upon earlier. This model has in different ways been related to the creative process (e.g., Neisser, 1967; Suler, 1980; Martindale & Dailey, 1996). Norlander (1999), following a comprehensive review, draws the conclusion that alcohol may influence the balance between primary and secondary processes and that this in turn has consequences for creativity. Alcohol consumption may contribute to a 'cognitive shift' from secondary process thinking to an increased level of primary process-oriented thinking. Following a series of experimental studies, Norlander (1997) drew the conclusion that the preparation and verification phases of creativity appeared to be disturbed by alcohol intake, i.e. phases wherein more logical and mechanical abilities were required, like flexibility of thought. He postulated too that the incubation and restitution phases of creativity were favoured by a moderate (Blood Alcohol Levels of about 0.08 %) intake of alcohol. It was particularly the actions of alcohol in the induction of "letting-go" that appears to contribute to increased originality after the incubation phase and more effective rest in the restitution phase.

Since Noy (1969) operationalised the primary process as an effect occurring during sensory isolation, it appeared quite natural to test whether or not the above results with alcohol and creativity could be replicated through access to the flotation tank procedure instead of alcohol. Norlander, Bergman och Archer (1998) therefore carried out two experiments. In the first, subjects were required either to first sit in a couch (control) or lie in the flotation tank and then solve a creative problem-solving task that placed great demand upon flexibility. In the second, three groups were arranged (non-REST, chamber-REST and flotation-REST). Following each respective condition, subjects were assessed on fluency, obvious answers, original answers, elegance and deductive thinking. The results (i.e. deteriorated flexibility and higher originality by the flotation-REST groups) were interpreted as indication of a primary process dominated thinking and were compatible with the above-described alcohol experiment (e. g., Norlander & Gustafson, 1998).

1.7. Rationale for the investigations

The purpose of the experiments in this study was to investigate different aspects of the effects obtained by flotation-REST. For increased transparency and fascilitation of the data-presentation, the following key issues were formulated and investigated separately:
1) Are primary process-related experiences accompanying flotation-REST influenced by the experimental contextual setting (strict-fantasy) as well as earlier experience of a markedly altered state of consciousness (**Paper I**)?

2) (a): Is there any difference between a single or a triple flotation experience regarding the influence on creative and logical mental processes?, (b) Are Chamber-REST and Flotation-REST equally effective in providing relaxation after induced stress? (c) Does stress or REST

(induced by Flotation-REST or by Chamber-REST) facilitate creativity and literacy skills? (d) Finally, can further information on the influence of primary and secondary processes be gained (**Paper II**).

3) Is the degree or level of altered state of consciousness of importance for the subjective experience of experimental pain induced when the participant already was induced into a mild altered state of consciousness? Can this altered state of consciousness be practically induced using sensory deprivation through a flotation-REST tank and on a couch in a dark, silent room (chamber-REST), respectively (**Paper III**).

4) Finally, efforts were made to investigate whether or not flotation-REST may offer an effective and reliable method for alleviating chronic pain, as well as psychosomatic symtoms resulting from long-term muscle tension and/or stress-related headaches (**Paper IV**).

2. THE PRESENT INVESTIGATIONS

2.1. Introduction

In the following three papers, a total amount of 158 participants have been investigated. In **Paper I** 28 persons, in **Paper II** and **Paper III,** 70 and 23 participants respectively , and in **Paper IV** 37 persons were enrolled in experimental studies in the Flotation-REST Research Laboratory at Karlstad University, Sweden.

2.2. Paper I

EXPERIENCES IN FLOTATION-TANK; COMPARISON BETWEEN DIFFERENT SETTINGS (STRICT/FANTASY) AND BY FORMER DRUG USERS/NON USERS.

Aim

The purpose of the study was to investigate if experiences induced by flotation-REST were affected by setting (strict/fantasy) or earlier experiences of drug induced altered states of consciousness (with/without earlier experiences).

Design

The experiment was conducted at the Flotation-REST Research Laboratory at Karlstad University, Sweden. Fourteen former psychedelic drug users, recruited within the province of Värmland, via a previously established network of contact persons (Kjellgren & Norlander, 2001), took part in the experiment. They were matched against fourteen participants without drug experience of comparable age, gender, and occupation. Participants were randomly assigned either to a "strict" setting (strict condition) or to a "fantasy" setting (fantasy condition). In the "strict" condition the experimenter was dressed in a white laboratory coat and no special instructions were given to the participants apart from those strictly and formally necessary. In the "fantasy" condition the experimenter was dressed in a colorful T-shirt with a "fantasy-motive" and a picture with a saga-motif was hung on the wall beside the flotation tank. Additionally, the experimenter read some fantasy inducing stories on other participants' flotation experiences and played low suggestive music both during the introductory discussion and during the time when the participants completed the pre-floating questionnaire.

Instruments

(a) *Flotation tank.* A flotation tank (Flytarium Norden AB) with measurements 2620 mm x 1670 mm x 950 mm was used. Water depth varied between 200-300 mm, depending on evaporation. The flotation tank was insulated so as to maintain a constant temperature and to isolate the participant from sound and light. The water temperature was maintained at 34.2°C. Ambient (air) temperature was the same as the water temperature, thus minimizing sensory perception. The water was saturated with magnesium sulfate in order to maintain a salt concentration of 1.3 g/cm^3.

(b) *Pre-floating questionnaire.* Besides demographic questions, questions regarding bodily aches and pain, present-day mood, subjective estimate health (physical and mental), degree of expectancy of floating, earlier experience of altered states of consciousness, use of alcohol/tobacco, and (for female participants) incidence of contraceptive medication use and phase of the menstrual cycle were asked for.

(c) *Post-floating questionnaire.* The questionnaire used after floating consisted initially of the same questions on aches, pain, and mood. In addition, there were several questions with fixed answering alternatives and the option to describe in own words pertaining to fears, the pleasantness of the experience, physical discomforts as well as different types of mental experiences (e.g. experience of noise, images, voices, time-perception, ego-disorganizing, out-of-body experiences and comparisons with dream states). Each participant was also required to present a description of the best and worst aspect of floating. Participants with further experiences not covered by the questionnaire were encouraged to write these down in their own words. Participants in the "Former drug users Group" also received questions regarding the extent of their previous drug use and a question requiring the comparison of the floating experience with their previous drug-induced experiences.

Procedure

All attributes of the experimental situation and the Experimenters' choice of dress (dependant upon the experimental condition "strict" or "fantasy") were arranged prior to arrival of each participant. On arrival, each participant was asked to answer all the questions in the "pre-floating questionnaire". Each participant was instructed to relax during the floating session in the tank and also given an easy breathing exercise for relaxation. For participants in the "fantasy" setting experimental condition, the experimenter read "fantasy-inducing" episodes of other participants' flotation-tank experiences. Each participant was encouraged to visit the toilet and shower, and was provided with earplugs prior to immersion in the tank. The period of immersion was 60 min. After showering and getting dressed, each participant completed the "post-floating questionnaire". Subsequently, each participant was given the opportunity to discuss their thoughts on the experience.

Statistics

For assessment of background variables the Mann-Whitney U-test and a two-way ANOVA were applied. For the dependent variables "time estimation", "comparison with dreams", "comparison with earlier psychedelic experiences" and specific experiences (e.g. hearing voices, visual images, out-of-body experiences) a Mann-Whitney U-test was used. Split-plot ANOVAs were applied with pain and mood as Within-Subject Factors and setting and group as Between-Subject Factors. Split-plot ANCOVAs was used for controlling differences between settings in regard to age and yielded no other significant results. For the dependent variables estimated expectancy, comfort during flotation, experience of fear, desire to float again and degree of ordinary thoughts during flotation Pillais MANOVA was used with group and setting as independent variables. For control of the differences between setting with regard to age, a MANCOVA was applied.

Results
No differences in subjectively reported experiences between settings or groups were found in the quantitative analysis. The verbal analysis indicated that there were no significant differences of experiences for either group or setting; transpersonal experiences were noted in all groups. If anything, it could be suggested that a weak tendency might be present that the drug group had to some extent livelier, more fantastic and complex experiences compared with the participants in the non-drug group. There was a significant effect of flotation-REST upon the participants' subjectively-experienced pain alleviation as well as a significant elevation of their mood in the direct comparison of pre- and post-floating. Flotation-REST was experienced by the participants as a positive event. The written reports of the participants contained experiences of visual (64.3 % of the participants) and auditory (35.7 %) pseudo-hallucinations, transpersonal experiences, e.g. meeting unfamiliar entities, feeling of unity with cosmos, experiences of leaving or losing contact with the body. Also, there are a few descriptions of perinatal experiences.

2.3. Paper II
EFFECTS ON CREATIVITY AFTER FLOTATION-REST/CHAMBER-REST DURING STRESS/NONSTRESS CONDITIONS.

Study 1:

Aim
The purpose of the study was to explore whether or not there was any difference between a single or a repeated (triple) flotation session regarding the influence on creative and logical thought processes.

Design
Thirty-eight participants were randomly assigned to two groups (a) one flotation session and (b) three flotation sessions. The independent variables were number of flotations and gender. The dependent variables were fluency (number of relevant responses on a divergent test) and logical ability (measured through the application of a deductive test) measured on two occasions, before and after treatment (flotation-REST).

Instruments
(a) *Flotation tank,* (for description see **Paper I**).
Questionnaires:
(b) *LOT (Life Orientation Test):* measures dispositional optimism, defined in terms of generalized outcome expectancies (Scheier & Carver, 1985). The test consists of eight items, plus four filler items. The task of each participant is to decide whether or not one is in agreement with each of the items described, on a scale of 0 - 4, where 0 indicates "strongly disagree" and 4 indicates "strongly agree". Parallel Test Reliability is reported to 0.76 and Internal Consistency to 0.76 (Scheier & Carver, 1985). LOT is also regarded to have an adequate level of convergent and discriminant validity (Scheier & Carver, 1985).
(c) *Syllogisms I - II*: A test presented in two versions (Holmquist, 1974) that measures the ability of logical and deductive thinking. Half of the participants received, randomly, version I before treatment and version II after treatment, and for the other half version I and II were presented in opposite order.

(d) *Beer can/Brick-test*: A test of divergent thinking (Ekvall & Holmquist, 1989) measuring the number of relevant responses for the number of ways one may use a beer can or a brick, respectively. The participants were encouraged to produce as many alternatives as possible. In this way, a measure of fluency is provided. Half of the randomized participants responded to beer can before treatment and brick after treatment, while the other half of the participants responded to beer can and brick in the opposite order.

Procedure
Participants belonging to the repeated flotation group had flotation sessions on two different occasions the previous week. On arrival, each participant filled out a form with background data and afterwards (in randomized order) LOT, Syllogisms (either version I or II) and beer can/brick (either beer can or brick). Subsequently, the experimental manipulation (flotation-REST) was conducted for 45 minutes, which is a commonly used treatment time. Afterwards, the participants were given the Syllogisms and beer can/brick tests, this time with the version they had not received earlier. After this, debriefing was initiated.

Statistics
Split-plot ANOVAs with fluency or logical ability as Within-Subject Factors and number of flotations and gender as Between-Subject Factor were used.

Results
There was no significant difference between one or three flotation sessions, nor between gender, on fluency or logical ability. There was a slight tendency (not significant) of fluency increasing after flotation compared with before. A significant difference was found related to the declination of the logical ability after flotation, as compared to pre-flotation.

Study 2:

Aim
To examine, (a) whether Chamber-REST and Flotation-REST are equivalently effective providing relaxation, and (b) whether stress or absence of stress in combination with REST (induced by Flotation-REST or by Chamber-REST) influence the creativity-measurements: elaboration, fantasy, liveliness, originality and realism.

Design
Thirty-two participants were randomly assigned to two equally large groups, Flotation-REST or Chamber-REST groups, and then randomly assigned to two further groups, either a Stress-group or to a Non-stress group. The most important dependent variables of this second study were derived from essay writing, which was judged on the basis of elaboration, fantasy, liveliness, originality and realism, also measured were experienced degree of altered states of consciousness, perceived amount of stress measured at three occasions before the actual experiment started, after stress-induction (for those belonging to this group) and after REST-treatment (flotation or chamber).

Instruments
(a) *Flotation tank*, (for description, see **Paper I**).
Questionnaires:
These instruments were used ***before*** the experimental manipulation:

(b) *FS (Change and Stability)* measuring the attitude to change and stability (Holmquist, 1986).
(c) *LOT*, (for description, see above study 1),
(d) *HAD-scale (Hospital Anxiety Depression scale)* measuring the degree of anxiety and depression (serving as a criteria for an eventual exclusion of participants with depression or anxiety disorders). The measurement scale discriminates between "normal", "borderline" and "probable" depression-anxiety diagnosis. The validity and reliability of the HAD-scale has been examined by Herrmann (1997).
In addition, background data on the participant's sleeping habits, consumption of tobacco and alcohol, age, number of stress symptoms and experienced stress (VAS-scale) were examined in a questionnaire before manipulation start. This was made in order to rule out any significant differences among the groups related to these variables.

These instruments were used ***after*** the manipulation:
(e) *Composition test*: where the participants were instructed to write an essay based on four fixed words. The essays were later examined by experienced evaluators and blindly judged for Elaboration, Fantasy, Liveliness, Originality and Realism. Consensual definitions (Amabile, 1983) of Elaboration, Fantasy, Liveliness, Originality and Realism were used.
(f) *EDN (Experienced deviation from normal state)*. Utilizing the internationally-applied psychometric instruments APZ-questionnaire and OAVAV (Dittrich, 1998) for obtaining judgements of altered states of consciousness, a shortened but similar instrument modified for use with flotation-REST was constructed (Kjellgren, Sundequist, Norlander, & Archer, 2001). The APZ- and OAVAV-forms are the internationally-applied standard for this purpose and these tests have been validated in several studies over different countries (Dittrich, 1998). Since the test forms were originally intended for the study of altered states of consciousness as induced by hallucinogenic substances, a number of the original questions were not relevant when flotation-REST was applied as the method of induction. In total, the EDN consists of 29 questions whereby each is responded on a visual analog scale (0-100). A complete "index of experience" was constructed from the points obtained from all 29 questions and were averaged to provide a "sum of experience". These values ought to reflect the total experience of degree of altered states of consciousness.

(g) As a manipulative step for the stress-group a *SIT (Stress Inducing Test)* was used (Modeus, Ståhlbröst, Wester, & Ögren, 1987) in order to induce stress. It consists of a number of tasks, with conflicting descriptions that are difficult to interpret. In order to reinforce the stress effect, they are presented to the participant in an inadequate amount of time (eight minutes). The same visual analog scale (VAS-scale) used before manipulations started, measuring experienced stress, was again used directly after SIT, and also after REST-session. (The stress measuring VAS-scale was therefor used altogether for three occasions during the experiment).

Procedure
Upon arrival, participants were allowed to rest for 5 minutes, then providing information regarding background data, first stress measurement, LOT, HAD and FS. Participants belonging to the non-stress group were instructed to sit in an armchair and read magazines. Participants belonging to the stress group had to carry out the Stress Inducing Test (SIT), whereas the participants of the non-stress group did not perform the SIT-test. Following this, the second stress measurement was registered. If the participant belonged to the Chamber-REST group, he was given relaxation instruction according to Benson (Benson, 1975), and was left alone wearing earplugs on a pallet in a dark quite room for 45 minutes. A similar

procedure for participant belonging to the flotation-REST group was used. The participant was left alone in the flotation tank for 45 minutes. After REST-treatment (chamber- or flotation-REST) all participants completed the EDN-test. Following this, the final (third) stress measurement was carried out. Following this, the debriefing procedure was carried out and each participant was thanked for participating.

Statistics

Two-way ANOVA, one-sample t-test, Mann Whitney U-test and chi-square test were applied to the background variables ($p<0.05$). For interjudge-reliability assessment Pearson's r correlation statistics was used ($p<0.05$). Statistical analysis of the essay-variables (elaboration, liveliness originality and realism) was carried out with the Pillai's MANOVA (2 x 2 factorial design). For analysis of dependent variable measured stress and independent variables REST (chamber/flotation) and STRESS (stress/non-stress), a two-way ANOVA was performed. Additionally, a two-way ANOVA was used for analyzing the dependent variable degree of altered states and independent variables of REST (chamber/flotation) and STRESS (stress/non-stress).

Results

The flotation-REST group experienced a significantly higher degree of ASC (as measured with the EDN-scale), as compared to the chamber-REST group. Flotation-REST induced more originality and impaired deductive thinking, in comparison to chamber-REST. Chamber-REST induced more realistic and elaborated thinking compared to flotation-REST. Participants who belonged to the stress-group in the flotation-REST condition were livelier, compared to the non-stressed participants under the same condition. Participants belonging to the stress-group in the chamber-REST condition showed more realism than their non-stressed counterparts. Both flotation-REST and chamber-REST were equally effective in reducing stress (as measured with the VAS-scale).

2.4. Paper III

ALTERED CONSCIOUSNESS IN FLOTATION-REST AND CHAMBER-REST: EXPERIENCE OF EXPERIMENTAL PAIN AND SUBJECTIVE STRESS

Aim

To study if altered states of consciousness may influence the experience of experimental pain, induced while the individual already is in an altered state of consciousness. To maintain this ASC-state sensory isolation in the form of flotation-REST and resting on a coach in a dark room (chamber-REST), respectively, was applied.

Design

Twenty-three male sportsmen were recruited. Each participant received a chamber-REST treatment and a flotation-REST treatment. There was a 6-week interim period between the two REST treatments and the order of treatments was randomized. Directly after the REST treatment, the degree of altered consciousness was measured. Subsequently they were introduced to an experimental ischemic pain induction (bloodpressure-cuff inflated to about 200 mm Hg.). During the 15 minutes of pain induction, their experience of pain and stress were measured. The participants were not aware of that the pain would terminate in 15 minutes. Finally, the participant's estimation of time duration during pain induction was asked for.

Instruments

(a) *Flotation tank*. A flotation tank (Aqua-Anima, Sweden) measuring 2700 mm x 1500 mm x 1300 mm was used. The depth of water varied between 250 and 300 mm (for description, see **Paper I**).

(b) *Couch*. A simple couch overlaid with a soft mattress, dimensions: 2000 x 800 mm was placed in the dark, quiet, noise-insulated room that was assigned to provide the chamber-REST condition.

(c) *Pulsoxymeter*. Ohmeda Biox 3700e. The apparatus consists of an ear probe attached to one ear lobe. Oxygen gas saturation, SpO_2, and pulse frequency may be assessed. The ear probe was attached to a participant's ear lobe immediately before the start of the pain induction procedure.

(d) *Sphygmo manometer*. Blood pressure cuff (Umedico, Sweden) as well as a 10-cm broad rubber band (Dauer, Sweden).

(e) *Questionnaire 1*. Background variables (eg. age, tobacco and alcohol usage, as well as education, occupation, sports and exercise) and Exclusion criteria (eg. acute illness, skin problems, ongoing medications, psychological problems) were asked for.

(f) *Life Orientation Test (LOT)*. Measuring dispositional optimism, (for description, see **Paper II**)

(g) *Hospital Anxiety Depression Scale (HAD)*. Measuring the degree of depression and anxiety, (for description, see **Paper II**).

(h) *Experienced deviation from normal state (EDN)*. Measuring level of experienced altered states of consciousness, (for description, see **Paper II**).

(i) *Subjective flotation experience (SFE)*. A questionnaire (Norlander, Kjellgren & Archer, 2001) pertaining to whether or not the flotation was experienced as pleasant, whether or not the subject experienced fear/anxiety during flotation, as well as whether or not the subject would be willing to float again was presented to each subject. These responses were estimated on a visual analog scale (0-100). The SFE form was applied directly after the first occasion of flotation in order to evaluate how much each of the participants "enjoyed" the treatment.

(j) *Visual Analog Scale (VAS)*. This scale was used for measuring pain and stress. The scale consists of a 100-mm horizontal line with the anchors "no pain" on the left extreme and "excruciating pain" on the right extreme.

(k) Final Questionnaire. On arrival for the third visit at the laboratory, each participant was asked about bodily pains, as well as their experience of remaining complaints after the prior occasion's induction of pain

Procedure

On the first of three meetings, each participant responded to the questionnaires (personal and social data, LOT-test, HAD-test). The procedure by which the experimental pain would be induced on the next occasion was demonstrated and discussed. After this, the flotation tank was demonstrated and a test flotation for 20 minutes was conducted.

On arrival to the second visit, the participant was allocated to either 45 minutes flotation-REST or 45 minutes chamber-REST, according to whichever he had been randomly assigned to. After completion of the respective REST-treatment the participant was required to complete the EDN-test. The participants who had been allocated to flotation-REST were also given the SFE-questionnaire. After this, the procedure of pain-induction was initiated. Measures of "experienced pain" and "experienced stress" were taken. Immediately after the cuff had been removed (total "cuff time" was 15 minutes), the participant was required to estimate the length of time that the cuff had remained inflated.

On arrival at the laboratory for the third and final visit, the participant was required to complete a questionnaire consisting of questions related to physical pain and eventual discomfort or adverse events following the previous induction of pain. After this, the experiment was carried out in an identical manner to the procedure used during the participant's second visit to the laboratory except that the other REST-condition, as compared to the one applied in the previous visit, was presented.

Statistics

Regression analysis (enter-method) was used in order to calculate Multiple R (R) thereby investigating the possibility of data reduction. In order to understand whether or not the order of the conditions may have influenced the results split-plot ANOVAs were used with altered state of consciousness (EDN), experienced pain, experienced stress, pulse rate and oxygen as Within-Subject Factors and order of each condition (i. e. flotation-REST on the first occasion or flotation-REST on the second occasion) as Between-Subject Factor. Analysis of differences between flotation-REST and chamber-REST were made for the following dependant variables with Paired-Samples t-test: experienced pain, experienced stress, pulse rate, blood pressure, oxygen saturation in blood, estimated time for REST-treatment, and estimated time for blood pressure cuff. Independent Samples t-test (5% level) were applied for analyzing differences between high and low degree of altered states of consciousness, for the above mentioned dependant variables.

Results

Flotation-REST induced a significantly higher level of altered state of consciousness (as assessed by the EDN instrument) than chamber-REST. Within the flotation-REST condition, a higher level of pain and stress was obtained in those individuals with high EDN compared with those with low EDN. The individuals presenting high EDN also experienced duration of cuff time as shorter compared with low EDN individuals, within the flotation-REST condition. Within the chamber- REST condition, there were no differences between the low EDN and high EDN individuals. It should be noted that the high EDN value in the chamber-REST condition was comparable to the low EDN level in the flotation-REST condition.

2.5. Paper IV

EFFECTS OF FLOTATION-REST ON MUSCLE TENSION PAIN.

Aim

To investigate whether flotation-REST is an effective and reliable method for treating chronic pain, as well as several psychosomatic symptoms resulting from long term muscle tension.

Design

The case history of the recruited participants was taken by the physician aiming at assessing the status of the pain symptoms and for judging whether or not each subject was free of exclusion criteria. On this occasion, blood samples also were taken. Following this, subjects were randomly assigned to the control or experimental groups. Subjects in the experimental group participated in a total of nine treatments (three times per week during three weeks). Each flotation treatment extended over 45 minutes. In addition to these treatments each participant was required to complete different types of questionnaires. Following the last flotation treatment, a second medical examination was made, incorporating new blood samples and a follow-up of the assessment of pain status. The control group was required to leave blood samples and complete the initial questionnaires without flotation or any other

treatment and then returned for a further blood sampling and examination of pain status after the identical three-week period.

Instruments

(a) *Flotation tank*, (for description, see **Paper I**).

(b) *Questionnaire 1*. At the initial medical examination a form was provided that estimated each subject's self-assessed pain: severity, duration, onset, treatment as well as experience/symptoms of other types of complaint. Additionally, information regarding sleep, dreams, and tobacco and alcohol habits were collected. Each subject's own descriptions of "Severest pain intensity" and "Normal pain intensity", respectively, were estimated on visual analog scales (0-100).

(c) *Questionnaire 2*. At the final medical examination after the three weeks of the experimental flotation procedure, the same questions were presented as in Questionaire 1.

(d) *LOT (Life Orientation Test)*. Measuring dispositional optimism, (for description, see **Paper II**)

(e) *HAD-scale (Hospital Anxiety Depression scale)* measuring the degree of anxiety and depression (serving as a criteria for an eventual exclusion of participants with depression or anxiety disorders), (for description, see **Paper II)**

(f) *Subjective flotation experience (SFE)*. Measuring how much the participants "enjoyed" the treatment, (for description, see **Paper III**).

(g) *EDN (Experienced deviation from normal state*). For description, see **Paper II.**

(h) *Analysis of Blood samples*: The blood samples taken from each subject were analyzed with regard to β-endorphin and 3-methoxy-4-hydroxyphenylethyleneglycol (MHPG), the major metabolic product of norepinephrine (NA), neurotransmitter and hormone released under stress conditions. Opioid peptide levels were determined by radioimmunoassay (RIA) method described by Bramnert, Ekman, Larsson & Thorell (1982). MHPG was measured with high-performance liquid chromatography using electrochemical detection described by Scheinin, Chang, Jimerson, & Linnoila (1983).

Procedure

Each subject's first contact with the project was at the interview with the GP at the initial medical examination where the present status of pain complaints was established through the application of Questionnaire 1. During this interview, each participants degree of anxiety-depression was assessed using HAD, in order to exclude individuals with excessively high degrees of anxiety-depression. After this, LOT was completed. Then, a blood sample was taken for later analysis of β-endorphin and MHPG. Participants were randomly assigned to either the control group or to the experimental group. The subjects belonging to the control group were followed up after three weeks with a new medical examination where they also completed Questionnaire 2, HAD, and LOT, and left a second blood sample. The subjects belonging to the experimental group were given flotation treatment during the forthcoming three periods (with 3 visits/week), whereby each floating session was of 45 minutes duration. Once the subject had emerged from the first treatment, showered and changed clothes he/she was required to complete the SFE. After the second flotation session each subject was required to complete the EDN. Three days (or 72 hours) after the final treatment session, a new blood sample was taken when subjects met the GP for the second medical examination and follow-up discussions, at which time they completed Questionnaire 2, HAD and LOT using the same procedure as for the control group.

Statistics

Two-way ANOVA and Mann-Whitney U-test were used for assessment of background variables ($p<0.05$). The dependent variables concerning both experimental groups were analyzed with help of split-plot ANOVAs with effects before and after treatment as Within-Subject factor and Group and Gender as Between-Subjects factors. With the purpose of examining to what extent beta-endorphin concentrations before treatments influenced the results, split-plot ANCOVAs with β-endorphin concentrations before treatments as covariate and with effects before and after treatment as the Within-Subject factor (i.e., MHPG, Pain intensity at its worst, "Normal" pain intensity, Dispositional optimism, Depression, Anxiety, Number of hours sleep/night, Time to sleep onset, Experience of sleep quality, and Blood pressure). The analyses did not yield any other significant effects other than those obtained through the ANOVAs which indicated that the difference between the groups with regard to beta -endorphin concentrations did not influence the above-mentioned Within-Subject factors. When the above mentioned analyze yielded significant interaction, paired samples t test (5% level), were applied. For experiences during floating one-way ANOVA were used for analyzing differences between "optimists" and "pessimists". Additionally, correlation analyses (Pearson's *r*) were made between the most significant dependant variables before and after treatment.

Results

The most severe perceived pain intensity was significantly reduced, whereas low perceived pain intensity was not influenced by the floating technique. Further, the results indicated that the circulating levels of noradrenaline metabolite MHPG (3-methoxy-4-hydroxy-phenylethyleneglycol) were reduced significantly in the experimental group but not in the control group following treatment, whereas endorphin levels were not affected by flotation. Flotatation-REST treatment also elevated the participants' optimism and reduced the degree of anxiety or depression; at nighttime, patients who underwent flotation fell asleep more easily. The present findings describe possible changes, for the better, in patients presenting with chronic pain complaints.

3. DISCUSSION

3.1. Introduction

The fundamental purpose of the present studies was to obtain a more comprehensive notion of the effects associated with the altered state of consciousness, presumably as induced by flotation-REST, and with particular to aspects of pain and stress. The importance stems both from a pure basic research interest, since every finding on this topic is of value due to the requirements of scientific data in this area, and perhaps above all in order to optimize the conditions for an eventual clinical application of REST under controlled circumstance. A number of initial questions for investigation have, as previously mentioned (2.2–2.5), been formulated in order to have a concrete approach to the investigation of the phenomenon of altered states of consciousness.

The empirical data that have been presented indicate in some sense the variation and diversity with which ASC may be experienced. This does not in any way claim completeness, but should instead be seen as a chosen sample of the potential of the human mind. The complexity of the human consciousness would demand a multitude of differently designed studies in order to be able to provide at least an orientating overview.

A 'birds-eye'view of the present studies reveals how the data has been generated from the following ares in particular: altered states of consciousness (3.2), expectancy and setting (3.3), pain perception (3.4), creativity (3.5), and influence on mood, comfort and stress (3.6). Each of these will be discussed in turn.

3.2. Altered states of consciousness

In all the studies, mild sensory isolation in the form of flotation-REST (**Paper I, II, III, IV**) and also chamber-REST (**Paper II, III**) has been applied for the induction of a mild ASC. As indicated earlier (1.2), some of the distinctive characteristics of this condition are states, such as altered perception, alterations in thinking, change in emotional expression and disturbed time sense. The effects that have been observed will be later discussed within the later sub-sections: Pseudo-hallucinatory perceptions (3.2.1), perception of time (3.2.2), comparison with dreams (3.2.3), transpersonal experiences (3.2.4) and fear (3.2.5).

Naturally, it is difficult to make exact measurements over the extent of experienced ASC, since the condition is a very subjective personal experience. The same constraints are present also with documentation of other types of subjective experiences, such as pain perception, experienced stress or the pleasantness of some experience. The EDN-scale, based on an internationally validated measure, "The standardized psychometric assessment of altered states of consciousness in humans" (Dittrich, 1998), but developed and applied by our laboratory, offers opportunities for using a coordinated measure of each individuals own judgement of deviation from the day-to-day 'normal' state of consciousness. A future avenue for investigation would be the derivation of more detailed statistical information on each of the different subitems (total 29) and treatment with different multivariate methods (e.g. factor analysis whereby similar variances may be clustered for further analysis).

In order not to limit the degrees of freedom in the participants' expressions of the subjective experiences, the investigation described in **Paper I** was designed to let the participants write

down in their own words what they experienced in the flotation tank. These descriptions could later be categorized in distinct clusters, being visual experiences (i.e. seeing forms, colors, mental imagery), hearing inner voices, tones or music, experience of one's own birth process (in accordance with Grof's descriptions of the perinatal level), experiences of emptiness and unity in cosmos, and partially leaving or losing contact with the body.

In **Paper II** and **Paper III** different comparisons between chamber-REST and flotation-REST were performed. In both these studies it was shown that flotation-REST induced a significantly greater degree of ASC than chamber-REST. Interestingly, it was observed in **Paper II** that experienced stress reduction was as high in each condition.

It is hoped that in the future flotation-REST may be applied in a clinical setting thereby providing a prerequisite for comprehensive documentation on the psychological experience itself. Limiting research efforts to mainly physiological aspects without sufficient attention to complex subjective experiences poses a serious constraint upon opportunities for optimizing eventual treatment results.

3.2.1. Pseudo-hallucinatory perceptions

Many different types of visual perceptual changes were reported as an effect of the flotation experience. In **Paper I** where, for example, 64.3 % of the participants stated experience of visual images. Some of these changes fall into the category 'phosphenes' (elementary perceptions of color and/or light, cf. Merkur, 1998), but others were of a pseudo-hallucinatory type, with vivid details on the course-of-events, scenery and colors. Naturally, it is presently impossible to grade objectively the intensity of experienced visual perceptual changes. It may be wise to consider, like that of Blackmore (2003), a continuum from mild changes "imagery" over more intensive "pseudo-hallucinations" to the most extreme "true hallucinations". For flotation-REST, the induced experiences occur somewhere between "imagery" and "pseudo-hallucinations". The more extreme "true hallucinations" ought to be reserved for experiences occurring during REM-sleep, powerfully drug-induced conditions and mental illness.

To a much lesser extent the hearing of complex sounds such as music or voices (21.4 % stated hearing voices) was noted. Out of the six participants reporting inner voices in **Paper I**, the first five belonged to the group with earlier psychedelic drug experiences. If this hints at an actual difference in the trained ability to "tune in" to inner discrete notions, and experience these as clearer perceptions through earlier experiences with altered states of consciousness, can evidently not be assessed by this limited data alone. It ought to be mentioned that the last participant hearing voices recounted substantial previous experiences with shamanic techniques training to improve discrete subjective perceptions.

The contribution of complex visual/auditory perceptual alterations for eventual clinical benefits, as for example in pain- or stress-reduction is unclear. **Paper IV** examined whether the degree of achieved ASC (which to a some degree may reflect the extent of perceptual change) was influenced by personal 'mind-set'. Thus, no significant differences were obtained between "optimists" and "pessimists", or between "low-anxiety"-"high-anxiety", or "low-depressive"-"high-depressive" with regard to their summated experience of deviation from a "normal" state. It was noted that experiences, such as e.g. "heard odd words", "heard tones and clangs" or "saw colors with my eyes closed" occurred spontantaneously now-and-then during floating-sessions (**Paper IV**) without posing either positive or negative inference. Probably, these are experiences that all individuals may potentially experience (e.g. during

dream-states) but it remains unknown which mechanism(s) may trigger the experiences during floating. One may consider the ability to relax as a contributory factor. It is necessary for clinical purposes that personnel and patients understand that these types of experiences may occur and that they are quite "normal" and innocuous (often experienced as enjoyable and desirable) and that they do not reflect a pathological feature.

3.2.2. Perception of time

Altered perception of time may present one aspect of an ASC condition, as indicated earlier. The most commonly documented descriptions suggest that time is experienced as "slower than normal", but here one generally refers to ASC as experimentally induced through the administration of psychedelic drugs (e.g. Leuner, 1981). Nevertheless, even altered temporal perception in relation to flotation-REST is a previously known phenomenon (eg. Mee, 1995). Raab & Gruzelier (1994) have drawn attention to this in a study wherein they found that 94% of the participants in flotation-REST lost their time perception to a significant extent. The results of Raab and Gruzelier (1994) lie close to those obtained in the present study, 89.3% (see Table 4, **Paper I**).

The global impression from the present investigations (**Paper I**, **Paper II**, **Paper III** and **Paper IV**) is that the participants tended to experience the flow of time as "quicker than normal" during their flotation-sessions. Perhaps the difference may be explained on the basis of altered temporal experience (quicker and slower, respectively) between different ways of inducing the ASC-condition wherein individuals receive increased sensory input/intensity (as with psychedelic drugs) or powerfully reduced impressions/intensities as in the case of sensory isolation (REST). During flotation-REST there occurs a loss of contact with time-pacing objects, movements and outer objects to relate to. The only time-pacer left in a restricted environmental setting should be physiological functions such as breathing frequency and the rhytm of the heartbeats and the internal subjective reference frame for temporal estimations.

One interesting result from **Paper III** is that the participants who reached the highest levels of ASC after floating estimated the time during which they were exposed to painful experimental-pain as significantly shorter than those participants who experienced lower levels of ASC. Note that this experimental-pain induction was performed after presentation of the REST-treatment. This result may indicate that the induced ASC-condition did not terminate with the end of the REST-period but was maintained over a certain interval thereafter. Future studies must examine the longevity of the flotation-REST induced ASC condition and its eventual association with perception of time or pain. No significant effects upon time-estimation were obtained in those participants, in **Paper III**, who did not achieve high levels of ASC. It is possible that there may exist a threshold level of ASC above which measureable changes in perception of time may be detected.

Research on percetion of time in connection with (experimental) pain is sparse and the existing evidence is ambiguous. Some studies report that individuals undergoing pain underestimate the time during which the pain is endured, i.e. the time is experienced to pass more quickly, (e.g. Hellström & Carlsson, 1997; Isler, Solomon, Spielman & Wittlieb-Verpoort, 1987). Isler et al (1987) who examined patients with headaches speculated that the pain caused these individuals to avoid sensory stimuli and reduce infomation processing, a condition, to some appearances, reminiscent of that induced by REST. Other studies show that there occur overestimations of time intervals in states of pain (e.g. Bilting, Carlsson, Menge, Pellettiere & Peterson, 1983) if individuals are exposed to distractors with the

purpose of drawing attention from the pain. This evidence seems to support the notion speculated earlier, namely that with increased sensory input time is construed to pass more slowly, i.e. the reciprocal situation to that existing in sensory isolation during REST.

Another conceivable explanation as to why the participants in **Paper III**, presenting highest levels of ASC, evidenced the amount of time under pain as significantly shorter may be related to alterations in mood-state. Hellström & Carlsson (1997) discuss the role of mood in time perception and refer to Hornik (1993) wherein it was found that positive mood resulted in underestimation of clock time, and negative mood in overestimation. Those subjects who achieved the highest ASC-levels in **Paper III** might also have been those in whom was induced the most positive mood. In **Paper I** and **Paper IV** it was found that flotation-REST increases significantly participants' optimism. Furthermore, those individuals showing the highest degree of optimism experienced flotation as significantly more pleasurable (**Paper IV**), those participants discussed in **Paper III** (above) presented the highest values for dispositional optimism. There may exist interesting differences in time perception if degree of optimismism taken into account. Through extension, one may consider the consequences of more differentiated assessment and treatment of the clinical association between chronic pain and depression. Since both serotonin and noradrenaline are implicated in the pharmacology of pain (Archer, Jonsson, Minor & Post, 1986; Archer, Arweström, Minor, Persson, Post, Sundström & Jonsson, 1987) and depression (Danysz, Fowler & Archer, 1987; Danysz, Kostowski & Archer, 1988), it is of some relevance to note their associations in stress-induced analgesia (Minor, Danysz, Post, Jonsson, Sundström & Archer, 1988).

The relevance of this altered temporal perception on stress reduction should also not be neglected. Not only the limitation of sensory impacts reduce the total workload of the attentive functions, but also the subjective experience of time. Viewed from a workload perspective, the reduction of non-physiological time-pacers is well able to ensue in an optimal temporal perception, with correlating effects in attentive functions and vigilance levels.

3.2.3. Comparison with dreams

The participants who had previous psychedelic drug experiences (**Paper I**) reported that the experiences obtained by flotation-REST showed several similarities with their dream contents. This was not to such an extent as in the case of non-drug users. Schulz & Kaspar (1994) describe more in detail the resemblance, but also the distinctions, between the experiences during REST and dreaming. The finding in the present investigation could be explained by the former drug users' more extensive experience with altered states or non-ordinary states of functioning, enabling a more precise correlation, but it should not be omitted to point out that a drug-sensitization effect separating the drug group from the non-drug group may have been operating.

Drug-sensitization effects induce behavior effects/experiences to occur with repeated, discrete and spaced presentations of the drug in a familiar context (Stewart & Vezina, 1988). Drug-sensitization effects results in the enhanced sensitivity to the behavioral and experiential effects of the drug (Robinson & Berridge, 1993) that may or may not encompass a cross-sensitivity to similar stimuli or to stimuli inducing similar physiological alterations in the affected brain region.

An exhaustive review of the literature on flotation-REST and substance use fails to provide any indication that the flotation technique may induce unwanted reactions in addicts or

remission in former addicts. Conversely, in several reports REST has been evaluated for beneficial effects for treating addictive behaviour (eg. Barabasz, Barabasz & Dyer, 1993; Borrie, 1991; Forgays, 1987; Suedfeld & Baker-Brown, 1987).

3.2.4. Transpersonal experiences

During flotation-REST (**Paper I**), several different transpersonal experiences were reported by the participants. These experiences could be framed within the following dominant clusters, or types:

1) Experiences related to individuals' foetal life or birth
2) The feeling of leaving or losing contact with one's own body
3) Experiencing a timeless, self-converging unity with cosmos

Other techniques, like holotropic breathing and psychedelic therapy are also known to induce states pertaining to 'time-of-delivery', described in detail by Grof (1975) and termed as contact with the perinatal level. In the last dominant type, the "self" was experienced as converging the "the universe" or cosmos.

No consistent theory is presently available to explain why these clusters seem to dominate transpersonal experiences. An attempt to contribute with one aspect might be to suggest a "death/rebirth impact" association. Delivery or birth into the physical existence could be seen as an experience of high impact for the consciousness. Likewise, at later stages of life, when consciousness has been modeled and consolidated with the neural structure of the body, the experience of being able to separate consciousness from the physical body whith its limited functions might have just as a high impact on the mind. This then results in the term of "ego-death experience" where the individual consciousness, perhaps to a great extent defined by the biographical experiences made within the limited physical body, dissolves into something experienced as wider, larger and more encompassing. These key experiences should leave powerful and distinct traces on the consciousness as it experiences itself within the limited neural frame of the physical body. This "shock-impact" - in a positive sense - could be one of the reasons for the recurrent descriptions of ASC as being life-events leading to a change in the overall life-situation and general quality of life level. Note that these experiences do not *prove* the existence of consciousness separated from the physical body - these phenomena are so far only seen as subjective experiences of the same.

The following investigations are focused more upon specific effects of REST-treatment (such as perception of pain and stress, creativity measurements and the comfort of the treatment) rather than transpersonal experiences, but nevertheless where ASC may exert an important role. Transpersonal experiences in connection with ASC may be considered to be more extreme conditions whose documentation requires considerably deeper and more comprehensive investigations than those presented. It is important with regard to eventual clinical applications of the REST-technique that there is an understanding that these types of experiences may sometimes occur, in order to avoid unnecessary worry or imaginary conclusions of pathology.

3.2.5. Fear

The general impression is that no remarkable fear could be noted among the participants during floating, but is rather experienced as being a pleasant experience (see 3.6). **Paper I, Paper III** and **Paper IV** all examine the experience of fear on a visual-analog scale, VAS (0-

100). No signs of fear were noted, for example in **Paper I** fear was noted with a mean amount of 14.14 (SD=26.36). In comparison, the experienced comfort was given a mean of 81.29 (SD=16.52) on the same scale. One possible explanation could be that the circumstance of floating, with the possibility of terminating the situation immediately, was experienced as comforting, thus contributing to fear-reduction.

Paper IV studied particularly whether or not any special 'mind-set' could contribute to unpleasant experiences, but the analysis did not indicate any difference between "optimists'" and "pessimists'" experience regarding "fear of floating" or "to what extent would you like to float again?". There was a significant difference regarding "how pleasant was it to float?", where the "optimists" experienced greater enjoyment than the "pessimists". No significant differences were obtained between participants with "low-anxiety" vs. "high-anxiety" or "low-depressive" vs. "high-depressive", respectively, regarding their experiences of enjoyment, fear, and willingness to float again. Future clinical applications, e.g. as in the case of stress reduction or pain alleviation require sufficient information to impress the comforting aspect of the method free from induction of unpleasant experiences.

During treatment with flotation-REST it is necessary to be aware that some individuals express concerns about fear of lying in a dark enclosed space. The construction of the flotation-tank makes allowance so that, in case an individual experiences the slightest discomfort in the situation, it is possible to enter the tank and maintain the entrance open as well as keeping the light on. Some of the subjects treated in our laboratory have utilized this procedure but after a short interval in the tank have suggested that the light be turned off and the entrance cover closed. It is possible too to close the entrance cover gradually since the cover may be adjusted to leave the aperture at several stages between open and closed. This latter characteristic is an important aspect in the design and construction of future models of flotation-tanks.

3.3. Expectancy & setting

The role of expectancy should not be overlooked in an experimental setting as the one described in these papers. As Norlander (1997, p. 49) pointed out: *"if there is experience, it is reasonable to assume that there may also exist expectations".* It is well known from studies on drug effects that the subjective expectations (set) and the outer surroundings (setting) in which a psychoactive substance is taken, strongly influence the experience of the drug intoxication (for example, Gustafson, 1991). Expectancy effects, as illustrated by the "placebo effects", present a necessary component of most aspects of conditioned responding in drug and non-drug settings (Archer, 1994).

Since flotation-REST is a technique readily resulting in psychological effects, it is of vital importance to try to define the influence of expectancy. Another interesting questing is the extent to which the immediate surroundings influence the REST experience? Also, there was an interest from our side to investigate any changes due to expectancy or immediate setting on other measurements. Despite a thorough review of the available literature, no such study or operationalization could be found. From this line of reasoning, **Paper I** was designed to test the hypothesis that contextual setting and the participants' previous experience of altered states of consciousness influence flotation-REST experiences. Interestingly, this hypothesis could not be confirmed by the quantitative analysis of the data obtained. The verbal analysis indicated a faint tendency towards more lively, fantastic and complex experiences by participants with previous experience of psychedelic drugs, as compared to the participants

lacking previous psychedelic drug experience, but all other factors of the primary process-related experiences during flotation-REST were to a great extent independent of factors like earlier experiences and direct influences prior to floating. It ought to be indicated that great effort was invested in the induction of a fantasy-evoking setting in **Paper I.** In addition to the Experimenter's dress and the interior miljeau, the flotation-laboratory was distinguished by fantasy-provoking motifs and music, and in addition excerpts from mind-provoking fantasy stories, which were said to have been written by earlier participants in floating sessions were read. These stories were retold at the moment just prior to submergence in the tank.

The psychological effect obtained during flotation-REST, through a 'cognitive-shift' to the advantage of the primary process, on the other hand, appears to be substantially less dependent on expectancy variables than seems the case in, for example, alcohol intoxication where psychopharmacological and expectancy factors are intertwined (Goldman, Brown & Christiansen, 1987; Gustafson, 1991). Further support for this hypothesis is given in **Paper II**, where stress immediately before flotation-REST had no effects on the psychological impact of the experience of the altered states of consciousness. In order to further investigate the possibility of an expectancy effect on the subjective experience of floatation-REST, the amount of creativity (fluency and logical and deductive thinking) was measured (**Paper II**). Here, the subject's abilities were tested after one and three floating sessions respectively, in order to see if previous experience of floatation-REST influenced the results. No significant influences of previous experience were noted.

Another measure of "generalized expectancy" is the life orientation test (LOT) measuring dispositional optimism. In **Paper IV,** it was examined whether the degree of achieved ASC was influenced by personal mind-set. No significant differences were obtained between "optimists" and "pessimists" (LOT-test) with regard to their summated experience of deviation from a "normal" state. The same also applied between "low-anxiety"-"high-anxiety", or "low-depressive-"high-depressive" (Hospital anxiety depression scale, HAD).
It appears as if expectancy is not a factor that determines the experience of flotation-REST.

3.4. Pain perception

There was a significant effect of flotation-REST upon the experienced pain reduction ($p<0.001$, **Paper I**) in the direct comparison of pre- and post-floating. In this study (**Paper I**), pain was simply assessed through a single item of the questionnaire, thus limiting the present possibility to discuss in depth further implications of this effect. The pain-alleviating effect of flotation-REST is supported by several external studies (e.g. Fine & Turner, 1985; Mereday, Lehman & Borrie, 1990; Wallbaum et al., 1992), that contributed to a more methodological examination of the effects of flotation (**Paper IV**). Here (**Paper IV**) individuals with chronic muscle tension pain complaints were studied during a series of treatments (nine occasions for flotation-REST treatment) extending over three weeks. A significant effect of pain alleviation was verified with regard to "severest experienced pain" on comparison before and after floating treatment but not for the subject's "normal pain" may not be obviously understood or apparent. One possibility may be the inability of the pain scaling method (VAS-scales) to discriminate between alterations of small magnitude at the extremes of the scale. The mean values for "normal pain" were before: $\underline{M} = 12.65$ and after: $\underline{M} = 12.21$. Thus, if the pain-sensation had, hypothetically, been reduced from 12.65 to, say, 8 or 10, then perhaps it would not be an easy task to make this intentional marking on a VAS-scale 0 - 100. In support of this hypothesis, several participants asked to see how they had responded prior to treatment (which they of course were not allowed to) because they had expressed "less pain now".

Objective measures of the type of pain studied here do not exist, since the experience of pain is always subjective. Maybe the established reduction of experienced pain could be explained on the basis of a reduction in anxiety/depression and increased positive thinking? Clearly, "*pain is as much a matter of mind as of sensory receptors*" (Atkinson et.al., 2000, p. 143). According to "the gate control theory of pain" (Melzak & Wall, 1982) it is not enough with solely sensory pain impulses from nociceptors for a consciousness of pain. There is the requirement for a "neural gate" in the spinal cord that must be open in order to allow the pain impulses to reach higher centres of the brain. The opening and shutting of the "neural gate" is mediated via neurons in the periaqueductal grey area (PAG) in the midbrain. If PAG-neurons are active they may inhibit ascending pain impulses, i.e. the neural gate closes. When the PAG-neurons are not active the gate is open. Endogenous endorphins or administered opiates may activate the PAG to 'shut the gate'. Signals too from higher centres, like the cortex, that may or may not correspond to an individual's mental may modulate the firing of the PAG. Most important of the inputs to the PAG are those arriving from the amygdaloid nuclei, in particular the lateral nucleus and central nucleus, associated with emotional states and brain regions involving emotions (LeDoux, 1995).
Another possibility is that the flotation-REST technique maintains a primary pain alleviation effect only for the experience of severe pain, and not for "normal" pain.

In **Paper IV**, a significantly shorter latency to fall asleep at nights could be measured. In order to sleep one ought to relax, a condition complicated by pain or too high a level of stress. Thus, this result may be interpreted to indicate that even "normal" pain was reduced after the REST-treatment.

It has been suggested that the experienced positive mood and even the analgesic action of flotation-REST may be mediated through the endogenous release of endorphins (Schulz & Kaspar, 1994; Turner & Fine, 1990). One possible supportive indication is that injections of naloxone influence the psychological experience of flotation-REST (Suedfeld, 1993). (Naloxone is a competitive μ-opiate receptor antagonist). So far, an actual increase of measurable plasma concentrations of endorphins during flotation-REST has not been satisfactorily proven. Indeed, in **Paper IV** the beta-endorphin levels before and after a series of flotations for three weeks showed no relevant elevation.

The interaction between the endogenous opioid- and anandamide (cannabinoid)-system of sustaining and modulating subjective well-being and pain-alleviation is not to be forgotten as a possible mechanism. Recent findings as to the importance of this interaction show that the psychological effects of the stimulation of the cannabinoid-receptors (CB_1- and CB_2-receptors) (Maejima, Ohno-Shosaku & Kano, 2001) may throw a promising light on otherwise contradictory results in the area of subjective pain alleviation and its physiological markers or correlates (Braida, Pozzi, Cavallini & Sala, 2001; Ross, Coutts, McFarlane, Anavi-Goffer, Irving, Pertwee, MacEwan & Scott, 2001; Welch, Thomas & Patrick, 1995).

The endogenous anandamide system (from Sanskrit *ananda*, bliss), is not only associated with nociception, but also with emotional modulations of mood, well-being and the "reward-system" (Beltramo, Stella, Calignano, Lin, Makriyannis & Piomelli, 1997; Rodriguez de Fonseca, Carrera, Navarro, Koob & Weiss, 1997; Tanda, Pontieri & Di Chiara, 1997). It is not to be excluded from the data presented that its activation might be the underlying mechanism of the reported positive mood. To date, a measurement *in vivo* without qualified neuro-radiological equipment is not available. This reduces the possibility to investigate this aspect at the present point of time, but might be a rewarding area of investigation in future studies.

Despite careful examination of the literature it would appear that until now there is a remarkable paucity of studies designed to look at eventual alterations of pain perception if pain is induced experimentally immediately after the REST-treatment has been administered, i.e. when the subject has already been induced to an ASC. All the studies available have examined the effects of REST upon ongoing pain states and these studies have shown an effect of pain reduction (similar to **Paper I** and **Paper IV**). In order to test the hypothesis that a state of pain, imposed upon an individual already in a mild ASC (following completion of REST-treatment), is instead experienced as more intensive, the set-up in **Paper III** was carried out. Here, it was found that individuals who had achieved high levels of ASC (following REST) experienced the pain induced afterwards as more intensive. One possible explanation may be that one of the hallmarks of altered states of consciousness is an increased focus upon inner processes (or signals), through which focus pain may be experienced as more intensive. ASC, e.g. induced by REST, appears to lead to a type of cognitive shift (Norlander, 1997; Norlander, Berman & Archer, 1998), whereby primary process thinking (i.e. 'here and now' thinking) is reinforced at the cost of secondary process thinking (i.e. more 'abstract and temporally-based' thinking). Exposure to intensive pain immediately after REST treatment may cause the individual a great discomfort due to the immediate termination of the primary process condition. Previous studies have demonstrated an "after-effect" (Norlander, Bergman & Archer, 1998) whereby an increased presentiment of primary process remains at least one hour after floating. Thus, it may be possible that the deeper the subject enters into the primary process, the greater the discomfort encountered at enforced cognitive shift.

3.5. Creativity

In **Paper II** some interesting effects on the measurement of creativity during flotation-REST versus chamber-REST appeared; this was so also for stress induction. On comparison between the two REST conditions it was shown that flotation-REST induces more originality than chamber-REST, as well as a more impaired deductive thinking (impaired problem-solving ability) between pre- and post-floating. It may be assumed that sensory isolation induces a shift in awareness to the advantage of primary process-oriented cognition (Noy, 1969). Concomitantly (**Paper II** and **Paper III**), it has been shown that the flotation-form of REST induces a higher degree of altered states of consciousness (or higher degree of primary processes) than the chamber-form of REST. A high degree of altered states of consciousness produces better conditions for originality and must also be assumed to disrupt the problem solving ability (being a secondary process ability). A lesser degree of ASC produces better conditions for immediate realism and elaboration, if viewed on a short time-scale only. In **Paper II** it was shown also that a significantly higher degree of realism and elaborated thinking was seen in chamber-REST, as compared to flotation-REST. These results are in agreement with earlier studies (e.g. Norlander, Bergman, & Archer, 1998; Sandlund, Linnarud & Norlander, 2001).

It is further to be pointed out that stress induction did not significantly alter the degree of the induced ASC and also did not significantly influence the creativity-measurements elaboration and originality. There was an interesting interaction insofar as more realism was induced under the stress-condition in chamber-REST. This result may be explained by suggesting that stress presents a secondary-process inducing factor (in combination with, the for realism, more favorable lower degree of ASC under chamber-REST conditions), which should favor increased expression of realism.

The observation that many (25 participants, 89.3%) described that they were caught in "a state between sleep and waking" (Table 3 in **Paper I)** and reports from **Paper IV** eg. "a dream-like time and space feeling", "feeling of drifting", "a feeling of falling asleep and "a feeling of deep peace within me" is not only in confirmation with earlier flotation-REST studies, but also as an important model of the induced capacity to enhance originality, creativity and inspiration. Budzynski (1990) further outlines how the flotation-REST experience often is associated with a hypnagogic state of mind (being a state of consciousness between dream and wakefulness, characterized by a lucid consciousness in a very dynamic setting of experiences). Furthermore, Sakata, Shinohara, Hori & Sugimoto (1995) have demonstrated, by analyzing EEG spectra, that flotation-REST induced a more hypnagogic condition than normal resting.

Several participants (75%) in **Paper I** reported a "feeling of gliding or flying". Schulz and Kaspar (1994) point out that this feeling of weightlessness is seldom drawn attention to in REST studies but they emphasize at the same time that the observation may be of great magnitude for the eventual explanation of the REST phenomenon. This dissociation between body and consciousness/mind may be seen as a milder form of the "out-of-the-body" phenomena. During dissociative states, there is not a complete separation from physiological functions and bodily experiences, but rather a varied detachment, often resulting in the subjective experience of floating, flying, hovering and sensing changes in the body image. Due to the remaining contact with bodily sensations, the aspect of fear is markedly lesser than by actual "out-of-the-body" experiences. If the increasing experience of retaining control in this borderline oscillation between "in-the-body" or "out-of-the-body" sensation enables a more creative use of fantasy, such as seen in **Paper I,** where the verbal analysis of the drug group showed a slight tendency towards more lively and complex experiences compared with the non-drug group, remains speculative, but not entirely impossible.

Paper IV provided also certain results that suggest an increased creativity in connection with a cognitive shift towards increased primary process thinking. The participants discribed experiences that fit in with Ekvall's (1983) definition of creativity where "the level of novelty" is central; as examples of these experiences may be named experiences such as "saw colors with my eyes closed", "heard tones and clangs", "received insights about previously puzzling occurences" and "came to think about things that I'd forgotten long ago".

3.6. Effects on mood, comfort and stress

Mood and Comfort.

The general impression from completed floating-sessions is that the participants consider it to be pleasant and comfortable. Many positive judgments were provided for "how pleasant it was experienced" and "how gladly they would like to float again" (see Table 2 in **Paper I**). Several participants spontaneously commented immediately afterwards that they "felt themselves to be in such good spirits", "glad" or "unreservedly happy".

None of the participants were troubled by fears or had any difficulties to relax. The high amount of reported "discomfort" (75%) in **Paper I** is probably an effect of inaccurate chosen vocabulary in the questionnaire, since further explorations led to the more elaborate description that the participants meant urges to explore the new bodily perceptions, the wish to continue the experience beyond the defined time and more technical problems such as condense precipitation, insufficient insulation, etc. These "discomforts" where thus not

marked unpleasantness arising from the experience of flotation as such, but rather expressions of the wish for even more undisturbed sensory restriction.

In **Paper I**, a significant elevation of participants' mood before and after the floatation session was noted. To investigate the extent to which a more long-term effect upon mood was evidenced or whether the reports in **Paper I** simply reflected the incidental "good humour" of pleasant and comfortable surroundings, **Paper IV** carried out a more thorough analysis. In **Paper I,** "mood" was measured using a VAS scale, 0-100, with the endpoints "sad and depressed" vs "happy, extremely joyful". In **Paper IV**, attempts were made to more carefully dissect out different components of "mood" through the application of clinically tests (Hospital Anxiety and Depression Scale) for depression and anxiety, as well as the test for dispositional optimism (Life Orientation Test). During the three-week long treatment period, there was a significant elevation of the participants' optimism and a significant reduction of their degree of depression and anxiety measured before and after the treatment period, respectively. No such differences were forthcoming for the control group. Thus, the results of **Paper IV** supported those of **Paper I** in displaying a "mood-enhancing" effect of floating. As indicated above, the concurrent analysis of biological markers, such as MAO-activity in blood platelets, plasma glucocorticoid levels, and levels of noradrenaline and serotonin and their main metabolites, and not least concomitants of immune function, are to be sought after. As found in **Paper IV**, the extent of endogeneous endorphin involvement remains unknown.

Stress.

Among the more physiological parameters, stress reduction played a role as a focus of interest in **Paper II**, where the study was conducted to see if the stress-reducing effect of flotation-REST was greater than REST-conditions on a berth alone. Both methods were, according to the participants, experienced as equally stress-reducing. On the other hand, flotation-REST is more effective than chamber-REST in the induction of ASC (**Paper II** and **Paper III**), which appears to be a condition not associated with stress-reduction. Whereas the apparent well-being of the participants after flotation-REST to a large extent could be assigned to the stress-reducing effect, the more subtle, but personally more potently felt effects of inspiration and enhanced creativity could only to a large extent be seen under the flotation-REST conditions. For pure short-term subjective stress-relief, it thus does not seem to be necessary for the more technical solution of flotation-REST. There do not appear to exist any investigations into the relaxation effects of flotation-REST compared with chamber-REST. One study (Jacobs, Heilbronner & Stanley, 1984) compared flotation-REST with a resting period in an ordinary room (with normal sensory stimulation), whereby a series of treatments indicated that flotation-REST produced a greater relaxation effect than ordinary rest.

Cortisol plasma concentrations are seen as a physiological indicator to the amount of physical stress an individual is exposed to (Ursin, Baade & Levine, 1978), but due to the large inter-individual differences in base-line concentrations, cortisol levels can only be discussed meaningfully through intra-individual differences pre/post experimental manipulation (Ursin et al, 1978). Some studies have demonstrated reduced plasma cortisol concentrations following floating (Suedfeld & Borrie, 1995; Turner & Fine, 1990). The evidence for flotation-REST causing sufficiently relevant reduction of stress hormone levels is not undisputed, though. Since some investigations fail to show a relationship between cortisol and subjectively experienced stress-reduction, other models and correlates have been discussed (Schulz & Kaspar, 1994). It must be remembered that baseline cortisol levels need to be established quite carefully before reliable results may be obtained. It should also be

remembered that both the glucocorticoid, e.g. cortisol, and the mineralocorticoids, e.g. aldosterone, are differentially mobilized in acute and chronic stress situations.

Another correlate of stress is the main metabolite of noradrenaline, MHPG (3-Methoxy-4-hydroxyphenylethyleneglycol), generally seen as an indication of the total stress-load (Weiss, Goadman, Losito, Corrgan, Charry & Bailey, 1981). In **Paper IV** it was shown a significant reduction of the noradrenaline-metabolite, MHPG, before and after a treatment series of flotations for three weeks which may be associated with a general level of stress reduction during the treatment period. Another effect associated with stress reduction is: time to fall asleep at bedtime. An inability to relaxe may be connected with lying in bed at night and not being able to fall asleep. In **Paper IV** it was shown that the experimental group fell asleep more quickly after treatment than before treatment; no similar difference was seen in the control group. In table 4 (see **Paper IV),** is described results showing how "after treatment" falling asleep time correlates with MHPG, i.e. long periods of wakefulness were correlated with higher levels of the noradrenaline metabolite. At the same time, one ought to be aware that the "falling asleep time" parameters bears a certain degree of uncertainty, since it is a subjective rating of time that each respective participant lies awake that is used.

Discussion of stress ought not to dwell upon solely the negative aspects of stress. A reduction of stress may not be suitable under every circumstance and a certain degree of stress may to some extent be beneficial. For example, some authors/editors/journalists would appear to write best when confronted by a deadline (Norlander, 1997). **Paper II** indicated significantly more realistic thinking (Realism) among participants who were stressed before the chamber-REST treatment than those that had not been exposed to the stress treatment. In the same study (**Paper II),** a greater measure of the creativity factor, Liveliness, was obtained by those participants exposed to stress before flotation-REST than by those that were not exposed to stress. Obviously, the present analysis are highly limited and may only provide a taste of possible effects of stress, whether disruptive or beneficial, in the context of REST.

3.7. Flotation-REST as a practical technique for inducing ASC in laboratory setting

The flotation technique is, as previously mentioned, a special form of REST where an individual is placed in a horizontally floating posture, immersed in salt water in a floating tank, thus reducing all incoming stimuli. Flotation-REST is a cost-effective and secure method with minimal or complete absence of serious adverse effects (Borrie, 1993; Suedfeld, 1983). Through the possibility of being able to induce ASC with this technique, without extensive previous training of the subjects and without a too limiting sensitivity to expectation, set and setting, the technique stands out as a possibility to reproduce ASC under controlled laboratory settings. The implications of this can be manifold. Through the possibility to study ASC under controlled forms, with the option of changing parameters as needed, a better operationalization, definition and understanding of these states could be made. This has been hindered for long times since either the physiological techniques presuppose long periods of training, sometimes in combination with a mystical inclination. As LSD and psilocybin was available as research tools for psychologists and psychiatrists, the substances were hailed as "the microscope of the psychiatrist" through their ability to uncover subjective contents. The intense research on humans stopped radically as soon as these substances were classified as harmful narcotic substances without areas of medical usefulness and with a high risk for inducing dependency (Passie, 1997). In retrospect, much criticism

was directed towards the scientists due to the lack of controlled studies, instead of the mass of documents on anecdotal experiences.

With flotation-rest, a new possibility opens up through the non-pharmacological technique, independent of long traditional exercises; a wide group of subjects can be investigated without ethic concerns. Likewise, the results stemming from these papers indicate that a laboratory setting is not only possible but also that subjective expectations are of less importance. Thus, more precise manipulations of variables are possible for studying different aspects of interest.

3.8. Possible practical applications

Many positive effects, including stress-reduction, relaxation, pain-reduction, increased originality and a general sensation of comfort, have been shown to result from flotation-REST. Furthermore, several subjective experiences can be induced, ranging from elementary sensory pseudo-hallucinations to complex altered states of consciousness, including transpersonal experiences.

No negative effects have been reported so far after flotation-REST. Taken together, these findings suggest that flotation-REST may be considered a practical and safe technique for stress- and pain-reduction and even for harnessing the beneficent effects of ASC. This consideration may have practical implications for clinical and therapeutic interventions, for instance in the areas of psychosomatic medicine and chronic pain rehabilitation. This notion is in agreement with observations from previously published material (Norlander, 1997).

Besides the more 'classical' applications (pain alleviation, stress-reduction, mental training in sports), the technique could later prove to be a useful adjunct to psychotherapy and personal development.

Non-verbal therapeutic techniques offer an established advantage over verbal therapy in the treatment of many disorders in psychotherapy, possibly associated with their ability to enhance primary processes. The experience of so-called "holistic" or spiritually integrative experiences may under correct therapeutic settings imply a major breakthrough for some patients. The therapeutic impact of spirituality or associated phenomena on the health and recovery-rates of patients in psychiatry has been recently asserted, and attempts are presently being made to find ways to integrate spirituality and associated experiences in the treatment methods (e.g. Blass, 2001; Breakey, 2001; Fallot, 2001).

Although no significant adverse events are reported and the resulting effects of flotation-REST seem promising, perhaps nevertheless more limited areas of application, such as pain research and pain treatment, should be used as promising areas of the next future research with flotation-REST, leaving the more complex psychotherapeutic areas for later investigations.

3.9. Final comments

Altered states of consciousness may be traced back several millenniums and trance-inducing techniques have been used by healers, shamans, spiritual seekers and in context with religious

rituals (Dobkin de Rios & Winkelmann, 1989; Wright, 1989). Some authorities even suggest that the innate desire to alter consciousness periodically is a normal drive analogous to hunger or the sexual drive, intimately linked to psychological and physical well-being and health (Weil, 1972).

These altered states of consciousness, or transpersonal experiences, are supposed to be generally independent of the individual's race, culture, or religion. They have been suggested to be a common human characteristic, which has a strictly biological basis, although definite studies hereto are lacking. It is also interesting that certain types of transpersonal experiences show many similarities with religious experiences described in ancient sacred scriptures (Schlichting & Leuner, 1995; Schultes & Hofman, 1992; Smith, 1992).

Given that consciousness is difficult to define or even to operationalize, *altered* states of consciousness ought to be regarded as a total complexity. Yet these altered states are observable and to some extent experimentally reproducible. By a deeper understanding of altered states of consciousness, not only beneficial psychological and physiological effects can be seen in a new light, but also - paradoxically enough - "everyday-consciousness" as such may be better understood.

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APPENDIX

Paper I

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Imagination cognition and personality

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Editor: Jerome L. Singer, Ph.D.
Robert G. Kunzendorf, Ph.D.

Volume 20, Number 2 — 2000-2001

The Experience of Flotation-REST as a Function of Setting and Previous Experience of Altered State of Consciousness

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BAYWOOD PUBLISHING COMPANY, INC.
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IMAGINATION, COGNITION AND PERSONALITY, Vol. 20(2) 161-178, 2000-2001

THE EXPERIENCE OF FLOTATION-REST AS A FUNCTION OF SETTING AND PREVIOUS EXPERIENCE OF ALTERED STATE OF CONSCIOUSNESS*

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ABSTRACT

The purpose of this study was to investigate if experiences induced by flotation-REST (in flotation-tank) are affected by settings or subjects earlier experiences of altered states of consciousness (ASC). No such significant differences were found. Significant effects owing to flotation-REST were found regarding reduction in experienced pain and enhancement of mood. Flotation-REST was considered a pleasurable technique. Different kinds of visual and acoustic effects, altered time perception, and a sense of weightlessness have been reported. Also, deep transpersonal experiences were quite common, and could be distinguished into three types: experiences of one's own childbirth/delivery; feeling of cosmic unity; and experiences of losing contact with the body or out-of-body experiences. Flotation-REST must be regarded as a consciousness-altering method with promising potential for clinical and therapeutic use.

*This study was supported by grants from Karlstad University, Sweden.

INTRODUCTION

Noy suggests [1], with the support of Goldberger's experiments in sensory isolation [2], that sensory deprivation or, to apply a contemporary conceptualization, Restricted Environmental Stimulation Technique (REST) results in a weakening of the secondary process in its turn leading to cognitive balance with a mainly primary process-orientation. The secondary process-primary process continuum ought to be considered as a purely descriptive and not as a psychoanalytic construct [3]. As such, the primary process optimizes unconventional, instinctive thinking that tends to operate on concrete images rather than abstract concepts, while secondary process is associated with studied, logical, analytical, abstract and reality-oriented thought. The balance between primary and secondary processes plays a critical role a given individual's state of consciousness or type of thinking and is reflected in his/her language content [4, 5], as exemplified by studies administering psychoactive drugs, e.g., psilocybin [6] and marijuana [7], that elevate the primary process content of verbal production.

The flotation-isolation technique is a special form of REST. The floating form of REST consists of a procedure whereby an individual is submerged (to neck-level) in a water-tank filled with saltwater of an extremely high salt concentration. The salt concentration of the bath exceeds even that of the Dead Sea but the type of salt used is magnesium sulfate which is beneficial for the skin. The complete technique centers upon reducing environmental sensations to a minimum. In order to achieve this the subject under study must lie down in the tank while a covering-lid is closed down over the opening. This covering-lid may be opened quite easily by the subject simply through pushing it up. The floating tank is isolated from the inside in order to preserve the warm water temperature and keep out both noise and light.

Experiments conducted earlier with REST often reported negative effects [8], such as problems with logical thinking, concentration problems, higher levels of anxiety, and even hallucinations. However, later research has also shown the occurrence of positive effects, such as improved relaxation [9], reduced anxiety [10], increased receptivity to information [11], pain reduction [12], heart rate reduction [9–12], and muscular tension reduction [13]. Corresponding positive effects have been reported for the floating form of REST (e.g., [14–18]). Several studies (e.g., [18–21]) provide strong support for the contention that the flotation-isolation procedure reinforces aspects of "imagery," a prerequisite to the creative process [22]. At the same time, these effects may also be regarded as an expression of a primary process domination [23–25]. Flotation REST has been applied within a sports psychology context in order to attain a more effective control over the negative consequences of stress, to reinforce various visualization techniques, and to improve the restitution process following training bouts and competition [18–28].

As yet, we are not aware of any systematic attempt to study the potential influence of expectancy upon Flotation REST and the ability of the technique to

induce a primary process condition. In support, some studies [29] examining other forms of REST have reported "encouraging instructions" gave rise to more frequent and more complex hallucinations (i.e., a stronger primary process orientation). Even the experimenter's role as "social reinforcer" produced similar effects [29]. The role of expectancy as an important variable in the psychopharmacology of alcohol and other drugs is well-established [30, 31] alcohol intoxication results in the weakening of the secondary process but an intact primary process [32]. The purpose of the present study was to test the hypothesis that primary process-related experiences accompanying flotation-REST are influenced by the experimental contextual setting (strict-fantasy) as well as earlier experience of a markedly altered state of consciousness.

METHOD

Participants

The experiment was conducted at the Flotation-REST Research Laboratory at Karlstad University, Sweden. Fourteen former drug-users, recruited within the province of Värmland via a previously-established network of contact persons [33], took part in the experiment. They were matched against 14 participants without drug experience of comparable age, gender, and occupation, thus constituting a group variable, i.e., subjects with drug experiences (Group 1) and subjects with no drug experiences (Group 2). Participants were randomly assigned to either a "strict" setting (strict-condition) or to a "fantasy" setting (fantasy-condition). The participants' mean age was 32.04 years (SD = 8.29), whereby 24 subjects were men and four were women. Only two of the subjects were unemployed, 16 were employed, and 10 were students. Of the 28 participants, two had previously tried flotation-REST and six reported previous attempts at meditation.

Two-way ANOVA with Group and Setting as independent variables and age as dependent variable did not indicate any significant Interaction effect or Groups effect ($ps > 0.75$) but a Settings effect ($F(1,24) = 9.92$, $p = 0.004$) whereby participants in the "strict setting" were younger ($M = 27.31$, $SD = 6.34$) than those in the "fantasy setting" ($M = 36.13$, $SD = 7.71$). Mann-Whitney U-tests did not indicate any differences between groups with regard to occupation, experience of flotation-REST ($ps > 0.9$) but for meditation where six participants with meditation experience were found to be in the drug group. U-tests showed no significant difference between "settings" for experience of flotation-REST and meditation but for occupation ($z = -1.20$, $p = 0.046$) where the "fantasy" participants had occupations (11) to a greater extent than those in the "strict" condition (5).

Further analysis with Mann-Whitney U-test showed no significant differences between groups with regard to gender, education, number of cigarettes smoked per

month, number of snuff dosages per month, alcohol consumption per month, female subjects' phase of the menstrual cycle, their use of preventive pills (p-pills), self-judgments of psychological stability and physical health satisfaction with life in general ($ps > 0.09$).

Still further analysis with Mann-Whitney U-test showed no significant differences between "settings" with regard to gender, education, number of cigarettes smoked per month, number of snuff dosages per month, alcohol consumption per month, female subjects' phase of the menstrual cycle, their use of preventive pills (p-pills), self-judgments of psychological stability and physical health, satisfaction with life in general ($ps > 0.07$).

Regarding the drug-use of earlier drug-users, it was established there was an average of 224.62 (SD = 349.45) weeks since last intake of any hallucinogenic (psychedelic) drug. In total over their life histories average drug frequencies were as follows: LSD = 22.75 (SD = 41.40) times, psilocybin = 2.39 (SD = 2.84) times. Average intake of both drugs during the course of a year of abuse was 8.63 (SD = 9.71) times. The drug group reported intake of other drugs only sporadically (see Table 1).

Analyses with help of Mann-Whitney U-test showed no significant differences between "settings" in the drug experienced Group in regard to time since latest intake of the hallucinogen drug, or extent of earlier use of LSD, psilocybin, cannabis, amphetamine, ecstasy (methylenedioxymethylamphetamine), cocaine, and heroin ($ps > 0.17$).

Design

The participants in Group 1 (individuals with earlier experience of hallucinogens) and Group 2 (individuals without earlier experience with hallucinogens) were subjected one of two experimental conditions ("strict" or "fantasy"). In the "strict" condition the experimenter was dressed in a white laboratory coat and

Table 1. Incidence of Non-Hallucinogenic Drugs in the Drug Group

Drug	Never	Sometimes	Quite often	No information
Cannabis	3	9	2	0
Amphetamine	7	4	1	2
Ecstasy	9	2	1	2
Cocaine	11	1	0	2
Heroin	12	0	0	2

no special instructions were presented apart from those strictly and formally necessary, and no special attributes were present in the flotarium. In the "fantasy" condition, the experimenter was dressed in a colorful T-shirt with a "fantasy-motif" and a picture with a saga-motif was hung on the wall beside the flotarium. Additionally, the experimenter read some stories of a fantasy nature about other subjects' flotation experiences and played low music both during the introductory discussion and during the time when the subject completed the pre-floating questionnaire.

Instruments

Floating Tank

A floating tank (Flytarium Norden AB) with measurements 262 mm × 167 mm × 140 mm was used. Water depth varied between 200-300 mm, due to evaporation. The floating tank was insulated on the inside so as to maintain a constant temperature and to isolate the participant from sound and sight. The water temperature was maintained at 34.2°C. Ambient (air) temperature was the same as the water temperature minimizing sense sensation. The water was saturated with magnesium sulfate in order to maintain salt concentration of 1.3 g/cm^3.

Pre-Floating Questionnaire

A questionnaire was prepared for administration before floating. Besides demographic questions, it consisted of questions regarding bodily aches and pains, present-day mood, ones' own estimate health (physical and mental), degree of expectancy of floating, earlier experience of altered states of consciousness, use of alcohol/tobacco, and for female subjects incidence of p-pill use and phase of the menstrual cycle.

Post-Floating Questionnaire

The questionnaire applied after floating consisted of the same questions on aches and pains, and mood as the first one. In addition, there were several questions pertaining to: fears, the pleasantness of the experience, physical discomforts, as well as different types of mental experiences (e.g., experience of noise, images, voices, time-perception, ego-disorganizing, out-of-body experiences, and comparisons with dream states). Each participant was also required to present a description of the best and worst aspect of floating. Subjects with further experiences not covered by the questionnaire were encouraged to register these in their own words. Participants in the "Drug Group" (Group 1) received also questions regarding extent of drug use and a question requiring the comparison of the floating experience with their previous drug-induced experiences.

Procedure

On arrival at the Flotation-REST Research Laboratory of Karlstad University, each participant was reminded of the confidential and self-chosen nature of the experiment, and also that he/she could withdraw without having to give any reason. The experiment's choice of dress and all other attributes of the experimental situation (dependent upon the experimental condition) were arranged prior to the arrival of each subject. Following this, each participant was given a tour of the premises (including shower, WC, floating-tank, changing rooms, etc.) and allowed to answer all the questions in the "pre-floating-questionnaire" in peace and quiet. Each participant was instructed to relax during the sojourn in the tank and try to suppress all thoughts pertaining to everyday life and hassles and instead attend to his/her breathing (with an explicit consciousness of inhalation and exhalation). For participants in the "fantasy" setting experimental condition, the experimenter read out fantasy-related stories of other subjects' floating-tank experiences. Each participant was encouraged to a visit to the toilet and shower, and was provided with ear-plugs prior to immersion in the tank. The period of immersion was interrupted after 60 minutes when the experimenter knocked on the wall of the tank. Directly after this each subject was allowed to use the toilet, shower, and get dressed. Following this, he/she was required to complete the "post-floating questionnaire." Those wishing to do so were given the opportunity to discuss their thoughts on experiences. Then each participant was debriefed and at the same time urged not to discuss the experimental design with any other person.

RESULTS

Experiences Before and After Floating

Split-plot ANOVA was used with experience of pain and mood, respectively, before and after floating, as the Within-subject factors and "setting" as the Between-subject factors. There were no significant differences either for Group, "setting" or any interaction effect but there were significant differences with regard to "pain" ($F(1,24) = 252.17$, $p < 0.001$) and "mood" ($F(1,24) = 5.62$, $p = 0.026$). Here, the mean "pain" experience estimated on a scale of 0–100 was assessed 9.57 units ($SD = 14.97$) pre-floating and 7.21 units ($SD = 14.07$) post-floating, whereas the "mood" experience on the same scale was assessed at 62.71 units ($SD = 16.00$) pre-floating and 73.46 units ($SD = 15.30$) post-floating. A Repeated Measures ANCOVA controlling for the differences between settings in regard to age yielded no other significant indications.

Global Experiences of Flotation-REST

A Pillais MANOVA was used to analyze the participants' expectancies whereby Group and "setting" were independent variables and estimated expectancy (Expectancies), estimated experience of comfort (Comfort), estimated experience of fear (Fear), estimated desire to float again (Float again), and estimated volume of ordinary thoughts (Ordinary) provided the dependent variables. The analysis did not indicate significant results for either an Interaction effect ($p = 0.265$), Group effect ($p = 0.472$) or an effect of "setting" ($p = 0.874$). The estimates were all performed on a scale of 0–100. A MANCOVA controlling for the differences between settings in regard to age yielded no other significant indications. Means and standard deviations are presented in Table 2.

Participants' Specific Experience of Flotation-REST

Mann-Whitney U-test with Group and "setting" as independent variables and report of physical discomfort during floating (Physical discomfort), feeling of one's body disappearing (Body-disappearance), experience of noise (Noise), hearing voices (Voices), experience of visual images (Images), experience of leaving one's body (Leave-body), experience of gliding or flying (Flying), experience of perceptual expansion outside the body (Expansion), emptiness-experience (Empty), experience of a half-awake, half-asleep condition (Hypnagog) as dependent variables. The analyses did not indicate any significant differences for either Group or "setting" for any of the dependent variables ($ps > 0.07$). Frequencies and percentages are presented in Table 3.

Table 2. Means (*M*) and Standard Deviation (*SD*) for the Participants' Expectancies, Experience of Comfort (Comfort), Fear, Wish to Float Again (Float Again), and Incidence of "Ordinary Thoughts" (Ordinary) in Connection with Flotation-REST

Variable	*M*	*SD*
Expectancies	72.32	16.00
Comfort	81.29	16.52
Fear	14.14	26.36
Float Again	84.89	16.82
Ordinary	27.14	20.00

Table 3. Frequency of No-Answer (No), Percent No-Answer (N-%), Frequency of Yes-Answer (Yes), Percent Yes-Answer (Y-%) with Regard to Physical Discomfort during Floating (Physical Discomfort), Feeling of One's Body Disappearing (Body-Disappear), Experience of Noise (Noise), Hearing Voices (Voices), Experience of Visual Images (Images), Experience of Leaving One's Body (Leave-Body), Experience of Gliding or Flying (Flying), Experience of Perceptual Expansion Outside the Body (Expansion), Emptiness-Experience (Empty), Experience of a Half-Awake, Half-Asleep Condition (Hypnagog)

Variable	No	N-%	Yes	Y-%
Physical Discomfort	7	25.0	21	75.0
Body Disappear	6	21.4	22	78.6
Noise	18	64.3	10	35.7
Voices	22	78.6	6	21.4
Images	10	35.7	18	64.3
Leave-Body	11	39.3	17	60.7
Flying	7	25.0	21	75.0
Expansion	17	60.7	11	39.3
Empty	19	67.9	9	32.1
Hypnagog	3	10.7	25	89.3

Participants' Temporal Experience

Mann-Whitney U-tests were used to analyze the participants temporal judgments whereby Group and "setting" were the independent variables and the temporal judgments on a four-point scale (time slowed-down, same time, time speeded-up, time stopped; 1–4) provided the dependent variable. The analyses indicated no significant differences either for Group or "setting" with regard to the dependent variables ($ps > 0.46$). Frequencies and percentages are presented on Table 4.

Participants' Comparisons with Dreams

Mann-Whitney U-tests were used to analyze participants' comparisons between the experience of floating and dream states where Group and "setting" were independent variables and comparisons made with regard to how precise

Table 4. Frequencey (*F*) and Percentage (*P*) with Regard to "Time Moves Slower," " . . . As Usual," " . . . Quicker," " . . . Has Stopped" as (Slower), (As Usual), (Quicker), (Stopped), Respectively

Statement	*F*	*P*
Slower	3	10.7
As Usual	3	10.7
Quicker	18	64.3
Stopped	4	14.3

the floating-tank was (Precision), how participating the subjects experienced themselves (Participation), how familiar the subjects experienced themselves (Familiarity), how real subjects experienced the floating-tank compared to dream states (Reality) gave the dependent variables. The analyses did not show any significant differences for either Precision, Familiarity or Reality ($ps > 0.07$) while there was found to be a Group difference with regard to Familiarity ($z = -2.15$, $p = 0.031$) the Drug group (10) experienced more Familiarity than the non-Drug group (6). There was however no significant difference of "setting" with regard to Familiarity ($p = 0.275$). Frequencies and percentages are presented in Table 5.

Drug Group Participants' Comparisons with Hallucinogenic Experiences

Comparisons between floating and drug experience in the Drug group were analyzed by Mann-Whitney U-tests where "setting" were the independent variable and the dependent variables were: how precise the floating tank experience was (Precision), how much subjects felt party the experience (Participation), how familiar the subjects experienced themselves (Familiarity), how real the subjects experienced the floating tank in comparison with hallucinogenic drugs (Reality). The analyses did not indicate any significant difference for either "setting" with regard to Precision, Participation, Familiarity or Reality. Frequencies and percentages are presented in Table 6.

Verbal Analysis

The qualitative analysis indicated that there were no principle differences of experience for either Group or "setting." Presented here is a descriptive summary over the whole group of participants followed by a few typical examples pertaining to Group (1 or 2) and "setting" (fantasy or strict), respectively:

Table 5. Frequency (*F*) and Percentage (*P*) with Regard to How Precise the Floating-Tank was (Precision), How Participating the Subjects Experienced Themselves (Participation), How Familiar the Subjects Experienced Themselves (Familiarity), How Real Subjects Experienced the Floating-Tank Compared to Dream States (Reality), Each Indexed on the Basis of Less Precise, as Precise, and More Precise

	Less Precise		As Precise		More Precise	
Variable	F	P	F	P	F	P
Precision	12	42.9	11	39.3	5	17.9
Participation	9	32.1	10	35.7	9	32.1
Familiarity	7	25.0	6	21.4	15	53.6
Reality	8	28.6	11	39.3	8	28.6

Table 6. Frequency (*F*) and Percentage (*P*) with Regard to How Precise the Floating-Tank Experience Was (Precision), How the Subjects Experienced Participation (Participation), How Familiar the Subjects Experienced Themselves (Familiarity), How Real the Subjects Experienced the Floating-Tank in Comparison with Hallucinogenic Drugs (Reality), All Indexed on the Basis of "Less Precise," "As Precise," and "More Precise"

	Less Precise		As Precise		More Precise	
Variable	F	P	F	P	F	P
Precision	10	71.4	3	21.4	1	7.1
Participation	7	50.0	5	35.7	2	14.3
Familiarity	3	21.4	7	50.0	4	28.6
Reality	5	35.7	7	50.0	2	14.3

The Best and Worst Aspects of Flotation

In response to the question "What was the best aspect of flotation?" 23 (82.1 percent) participants formulated their answers in terms of calmness, comfort, relaxation and stress-reducing. The experience of "escaping from daily hassles" was expressed with positive descriptions of weightlessness, lack of caring necessity, and diffuse border between body and water, by 11 (39.3 percent) participants.

Other positive judgments obtained were: quietness, harmony, "unity-of-senses," and "a positive new experience." The question "What was the worst aspect of floating?" was dominated by the responses "stale air," condensation, or temperature dissatisfaction (both warm and cold directions) by 7 (25.0 percent) subjects as well as pains and uncomfortable body posture by 5 subjects (17.9 percent). Other negative judgments, produced by single participants, were "the salt in the water stung my eyes," "travel-nausea," "thirstiness," and "it was too short a period."

Visual Experiences in the Tank

Presented below is a summary of the descriptions of visual experiences:

> I saw horses and a woman that fell off and hit her head. (Group 1, fantasy)
>
> I saw color pictures of space, cosmos and the stars. (Group 1, strict)
>
> Blue, not really picture but mostly colors. (Group 2, strict)
>
> Fantasy pictures, hazy contours and no colors. (Group 2, fantasy)

Experience of Hearing Inner Voices

Six persons stated that they heard inner voices. Some descriptions:

> Voices spoke coherently, it was people and power-animals. (The subject had a long-lasting experience of Shaman techniques) (Group 1, strict)
>
> Two women's voices, talking with murmuring pitch. (Group 2, fantasy)
>
> One subject heard "remote speech." (Group 1, fantasy)
>
> One subject heard "the voice of his mother." (Group 1, strict)
>
> One person described a meeting with the creature "Araknion" that said: "You decide yourself how you should have it. Create your own world." (Group 1, fantasy)

Experiences of Foetal Life-Birth-Breastfeeding

Four participants gave descriptions of that type of experience, parts of which are described here:

> Think I experienced birth—I was dazzled by a sharp light, I screamed/cried and was held up. I experienced even breastfeeding and the warm skin of my mother. (Group 1, fantasy)
>
> Quite unexpectedly, I was moved to a very tight place and was panic-stricken when I felt that I could not get air and was choking. I became very frightened. I believe this was some type of birth experience. (Group 1, strict)

> I saw images of a small foetus that lay outstretched on its side. The foetus was real, it felt as if I was inside mother, I heard voices, the tone was my mothers, that gave me a secure feeling. (Group 1, strict)

> It felt like going back in the embryonic fluid when I floated. I felt almost as if I was being reborn, it felt as if forces were drawing me in different directions. (Group 2, strict)

Experiences of Feelings of Emptiness and Unity with Cosmos

Many participants reported this experience. Some of the descriptions:

> I did not exist as a physical body, just a consciousness. It felt like gliding in a great emptiness. (Group 1, strict)

> Everything was one and I could touch everything. (Group 1, fantasy)

> Went up, down, out in the black emptiness, I went up in the universe. Nothing remained, absolutely nothing. (Group 2, strict)

> This is how it must be to die. (Group 2, fantasy)

Experiences of Meeting Strange Beings

Five subjects described that they "had met" strange beings and some even identified them:

> He said he was called Araknion, he was an elder man, grey-white hair in a white shift." The subject gave a detailed description of features and movement-patterns and related the conversation with this being, who conveyed words of wisdom. (Group 1, fantasy)

> I experience things that belong in dreams but at the same time am awake." The person described a meeting with a whale-like being he afterwards identified with. "I had an enormously large and long body that I could move with in the sea. I could clearly feel my strength and size. (Group 2, fantasy)

> I got together with the elves who dance on the mosses on an early summer morning. Diffuse contours and no colors, just a harmonious light. (Group 2, fantasy)

Experiences of Leaving or Losing Contact with the Body

Seventeen (60.7 percent) subjects experienced that they lost contact with their body during floating. Some of these also experienced the feeling of completely leaving their body. Some comments:

> I became a point of consciousness that traveled around in a cosmos/vacuum. (Group 1, strict)

> I was separated from my body partially. It was fixed or locked in a resting position since I did not need it at the time. I could resume contact

(i.e., terminate the separation) immediately and without difficulty. (Group 1, fantasy)

I could not see my body from the outside, but it was experienced unnecessary. (Group 2, fantasy)

I had no contact with my muscles, I had to force them to move and indicate their presence to me. (Group 2, strict)

DISCUSSION

The main purpose of the present study was to test the hypothesis that flotation-REST experiences are influenced by contextual setting and the participants' previous experience of a significantly altered state of consciousness. This hypothesis could not be confirmed by the quantitative analysis of the data obtained. The verbal analysis, on the other hand, indicated that the participants in Group 1 (i.e., those with previous experience of hallucinogens) had more lively, fantastic, and complex experiences compared with the participants from Group 2 (i.e., those lacking previous hallucinogenic drug experience). The global impression, however, is *that the primary process-related experiences during flotation-REST are to a great extent independent of factors like earlier experiences and direct influences just prior to floating.* The psychological effect obtained during flotation-REST, through a "cognitive-shift" to the advantage of the primary process, appears to be substantially less dependent upon expectancy variables than seems the case in, for example, alcohol intoxication where psychopharmacological and expectancy factors are intertwined [34].

At present it is not possible to describe which physiological components may be of importance for experiences during REST in general and flotation-REST in particular remains to be delineated. It is of interest in this context that flotation-REST has been shown to increase nerve cell activity in the right hemisphere [35, 36]. Further, certain studies have demonstrated reduced plasma cortisol concentrations following floating [37, 38] although the evidence for whether flotation-REST causes reductions of the stress hormone levels or not is not undisputed [39]. It has also been suggested that the experienced positive mood and in several cases even the analgesic action of flotation-REST may be mediated the endogenous release of endorphins [38, 39]. One possible supportive indication may be that injections of naloxone influence the psychological experience of flotation-REST [35-39]. Naloxone is an opiate receptor antagonist that displaces morphine and other opiate compounds via a competitive binding mechanism to the opiate receptor.

There was a significant effect of flotation-REST upon the subjects' subjectively-experienced pain alleviation as well as a significant elevation of their mood in the direct comparison of pre- and post-floating. Flotation-REST was experienced by the participants as a positive event. Many positive judgments were

provided for "how pleasant it was experienced" and "how gladly they would like to float again" (see Table 2). Several participants spontaneously commented immediately afterwards that they "felt themselves to be in such a good humor," glad or unreservedly happily. Even the participants' positive expectancies were high (Table 2). In addition, the study indicates that subjects were only to a negligible extent "preoccupied with everyday thoughts" and were troubled negligibly by fears (Table 2). Taken together, these findings suggest that flotation-REST ought to be considered a potentially considerable clinical intervention, for instance in the areas of stress-reduction and chronic pain rehabilitation. This is in agreement with observations from previously published material [18, 19, 23–39]. The result that 75 percent of the participants reported "physical discomfort" during floating (Table 3) may seem remarkable in view of the positive nature of all other judgments, prompting some explanation: nearly all the subjects that answered the question with "yes" later commented that they did not experience "a discomfort" per se but that they sometimes felt the need to move some body part in order "to ensure that it was still there" or that they felt a slight muscle spasm. The most reliable explanation seems to be that the question formulation was inadequate and the subjects did not experience real "discomfort" during floating.

The comparison of dreams and floating experience indicated there were no significant difference between Group or Setting with regard to precision, participation, familiarity or reality (Table 5). The drug group's experience of significantly more familiarity defies a satisfactory explanation. Possibly this group possessed a stronger habit for entertaining "out-of-the-ordinary realities" and to a greater extent than the non-drug group "felt familiar with" the situation and thereby experienced the situation as more familiar. It must also be stated that a drug-sensitization effect separating the drug from the non-drug group may have been operating. Drug-sensitization effects induce behavior effects/experiences to occur with repeated, discrete and spaced presentations of the drug in a familiar context [40, 41]. Note that drug-sensitivity results in the enhanced sensitivity to the behavioral and experiential effects of the drug [42] that may or may not encompass a cross-sensitivity. Independent of Group and Setting it is of interest to note the comparison of the floating-tank experience with that of dream states. Table 5 indicates the portion of participants that experienced floating as "similar" or "more" than dream state with regard to precision (16 subjects, 57.1 percent), participation (19 subjects, 67.8 percent), familiar (21 subjects, 75 percent) and reality (19 subjects, 67.8 percent). This suggests that flotation-REST offers a powerful technique for the generation of experiences. In a speculative sense, one may suggest that contact with an implicit, pre- or subconscious memory resource at the "source of creativity" may be available during flotation-REST.

Numerous participants, 21 subjects (75 percent), reported a "feeling of gliding or flying" (Table 3). Schulz and Kaspar [23, 35, 38–42] point out that this feeling of weightlessness is seldom drawn attention to in REST studies but underlies at

the same time that the observation may be of great magnitude in the eventual explanation of the REST phenomenon. Altered temporal perception in relation to flotation-REST is also a previously known phenomenon. Raab and Gruzelier [23, 35–42] have drawn attention to this in a study wherein they found that 94 percent of the participants in flotation-REST lost their time perception. The results of that study lie close to those obtained in the present one, 89.3 percent (see Table 4), thereby further confirming the conclusion.

Several different transpersonal experiences were reported by the participants. There were three dominant types: the experience of one's own delivery/childbirth; the feeling that to a greater or lesser extent leave or lose contact with own body; and a feeling of experiencing a timeless condition whereby the "self" was experienced as converging with "the universe" or cosmos. The fact that so many (25 subjects, 89.3 percent) described that they were caught in "a state between sleep and waking" (Table 3) is in confirmation reports from earlier flotation-REST studies. Budzynski [23, 35–42] outlines further how the REST-experience is often associated with a hypnagogic state. Sakata, Shinohara, Hori, and Sugimoto [43], applying EEG-spectra analyzes, demonstrated that flotation-REST induced a more hypnagogic condition than normal sleep/resting. Budzynski [23, 35–43] further describes how REST can give access to earlier (Traumatic) memories in the main stored in the non-dominant (right) hemisphere, a possible explanation for the "childbirth-delivery experience" of subjects in the present study. Other techniques, like holotropic breathing and psychedelic therapy are also known to induce states pertaining to "time-of-delivery", described in detail by Grof [44] and termed as contact with the perinatal level.

Many different types of visual perceptions were reported. Some of these fall into the category "phosphenes" (simple experiences of color and/or light), but most were of an "hallucinatory" type, with detailed descriptions of course-of-events, details, and colors. Of the six subjects reporting inner voices, five belonged to the Drug group. The hearing of inner voices is a condition mainly associated with psychotic hallucinations but is quite unremarkable in connection with a psilocybin-rush. The penchance of psilocybin to induce acoustic hallucinations, "voices," is viewed with respect and devotion in several shaman cultures [45]. In a study by Beach [46] it was found that above a third of those consuming psilocybin mushrooms heard voices.

The findings of this study indicate that flotation-REST offers a technique with notable potential for clinical and therapeutic application. Previous investigations have shown the technique to be used in association with the treatment of drug abuse problems. In the present study half of the subjects had a background of illegal substance abuse. There were no indications that flotation-REST was unsuitable for persons with a background of abuse. Besides the more 'classical' applications (pain alleviation, stress-reduction, mental training in sports), the technique ought to provide a useful adjunct within psychotherapy and personal development.

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Imagination, cognition and personality

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Robert Kunzendorf, University of Massachussetts Lowell

Aims & Scope

After decades of relative neglect by the scientific community, the stream of consciousness has emerged as a fascinating focus of theory, research, and practical applications. This *Journal* presents thoughtful explorations of the flow of images, fantasies, memory fragments, and anticipations, which constitute our moment-to-moment experience of awareness. It presents original scientific research examining the relationship of consciousness to brain structure and function, to sensory process, to human development to aesthetic experience, and to the flow of life events. The stream of consciousness reveals its vast array of resources, not only in coping with distress and disability, but also in fostering adaptive approaches to everyday life, growth, and creative enrichment of life's possibilities.

ISSN: 0276-2366

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II

Paper II

Effects of Flotation- versus Chamber-restricted environmental stimulation technique (REST) on creativity and realism under Stress and Non-stress conditions*

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ABSTRACT

Two studies examining different aspects of the Restricted Environmental Stimulation Technique (REST) were carried out. In the first study, 38 participants were assigned randomly to either a group that floated on one occasion or a group that were given floating on three occasions. Following this, the subjects performed a test of divergent creativity and a test of logic. In the second study, 32 participants were assigned randomly to, first, two groups, Flotation-REST or Chamber-REST groups, and then randomly assigned to two more groups, namely to either a Stress-group or to a Non-stress group. The most important dependent variables of this second study were derived from essay-writing, which was adjudged on the basis of elaboration, liveliness, originality and realism. The results did not indicate any differences deriving from one or three flotations; both groups performed worse on the test of logic but tended to be better on the test of creativity. Both REST groups were similarly relaxed after treatment although the Flotation-REST group showed altered states of consciousness to a greater degree. The Flotation-REST group showed more originality whereas the Chamber-REST group showed more elaboration and realism. The results are discussed from the standpoint of fluctuations within the primary-secondary process continuum.

*This study was supported by grants from Karlstad University, Karlstad. The authors thank Mr. D. Ekholm-Andersson, Ms. U. Sildéus, and Ms. U. Sundholm for valuable help with collecting the data.

INTRODUCTION

The multifaceted nature of pain implies that direct activation of peripheral sensory fibers is not necessarily equivalent to the experience of pain (Melzack & Wall, 1965). Pain may be viewed as a subjective experience that includes a strong emotional (affective) component. Several other factors beyond direct sensory activation, e.g. experience of control, support from the surroundings, level of stress and other individual and situation-dependent factors have been shown to modulate the extent and amount of pain experienced to greater or lesser degrees (Skevington, 1995).

Experimental methods for studying pain processes may elucidate questions arising in clinical pain research. For example, experimental pain studies may be used to develop 'coping' strategies as well as to evaluate the efficacy of these strategies (Edens & Gil, 1995). Nevertheless, studies involving experimentally-induced pain are severely limited in their capacity to model the pain experienced, e.g. in chronic pain conditions, since among restrictions the affective component is missing generally in the experimental setting (Rang, Dale & Ritter, 1999). Furthermore, whereas experimental pain is usually predictable, this is not the case in chronic pain, as participants in a pain experiment may terminate the study at any time in full knowledge that at no time are they at risk for tissue damage (Edens & Gil, 1995).

Although several methods exist for induction of experimental pain, induced ischemia (due to lack of oxygen) and cold-presser pain are considered methods-of-choice as models of chronic pain condition (Rainville, Feine, Bushnell & Duncan, 1992). In the latter case, the participant is required to submerge his/her hand into a bucket of ice water whereas in the former ischemic pain is induced by elevating pressure at the blood pressure cuff on the participant's arm. In ischemic pain, lack of tissue oxygen at the cuff inhibits the sodium-potassium pump thereby increasing extra cellular K^+ concentrations which in turn depolarize pain receptors with consequent impulse generation and perception of pain (Nisell & Lundeberg, 1993). Lack of tissue oxygen leads also to bradykinin accumulation, further reinforcing the pain (Nisell & Lundeberg, 1993; Rang, Dale & Ritter, 1999).

Measurement of pain intensity can be performed using a Visual Analog Scale (VAS) from 0-100, which is expressed often as being the "gold standard" for assessment of pain (Yarnitsky, Sprecher, Zaslansky & Hemli, 1996), although verbal described are utilized too. Comparisons of VAS with verbal descriptor techniques indicate that both methods equally sensitive for quantification of pain intensity and its affective component (Duncan, Bushnell & Lavigne, 1989).

At present, there are only a few studies on human participants involving *experimental pain* in combination with relaxation/stress-reduction, whereas there are a substantial number of studies showing the analgetic effect of relaxation when using flotation-REST on *clinical pain* (e.g. Fine & Turner, 1985; Kjellgren, Sundequist, Norlander & Archer, 2001; Mereday, Lehmann & Borrie, 1990). Flotation-REST (Restricted Environmental Stimulation Technique) is a mild form of sensory deprivation where the participant is comfortably floating on his back in a saline solution contained in a dark, anechoic tank. In order to further reduce incoming sensory perceptions, the participant wears ear-plugs and the saline water solution is heated to skin temperature, thus reducing auditory and tactile stimulation. The method induces a state of relaxation and stress-reduction (e.g. Norlander, Kjellgren & Archer, 2001).

The expression "relaxation" is often used without further definition, often to describe a state of reduced tension. It is even more difficult to define "a state of relaxation" than a relaxation technique (Kokoszka, 1992). A review of the contemporary literature shows that most studies and theoretic discussions related to relaxation focus on the physiological

mechanism and pay very little attention to the alternation of states of consciousness (Benson, 1975; Davidson & Schwartz, 1976).

In common for the studies that have been made with REST and pain-relief is that they study an already existing, chronic pain which is present when the REST-treatment is begun (e.g. Fine & Turner, 1985; Kjellgren, Sundequist, Norlander & Archer, 2001; Mereday, Lehmann & Borrie, 1990). These studies in no way claimed that the pain-relief was to be explained by the elevation of the participant's pain-threshold, but rather noted that the participants experienced that the existing pain was attenuated over time as REST-treatments were continued.

The aim of this investigation was consequently to investigate if the degree or level of altered state of consciousness could be of importance for the subjective experience of experimental pain induced when the participant already was in a mild altered state of consciousness. In order to practically achieve this altered state of consciousness; sensory deprivation was used in a flotation-REST tank and on a couch in a dark, silent room (chamber-REST), respectively.

METHOD

Participants

The present study was carried out during two weeks, with a six-week interval separating each week, at the Flotation-REST laboratory at Karlstad University (Karlstad, Sweden). Twenty-three sportsmen were recruited through association with sports-active groups in the province of Värmland (Sweden). Their mean age was 29.48 years (SD = 4.97, *range* = 21 to 41), and 13 individuals were students whereas as 10 had professions. The participants reported that they performed some form of sports activity at least 353.48 minutes per week (SD = 265.63). 16 participants had never smoked, 4 participants smoked only on special occasions, like parties, and only 3 participants were regular smokers. The participants confided that they consumed a mean of 375.65 ml 100% alcohol per month (SD = 249.93) which may be compared with the Swedish national (per capita, 15 years or more) mean of 667 ml 100% alcohol per month (Kühlhorn, Hibell, Larsson, Ramstedt & Zetterberg, 2000).

In order to obtain further background data, two tests of personality, namely the Hospital Anxiety Depression scales (HAD, Herrmann, 1997) and Life Orientation Test (LOT, Scheier & Carver, 1985), were applied. The mean values for HAD were: for the depression scale: 2.17 points (SD = 1.59), and for the anxiety scale: 4.91 points (SD = 2.19), which may be compared with the clinical boundary of 6 points for evidence of both depression and anxiety. The mean value for LOT, that estimates the fundamental degree of dispositional optimism, was 23.39 points (SD = 4.13), which may be placed at a level comparable with that of athletes within physically and mentally demanding sports (Folkesson, Nyberg, Archer & Norlander, 2002; Norlander & Archer, 2002) and somewhat higher in comparison with a student average (Perrin-Wallqvist, Eriksson & Norlander, 2001; Sandlund, Linnarud & Norlander, 2001).

The participants visited the laboratory on two occasions (see "Design") and on both occasions experienced pain, already at arrival at the laboratory, was estimated on a 100-degree scale (where, 0 = "no pain", 100 = "intensive pain"). Mean values on the first occasion were estimated to be 10.08 (SD = 16.36) and on the second occasion 8.00 (SD = 14.72), a difference that was not found to be significant (Paired-Samples t-test, p = 0.413).

Design

The thirty-eight participants were randomly assigned to two groups, i.e. one flotation (9 male and 7 female subjects), and another of three flotations (8 male and 14 female subjects), thereby constructing the variable Number of Flotations that together with Gender provided the independent variables of the study. The dependent variables were fluency (number of relevant responses on the divergent test) and logical ability (measured through application of a deductive test) measured on two occasions, before and after treatment (flotation-REST).

Instruments

LOT – Life Orientation Test. The test [35] consists of eight items, plus four filler items. The task of each subject is to take up a standpoint to the extent of whether or not one is in agreement with each of the items described, on a scale of 0 – 4, where 0 indicates "strongly disagree" and 4 indicates "strongly agree". The test measures dispositional optimism, defined in terms of generalized outcome expectancies.

Syllogisms I – II. A test presented in two versions [36] that measures the ability of logical and deductive thinking. Each Syllogism test consists of 21 items demanding a quantitative type of deduction reasoning (e.g. Tom is taller than John. John is smaller than Bill. Is John taller than Tom?). Time was limited to 5.5 minutes and the number of correct answers were registered. During this examination, half of the participants received, randomly, version I before treatment and version II after treatment, and for the other half of participants versions I and II were presented in the opposite order.

Beer can/Brick. A test of divergent [37] that measures the number of relevant responses for how many different ways one may use a beer can or a brick, respectively. The subject was allowed two minutes for each item in order to produce as many alternatives as possible. In this way, a measure of Fluency is provided. In this study, half of the subjects, randomly, responded to beer can before treatment and brick after treatment, while the other half of the subjects responded to beer can and brick in the opposite order.

Procedure

Participants were instructed to bring swimming trunks and a towel. If the participant belonged to the three-flotations group the subject had floated on two different occasions the previous week. On arrival, each subject was instructed by Experimenter to fill out a form with background data and then (in randomized order) LOT, Syllogisms (either version I or II) and beer can/brick (either beer can or brick). Then, the experimental manipulation (flotation-REST) took place for 45 minutes, and afterwards the participants were given the Syllogisms and beer can/brick tests and this time with the particular version they had not received earlier. After this, debriefing was initiated.

Second Study

Participants

The experiment was performed at the flotation-REST laboratory at the University of Karlstad. Thirty-two subjects were recruited from the pool of students attending evening courses on a random basis. Of these 43.8% were students, 40.6% were employed occupationally and 15.6% described themselves as being occupationally redundant. The mean age of the participants' was 30.37 years (*SD* = 10.48, *age range* = 18 till 65), 13 were men and 19 women. The subjects were randomly assigned to two conditions (see below, "Design"), i.e. to a Flotation-REST or a Chamber-REST group (REST) and to a Stress or Non-stress group (Stress/Non-stress). The analyses were performed through application of

two-way ANOVA with REST and Stress/Non-stress as independent variables and with dispositional optimism (LOT), anxiety (HAD), depression (HAD), Change-Stability (FS), sleeping-time, latency to fall asleep, quality of sleep, number of nightmares, dream remembrance, amount alcohol consumed per month, number of cigarettes per month, number of snuff doses per month, number of stress symptoms, age, and stress experience as the dependent variables. The analyses showed no significant effects either for REST or Stress/Non-stress, nor were there any significant interaction effects between the independent variables (*ps* > 0.1). The personality test FS which measures creative attitude was transformed to stanine in order to allow a comparison with the norm group (derived from industrial workers and office staff) of the test. An one sample t-test indicated no difference between the sample of this investigation and the norm group arose ($p = 0.919$).

Further analyses were performed through application of the Mann-Whitney U-test with REST and Stress/Non-stress as the independent variables and with profession, education, period within the menstrual cycle (for women), and use of preventive pills by the female subjects as dependent variables. The analyses did not indicate any significant effects either for REST or Stress/Non-stress (*ps* > 0.1). Finally, the Chi-Square test (Goodness-of-fit) was used to examine gender distribution in the four groups of the investigation (i.e. Flotation-REST, Chamber-REST, Stress and Non-stress). It was indicated that the differences in number between genders was non-significant (*ps* > 0.1).

Design

The subjects were randomly assigned in similar numbers to either a Flotation-REST group (16 subjects) or a Chamber-REST group (16 subjects), thereby constituting the independent variable *REST*. Furthermore, the same participants were randomly assigned to either a Stress-group (16 subjects) or to a Non-stress group (16 subjects) thereby constituting the independent variable *Stress/Non-stress*. The most important dependent variables of the investigation were derived from essay-writing, wherein a panel of judges was assigned the task of judging the essays with regard to *Elaboration, Fantasy*, linguistic *Liveliness*, *Originality* as well as social *Realism*.

Instruments

During the experiment three instruments were applied before the manipulation as background variables (FS, LOT and HAD) and two after the manipulation (Composition test and EDN) and a modified version of a test (Stresstest) was applied as a manipulative step (i.e., for Stress group). Finally the floatation tank was used in one of the experimental groups (i.e., the Flotation-REST group).

FS – Change and Stability. An attitude to change and stability test [38] which correlates high with several creativity tests was applied. The test consists of 20 items of the type: "Risk-taking is necessary for success", and each subject was asked to respond on a 4-point scale, ranging from agree to disagree. There was no time limit for the FS test.

LOT – Life Orientation Test. The test [35] consists of eight items, plus four filler items. The task of each subject is to take up a standpoint to the extent of whether or not one is in agreement with each of the items described, on a scale of 0 – 4, where 0 indicates "strongly disagree" and 4 indicates "strongly agree". The test measures dispositional optimism, defined in terms of generalized outcome expectancies.

HAD – Hospital Anxiety Depression Scale. The validity and reliability of the HAD-scale for assessing degree of anxiety and depression symptoms has been examined by Herrmann [39]. The HAD-scale measures the degree of anxiety and depression wherein values under 6 are considered normal, those between 6 and 10 as being borderline, and all values over 10 points are indicative of a probable depression-anxiety diagnosis.

Composition test. Participants were instructed to write an essay based on the four words: ambition, choice, ring and disappointment. Two experienced evaluators of creative production separately judged the essays on a scale from 1 to 10 for Elaboration, Fantasy, Liveliness, Originality and Realism. Consensual definitions [40] of Elaboration, Fantasy, Liveliness, Originality and Realism were used.

EDN – Experienced deviation from normal state. A shortened instrument modified for use with flotation-REST [19] utilizing the internationally-applied psychometric instruments APZ-questionnaire and OAVAV [41] for obtaining judgements of altered states of consciousness. The APZ- and OAVAV-forms are the internationally-applied standard for this purpose and these test have been validated in several studies over different countries [41]. Since the test forms were originally intended for the study of altered states of consciousness as induced by hallucinogenic substances, a number of the original questions were not relevant when flotation-REST was applied as the method of induction. In total, the EDN consists of 29 questions whereby each is responded on a visual analog scale (0-100). A complete "index of experience" was constructed from the points obtained from all 29 questions were averaged to provide a "sum of experience". These values reflect the total experience of deviation from normal states (EDN).

Stress test. The test [42] was developed in order to induce stress in subjects. It consists of a number of tasks, with conflicting descriptions that were difficult to interpret, presented to the subjects under a marked inadequate amount of time availability (eight minutes). In order to reinforce the stress effect in the present case, several more tasks of the same type were included at the same time as amount of time for responding was increased to twelve min.

Flotation tank. A flotation tank (Flytarium Norden, Sweden) measuring 2620 mm x 1670 mm x 950 mm was used. The depth of fluid (salt water) varied between 200-to-300 mm. The flotation tank was insulated partly to maintain a constant fluid temperature (in the water and in the air) and partly to encapsulate each subject from incoming light and noise. The temperature of the fluid was maintained at 34.4°C. The water in the tank was saturated with magnesium sulphate (density: 1.3 g/cm^3). The tank was equipped with a horizontally hinged lid that was easy to open and close (from inside and out) by the subject. Between flotations a hydrogen peroxide solution was regularly poured in, and after this the salt water was filtered and sterilized with UV-light.

Procedure

Directly on arrival, the participant was informed that he/she could terminate the experiment at any time, for any reason. Thereafter he/she was allowed to be seated in an armchair and read the available magazines over 5 min. This procedure has been shown to be effective in allowing the subjects to adapt to the laboratory environment. Following this, each subject was required to complete the information regarding background data, as well as registering on a VAS-scale the degree of stress one experienced during that particular occasion (Stress 1). The next task for the subject was to complete, in random order, the Life Orientation test (LOT), the Hospital Anxiety and Depression scale (HAD) and the change and stability test (FS). If the subject belonged to the Non-stress group then he/she was instructed to return to the armchair and read the magazines, on this occasion for twelve min. If, on the other hand, the subject belonged to the Stress group then he/she instead was required to carry out the test which was designed to induce stress (Stress test) during the same twelve min period. Following this, another stress measurement was registered (Stress 2). If the subject belonged to the Chamber-REST group he/she was given relaxation instructions, according to Benson [43] and the instruction was to employ these exercises as necessary while relaxing on the pallet. Each subject was given wax ear plugs to place in their ears. After this, the door was closed with the subject left alone in the darkened chamber. If the subject belonged to the

Flotation-REST group he/she was instructed to visit the bathroom and then take a shower. Furthermore he/she was instructed to thoroughly dry his/her face so as to avoid irritating droplets of water that might have disturbed the relaxation in the tank. Thereafter the subject was given relaxation instructions according to Benson [43, pp. 159 - 163] and the instruction to utilize these exercises as necessary during floating. So as not to be disturbed by the water and to further eliminate noisy sounds, wax plugs were inserted into the subject's ears. Thereafter the subject entered the tank.

Both REST conditions were maintained for 45 minutes. The reason for this was that the norm for flotation in experiments often is 45 minutes. The norm for chamber REST is however often considerably longer [44]. After 45 min, the REST-treatment was terminated and the subject was asked to complete the EDN instrument, after which a final stress measurement was registered (Stress 3), directly followed by the essay writing task which was continued for 20 min. Following this, the debriefing procedure was carried out and each participant was thanked for taking part.

Interjudge reliability

Correlational statistics (Pearson's r) indicated that there were significant correlations between the two judges with regard to Elaboration ($r = 0.71$, $p < 0.001$), Liveliness ($r = 0.66$, $p < 0.001$), Originality ($r = 0.74$, $p < 0.001$) as well as Realism ($r = 0.72$, $p < 0.001$). On the other hand, there was no significant correlations effect obtained with regard to Fantasy ($r = 0.20$, $p = 0.273$). The results of the correlational analyses indicated that it was possible to combine the two judges' estimates to a mean value for the variables Elaboration, Liveliness, Originality and Realism where it was not possible to employ further the variable Fantasy in data analysis.

RESULTS

First Study

Fluency

Two-way split-plot ANOVA with Number of Flotations and Gender as Between-subject factors and Fluency before and after flotation-Rest, respectively, as Within-Subject factors did not indicate any significant differences with regard to number of flotations ($p = 0.364$), Gender ($p = 0.339$) and nor were there any significant interaction effects between the independent variables or between Between-Subject and Within-subject factors ($ps > 0.4$). There was however a tendency with regard to Fluency before and after treatment [$F(1,34) = 3.76$, $p = 0.061$] whereby it was found that fluency tended to increase after flotation-REST ($M = 15.47$, $SD = 5.67$) compared with before ($M = 14.03$, $SD = 4.52$). Table 1 presents means and standard deviations.

Logical ability

Two-way split-plot ANOVA with Number of Flotations and Gender as Between-Subject factors and Logical ability before and after flotation-REST, respectively, as Within-subject factors did not indicate any significant differences with regard to Number of Flotations ($p = 0.276$), Gender ($p = 0.446$) and nor were there any significant interaction effects between the independent variables or between Between-Subject and Within-subject factors ($ps > 0.5$). There was however a significant difference with regard to Logical ability before and after treatment, respectively [$F(1,34) = 7.70$, $p = 0.009$] whereby it was indicated

that Logical ability deteriorated after flotation ($M = 10.79$, SD = 5.31) compared with before ($M = 12.50$, $SD = 5.36$). Further, there was a tendency towards an interaction effect between Number of Flotations and Gender [$F(1,34) = 3.67$, $p = 0.064$] whereby the male subjects in the one flotation condition tended to obtain lower scores on Logical ability compared with the female subjects in the three flotation condition. Table 1 presents the means and standard deviations.

Table 1. Means and (standard deviations) with regard to Fluency before and after Flotation-REST, respectively, as a function of Number of flotations (one or three) and Gender (male or female).

	One flotation		Three flotations	
	Male	Female	Male	Female
Fluency before	14.44 (4.82)	16.00 (5.72)	13.00 (4.31)	13.36 (3.93)
Fluency after	14.11 (6.55)	18.00 (5.20)	15.00 (2.78)	15.36 (6.62)
Logical before	10.78 (5.19)	13.14 (5.61)	15.62 (4.75)	11.50 (5.40)
Logical after	9.33 (5.20)	10.71 (4.68)	14.38 (6.48)	9.71 (4.51)

Second Study

Essay variables

Statistical analysis was carried out through use of two-way ANOVA (2 x 2 factorial design) with REST and Stress/Non-stress as independent variables and Elaboration, Liveliness, Originality and Realism as dependent variables. The results of each ANOVA are described below. Table 2 presents the mean values and standard deviations.

Table 2. Means and (standard deviations) in regard toElaboration, Liveliness, Originality and Realism in REST and Stress/Non-stress conditions.

	Flotation-REST		Chamber-REST	
	Stress	Non-stress	Stress	Non-stress
Elaboration	3.63 (2.43)	3.44 (1.05)	6.00 (2.38)	5.25 (1.79)
Liveliness	6.38 (1.89)	3.31 (1.33)	4.13 (2.10)	5.13 (2.12)
Originality	6.56 (1.72)	5.13 (2.40)	3.63 (1.79)	4.75 (2.45)
Realism	3.56 (1.82)	5.50 (2.04)	7.13 (1.13)	5.06 (2.03)

Elaboration. The analysis did not show any significant effects with regard to either interaction or effects of Stress/Non-stress ($ps > 0.5$), but did with regard to REST [$F(1,28) = 8.84$, $p = 0.006$] whereby further analysis indicated that the Chamber-REST group demonstrated more elaboration ($M = 5.63$, $SD = 2.07$) in comparison with the Flotation-REST group ($M = 3.53$, $SD = 1.81$).

Liveliness. The analysis did not show any significant effects for either REST or Stress/Non-stress ($ps > 0.1$) but did show an interactions effect [$F(1,28) = 9.28$, $p = 0.005$]. Interactions analysis (unrelated t-test, 5% levels) indicated that the subjects that had been

exposed to stress in the Flotation-REST group produced higher scores on Liveliness (M = 6.38, SD = 1.89) in comparison with the subjects in the Flotation-REST group that had not been exposed to stress (M = 3.31, SD = 1.33). In the Chamber-REST group no significant differences were obtained between those subjects exposed to stress (M = 4.13, SD = 2.10) and those not exposed to stress (M = 5.13, SD = 2.12), respectively.

Originality. The analysis did not show any significant differences for either an interactions effect or Stress/Non-stress ($ps > 0.09$), but did so with regard to REST [$F(1,28)$ = 4.90, $p = 0.035$] whereby further analysis indicated that the Flotation-REST group showed a greater degree of originality (M = 5.84, SD = 2.15) in comparison with the Chamber-REST group (M = 4.19, SD = 2.15).

Realism. The analysis did not show any significant effect for Stress/Non-stress (p = 0.922), but did so with regard to REST [$F(1,28) = 6.090$, $p = 0.020$] as well as an interactions effect [$F(1,28) = 9.98$, $p = 0.004$]. Further analysis indicated that the Chamber-REST group showed more Realism (M = 6.09, SD = 1.91) in comparison with the flotation-REST group (M = 4.53, SD = 2,12). Interactions analysis (unrelated t-test, 5% level) indicated that the subjects who had been exposed to stress in the Chamber-REST group scored more points on Realism (M = 7.13, SD = 1.13) than those subjects in the Chamber-REST group that had not been exposed to stress (M = 5.06, SD = 2.03). In the flotation-REST group, there were no significant differences obtained between those subjects who had been exposed to stress (M = 3.56, SD = 1.82) and those that had not been exposed to stress (M = 5.50, SD = 2.03), respectively.

Manipulation controls

Experience of stress. As already reported in the presentation of the background variables, there were no significant differences with regard to either REST or Stress/Non-stress in the measure of experienced stress at the start of the experiment. Following the induction of stress a further measurement of stress (Stress 2) was undertaken. A two-way ANOVA with REST and Stress/Non-stress as independent variables and with Stress 2 as the dependent variable did not indicate any significant effects with regard to REST or an interaction effect but did show a significant effect of Stress/Non-stress [$F(1,28) = 20.74$, $p <$ 0.001]. Further analysis indicated that the group that had been exposed to experimental stress demonstrated higher values (M = 5.92, SD = 2.12) than the group that had not been exposed to stress (M = 2.39, SD = 2.21). Directly following flotation and lying on the coach, respectively, and prior to essay-writing a further measure of experienced stress was taken (Stress 3). A two-way ANOVA with REST and Stress/Non-stress as independent variables and with Stress 3 as independent variable did not show any significant effects with regard to REST, Stress/Non-stress or any interactions effect ($ps > 0.1$). The stress group value was now 1.42 (SD = 1.70) and the group not exposed to stress 0.61 (SD = 1.07).

Experience of an altered state of consciousness. Experiences of altered states of consciousness (EDN) were summated to an index. A two-way ANOVA with REST and Stress/Non-stress as independent variables and with experience of altered state of consciousness as dependent variable did not indicate any significant effects with regard to Stress/Non-stress or any interaction effect but did with regard to REST [$F(1,28) = 4.93$, $p =$ 0.035]. Further analysis indicated that the flotation-REST group experienced a higher degree of altered consciousness (M = 40.46, SD = 22.54) compared to the Chamber-REST group (M = 24.59, SD = 17.45).

Gender with regard to the dependent variables

One-way ANOVA statistics with gender (male, female) as independent variable and with Elaboration, Liveliness, Originality and Realism as dependent variables showed no significant differences between the genders (*ps* > 0.15).

Correlational analyses

In order to analyze any eventual relationship between the essay variables and the personality variables and altered state of consciousness correlational analyses (Pearson's *r*) were applied (see Table 3).

Table 3. Correlations between dependent variables and dispositional optimism (LOT) and Change and Stability (FS) and Experienced deviation from normal state (EDN)

	Elaboration	Liveliness	Originality	Realism	LOT	FS	EDN
Elaboration	1.00						
Liveliness	0.53**	1.00					
Originality	-0.13	0.21	1.00				
Realism	0,06	-0.43**	-0.04	1.00			
LOT	0.13	0.26	0.36*	-0.13	1.00		
FS	0.13	0.20	0.36*	0.06	0.27	1.00	
EDN	0.05	0.38*	0.07	-0.59**	0.13	0.10	1.00

* Correlation is significant at the 0.05 level (2-tailed)
** Correlation is significant at the 0.01 level (2-tailed)

DISCUSSION

The results of the present study may be summarized as follows: (1) No differences concerning divergent or logical production were obtained whether flotation occurred once or on three occasions. (2) Flotation-REST induced more originality, yet less deductive thinking. (3) Chamber-REST induced more realistic and elaborated thinking. (4) Subjects that were stressed in the Flotation-REST condition were more lively compared with the non-stressed subjects in that condition. (5) Stressed subjects in the Chamber-REST condition showed more realism than their non-stressed counterparts. (6) Both Flotation-REST and Chamber-REST were equally effective in reducing stress, i.e. showed comparable efficacy as relaxation techniques. However, Flotation-REST altered consciousness to a greater extent than Chamber-REST. (7) Correlational analysis indicated that the more adaptable and receptive to change and the more optimistic one was, the more originality on essay-writing one exhibited. Further, there was a relationship between more lively accompanied by less realistic.

Thus, it may be possible to derive certain conclusions against a background assumption that sensory isolation induces a shift in awareness to the advantage of primary process-oriented cognition [28], namely that a high degree of altered consciousness (or, high degree of primary process) in combination with an optimistic outlook produces optimal conditions for originality, whereas a lesser degree of altered consciousness (or, higher degree of secondary process) produces optimal conditions for realism and elaboration. It is reasonable to consider that primary process condition disrupt problem-solving abilities (i.e.

since problem-solving is based on the secondary process). These results are in agreement with earlier studies [12, 21].

The novel findings of the present study pertain to stress interactions. Here, one may draw comparisons with earlier observations [45] indicating that in many professions with a demand upon creativity (e.g. writers, journals, advertising agents) there is a penchance to seek out stressful situations, e.g. 'just making deadlines', and the feeling thereby that a 'bonus of productivity' is achieved. Furthermore, the present findings suggest that stress induces the secondary process to greater realism.

Finally, the present study provides further support for the notion that previous experience and expectancies have a relatively minor involvement in how one experiences flotation-REST. It was shown that whether subjects underwent one or three flotations had no effect since creative ability was improved, and deductive ability deteriorated, to the same extent. On the other hand, whether subjects underwent three, rather than one, flotation(s) failed to influence the extent of outcome for creativity (i.e. improvement) or deductive powers (i.e. deterioration), i.e. through any possible extinction-like effect. These results may be associated with an earlier study [23] wherein it was found that earlier experience of an altered state of consciousness or the instruction "strict" or "fantasy" to subject had negligible effect upon their experience of sensory isolation in the tank. Thus, the present results stand in contrast to drug-related studies [34] where it was shown that experience and expectancies often play a critical role in the expression of drug-induced effects. This dissociation is understandable since flotation and sensory isolation ought not to affect brain processes by the type of direct chemical action that substances, particularly abused substances, exert on specific regions, e.g. the reticular formation. However, further studies are required to map out the circumstances dictating when several flotations are efficacious or when a single occasion induces the desired effect. Generally, flotation REST experiments maintain only one control group, i.e. an armchair group or a couch group. In the present study the couch group was used. A better solution had been the "double-control group design" [12] i.e., using both the couch and armchair groups thereby making comparisons possible with flotation-REST, short relaxation through chamber-REST and non-REST.

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Paper III

III

Altered Consciousness in Flotation-REST and Chamber-REST: Experience of Experimental Pain and Subjective Stress*

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ABSTRACT

Twenty-three sportsmen were given one 45-min exposure to flotation-Rest and one exposure to chamber-REST on two occasions, incorporating random assignment to either flotation-REST followed by chamber-REST or vice versa. On each occasion, the REST procedure was followed immediately by testing of experimentally-induced pain to one arm using a blood pressure cuff. It was found that flotation-REST induced a significantly higher degree of altered states of consciousness (ASC), as measured with an instrument assessing deviation from normal state (EDN), than chamber-REST. Participants experiencing High EDN in the flotation-REST condition reported higher levels of both 'experienced pain' and 'experienced stress' than those experiencing Low EDN. The present results suggest that the particular distinguishing features of flotation-REST and chamber-REST may cause selective deviations from normal levels of consciousness, under experimental conditions, that may underlie the subjective experience of pain and stress thresholds.

*The study has had ethical approval from the Ethical Board on Experimentation on Human Subjects (Forskningsetikkommittén) at Karlstad University, Sweden.

background data and exclusion criteria were assembled and collected and the participants responded on the LOT-test and HAD-test. Afterwards, each participant was demonstrated the procedure by which experimental pain would be induced on the next occasion. An ordinary blood pressure cuff was applied to each participant's non-dominant arm. Systolic blood pressure was measured. The participant was asked then to hold his arm an upright position for 2 minutes, and at the same time to keep all his fingers outstretched. After this, the arm (still upright) was bound hard with a rubber band (the so-called Dauer binding) in order to constrict blood circulation from the fingers to the point where the as yet deflated blood pressure cuff was applied. Then the participant's arm was allowed to descend to a normal resting position on the table. Following this, the blood pressure was pumped up to double the systolic blood pressure that had been measured earlier (normally about 250 mm Hg). It was at this point that the actual pain induction (as performed in all the following tests) was initiated, but during this first, introductory occasion the demonstration was terminated by instead releasing the air from the cuff and removal of the rubber band. After this, the laboratory and flotation tank was demonstrated to the participant who was asked to use the lavatory and shower before floating and shown how to apply the ear-plugs before going into the tank. Following this, a test flotation over 20 minutes was given. Later, after showering and dressing the participant was randomly assigned, for his next visit, to either the flotation-REST or chamber-REST condition. Then the dark, quiet room with the couch for chamber-REST was shown and the next visit of the participant was booked.

On arrival for his second visit, the participant experienced either flotation-REST or chamber-REST during 45 minutes, according to whichever he had been randomly assigned to. Flotation-REST procedures were maintained as described above. The chamber-REST procedure was preceded by a toilet visit and a change to comfortable clothes (T-shirt and underpants). On completion of flotation-REST, the participant was allowed 15 minutes for showering and changing. In order to ensure a similar temporal arrangement for chamber-REST, the participant was required to remain in the room a further 15 minutes. After completion of the respective REST-treatment the participant was required to complete the EDN-test. Those participants that experienced flotation-REST were provided also with the SFE-questionnaire. After this, the induction of pain procedure was initiated. The same procedure was completed, as described earlier, during the first visit as well as the careful attachment of the pulsoxymeter and ear-probe to the participant's ear. Paper and coloring pens were available on a table in front of the participant and he was urged to "draw something" with his free arm during the time that the induction of pain procedure was maintained.

Measures of experienced pain were taken, by questioning, then every minute (which the participant marked on the horizontal line on the VAS-scale, whereby 0 indicated "no pain" and 100 indicated "excruciating pain"). Degree of "experienced stress" was estimated, by questioning, at 2, 5, 8, 10, 12, 13, 14 and 15 minutes, here too the VAS-scale was used whereby 0 indicated "not stressed at all" and "maximum possible stress". Concurrently with the participant's estimations of experienced stress, pulse frequency and oxygen levels with measured using the pulsoxymeter. The participant had not received any information about how long the experiment could continue but were rather instructed to carry on as long as they were able to. After 15 minutes the cuff was removed and the experiment terminated. As part of the experimental it was decided that the Experimenter would terminate the experiment if any participant estimated "experienced pain" on the VAS-scale to 75-80 or more, or if some aspect of the verbal communication between the Experimenter and the participant indicated that the individual was unnecessarily troubled by pain. However, this situation did not occur for any of the participants. Immediately after the cuff had been removed, the participant was required to estimate the length of time that cuff had remained inflated upon his arm.

On arrival at the laboratory for the third and final visit, the participant was required to complete a questionnaire presenting questions about bodily pain and eventual discomfort following previous induction of pain. After this, the experiment was carried out in an identical manner to the procedure used during the participant's second visit to the laboratory except that the other REST-condition, compared to that applied in the previous visit, was presented. On completion of the experiment the participants were each thanked for their participation.

RESULTS

Data reduction

In order to facilitate the statistical analysis, the possibility to perform reduction of the data regarding experienced pain, experienced stress, pulse rate and oxygen saturation was investigated by regression analysis (enter-method) through calculating Multiple R (R).

The analyses indicated significant correlations for *experienced pain* following couch ($R = 0.99, p = 0.002$) and following flotation tank ($R = 0.99, p < 0.001$), for *experienced stress* following couch ($R = 0.94, p < 0.001$) and following flotation tank ($R = 0.96, p < 0.001$), for *pulse* rate following couch ($R = 0.91, p < 0.001$) and following flotation tank ($R = 0.95, p < 0.001$), as well as for *oxygen saturation* following couch ($R = 0.91, p < 0.001$) and following flotation tank ($R = 0.93, p < 0.001$). Since these analyses indicated high correlation values ($R > 0.90$), the mean values for the results pertaining to experienced pain, experienced stress, pulse rate and oxygen saturation in exhaled air were applied to further statistical analysis.

Reliability

In order to understand whether or not the order of the conditions may have influenced the results, participants that underwent floating on the first occasion were compared with those that received floating on the second occasion. Split-plot ANOVAs were used with altered state of consciousness (EDN), experienced pain, experienced stress, pulse rate and oxygen saturation as Within-Subject Factors and order of each condition (i.e. flotation-REST on the first occasion or flotation-REST on the second occasion) as Between-Subject Factor. The analyses indicated that the order of each condition did not exert any influence upon either altered state of consciousness ($p = 0.165$), experienced pain ($p = 0.263$), experienced stress ($p = 0.351$), pulse rate ($p = 0.234$), blood pressure ($p = 0.353$), oxygen saturation ($p = 0.489$), experienced time for REST treatment ($p = 0.073$), as well as experienced time for the blood pressure cuff. Nor were there any interaction effects obtained between the Between Factors and the Within Factors ($ps > 0.05$).

Comparison between chamber-REST and flotation-REST

In order to analyze the dependent variables, statistics with Paired-Samples t-test (5% level) were used. The analyses did not indicate any significant differences between chamber-REST and flotation-REST with regard to experienced pain ($p = 0.989$), experienced stress ($p = 0.985$), pulse rate ($p = 0.293$), blood pressure ($p = 0.476$), oxygen saturation in blood ($p = 0.316$), estimated time for REST-treatment duration ($p = 0.086$), and estimated time for blood pressure cuff duration ($p = 0.966$). However, there was a significant difference with regard to altered state of consciousness (EDN) [$t\,(22) = 4.88, p < 0.001$], whereby it was indicated that flotation-REST induced a higher degree of altered state of consciousness ($M = 32.48$, $SD = 15.94$) compared with the chamber-REST condition ($M = 15.10$, $SD = 13.11$).

Table 1 presents the means and standard deviations for each variable in the flotation-REST and chamber-REST conditions.

Table 1. Means (and standard deviations) for the variables pertaining to the REST-conditions.

	Chamber-REST	*Flotation-REST*	*%Quotient*
Experienced pain	26.92 (15.63)	26.88 (18.37)	100
Experienced stress	11.61 (12.42)	11.65 (13.30)	100
Pulse	69.26 (11.01)	70.77 (10.90)	102
Blood pressure	108.26 (12.76)	111.09 (10.76)	102
Experienced REST-time	36.17 (8.05)	41.89 (10.06)	116
Experienced cuff time	10.08 (2.89)	9.46 (2.96)	94
EDN *	14.57 (13.06)	32.48 (15.94)	223

* indicates significant difference (5% level) between REST-conditions.
% Quotient was derived by dividing Flotation-REST mean values by chamber-REST mean value and multiplying by 100.

Comparison between low and high EDN within respective REST condition

The participants' points regarding altered state of consciousness (EDN) following the chamber-REST treatment were divided to form two groups (*cut-off-point* = 47.8 %), i.e. one group presenting a low altered state of consciousness (Low EDN, 11 individuals, $M = 4.98$, $SD = 2.12$) and one group presenting a high altered state of consciousness (High EDN, 12 individuals, $M = 23.36$, $SD = 12.69$). An identical procedure pertaining to participants' points regarding altered level of consciousness (EDN) following the flotation-REST treatment were divided to form two groups (*cut-off-point* = 47.8 %), with one group presenting a Low EDN (11 individuals, $M = 19.29$, $SD = 7.23$) and the other group presenting a High EDN (12 individuals, $M = 44.58$, $SD = 12.26$).

Chamber-REST. Independent Samples t-tests (5% level) with EDN (Low, High) as independent variable did not indicate any significant differences between low and high degree of altered state of consciousness regarding experienced pain ($p = 0.073$), experienced stress ($p = 0.110$), pulse rate ($p = 0.762$), blood pressure ($p = 0.410$), oxygen saturation in blood ($p = 0.462$), estimated time for REST-treatment duration ($p = 0.443$), as well as estimated time for blood pressure cuff duration ($p = 0.355$). Table 2 presents the means and standard deviations between Low and High EDN in the chamber-REST condition.

Table 2. Comparisons between the Low-EDN and High-EDN reporting participants within the chamber-REST condition.

	Low-EDN	*High-EDN*	*%Quotient*
Experienced pain	20.84 (7.50)	32.49 (19.15)	155
Experienced stress	7.27 (6.04)	15.58 (15.46)	214
Pulse	70.01 (7.69)	68.57 (13.70)	98
Blood pressure	105.91 (13.75)	110.42 (11.96)	104
Experienced REST-time	34.57 (7.16)	38.40 (9.50)	111
Experienced cuff time	9.38 (2.83)	10.72 (2.97)	115
EDN *	4.98 (2.12)	23.36 (12.69)	469

* indicates significant difference (5% level) between High and Low EDN.
% Quotient was derived by dividing High-EDN mean values by Low-EDN mean value and multiplying by 100.

Flotation-REST. Independent Samples t-tests (5% level) with EDN (Low, High) as independent variable did not indicate any significant differences between low and high degree of altered state of consciousness levels regarding pulse rate ($p = 0.820$), blood pressure ($p = 0.156$), oxygen saturation in blood ($p = 0.192$), and estimated time for REST-treatment duration ($p = 0.191$). However, there was a significant difference with regard to experienced pain [$t(21) = 3.59$, $p = 0.002$], whereby further analysis indicated that the participants presenting High EDN experienced a higher level of pain ($M = 37.49$, $SD = 18.84$) compared with those presenting a Low EDN ($M = 15.30$, $SD = 8.30$). Furthermore, there was a significant difference with regard to experienced stress [$t(21) = 2.23$, $p = 0.037$], whereby further analysis indicated that the participants presenting High EDN experienced a higher level of stress ($M = 17.10$, $SD = 16.06$) compared with those presenting a Low EDN ($M = 5.70$, $SD = 5.54$). Finally, there was a significant difference with regard to estimated time for blood pressure cuff duration [$t(21) = 3.057$, $p = 0.010$], whereby further analysis indicated that the participants presenting Low EDN experienced a longer duration of blood pressure cuff ($M = 12.00$, $SD = 2.74$) compared with those presenting a High EDN ($M = 8.00$, $SD = 2.07$). Table 3 presents the means and standard deviations between Low and High EDN in the flotation-REST condition.

Table 3. Comparisons between the Low-EDN and High-EDN reporting participants within the flotation-REST condition.

	Low-EDN	*High-EDN*	*%Quotient*
*Experienced pain**	15.30 (8.30)	37.49 (18.84)	245
*Experienced stress**	5.70 (5.54)	17.10 (16.06)	300
Pulse	71.33 (10.09)	70.26 (12.06)	98
Blood pressure	107.73 (8.47)	114.17 (12.03)	106
Experienced REST-time	39.27 (9.21)	45.50 (10.66)	116
*Experienced cuff time**	12.00 (2.74)	8.06 (2.07)	67
EDN *	19.29 (7.23)	44.58 (12.26)	231

* indicates significant difference (5% level) between Low and High-EDN.
% Quotient was derived by dividing High-EDN mean values by Low-EDN mean value and multiplying by 100.

DISCUSSION

In the present study, twenty-three male athletes participated in two REST conditions (chamber, flotation), wherein the order of presentation of the conditions was randomized, but the time-interval between each REST condition was held constant, i.e. six weeks. One main finding was that flotation-REST induced a significantly higher degree of altered states of consciousness (ASC), as measured with EDN, than chamber-REST. This finding confirms the results of earlier studies (eg. Norlander, Kjellgren & Archer, in press). In this study the experience of an ASC is described in terms of a continuum of the two REST conditions by which participants achieving a ´higher altered state´ in the Chamber-REST condition essentially displayed the same EDN points as those participants achieving a ´lower altered state´ in the flotation-REST condition. Participants achieving higher ASC in the latter condition experienced significantly more pain and stress, and also perceived pain duration as shorter compared with those participants with a lower ASC in the same condition. Comparison of lower and higher ASC in the chamber-REST conditions did not produce such differences. Thus, it is possible that acute, induced pain may be experienced with more intensity under conditions wherein the higher levels of ASC (as assessed by EDN) are associated with elevated levels of awareness and sensitivity consciousness and sensitivity for sensory stimuli. It appears that the hypothesis regarding the role of ASC upon receptivity to acute pain was confirmed. As indicated previously, an ASC is marked by increased focus and attention upon internal stimuli and processes (Ludwig, 1990). Nevertheless, it does not appear that the role of ASC in acute induced pain has been addressed earlier. With regard to chronic pain, several studies have shown that flotation-REST induced an alleviation of pain (eg., Kjellgren et al., 2001).

Certain cognitive relationships may underlie the influences of Flotation-REST upon acute and chronic pain, respectively. REST appears to induce a 'cognitive shift' (Norlander, 1997; Norlander, Bergman & Archer, 1998) whereby primary process thinking (i.e. "here and now" thinking) is reinforced at the cost of secondary process thinking (i.e. a more "abstract and temporal-based" thinking). It is possible that under the influence of heightened primary process thinking, e.g. through Flotation-REST experience, an individual with an existing pain (chronic) experiences greater attention upon physical and psychological relaxant effects accompanied by reduced attention upon the pain signal. Conversely, if an individual not bearing any particular pain experience directly after Flotation-REST is exposed to intense pain he/she may experience intensive distress due to the abrupt termination of primary process thinking. Previous studies (Norlander, Bergman & Archer, 1998) have demonstrated an "after-effect" whereby elevation of primary process remains for at least an hour after Flotation. Possibly, the stronger the influence of primary process the greater the distress due to enforced 'cognitive shift'.

The application of intense experimental pain in the present study distinguishes it from other REST studies. Furthermore, all the participants were aware that the experimental pain would not cause lasting damage, and the pain would end when the experiment was terminated or when they themselves, as free volunteers, chose to terminate. These considerations indicate that the affective components otherwise associated with chronic pain were missing (as discussed earlier, this is one of the weaknesses of experimental pain studies). Further, it ought to be noted that the present study incorporated a single instance of REST-Flotation rather than a series of treatments as applied in the previous pain-reduction studies

wherein different types neurohumoral and/or physiological changes may have occurred and to some extent measured (Kjellgren, et al., 2001).

The present study suggests the existence of some "threshold-level" in the degree of ASC that must be overcome before measurable effects on the variables investigated are observed. The finding that degree of experienced ASC in the chamber-REST condition induced means for the highest EDN values (i.e. most altered) that were comparable to those of the lowest EDN values for Flotation-REST seems to support this notion. Note that the means of the highest EDN values (ASC) for Flotation-REST are much higher (High-EDN as a percentage of Low-EDN: Experienced pain = 245%, and Experienced stress = 300%) than those of the highest EDN values for chamber-REST (High-EDN as a percentage of Low-EDN: Experienced pain = 155%, and Experienced stress = 214%). It ought to be indicated that there were no significant differences for experienced pain and stress on the comparison between the methods, Flotation-REST and chamber-REST, but rather the significantly higher pain and stress experiences were reported from individuals showing the highest ASC values.

One characteristic property of ASC is disturbance of temporal perspective (Ludwig, 1990). It was found that the experience of time during which pain was applied (cuff-duration) was significantly different for participants expressing a high degree of ASC within the Flotation condition. Earlier Flotation-REST studies (Norlander, Kjellgren & Archer, 2001) have shown too that individuals under the influence of the flotation tank experience that time passes more quickly. The shortened time perspective by the High-EDN participants in the Flotation-REST condition (High-EDN as a percentage of Low-EDN: Experienced cuff duration = 67%) compared to Low-EDN participants may offer further effects of the condition that may be pertinent to the more intensive experience of pain. In the chamber-REST condition, the High-EDN participants indicated a slightly, but non-significantly, lengthened time perspective (High-EDN as a percentage of Low-EDN: Experienced cuff duration = 67%) compared to Low-EDN participants.

It is possible that a different group of participants may have provided a different set of results. In the present study young male students participated. Other investigations have shown that increasing age is associated with higher pain threshold and impaired ability to discriminate between levels of noxious stimuli (Gagliese & Melzack, 1997). Naturally the effects of aging offer an important feature for further research. Gender may be another factor of importance in regard to experienced pain intensity since women often report higher levels of subjective pain as compared to men in experimental pain studies (eg. Berkley, 1997; Unruh, 1996). In this regard, further studies ought to examine the potential effects of gender in both young and older groups.

The pain experience in an experimental pain method may also be modulated by the type of instructions provided to participants. Here, the instruction was: "try to withstand the pain as long as you are able to" instead of informing the participants that pain was to be experienced during a fixed time duration (in this case 15 minutes). Thorn & Williams (1989) have shown that estimations of pain in ischemic pain tests are lower if participants are given prior information that the pain was of fixed duration. The "fixed-time" instruction was withheld in order to provide a semblance of clinical pain wherein an uncertainty regarding duration of pain is probably a factor of some influence.

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Paper IV

Effects of flotation-REST on muscle tension pain

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A Kjellgren, U Sundequist, T Norlander, T Archer. Effects of flotation-REST on muscle tension pain. Pain Res Manage 2001;6(4):181-189.

The purpose of the present study was to investigate whether the floating form of the restricted environmental stimulation technique (REST) may be applied within the field of pain relief. Flotation-REST consists of a procedure whereby an individual is immersed in a tank filled with water of an extremely high salt concentration. Thirty-seven patients (14 men and 23 women) suffering from chronic pain consisting of aching muscles in the neck and back area participated in the study. They were randomly assigned to either a control group (17 participants) or an experimental group (20 participants). The experimental group received nine opportunities to use the flotation-REST technique in the water tank over a three-week period. The results indicated that the most severe perceived pain intensity was significantly reduced, whereas low perceived pain intensity was not influenced by the floating technique. Further, the results indicated that circulating levels of the noradrenaline metabolite 3-methoxy-4-hydroxyphenylethyleneglycol were reduced significantly in the experimental group but not in the control group following treatment, whereas endorphin levels were not affected by flotation. Flotation-REST treatment also elevated the participants' optimism and reduced the degree of anxiety or depression; at nighttime, patients who underwent flotation fell asleep more easily. The present findings describe possible changes, for the better, in patients presenting with chronic pain complaints.

Key Words: *Altered state of consciousness; Anxiety; Depression; Flotation; Life orientation test; Pain reduction; Restricted environmental stimulation technique*

Effets d'une technique de restriction des stimuli environnementaux et de flottement sur la douleur d'origine musculaire

RÉSUMÉ: Le but de la présente étude était de vérifier si le volet flottement d'une technique de restriction des stimuli environnementaux (technique REST pour *restricted environmental stimulation technique*) peut s'appliquer au domaine de l'analgésie. La technique de flottement-REST consiste à immerger le sujet dans un réservoir empli d'eau à teneur extrêmement forte en sel. Trente-sept patients (14 hommes et 23 femmes) souffrant de douleurs chroniques, soit de douleurs musculaires au cou et au dos, ont pris part à l'étude. Ils ont été assignés aléatoirement soit à un groupe témoin (17 patients) ou à un groupe expérimental (20 patients). Le groupe expérimental a reçu neuf occasions d'utiliser la technique de flottement-REST dans un réservoir d'eau au cours d'une période de trois semaines. Selon les résultats enregistrés, l'intensité douloureuse la plus grave perçue a été significativement atténuée, alors que l'intensité douloureuse la plus faible perçue n'a subi aucune influence de la technique de flottement. En outre, les résultats ont montré que les taux du métabolite circulant 3-méthoxy-4-hydroxyphénylélthylèneglycol de la noradrénaline était significativement diminué dans le groupe expérimental et non dans le groupe témoin après le traitement, alors que les taux d'endorphine n'ont subi aucune influence de la technique de flottement. Le traitement par flottement-REST a en outre stimulé l'optimisme des participants et réduit leur degré d'anxiété ou de dépression. Au coucher, les patients soumis au traitement de flottement se sont endormis plus facilement. Ces résultats décrivent certaines améliorations possibles chez les patients qui souffrent de douleurs chroniques.

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Received for publication June 9, 2000. Accepted November 29, 2000

The current achievement-based, demanding, high tempo society has incurred increased risks and vulnerability for stress-related chronic pain and other illnesses. Increased muscle tension facilitates the development of chronic pain, and has been observed to induce negative effects on concentration, self-confidence, learning and memory. The brain and central nervous system undergo constant bombardment with information. Relaxation exercises offer a means of reducing the physiological and psychological reactions to stress; however, the individuals most in need of relaxation techniques are often those who find it most difficult to perform these exercises (1,2).

The flotation-restricted environmental stimulation technique (REST) is a method whereby an individual is placed in a horizontally floating posture, immersed in high-concentration salt water, in an environment (the floating tank) where all incoming stimuli are reduced to the minimum during a short period. The salt water in the floating tank is maintained at skin temperature, ear-plugs are used to minimize sounds, and when the tank is closed complete darkness ensues. Flotation-REST is cost effective and secure, with minimal or complete absence of adverse effects (3,4). The method was developed by Lilly (5) in the 1950s, and no accidents or mishaps have been reported with its use. Previous reports concerning stimulus-reduction to the sensory organs (sensory deprivation) indicated several negative effects, such as confusion, worry and stress (6), whereas more recent research has shown that meaningful, positive effects may be obtained (7). However, several studies have demonstrated positive effects, such as increased well-being (8); mild euphoria (7); increased originality (9); improved sleep (10); reduced stress, tension and anxiety (4,7,11); reduced blood pressure (11,12); and less muscle tension (13). The technique has also been shown to be a suitable complement to psychotherapy (8,14). The experience is pleasant, and subjects always endorse it on further occasions (15).

Several studies have applied flotation-REST as a method of alleviating different types of pain conditions. Patients suffering from chronic headache experienced significant improvements after flotation-REST treatment, and these improvements were maintained during follow-up six months later (16). Notable improvements in patients with rheumatic aches were observed by Mereday et al (17). Alleviation of premenstrual pain was noted by Goldstein and Jessen (18). Other studies showing analgesic effects associated with flotation-REST have been reported by Fine and Turner (19), and Norlander et al (15). Attempts have been made to identify the physiological markers for the subjectively experienced pain alleviation that is often reported with flotation-REST. Significant reductions in adrenocorticotropic hormone and plasma cortisol levels have been found after REST (20,21). One study (12) showed, in a series of eight sessions, that REST was followed by a decrease in plasma cortisol levels and a reduction in arterial blood pressure compared with the initial treatment. However, Schulz and Kaspar (7) did not find any changes in plasma cortisol levels and other endogenous substances in subjects 60 min after floating compared with lying on a mattress for an equivalent period of time.

Flotation-REST is a technique that readily induces a state of altered consciousness (22). This condition has been described as a cognitive shift to the advantage of primary process-oriented cognition (2,23). More logical thinking and directed attention (secondary process) are shunted aside by more intuitive thinking and nondirected fantasy (primary process). To apply flotation-REST as a treatment or therapy, it is essential that the personnel involved have sufficient knowledge of the conditions being treated. The degree to which a person experiences an 'altered state' is highly individual. The most usual experience is likely one of calm and pleasant relaxation, often in combination with a somewhat altered perception of time (24). Other individuals experience, over and above this relaxation, a dream-like or hypnotic state (15), wherein slight perceptual or cognitive alterations may occur. Visual phenomena, ranging from spots, colours and lights to lively spontaneous images (unwilled vivid imagery) have been described by Forgays and Belinson (24), and Raab and Gruzelier (25). Lilly (5) accumulated a comprehensive literature on mental experiences in the floating tank. Norlander et al (15) reported that flotation-REST can induce intense transpersonal experiences that generally occur with altered states of consciousness, despite the type of induction, but are perhaps strongest in drug-induced states (26,27).

The purpose of the present study was to investigate whether flotation-REST is an effective and reliable method for treating chronic pain, as well as several psychosomatic symptoms resulting from long term muscle tension and/or stress-related headaches.

SUBJECTS AND METHODS

Participants

A portion of the participants were recruited through a 'remission' procedure (a procedure that allows patients access to specialized treatment on recommendation from their physician) from each one's general practitioner. A portion of the participants responded to announcements by the Karlstad University, Sweden, for individuals suffering from localized muscle tension pain in the neck and shoulder area, with or without temporal headache, associated with myofascial tender points (28) or trigger points (29,30). Each individual was required to make an initial visit to the clinic, where he or she was informed about the project, was screened for suitability, and underwent a medical examination and a careful pain analysis, including palpation of muscle status and neurological examination. Among the exclusion criteria were pregnancy or ongoing breastfeeding, somatic problems or illnesses requiring other types of treatment, open wounds, manifest psychiatric symptoms, neurological disturbances, whiplash-related disorders, manifest post-traumatic stress disorder, regular treatment with opiate analgetics or sedatives, and signs of anxiety, fear or discomfort due to enclosure in a restricted environment. The 44

subjects were randomly assigned to either the control group or the experimental group. Five subjects in the experimental group and two subjects in the control group withdrew from the experiment. Therefore, the final experimental population consisted of 37 subjects comprising a control group (17 subjects – seven men and 10 women) and an experimental group (20 subjects – seven men and 13 women). The mean age of the participants was 31.63 years (SD=9.87). Approximately half of the participants (56.75%; 21 patients) presented with more than one type of pain complaint, and almost the same number (51.36%; 19 subjects) reported that the onset of pain had been immediate. One subject (2.7%) reported that the pain had begun in association with an illness (infection); seven subjects (18.92%) indicated that 'accidents' (fall) were the cause of the pain. Other causes named were 'postoperative' (two subjects; 5.41%) and 'postphysical abuse' (one subject; 2.7%), but the majority of subjects reported the common causes of myofascial pain, such as monotonous, repeated physical strain or high demands. The participants' earlier experiences of pain treatment consisted of such methods as analgesics (paracetamol, nonsteroidal anti-inflammatory drugs, opioids), physiotherapy and acupuncture, the relative frequencies of which are presented in Table 1. Approximately one-third of the participants (14 subjects; 37.84%) reported that they were taking an occasional paracetamol medication (maximum 4000 mg during the three weeks) or ibuprofen (one subject with a total of 1200 mg) during the course of the experiment; these participants were from both the control and experimental groups. The subjects did not receive any other type of medication treatment during the study period. Sleep disturbances were reported by seven subjects (18.92%; three control and four experimental). None of the patients were receiving any other form of treatment (eg, physiotherapy) during the study period. This stipulation was ensured contractually and was monitored throughout the study.

The total frequencies of the reported health-related problems (eg, allergies, constipations, heart-flutters, neurological deficiencies, breathing problems) were summated (according to the information acquired at the initial medical examination) to measure the 'total burden'. A two-way ANOVA with sex and groups as independent variables did not show any significant differences between the groups or any effect of the interaction (P>0.67). However, there was a significant effect of sex (F[1,42]=10.90; P= 0.002), whereby the female subjects (5.63±1.24 [mean ± SD]) had encountered a larger number of complaints than the male subjects (3.13±1.25).

Statistical analysis through application of two-way ANOVA with group and sex as independent variables did not show any significant differences between groups with regard to blood pressure, age, anxiety and depression scales (Hospital Anxiety Depression Scale [HAD]), degree of dispositional optimism (life orientation test [LOT]), cigarette and alcohol consumption, and self-estimations of the most severe pain and normal pain, respectively (P>0.12).

TABLE 1
Incidence of previous treatment for chronic pain

Method	n (%)
Analgesics	20 (54.05)
Other medications	7 (18.92)
Physiotherapist	29 (78.38)
Surgical/orthopedic treatment	2 (5.41)
Acupuncture	12 (32.43)
Transcutaneous electrical nerve stimulation	4 (10.81)
Relaxation training	15 (40.54)
Other treatments	19 (51.35)

However, there was a significant difference (F[1,42]=6.89; P=0.012) between groups with regard to how long (number of months) the pains had persisted, whereby the control group had experienced pain during a shorter period (41.03±38.68) than the experimental group (67.58±58.17); it should be noted that longer durations of chronic pain may have affected the pain sensitivity of the patients, but whether this affects receptivity for the flotation treatment remains to be resolved. A significant effect of sex was found for anxiety (F[1,44]=7.702; P=0.008), whereby the men had lower values for anxiety (5.94±2.82) than women (8.93±3.75). No other significant differences were obtained with regard to group and sex. Nor did Mann-Whitney U-tests show any group or sex effects with regard to the use of analgesics, other forms of therapy or how long the pain symptoms had persisted (P>0.10).

Design

The case history of the recruited participants was taken by the physician (a senior physician in pain management) to assess the status of the pain symptoms (using a combined interview and questionnaire technique) and judge whether each subject was free of exclusion criteria. Blood samples were taken at that time. Subjects were then randomly assigned to the control or experimental groups. Subjects in the experimental group participated in a total of nine treatments (three times per week during three weeks). Each flotation treatment lasted 45 min, resulting in a total of 300 h of treatment. In addition to these treatments, each participant was required to complete different types of questionnaires. After the last flotation treatment, a second medical examination was made, incorporating new blood samples and a follow-up of the assessment of pain status. The control group was required to leave blood samples and complete the initial questionnaires without flotation or any other treatment and then returned for a further blood sampling and examination of pain status after the identical three-week period.

Instruments

Flotation tank: The flotation tank (Flytarium Norden AB, Sweden) measured 2620×1670×950 mm. The depth of fluid (salt water) varied between 200 and 300 mm. The flotation

tank was insulated to maintain a constant air and water temperature, and to reduce incoming light and noise. The water temperature was maintained at 34.4°C and was saturated with magnesium sulphate (density 1.3 g/cm^3). The tank was equipped with a horizontal entrance that was easy to open and close (from inside and out) by the subject. Between flotations, a hydrogen peroxide solution was added regularly, followed by filtration of the salt water and sterilization with ultraviolet light. The number and duration of treatments, ie, nine over a three-week period, were chosen from similar schedules described in the literature. Another reason for maintaining a three-week duration was that female subjects participating could plan the timing of their flotation treatments around the incidence of each menstrual cycle. Blood sampling for women in the control group was scheduled in the same manner.

Questionnaire 1: At the initial medical examination, the participants were given a form to estimate self-assessed pain severity, duration, onset and treatment, as well as experiences and symptoms of other types of complaints. Information regarding sleep, dreams, tobacco and alcohol habits was also collected. Each subject's own descriptions of 'severest pain intensity' and 'normal pain intensity', respectively, were estimated on visual analogue scales (0 to 100).

Questionnaire 2: Questionnaire 1 was given again at the final medical examination, after three weeks of the experimental flotation procedure.

HAD: The validity and reliability of the HAD scale for assessing degree of anxiety and depression symptoms were examined by Herrmann (31). The HAD scale measures the degree of anxiety and depression, wherein values under 6 are considered normal, those between 6 and 10 are borderline, and all values over 10 points are indicative of a probable depression-anxiety diagnosis.

LOT: The LOT test (32) consists of eight items, plus four filler items. The task of each participant is to decide whether one is in agreement with each of the items described, on a scale of 0 to 4, where 0 indicates 'strongly disagree' and 4 indicates 'strongly agree'. The test measures dispositional optimism, defined in terms of generalized outcome expectancies. Parallel test reliability is reported to 0.76 and internal consistency to 0.76 (32). LOT is also regarded to have an adequate level of convergent and discriminant validity (32), demonstrated by correlation statistics and by using LISREL VI (r=0.64).

Subjective flotation experience: Each subject was given a questionnaire (15) to determine whether the flotation was experienced as pleasant, whether the subject experienced fear or anxiety during flotation, and whether the subject was willing to float again. These responses were estimated on a visual analogue scale (0 to 100). The severe flotation experience (SFE) form was applied directly after the first occasion of flotation to evaluate how much each of the participants 'enjoyed' the treatment. The dependent variable measured (visual analogue scale 0 to 100) 'how pleasant was it to float?', 'how intensive was the experienced fear?' and 'to what extent would you like to float again?'.

Experienced deviation from the normal state: Using the internationally applied psychometric instruments, the APZ questionnaire and the OAVAV (6), for obtaining judgements of altered states of consciousness, a shortened but similar instrument modified for use with flotation-REST was applied. The APZ and OAVAV forms are the internationally applied standard for this purpose, and these tests have been validated in several studies over different countries (33). Because the test forms were originally intended for the study of altered states of consciousness as induced by hallucinogenic substances, a number of the original questions were not relevant when flotation-REST was applied as the method of induction. In total, the 'experienced deviation from the normal state' (EDN) consists of 29 questions, with responses marked on a visual analogue scale (0 to 100). The major portion of these data are not applicable to the present study, so only a part of the test results are presented here. A complete 'index of experience' was constructed from the points obtained from all 29 questions and were summated to provide a 'sum of experience'. These values should reflect the total EDN.

Analysis of blood samples: The blood samples taken from each subject were analyzed with regard to beta-endorphin and 3-methoxy-4-hydroxyphenylethyleneglycol (MHPG), the major metabolic product of noradrenaline, neurotransmitter and hormone released under stress conditions. Opioid peptide levels were determined by the radioimmunoassay method described by Bramnert et al (34). MHPG was measured with high-performance liquid chromatography using electrochemical detection described by Scheinin et al (35).

Procedure

Participants experiencing pain, tension or headache were recruited through noticeboard announcements at the Karlstad University, Sweden. Some participants were recruited through the 'remission' procedure (see above) from their corporate or institutional health boards, as well as from general practitioners, to take part in the project. Each subject's first contact with the project was during the interview with the general practitioner at the initial medical examination where the current status of pain complaints was established through the application of questionnaire 1. During this interview, each participant's degree of anxiety-depression was assessed using HAD to exclude individuals with excessively high degrees of anxiety or depression. After this, LOT was completed. Then, a blood sample was taken for later analysis of beta-endorphin and MHPG. Every participant received a leaflet with patient-oriented information about flotation-REST, wherein, in addition to being provided with the purely practical details associated with treatment, they were informed that driving was not recommended shortly after treatment (due to increased risk of transient tiredness). During this initial contact, each subject was shown around the floatarium, and participants were told that those assigned to the control group would also receive flotation treatment. The information was strict (no mentioning of possible changes in consciousness), and the partici-

pants were only informed that most people find the floating to be relaxing. Following this orientation, participants were randomly assigned to either the control group or the experimental group. Subjects in the control group were followed up after three weeks with a new medical examination, where they also completed questionnaire 2, HAD and LOT, and gave a second blood sample. Subjects in the experimental group underwent flotation treatment during the forthcoming three periods (with three visits per week); each floating session was of 45 min duration. The experiment was carried out over four months at the flotation-REST laboratory, Karlstad University. Group assignments were made by the project leader and the resident physician. The project leader never met any of the patients, and the resident physician never met the patients in the context of flotation. The experimenters at the flotation site were ignorant of the group identity of each participant and thus, to all purposes, experimentally blind. A 'spontaneous randomization' process consisting of a 'first come, first assigned' method was applied. When the subjects were using the flotation tank on the very first session, they were informed of the floating technique, shown the toilet and shower, and reminded that they were free to terminate the session whenever they wanted. After visiting the toilet, showering and inserting the earplugs, each subject was allowed to immerse his- or herself into the tank and close the entrance of the tank unaided, after having been instructed to relax. Treatment was terminated after 45 min when the experimenter gently knocked on the wall of the tank. Once the subject had emerged, showered and changed clothes, he or she was required to complete the SFE. An identical routine was maintained at each succeeding treatment session. After the second flotation session, each subject was required to complete the EDN. Three days (or 72 h) after the final treatment session, a new blood sample was taken when subjects met the general practitioner for the second medical examination and follow-up discussions, at which time they completed questionnaire 2, HAD and LOT using the same procedure as for the control group. All the patients described in the present study completed the entire course of treatment (ie, nine sessions over three weeks). However, patients who abandoned the treatment program were excluded at once and are described as such above.

RESULTS

The dependent variables concerning both experimental groups were analyzed with three-way split-plot ANOVAs, with effects before and after treatment as the within-subject factor, and group and sex as the between-subjects factors. Three-way split-plot ANCOVAs with beta-endorphin concentrations before treatments as the covariate, and before and after treatment as the within-subject factor (ie, MHPG, pain intensity at its worst, 'normal' pain intensity, dispositional optimism, depression, anxiety, number of hours of sleep per night, time to sleep onset, experience of sleep quality and blood pressure) were used to examine the extent that beta-endorphin concentrations before treatments influenced the results. The analyses did not yield any significant effects other than those obtained through the ANOVAs, which indicated that the difference between the groups with regard to beta-endorphin concentrations did not influence the above-mentioned within-subject factors. For means and standard deviations see Table 2.

TABLE 2
Beta-endorphin (END), 3-methoxy-4-hydroxyphenylethyleneglycol (MHPG), severe pain (SPAIN), normal pain (NPAIN), dispositional optimism (LOT), depression (DEP), anxiety (ANX), and falling asleep time (FASLP) before (-1) and after (-2) treatment with regard to group (control, restricted environmental stimulation technique [REST])

	Control	REST	Total
END-1 (pmol/L)	34.00±7.45	27.83±5.61	30.83±7.18
END-2 (pmol/L)	33.53±6.36	30.00±6.10	31.71±6.39
MHPG-1 (nmol/L)	10.18±2.74	10.83±4.22	10.51±3.54
MHPG-2 (nmol/L)	10.12±2.78	8.94±1.80*	9.51±2.37
SPAIN-1 (VAS)	59.06±17.68	61.75±18.78	60.51±18.08
SPAIN-2 (VAS)	60.41±17.21	37.25±30.22*	47.89±27.40
NPAIN-1 (VAS)	16.53±8.74	12.65±12.16	14.43±10.76
NPAIN-2 (VAS)	25.06±16.44*	12.20±14.55	18.11±16.55
LOT-1 (points)	21.88±6.22	22.25±5.42	22.08±5.72
LOT-2 (points)	22.76±6.07	24.95±5.22*	23.95±5.65
DEP-1 (points)	3.53±2.94	3.40±2.91	3.46±2.88
DEP-2 (points)	3.47±2.85	2.25±2.20*	2.81±2.56
ANX-1 (points)	7.94±3.65	7.50±3.32	7.70±3.43
ANX-2 (points)	8.18±4.53	4.95±4.11*	6.43±4.55
FASLP-1 (min)	19.21±15.15	13.98±13.66	16.38±14.40
FASLP-2 (min)	16.06±11.48	8.42±7.86*	12.03±10.34

*Values are means ± SD. VAS Visual analogue scale. *Significant difference between before and after treatment*

Analysis of blood samples

Beta-endorphins: There were no significant differences in beta-endorphin concentrations before and after treatments, or between the sexes (P>0.1), but higher beta-endorphin concentrations were found in the control group than in the experimental group ($F[1,31]=4.41$; $Eta^2=0.13$; $P=0.044$).

MHPG: There was a significant difference in MHPG concentrations before and after treatments ($F[1,31]=4.99$; $Eta^2=0.14$, $P=0.033$], whereby MHPG concentrations were lower after treatment than before. There was a significant interaction effect between MHPG concentrations and group before and after treatments ($F[1,33]=4.19$, $Eta^2=0.12$, $P=0.049$). Analysis of interaction (paired samples *t* test, 5% level) indicated that the experimental group had lower concentrations of MHPG after treatment than before. There were no differences obtained before and after treatment for the control group. No other interaction effects were obtained, nor were there any other differences with regard to group or sex (P>0.15).

Experience of pain intensity

Pain intensity at its worst: The analysis indicated that there was a significant difference in experienced 'worst pain' before and after treatment ($F[1,33]=6.90$; $Eta^2=0.17$; $P=0.013$), whereby pain was experienced as being more severe before treatment than after. There was a significant correlation between group and pain before and after treatment ($F[1,33]=9.82$; $Eta^2=0.23$, $P=0.004$). Analysis of interaction (paired samples *t* test, 5% level) indicated that the experimental group experienced less severe pain after treatment than before treatment. This was not the case for the control group. There were no other interaction effects, and no differences with regard to sex ($P>0.25$).

'Normal' pain intensity: The analysis indicated a significant difference in experienced 'normal pain' before and after treatment ($F[1,33]=5.15$; $Eta^2=0.14$, $P=0.030$), with pain being less intense before the treatment period than after. There was a significant correlation between group and 'normal' pain before and after treatments ($F[1,33]=5.04$; $Eta^2=0.13$; $P=0.032$), whereby interaction analysis (paired samples *t* test, 5% level) indicated that the control group experienced more pain after the treatment period than before. In the experimental group, no significant differences before and after treatment were found. No other interaction effects were obtained, nor were any sex differences evident ($P>0.41$).

Personality traits

Dispositional optimism: The personality trait dispositional optimism was measured with the LOT-test. Results indicated a significant change in optimism from before to after treatment ($F[1,32]=18.08$; $Eta^2=0.37$, $P=0.001$), with degree of optimism increasing after treatment. There was a significant correlation between group and optimism before and after treatments ($F[1,32]=5.755$; $Eta^2=0.16$; $P=0.022$), where analysis of interaction (paired samples *t* test, 5% level) showed that the experimental group had a higher degree of optimism after treatment than before treatment; no difference between before and after treatment was seen in the control group. No other significant differences with regard to group and sex, or interaction effects were obtained ($P>0.2$).

Depression: The results indicated that there was a significant difference in depression assessment before and after treatment ($F[1,32]=5.51$; $Eta^2=0.13$; $P=0.025$); the degree of depression was reduced after treatment. There was a significant correlation between groups and degree of depression before and after treatments ($F[1,32]=5.04$; $Eta^2=0.12$; $P=0.032$). Interaction analysis (paired samples *t* test, 5% level) showed that the experimental group had a lower degree of depression after treatment than before treatment. There were no such differences in the control group. No other results were significant ($P>0.50$).

Anxiety:. The analysis indicated that there was a significant difference in anxiety before and after treatment ($F[1,33]=6.88$; $Eta^2=0.17$; $P=0.013$); level of anxiety decreased after treatment. There was a significant correlation between groups, and level of anxiety before and after treatments ($F[1,33]=9.87$; $Eta^2=0.23$; $P= 0.04$). Interaction analysis (paired samples *t* test, 5% level) showed that the experimental group had a lower level of anxiety after treatment than before treatment; no such differences were seen for the control group. No other significant results were obtained ($P>0.11$).

Sleep

Number of hours of sleep per night: Participants were required to indicate their duration of sleep before and after treatment. There were no significant differences or correlations ($P>0.10$).

Time to sleep onset: There was a significant difference in time to sleep onset before and after treatment ($F[1,32]=4.71$; $Eta^2=0.20$, $P=0.038$). Time to sleep onset was shorter after treatment than before treatment. There was a significant correlation between time (minutes awake) and sleep onset before and after treatments and group ($F[1,32]=4.71$; $Eta^2=0.23$; $P=0.038$). Interaction analysis (paired samples *t* test, 5% level) showed that the experimental group fell asleep more quickly after treatment than before treatment; no similar difference was seen in the control group. Finally, there was a group effect ($F[1,32]=4.53$; $Eta^2=0.17$, $P=0.041$), whereby the experimental group fell asleep more quickly than the control group. No other significant differences were found.

Experience of sleep quality: Participants were required to assess, on the VAS scale (0 to 100), their sleep quality before and after treatment. Analysis did not indicate any significant differences or interactions ($P>0.16$).

Cigarette and alcohol consumption: No significant differences in cigarette or alcohol consumption were found ($P>0.10$) .

Blood pressure: A three-way split-plot analysis was used to examine whether the participants' blood pressures were altered during treatment. The within-subjects factor was systolic-diastolic blood pressure, and the between-subjects factors were group and sex. No significant differences or interactions were found ($P>0.10$).

Mental experiences during floating

Global notions about floating: Using the personality inventory provided by the LOT (collected before treatment), the participants were classified as either 'optimists' (more than 23 LOT points) or 'pessimists' (fewer than 22 LOT points). In addition, the participants were classified in a similar manner as 'low anxiety' or 'high anxiety', and 'low depressive' or 'high depressive', from the results of the HAD test. Differences between optimists and pessimists, between low and high anxiety, and between low and high depressive, were analyzed on the SFE scales. One-way ANOVA did not show any difference between optimists and pessimists with respect to fear of floating or the extent to which the subjects would like to float again ($P>0.07$). There was a significant difference in the factor 'how pleasant was it to float?' ($F[1,24]=5.58$; $P=0.027$); optimists experienced

TABLE 3
Correlation analyses (Pearsons' r, corrected for the number of comparisons according to Bonferroni) between the most significant dependent variables before treatment: severe pain (SPAIN), normal pain (NPAIN), beta-endorphin (END), 3-methoxy-4-hydroxyphenylethyleneglycol (MHPG), anxiety (ANX), depression (DEP), dispositional optimism (LOT) and falling asleep time (FASLP)

	SPAIN	NPAIN	END	MHPG	ANX	DEP	LOT	FASLP
SPAIN	1.00							
NPAIN	0.34	1.00						
END	0.11	0.29	1.00					
MHPG	–0.17	–0.08	–0.16	1.00				
ANX	0.19	–0.01	–0.18	–0.31	1.00			
DEP	–0.05	0.21	0.05	0.07	0.44*	1.00		
LOT	–0.24	–0.10	0.02	0.07	–0.69**	–0.55**	1.00	
FASLP	–0.04	–0.23	–0.02	0.07	0.35	0.39*	–0.22	1.00

*$P<0.05$; **$P<0.01$

TABLE 4
Correlation analyses (Pearsons' r, corrected for the number of comparisons according to Bonferroni) between the most significant dependent variables after treatment: severe pain (SPAIN), normal pain (NPAIN), beta-endorphin (END), 3-methoxy-4-hydroxyphenylethyleneglycol (MHPG), anxiety (ANX), depression (DEP), dispositional optimism (LOT) and falling asleep time (FASLP)

	SPAIN	NPAIN	END	MHPG	ANX	DEP	LOT	FASLP
SPAIN	1.00							
NPAIN	0.55**	1.00						
END	0.41*	0.24	1.00					
MHPG	0.14	0.37	–0.01	1.00				
ANX	0.12	0.30	–0.08	0.27	1.00			
DEP	0.19	0.42*	–0.01	0.23	0.65**	1.00		
LOT	–0.29	–0.28	–0.03	–0.11	–0.74**	–0.71**	1.00	
FASLP	0.22	0.40*	–0.18	0.56**	0.49**	0.39*	–0.30	1.00

*$P<0.05$; **$P<0.01$

greater enjoyment (80.71±15.01) than the pessimists (61.00±26.34). There was no significant difference between participants with low anxiety and those with high anxiety, or between those who were 'low depressive' and those who were 'high depressive', respectively, regarding their experiences of enjoyment, fear and wanting to float again ($P>0.11$).

Experience of altered state compared with normal state: EDN forms were used to measure the extent of different types of experiences. Every experience was measured as a deviation from a normal state on a VAS-scale of 0 to 100. Experiences that were most common were: 'feeling of drifting' (68.2±31.88), 'my body feels wonderful' (65.72±26.89), 'a dream-like time and space feeling' (63.97±34.25), 'a feeling of deep peace within me' (54.07±32.51) and 'a feeling of falling asleep' (47.10±37.90). Feelings that occurred least frequently were: 'heard odd words' (2.48±6.40), 'heard tones and clangs' (7.00±14.57), 'saw colours with my eyes closed' (9.41±16.74), 'received insights about previously puzzling occurrences' (10.42±21.13) and 'came to think about things that I'd forgotten long ago' (10.52±19.79). No significant differences (one-way ANOVAs) were seen between optimists and pessimists, between those with low anxiety and those with high anxiety, or betwen low depressives and high depressives with regard to the summated experience of deviation from a normal state.

Correlations

Correlations (Pearsons' r) between the most significant variables before (Table 3) and after (Table 4) were computed.

DISCUSSION

The main finding of the present study was that flotation-REST induced a significant reduction of 'severest' pain intensity, a significant decrease of noradrenaline metabolite, MHPG, values in the blood, a significant reduction of anxiety and depression concomitant with an increase in the degree of dispositional optimism. In addition, a significantly shorter latency to fall asleep at night was noted. The observation that the method was generally experienced as pleasant suggests that flotation-REST should harness a large positive potential for reducing pain and at least some of the effects of chronic, negative stress. It should be noted that several participants had suffered from pain for many years and had been subjected to several types of treatment during that period (Table 1).

A significant effect of pain alleviation was verified only with regard to 'severest experienced pain' on comparison before and after floating treatment, but not for 'normal pain', which may not be obvious or apparent. It is most likely that the flotation-REST technique maintains a primary pain alleviation effect for the experience of severe pain and not for 'normal' pain. However, judging from all the enthusiastic comments derived during the treatment period, other explanations over and above the documented effect should be examined. For example, it is possible that the flotation-REST treatment affects 'worst' pain without altering 'normal' pain. The answer to this dilemma may rest with the patients' experiences of these two types of pain. Recent results (unpublished data) suggest that flotation-REST affects the pain intensity experience of healthy volunteer subjects.

Whether the significantly increased degree of optimism (LOT test) seen in the present study was a consequence of the pain-alleviating effect of the treatment, pleasantness, the feeling of hope and enthusiasm engendered by the novel technique, or some other mechanism is outside the scope of this study. However, the connection here is interesting because the patients (subjects) presented with pain in association with muscle tension or headache – a situation indicative of a psychosomatic connection. Further, the established degree of the reduction in anxiety and depression (the HAD scale) also implicates a psychosomatic connection, with the

potential for reducing anxiety and depression. It should be noted that 'optimists' found the treatment to be more pleasant than 'pessimists'. These observations agree with earlier reports demonstrating that flotation-REST is a technique that increases well-being, and decreases tension and anxiety (7,8,13,19). Further associations among personality variables and overall experiences are presented in Table 4, which indicates that the time to fall asleep correlated with MHPG, anxiety and depression. This observation is relevant because alterations in noradrenaline neurotransmission and metabolism, and sleep difficulties have been implicated in anxiety and depression. Additionally, it was found that the personality trait of dispositional optimism (as indexed by the LOT test) correlated negatively with depression and anxiety (as indexed by the HAD scale). This relationship between LOT and HAD does not provide new insights into flotation-REST as a method for pain relief but may indirectly confirm the validity of each test. However, there is no sure means of ascertaining the extent to which the participants' pain complaints were of a psychosomatic nature. Gustafson and Källmén (36) found that pain patients showed higher manifest anxiety than patients presenting with pain judged to be of a clearly somatic type. If this is the case, pain reduction may induce anxiety-reducing and general antidepressive effects.

Flotation-REST has been employed in the treatment of sleep problems (10). In the present study, there were no changes with regard to either the duration of sleep or the quality of sleep, but there was a significant reduction in the time taken to fall asleep. One condition for falling asleep is being able to relax. Thus, the present result supports the possibility that flotation-REST suppresses anxiety and the generation of negative emotional patterns, and facilitates the acquisition of more effective relaxation techniques. In this regard, it should be noted that the control patients had to remain on a waiting list for the flotation-REST treatment. Thus, it is possible that at least a part of the ameliorative effects may not be due to flotation-REST but that a more general effect might have been induced by the attention the patients received, by a higher level of activity/engagement (ie, leaving home nine times in three weeks), and possibly increased levels of self-efficacy (see LOT result), attention-placebo (ie, receiving the same amount of attention from the experimenters involved), etc. It is unfortunate that no follow-up procedure, particularly one reversing the control and experimental groups for flotation-REST, was incorporated in the experimental design; this might have indicated the longevity of effects, from which the clinical and economical utility might have been noted.

It is possible that the observed pre- to post-treatment reduction in the noradrenaline-metabolite MHPG reflects an altered stress-relaxation relationship in these individuals. However, it must be noted that circulating levels of noradrenaline are known to modulate pain thresholds (37). In the present study, endorphin levels were not affected directly, although, for unknown reasons, the control group indicated higher levels than the experimental group at both pre- and post-treatment measurements. There were no measures of serotonin metabolites in the present study. There is a vast amount of evidence not only for the role of serotonin in the pharmacology of pain but also for the intricate serotonergic-noradrenergic interactions (38), while the relative roles of these neurotransmitter systems is evident in stress-induced analgesia (39). Further, serotonergic mechanisms have been shown to be involved in beta-endorphin-mediated analgesia (40). Thus, it is imperative that further investigations of flotation-REST efficacy in chronic pain alleviation include measures of the serotonin metabolite 5-hydroxyindole acetic acid.

Independent of whether flotation-REST influences levels of endorphins, other biologically active markers may be directly or indirectly affected by the treatment, possibly through a complex array of feedback mechanisms. Independent of which circulating biological markers may be implied in the experienced pain reduction, it is necessary to consider which changes represent cause and effect, respectively. Altered concentrations of endogenous compounds may trigger or be triggered by deeply underlying psychological functioning that may be influenced by situations in which an individual experiences an altered state of consciousness or deep relaxation.

The most common experiences that were deviations from a normal state were: 'feeling of floating', 'my body feels wonderful', 'dream-like alteration of time and space perspective', 'feeling of intense peace' and 'feeling of falling asleep'. These experiences may largely be described as a pure relaxation effect. Subjects who experienced 'inner images/visions and noises/voices' and experiences characterized by 'unity, limitless, religious' have emerged from more intense experiences than those that have been described as pure effects of relaxation.

CONCLUSIONS

The results of the present study tentatively suggest that flotation-REST may offer an effective method of alleviating low to moderately severe pain induced by muscle tension. Further investigations are aimed at extending the scope of the subjective changes and the neurochemical markers (eg, with the serotonin metabolite 5-hydroxyindole acetic acid, oxytocin and cortisol) followed by a comprehensive six-month follow-up investigation.

ACKNOWLEDGEMENTS: This article was supported by grants from Karlstad University, Sweden. The study has had ethical approval from the Ethical Board on Experimentation on Human Subjects (Forskningsetikkommittén) at Karlstad University.

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ISBN 91-628-5872-6