

# Smartbrain

## QEEG Study of Specific Self-development and Self-regulating Methods

by Odrun Flatabø and Haldor Sjøheim

2 April 2011

## Contents

|     |                     |    |
|-----|---------------------|----|
| 1.0 | Abstract .....      | 3  |
| 2.0 | Introduction .....  | 3  |
| 2.1 | Target group .....  | 4  |
| 2.2 | Financing .....     | 4  |
| 3.0 | Intervention .....  | 4  |
| 3.1 | Selection .....     | 4  |
| 4.0 | Method .....        | 5  |
| 4.1 | QEEG-protocol ..... | 6  |
| 5.0 | Results .....       | 9  |
| 5.1 | Survey .....        | 12 |
| 6.0 | Discussion .....    | 15 |

## **1.0 Abstract**

In the autumn of 2010, Smartbrain carried out a QEEG study of a selection of 30 persons who participated in the Unique Mind ESP course. Participants took EEG before the course, after the course and after 12 weeks of home training and a repeat course. A survey was also carried out before the course and after 12 weeks, by an external third party. The QEEG study shows that participants learn techniques (P101 – P106), that enable them to self-regulate by lowering brain-wave activity while increasing high gamma (40 – 50 Hz). The Results indicate that the group, after the course weekend, has a highly significant QEEG-baseline increase by 32% of high gamma. After 12 weeks the QEEG-baseline increased by 58%, which may indicate that the course and/or the exercises change the way the brain functions at the highest frequencies. When compared to the survey, the high gamma score shows that it is optimal for increased intuition to use the two exercises: P101: Counting from 7 – 1 and P105: Nightfilm, once daily.

## **2.0 Introduction**

The purpose of this study was to quantify and visualize any objective changes in brain-wave activity resulting from 10 specific visualization, focusing and meditation exercises. These were combined in a concentrated form and were presented in a combination of two courses, each lasting for 20 hours. In addition the participants carried out individual self-training for 12 weeks in their usual environment. The contractor wanted to evaluate the effect of learning for self-development and self-regulating of the brain's functionality. During the course, participants were guided to normalizing levels of tension, resetting of focus and self-regulation of intentions. These were also goals for self-training.

## **2.1 Target group**

The target group for this report is course participants and others who are interested. This report is not a scientific article.

## **2.2 Financing**

Smartbrain AS has, through Unique Mind ESP (the contractor), been commissioned to carry out and analyse QEEG measurements of their course participants during the autumn of 2010. The survey has been carried out and analyzed by an external third party, also financed by Unique Mind ESP.

## **3.0 Intervention**

The contractor had designed 10 exercises that were carried out during the course. The exercises were chosen based on the course leader's own experience as course teacher, together with previous course participants' positive experience of change evaluated by anecdotal descriptions of experiences and reporting of their own experiences via questionnaires. The primary goal of the contractor and course teacher's design was to guide participants to induce left frontal brain waves in Theta and Delta. She did not know precisely which instructions would lead to such changes. A pilot study of four course teachers had formed the hypothesis that such a focused and concentrated learning and training situation would lead to a systematic and quantifiable change in the electro-cortical activity of the brain within these areas.

In this study, participants were in parallel asked to fill out several questionnaires in connection with the measurements in T1, T2 and T3, in order to map qualitative changes before the course and after 12 weeks. T1 = EEG recording before course; T-2 = EEG recording after course; and T-3 = EEG recording after 12 weeks.

### **3.1 Selection**

A group of 30 individuals made up of 24 women and 6 men, were recruited via Facebook and the website of the contractor. Ages were between 20 and 55 years, with

an average age of 35.5 years. The group was homogenous in that they did not previously have any particular experience with meditation.

## 4.0 Method

EEG (electroencephalogram) measurements were done using 19 electrodes according to the international 10-20 system with Linked Ears mounting. In this report the changes in QEEG (Quantitative electroencephalogram) absolute power are evaluated. We used Brainmaster Discovery EEG Module with 510K approval and Electrocap hoods. The EEG – recording was done using Brainmaster Discovery software 1.5.2 processed in Neuroguide 2.5.4 with Neurobatch and Neurostat. The EEG was processed and analyzed statistically by studying the average of the group in an FFT absolute-power percent difference (%) test in order to show direction and percentage of change between the different measurements: EO1-6 and EC2-8.

The bands are divided into different names according to number of hz (cycles per second):

Delta: 1 – 4 Hz

High Beta: 25 – 30 Hz

Theta: 4 – 8 Hz

Gamma: 30 – 40 Hz

Alpha: 8 – 12 Hz

High Gamma: 40 – 50 Hz

Beta: 12 – 25 Hz

We looked at the percentage of change per band and on each single frequency between measurements where the subject either had eyes open or eyes closed. FFT absolute-power group paired T-test (p-value) was used to analyze the significance of these changes.

We also looked at individual level and consistency between percentage of change in the different measurements compared to the survey. We prepared a High Gamma score. That is the number of placings with increased high gamma (40 – 50 Hz), divided by the

number of electrodes (19) x high gamma peak value for the individual. This scale gives a connection between high gamma increase and spreading.

#### 4.1 QEEG-protocol

**The following measurements were done:**

##### **T1: Before course (Baseline)**

EO1 = Eyes open 5 min

EC2 = Eyes closed 5 min

The individuals first participated in one baseline EEG recording with eyes open for 5 minutes. Thereafter an equivalent recording was done with eyes closed for 5 minutes. The measurements were done during three days: Wednesday, Thursday and Friday before the weekend course which lasted 10 hours on Saturday and 10 hours on Sunday.

##### **T2: After course**

EO3 = Eyes open 5 min

EC4 = Eyes closed 5 min

EC5 = Eyes closed 5 min with intention to go to The Creative Corner

On Monday, Tuesday and Wednesday after the course the participants were measured in the same way as in baseline T1. Five minutes with eyes open and 5 minutes with eyes closed. In addition, the participants were asked to carry out a guided visualization and meditation exercise to “The Creative Corner”, as they had learned at the course, with eyes closed for 5 minutes.

##### **T3: After 12 weeks**

EO6 = Eyes open 5 min

EC7 = Eyes closed 5 min

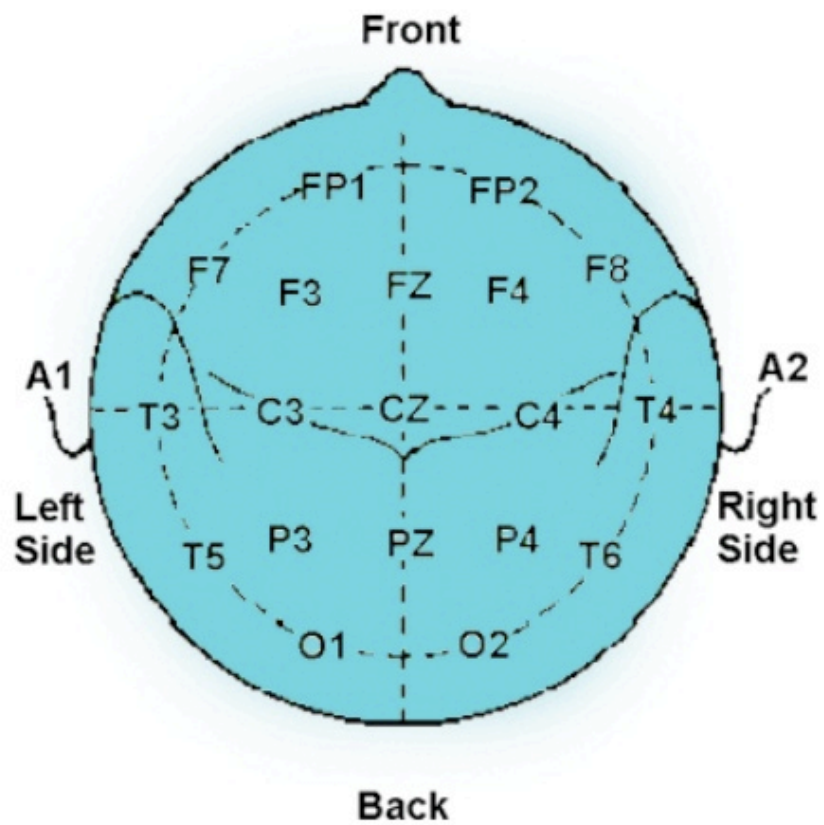
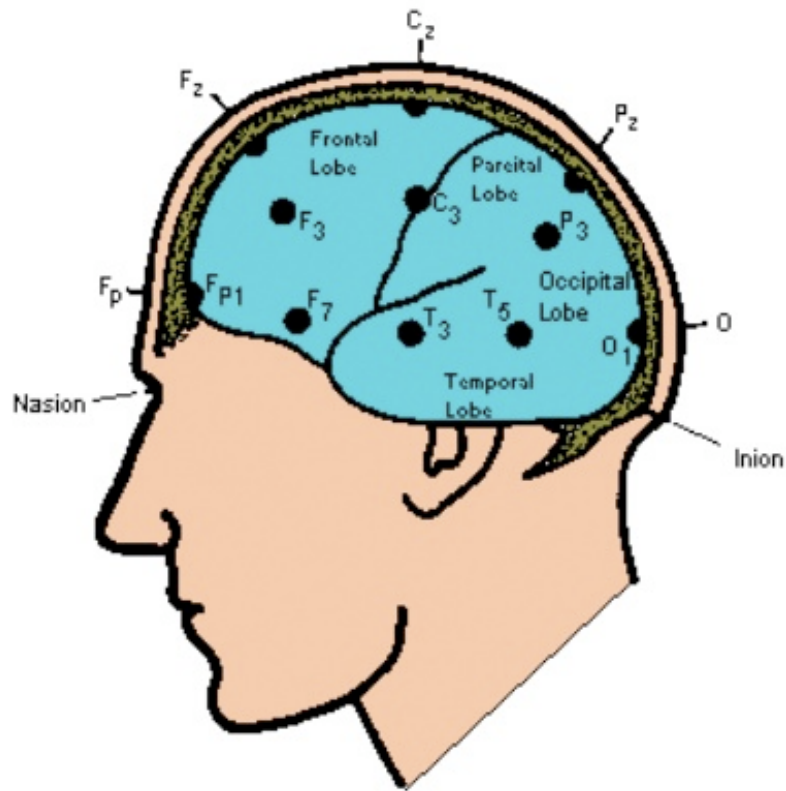
EC8 = Eyes closed 5 min and with an intention to go to The Creative Corner

The participants then continued to train at home daily for 12 weeks, as they had learned at the course. In the course of these 12 weeks they also participated in a refresher course consisting of 10 hours on Saturday and 10 hours on Sunday, and were thereafter

tested again with eyes open for 5 minutes, eyes closed for 5 minutes, and finally they carried out the same visualization exercise as in T3, with eyes closed, for 5 minutes. These measurements were done after 12 weeks of self training.

All of the 30 participants completed all of the 8 recordings and participated in both the starter course and the refresher course. All of the 30 participants completed the survey.

An illustration on the next page shows the placement of the electrodes on the head according to the 10 – 20 system as well as the names of the different main structural parts of the brain.



## 5.0 Results

This study shows that guided and concentrated learning where relaxation, visualizing and mental drilling as well as conscious focusing are emphasized, can lead to changes in the the functional network of the brain. This can happen in both local and global networks in the brain. The course and self-training seems to have resulted in increased experience of the participants own control of presence-of-mind and increased experience of subjective change. It also seems to have assisted participants to increased experience of mastering in everyday life, subjective well-being and more satisfaction with use of and access to one's own intuition. This has also been visualized by 58% increase of global high Gamma, 48, 49 and 50 Hz as a group measurement. The visualization in the brain maps are within pre-frontal /frontal /central /parietal and occipital activity. This is visualized as centering of the brain activity, which many believe is the essence of meditation. (Meditation comes from the word meditare, which means to center).

We found several interesting changes in the EEG activity of the group, which began right after the course and were significantly reinforced after 12 weeks. We go through the difference between most EC (eyes closed) measurements. The maps to the left show the per cent of difference between the average of all 30 recorded measurement A and the average of all 30 recorded measurement B. We present the bands that are most interesting. The maps to the right are Group Paired T-test that show whether the per cent difference to the left is significant.

T1 = Measurement 1, before course

T2 = Measurement 2, after course

T3 = Measurement 3, after 12 weeks and the refresher course weekend.

## T1 – before course & T2 – after course: EC2 – EC4

### Group difference (%) (left picture)

Green = no difference

Red = increased activity between measurements

Blue = lower activity between measurements

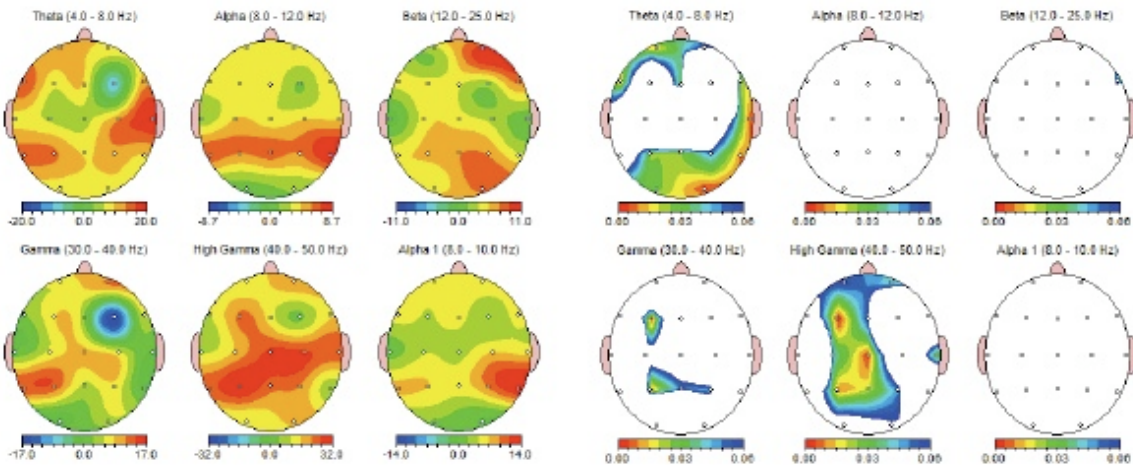
### Group paired T-Test (right picture)

White = no significant change

Blue and Green = border significant change

Yellow = significant change

Red = highly significant change

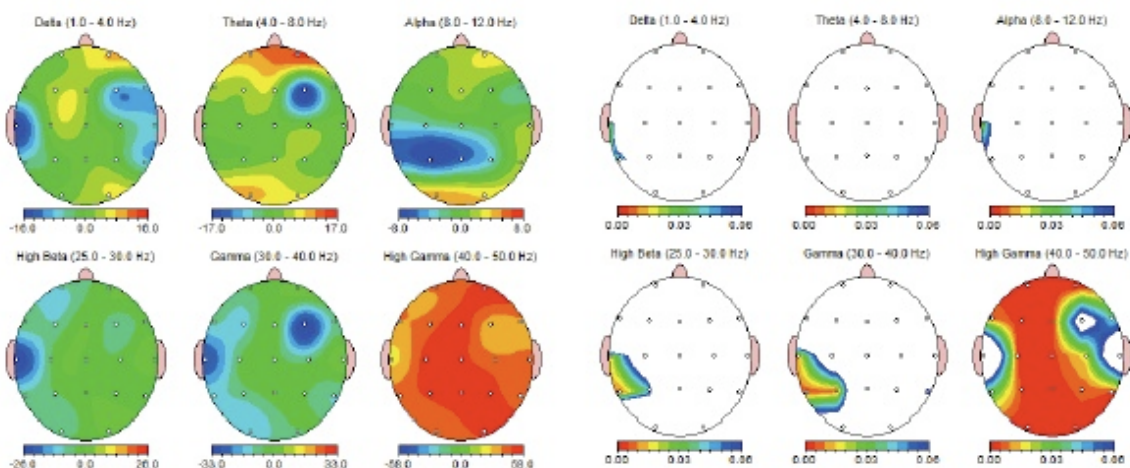


We see that the course participants have significant changes in production of theta (4 – 8 hz) and high gamma (40 – 50 hz) already between the time of the first baseline measurement and after the course weekend. The group level shows an increase of 32% between 40 – 50 hz (high gamma) with high significance under 0.001 at CZ. We also see a significant increase of Theta left frontal (F7 – FP1) and highly significant right occipital (O2) / temporal (T4 – T6).

## T1 – before course & T3 – after 12 weeks: EC2 – EC7

### Group difference (%) (left picture)

### Group paired T-Test (right picture)

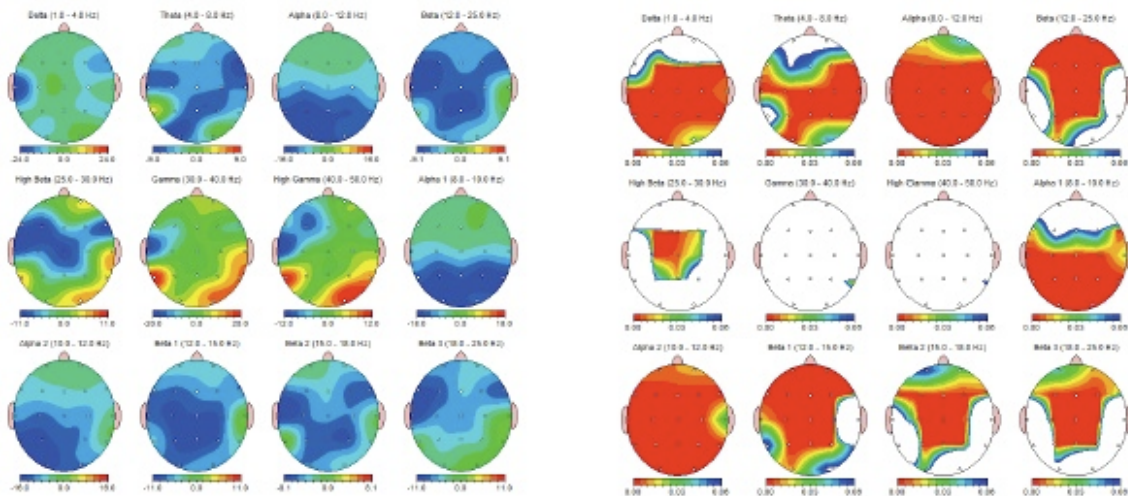


From before the course (EC2) to 12 weeks after the first course and after the last course weekend (EC7), we see that the changes we observed right after the first course (EC4) have been strengthened. At group level we see a 17% increase of Theta frontal and highly significant 58% increase of high Gamma frontal, central and occipital. A significant 26% lowering of high beta (25 – 30 hz) left temporal (T5), 33% lowering of Gamma left temporal and 58% increase of high Gamma frontal, central, occipital and temporal (T5 – T6) are also shown.

**T2 – after course – between baseline and intention about The Creative Corner:  
EC4 – EC5**

**Group difference (%) (left picture)**

**Group paired T-Test (right picture)**



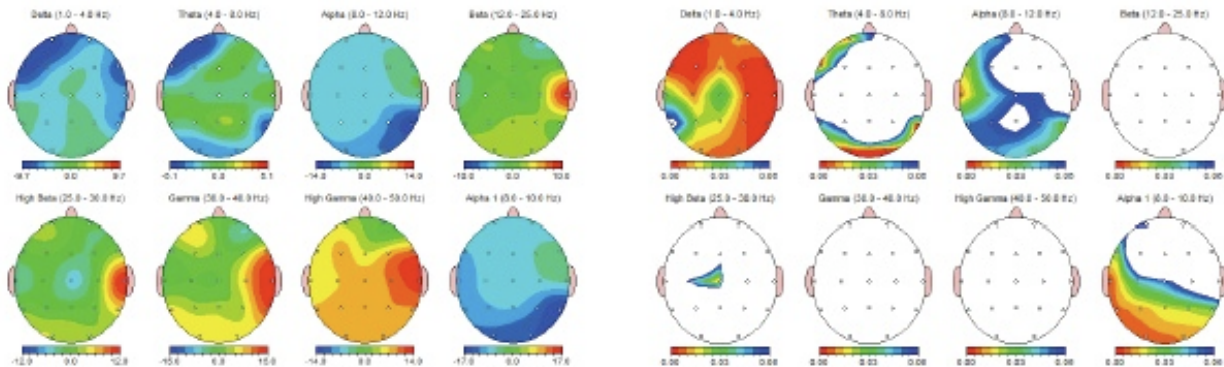
When participants were asked to carry out the visualization exercise they had learned with eyes closed (EC4 – EC5), we found that the group produced considerably less amplitude in Delta (1 – 4 hz), Theta (4 – 8 hz) and Beta (12 – 25 hz). We saw a trend where Delta and Theta do not have a significant amplitude difference frontal or right temporal (T6) and right occipital (O2) as well as Alpha frontal. There was little or no change in these bands right temporal (T4 – T6), which are a part of the visual part of the brain that processes conceptual perspective as taught in the course exercises. We saw a corresponding increase by 20% of Gamma and 12% high Gamma right temporal (T6) and occipital (T2), but this turned out to be insignificant. The partially global lowering of

all bands except Gamma, where we saw an increase, concurs with similar EEG-studies about meditation and hypnotic state.

**T3 – after 12 weeks – between baseline and intention about The Creative Corner:  
EC7 – EC8**

**Group difference (%) (left picture)**

**Group paired T-Test (right picture)**



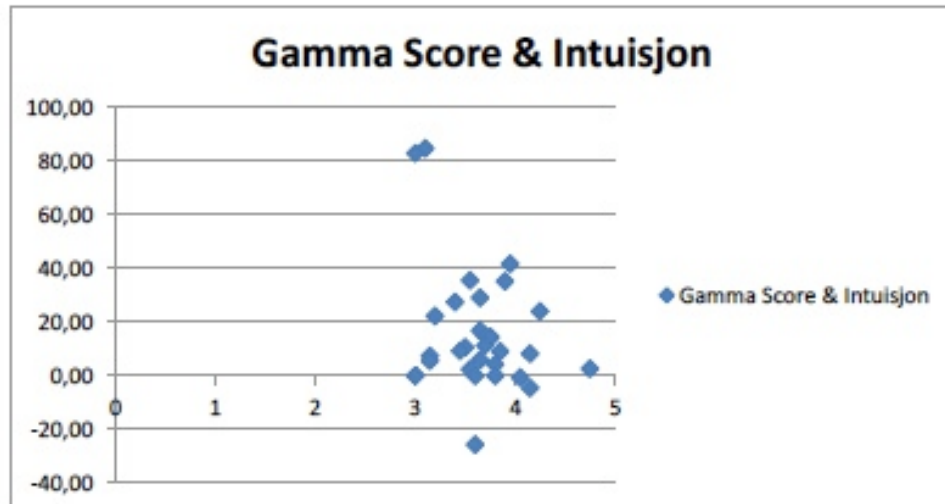
When participants were again asked to carry out the visualization exercise they had learned with eyes closed (EC7 – EC8) after 12 weeks and the refresher course weekend, we found that the group still had lowering of Delta, Theta, Alpha but not Beta or high Beta. We still saw increasing Gamma and high Gamma by about 14%. This is in addition to the baseline increase of 58%, but changes in Gamma or high Gamma are not considered significant. We also saw a lowering by 9.7% of left frontal Delta (F7 – FP1) and 5.1% lowering of right frontal Theta occipital and left frontal, and 14% lowering of Alpha occipital and left temporal that are significant.

**5.1 Survey**

The survey was completed by 30 individuals that were included in the QEEG study. From the questionnaires that consisted of 106 questions from six standardized tests, we observed the greatest significant group result in terms of enhanced intuition, regarding both strengthened experience of ability and strengthened use of ability. All experienced significant change in intuition. Twenty-four of the 30 had a positive high gamma score.

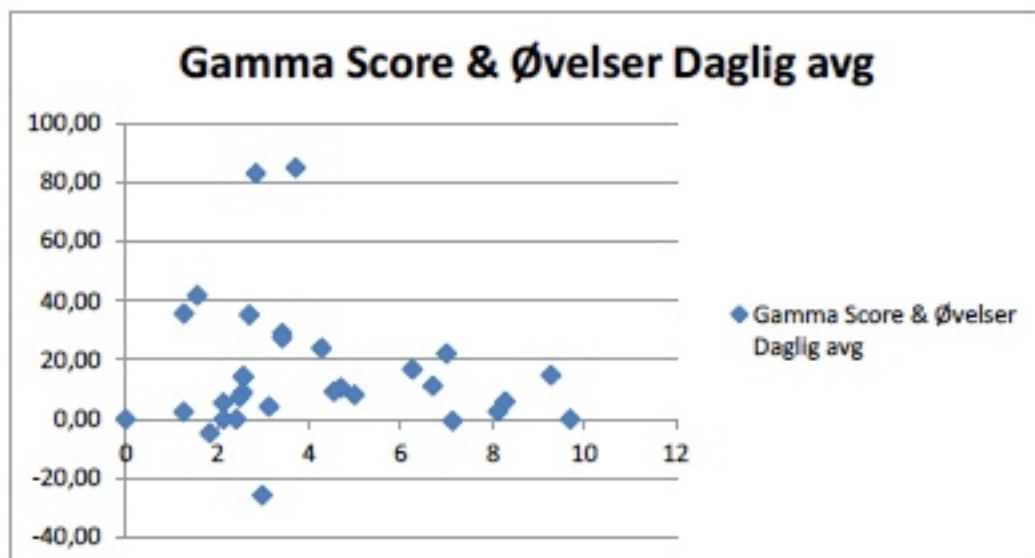
This correlates with the fact that 24 of totally 30 individuals had significantly increased high gamma activity.

Gamma Score & Intuition



The survey also showed less significant results regarding lowering of stress-related muscle afflictions such as headache, neck pain, pain in upper back, pain in lumbar region of the back, in arms and shoulders, migraine and general stress that were experienced as less bothersome. Significant improvements regarding self-confidence and mastering life, also regarding satisfaction with life, were also reported. The group also reported feeling the presence of meaning with life.

Gamma Score & Exercises Daily avg.



We found negative correlation between the number of exercises used daily and high Gamma score. The above figure shows that high Gamma score becomes lower the more times one on average does the exercises together. One to four exercises per day seems to optimize the learning effect (Gamma activity), as this was preferred by most course participants. Those who did the exercise more often than < 4 had low Gamma score that can mean that they have automated the processes and are no longer in the same learning phase.

The home training consisted of a total of two mental techniques divided into five different functions as well as a relaxation CD:

P101 = Count down from 7 – 1 to come to The Creative Corner

P102 = Take a deep breath to come to The Creative Corner

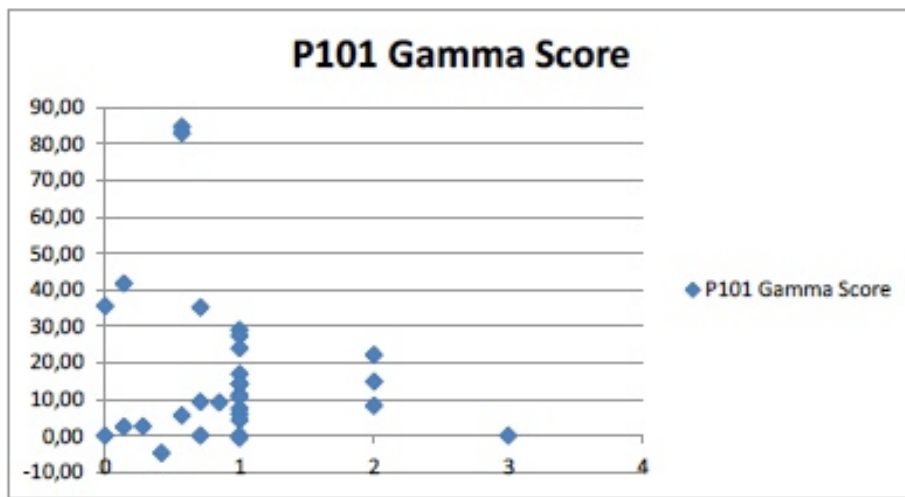
P103 = Technique: The Creative Corner for goals

P104 = Technique: The Creative Corner for transformation

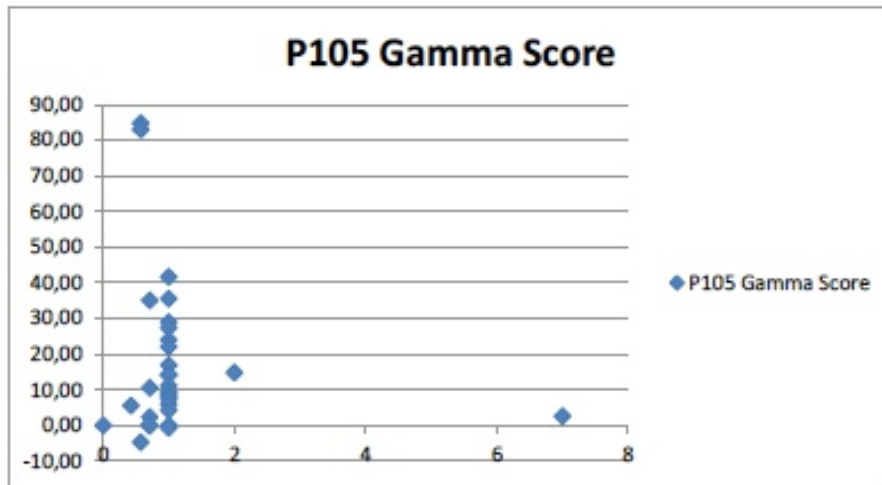
P105 = The Nightfilm technique

P106 = Relaxation exercise with CD

On a group level, it seems that most participants choose to do exercises P101 and P105 once daily. The other exercises were done more scattered by individuals and were done less than > 1.



P101 – Count down from 7 – 1 to come to “The Creative Corner”. This is a technique similar to others that are described in the literature, and is used during self-programming, self-hypnosis and within different types of meditation. A cluster formation is shown around training once daily.



P105 – Nightfilm. Also here a cluster is shown around once daily. High Gamma synchronizing may indicate alertness and hence increased learning potential, and once daily is preferred by the group participants.

## 6.0 Discussion

The discovery that the human brain can change its function and structure due to thoughts and experience, as well as turn on its own genes to change its electrical circuits in order to reorganize itself and thereby change its ability to function, is by many now deemed the most important change in our understanding of the brain in the past 400 years. The plasticity and ability to learn and self-regulate are functions that have fascinated researchers within many different fields and disciplines.

The brain also changes in the course of a life cycle. Such changes may either be adaptive and lead to functional advantages, or they may be the actual cause of disability and illness. It is therefore still a great challenge for society to develop and support more

evidence-based courses and methods of treatment that support the individual in their own rehabilitation and self-development process.

High Gamma waves were little researched before 1970 due to limitations in measuring devices that made access to knowledge difficult. New and increasingly better technologies have resulted in clearer signals and better mathematical software. Discussion goes on today about the potential for increased Gamma waves that naturally arise from occipital, parietal, central and frontal regions to facilitate restoration to more functional frequency distribution throughout the brain. Today it is presumed that Gamma wave potentials aid the “resetting” of frequencies that are in these areas and that they also have global implications for decline of symptoms experienced by persons, and many reports and anecdotes are found about experiencing self-development and mastering. Improvement of the symptoms of clients have been observed in other studies. Spatial attention and increased alertness have been shown to increase the activity of the Gamma band in somato-sensory cortex and parietal-occipital areas. High Gamma has been found to work together with the Theta wave band. Some believe that this combination seems to potentialize and thereby increase learning ability and mental activity through increased learning at several levels of the brain.

Delta has been considered to protect the brain from activity, as when sleeping. It is known that this allows muscular relaxation and release of accumulated muscular stress. Global sleep, micro-sleep and other forms can be restorative for muscles, inner organs and bodily tissue.

Various meditation practices have published experiences of different states of mind, and hence reported somewhat different patterns of changes in brain function. Compassion meditation has been said to activate the area associated with empathy and flexibility. So-called wisdom meditation seems to activate areas with insight into verbal problems, conceptual perspectives that may be taken and mental fantasy. Persons who have meditated for a long time have learned to self-instruct themselves in a process where they produce high amplitude of Gamma synchronicity when they practice mentally. Other studies where QEEG has been used as a measuring device have concluded

increased activity in areas of goal-focusing, experience of essence from within, ability to see phenomena more clearly (wisdom) and more heartfelt presence (compassion).

In current research, stress has shown a tendency to induce psycho humane changes due to general adaptation syndrome. In several studies, meditation has been shown to have an effect in calming the autonomous nervous system and the parasympathetic response. Some have also indicated an experience of inner quietness and a feeling of being one with nature.

Self-development and self-regulating traditions are partly Eastern and partly Western traditions. Meditation, yoga, exercises in self-discipline and mental focus have been part of a more than 3000-year old tradition in the East. In the West, prayer has long been a tradition, along with cultivation of work discipline. Physical training, self actualizing and psychological integration such as attention, mindfulness training and also Alpha-Theta biofeedback training, have been important traditions, especially at the end of the last century, that have increased in scope after the turn of the century.

In recent years QEEG has shown itself to be suitable for studying “mystical” changes in various states of consciousness in real time. The middle line and the top of the central cortex are shown by several to represent the limbic brain system, that is the brain center that is associated with regulating emotions. Many therefore believe that the experience of happiness and grades of satisfaction may be associated with centering and synchronizing energy. Self-regulated frontal and central Delta, Theta and Gamma activity seems to be able to give more focused attention such as increased alertness and working more effectively with memory tasks. The pre-frontal part of the brain and frontal mid-line may with low Theta and Alpha activity reflect emotionally positive states, more calmness and internalized experience of awareness. Normal or increased frontal Theta activity is associated with a feeling of well-being, less anxiety and reduced activation of the central nervous system. Reprograming and/or resetting of the brain for development towards an altered or higher state, consciousness and function is the essence of old and new traditions.

More than 100 published research articles are found that are related to statements about: changes in brain activity, changes in other body processes, changes in metabolism and blood pressure. These studies show that clinical methods have been used to reduce stress and pain. It has been asserted that self-training to non-judgmental presence may be used to increase bodily ability to self-healing, less depression and anxiety, more happiness and relaxation and greater emotional balance.

Increased synchronizing of all heart rhythms is a state that is experienced as more positive because the neural networks are integrated. The experience is often described as observant stillness, presence-of-mind, awareness, freedom from critical inner voices, carrier wave to bliss, and a peaceful place of stillness. This study has shown that the contractor has put together an impressive and effective collection of exercises that give participants learning, change and development experiences with better use of more parts and greater wholeness in synchronized activity. Continued self-training and independent work by the participants will most likely give the participants greater inner control, increased learning of more, and more complex exercises so that the mental techniques taught at the course become memorized and automated. This improvement of efficiency of one's own ability to regulate brain activity in a more favorable direction agrees with the contractor's main assertion about the effect of the course. Increased intuition demands increased synchronicity of brain activity and more functional use of the brain. Participants experienced a significant increase of Gamma activity and may therefore, according to new research, have started a learning process. Gamma activity is, according to new research, a wave that is activated when the brain is learning something new by "burning" new neural pathways and is also important for perception, organizing and production of new brain cells. Gamma activity has unfortunately not been thoroughly investigated due to limitations in technology, but new systems and new research indicate a connection.