

Understanding and Activating Your Brain's Pleasure Centers

By Jonathan Cowan, Ph.D. and John Starman, MA

The Prefrontal Pleasure Center and the Neureka! System

Many recent studies of the brain have led to remarkable new insights about the relationships among pleasure, learning, and motivation. By synthesizing the new insights, we are now able to show that there is a Pleasure Center in the middle of the very front of the brain—the Medial Prefrontal Cortex—and that it is clearly involved in processing new learning and motivating us to continue to explore. The brain's system for learning about new discoveries, which we call Neureka! (short for Neural Eureka!), is mediated by high frequency brainwaves (gamma). These interact with the Prefrontal Pleasure Center to enhance the memory of important pleasant events. These new insights complement the recent trend towards positive psychology—the study of happiness—which has produced fascinating information. This special report integrates all three of these streams of knowledge into a more complete picture of the psychobiology of pleasure, happiness, motivation and learning.

The Reason for Happiness and Pleasure – The Basis for Life's Motivations

Pleasure and happiness are fundamental motivators for our lives. When many of our drives are satisfied, we feel happiness and pleasure. The desire to enhance happiness and pleasure develops its own momentum. We learn to associate many types of events with these feelings. Having our full measure of happiness powerfully changes our view of life, our reactions to events and situations, our learning and memory and our general feeling of well being. It is amazing how different things appear when we are in a state of fear, rage, dire emergency or struggle compared to our experience when in a state of harmony, fulfillment and love. We learn better and relate to each other better when we are happy. Our "Quality of Life" is greater when we feel happy. We now know that enhancing positive emotions promotes health and holding negative emotions contributes to disease. We are all looking for ways to be happy more of the time.

Pleasure is only part of what we call happiness. It usually does not last for very long, without being renewed by more stimulation. Happiness appears to be a far more complex concept, which according to Dr. Martin Seligman, also includes the experience of gratification and can be enhanced by a meaningful, virtuous life.

There are systems in the brain that have been developed to provide the feelings of happiness and pleasure—including the pleasure centers in the Ventral Tegmentum

(VT), the Nucleus Accumbens (NA), and the Medial Prefrontal Cortex, which we call the Prefrontal Pleasure Center (PPC). These centers provide the connections to cells that secrete brain chemicals including dopamine and the endorphins, which are strongly associated with these positive feelings. All of the psychological approaches to enhancing pleasure *indirectly* affect these pleasure centers to increase their production of these mood enhancers.

We can now bypass this weak link in the system and *directly* produce feelings very similar to those from releasing these chemicals by using a new scientific discovery called the Peak Brain Happiness Trainer. By using biofeedback to enhance the output of the brainwaves from the Prefrontal Pleasure Center, people have been able to help their brain learn to increase their happiness and other powerful positive feelings.

The Multiple Causes of Happiness

Some people seem to be happier than others. Scientists have studied this and made a key discovery—that each individual has their own typical baseline range of happiness, to which they usually tend to return after temporarily feeling better or worse due to changes in life circumstances. The bluebird of happiness sometimes perches on a branch!

In their studies of identical twins raised separately, scientists found that this genetically-based inheritance determines around 50% of our total happiness level. Positive psychologists argue that we can personally have an effect on about 40% of this total by our own actions such as: changing our attitude or thoughts, or doing activities we like. Amazingly, research shows that only the remaining 10% depends on the circumstances of our lives. This goes against our belief. We seem to believe if only our circumstances were right, we would be happy.

Put another way, people react differently to changes in circumstance, and the strength and quality of their reactions is more important than the actual severity of the change in circumstances in determining the subsequent level of happiness. Positive psychologists have been developing new strategies for enhancing and sustaining happiness by changing our reactions to life events. Recently, there have been a number of popular “How to” books which built on the evidence from groundbreaking studies showing that long-term levels of happiness can change for some individuals who do certain practices.

Biology: The Missing Cause

However, the positive psychologists who have studied happiness and come up with these percentages have made a rather serious error. They have left out the possibility of influencing the system (and its reactivity) by changing the biology—the physiological

function of the brain—by altering sleep or exercise patterns, or using drugs, supplements, and biofeedback. They have also forgotten that the genetic influences on happiness are actualized by changing the psychophysiology of the brain—the balance between the activities of the various brain systems that affect our moods. In order to really understand happiness and pleasure, we need to take a broader perspective, uniting both biology and psychology—a point of view usually labeled psychobiological or psychophysiological. Yet none of the indexes of four recent outstanding popular books about happiness and/or emotion written by academic psychologists even listed “dopamine”, “psychophysiology”, “physiology” or even “biology”.

Several brain systems have been identified as important in changing our moods and feelings. They are usually sorted out by labeling them by the major chemicals involved as neurotransmitters--or more slowly acting neuromodulators--such as dopamine, norepinephrine, serotonin, oxytocin, the cannabinoids, and the opiates. This became even more complicated when scientists realized that many of these chemicals had different actions in different areas of the brain due to variations in the way that each chemical system is designed. In order to begin to see the forest, rather than getting lost in the trees, we will focus primarily on one system—the dopaminergic reward and pleasure system, which is the most well-established.

The Brain's Major Motivational Systems

Survival of the species depends on individuals taking action: for getting food and water, for self-protection, and for reproducing.

In order to make sure this gets done, nature provides pleasurable sensations as part of a Reward/Pleasure system. This system links the primitive parts of the brain to the most developed by using a circuit which runs on dopamine, the so-called “pleasure chemical”. The study of the Reward/Pleasure System was initiated by a surprise finding in 1954, when researchers James Olds and Peter Milner placed an electrode in the septal area of an animal's brain, near the NA. When they stimulated this area, the animal would walk across an electrified “shock” grid to get more. This showed that it caused great pleasure. When the animal could press a bar to send the signal to this area, they would activate the signal, rather than eat or drink. In a human experiment, when the stimulus was sent into this part of the brain, the subject said: “All the bells of Heaven were ringing”.

The system has three parts, the Reward/Approach Circuit involving dopamine, with its feelings of pleasure, satisfaction and well being, and the Loss and Avoidance Circuit, with its feelings of anxiety, fear and panic, when we are more highly aroused.

Both parts of the system can be accentuated by the third part, the Arousal response system, also known as the “fight or flight” system. It is mediated by adrenaline in the

body and noradrenaline (norepinephrine) in the brain. It is related to the Alertness measurement of the Peak Achievement Trainer. At low to moderate levels, the excitement and activation produced by the arousal response are beneficial, leading to optimal performance at the peak arousal level, and enhanced learning.

Scientists believe if one system is highly activated, the other may be less activated. Feelings of fear surely diminish happiness, but if we can reduce the activation of the amygdala, fear is lessened.

Pleasure and Arousal: Two Learning Enhancers

Obviously, learning from our experiences has great value for improving our odds for survival. It's not at all surprising that the brain is equipped with several systems for enhancing learning. There is ample evidence that the dopamine Reward/Approach System and the norepinephrine (adrenaline) Arousal System both enhance memory through the activities of these chemicals. One of the major functions of the limbic system is to select those events that are important enough to remember and activate the appropriate combination of system responses, including emotional responses and the release of these related chemicals. Although, in some parts of the brain, norepinephrine and dopamine both may act as neurotransmitters, carrying signals across the synapses, they may also take on the role of longer acting neuromodulators, which act to change the sensitivity of the neuron's response to other chemicals, like turning up (or down) the volume control of the amplifier on your home theater system. So when an important event takes place, these chemicals (and others) are released in order to help the brain respond and learn, not just immediately, but for the next few moments. This is one reason why your emotional reactions last longer than the initiating event does.

However, the reward sensations produced by this dopamine pleasure system are usually very brief. This is actually a very fortunate part of the natural design of animals, since it prevents an animal from remaining so absorbed in their pleasure that they end up as fodder for a predator. The Peak Brain Happiness Trainer helps us learn to keep the reward system active by sustaining and intensifying these bursts, so we tend to have more of the powerful positive feelings and less of those limiting emotions.

Many drugs of abuse act by enhancing the activity of dopamine and/or its chemical relative, norepinephrine, in parts of the Reward/Pleasure system. For example, amphetamine acts to sustain the activity of both, producing a combination of pleasure and arousal. Unfortunately, the brain adapts to this type of long-lasting stimulation, producing an "opponent process", a combination of adaptations to minimize these effects. When the stimulating chemicals leave the system, these adaptations remain, causing the unpleasant feelings of the amphetamine "crash". Using a more natural

approach, such as learning to shift the typical range of the Pleasure/Reward system by brainwave biofeedback and/or the techniques of positive psychology, should avoid most of the problems of the opponent process and put the degree of happiness under greater conscious control from the Prefrontal Pleasure Centers.

A Personality Type with High Dopamine

There are many people who have a higher functioning level of this Pleasure/Reward system. Dr. Helen Fisher, who has combined years of fMRI research on dopamine and brain function with large scale surveys on the website, www.chemistry.com, describes these people as Explorers, and details a variety of their personality characteristics in her book, "Why Him? Why Her? Finding Real Love by Understanding Your Personality Type". These characteristics include a sunny personality, optimism, enthusiasm, energy, seeking pleasurable sensations, curiosity, creativity, impulsivity, and an intense focus on new stimuli coupled with easily becoming bored. They are very adaptable because they learn quickly. To understand how all these tie together, we need to learn more about the pleasure centers in the brain.

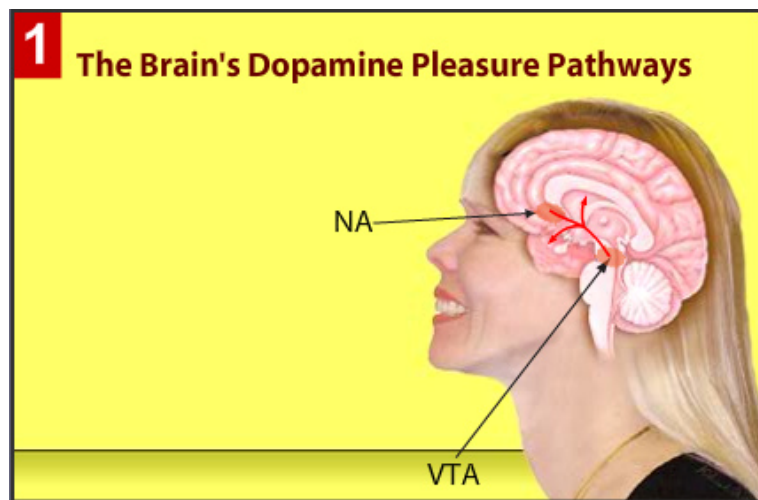
The Principal Pleasure Pathways and Centers

This sequence of illustrations is from a Flash especially developed for our website, www.peakachievement.com/PBHT. Take a look at it now.

The Ventral Tegmental Area (VTA) and Nucleus Accumbens (NA)

The brain's Reward/Approach circuit starts deep in the brain in areas called the VTA (ventral tegmental area) and the NA (nucleus accumbens). This circuit is designed to reward us for getting the physical things we need to survive done. It signals several important deep brain structures which have strong influence on our behavior, including: the amygdala [decides

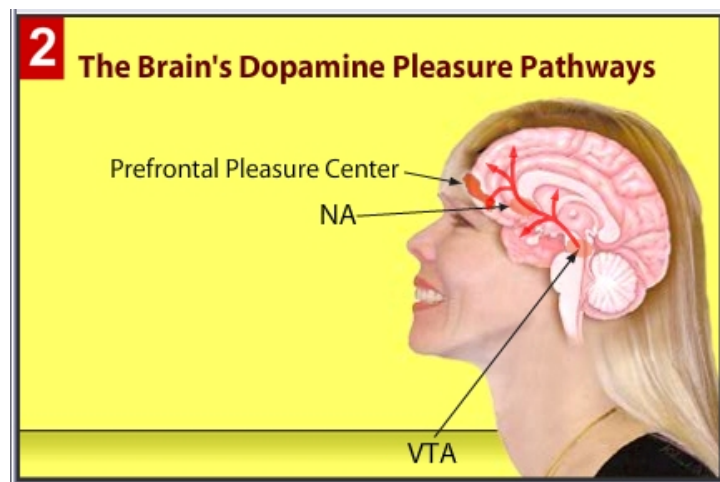
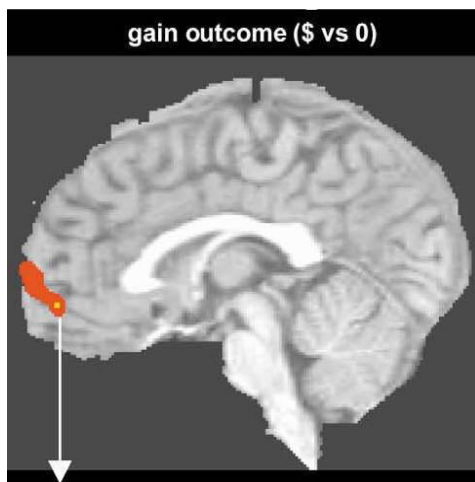
if a thing is good or bad and can activate appropriate responses], the hippocampus [remembers the actions necessary to get this good thing again] and the thalamus [connects and brings together emotions, thinking and senses]. For our purposes, the most important signals are sent forward to the Prefrontal Pleasure Centers, which also communicate back to the VTA and NA to modulate their activity. Dr. Fisher's fMRI studies indicated that feelings of romantic love activate the VTA.



The Prefrontal Pleasure Centers

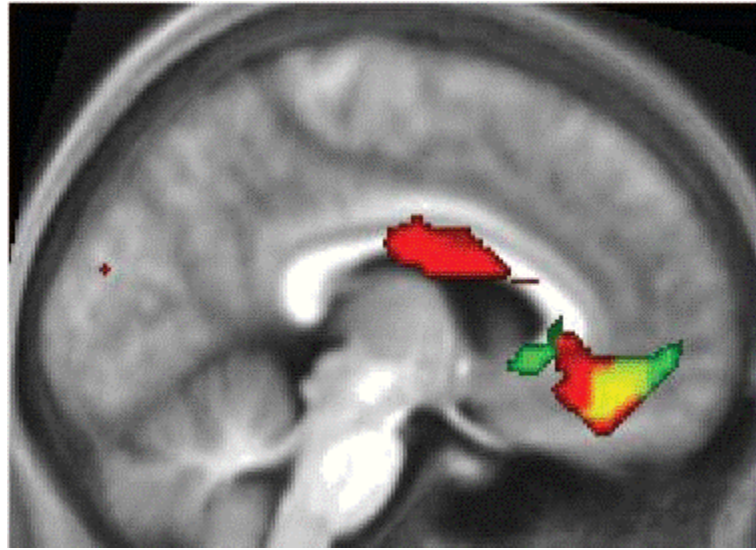
The Prefrontal Pleasure Centers are in the most highly developed part of the brain, the Prefrontal Cortex (PFC), located right behind the forehead. This executive decision maker governs our higher human virtues of compassion, empathy and understanding, and our advanced intellectual skills such as computing, reasoning, analysis and imagination.

There is a great deal of scientific evidence from studies of brain functioning during decision making—a new field called neuroeconomics—that the positive psychologists have not considered. It clearly indicates that there are Prefrontal Pleasure Centers at the very front of each hemisphere of the brain, right behind the middle of the forehead, in the region known as the medial Prefrontal Cortex (mPFC).

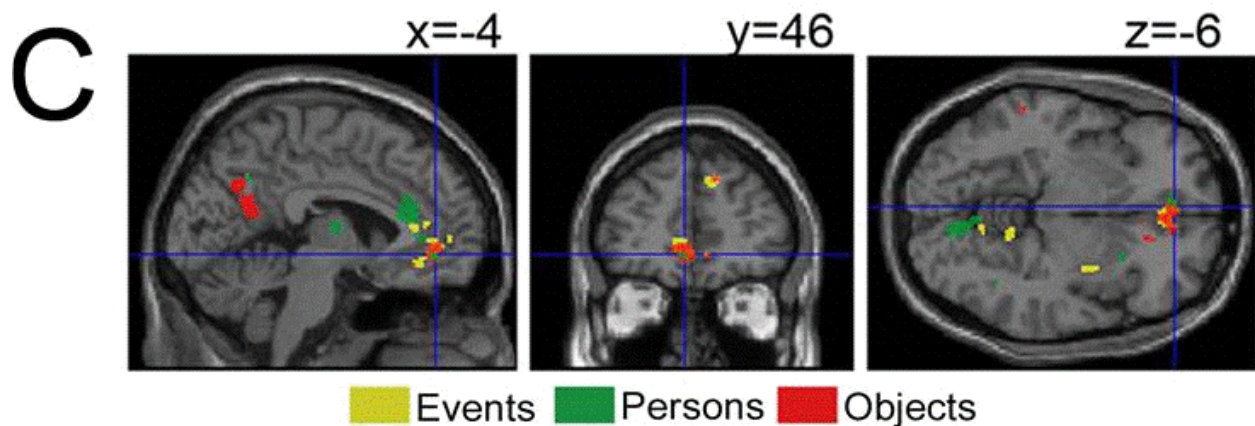


On the left is a picture of the data from a fMRI brain scan study (from Stanford's Dr. Brian Knutson) of people who have just won money in a betting game carried out in the scanner. The region in red is the Prefrontal Pleasure Center. There are other studies which indicate that this area is activated by the presentation of attractive faces, pictures of loved ones, aesthetic artwork, erotica, and addictive drug cues. The Stanford group has advanced the idea that when the brain makes decisions, the relative degrees of activation of this Prefrontal Pleasure Center and the Fear/Avoidance circuit located in the amygdala and the left insular cortex play a key role.

There is also fMRI evidence that the part of the brain that is most responsive to beauty is located right nearby. Here, the red areas are the response to visual beauty, the green are responses to musical beauty, and the yellow is the overlap:

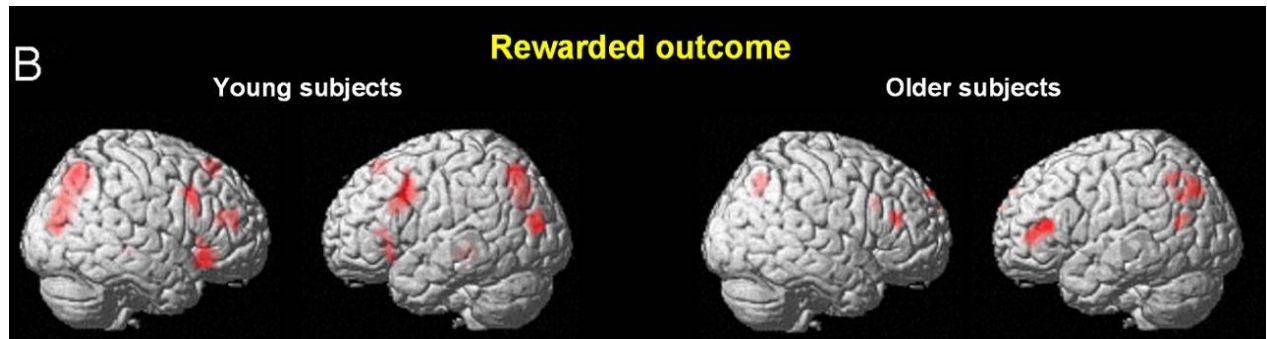


Desirability for events, persons, and objects is also centered in an overlapping area.



Other studies have indicated that there may be an additional area of the left Prefrontal Cortex that is also a Prefrontal Pleasure Center, but finding the location has proven difficult. A recent study from the National Institute of Mental Health found that the location of this center shifts with age, and that 25 year olds show a larger pattern of excitation than 60 year olds. The illustration on the right side of each panel shows the left side of the brain (facing left), and indicates that in older people, another Prefrontal Pleasure Center is located near the left temple, with a smaller counterpart near the right temple. Surprisingly, younger subjects seem to have several Prefrontal Pleasure Centers, in multiple areas in both hemispheres of the Prefrontal Cortex. The study convincingly tied the activation of these centers to the synthesis of dopamine in the NA, but it also showed that this relationship changed with aging. These results appear to be

consistent with what's known about how our experience of pleasure changes as we age and mellow.



The Neureka! Brain System

The brain's response to learning also involves the system that makes sense of our experiences, putting together all of the various parts of them into unified wholes. It does this by scanning itself about 40 times a second, with a brain rhythm from the central part of the brain called the thalamus. This Event Binding Rhythm from deep within the thalamus is like an organized group of scouts that checks what's happening on the front lines of the cortex, where parts of the experience are registered, and reports back to the observation post. This center of awareness then puts together the information from all the scouts and sends them out again, with new questions to answer. After a few cycles, it sends the information to the limbic system for emotional evaluation and to the appropriate parts of the cortex to develop an action plan

We call this system that learns about new discoveries the Neureka! System. The 40 Hertz (cycles per second) brain rhythm that it uses to bind the aspects of an event together is one type of gamma EEG rhythm. Gamma is used to refer to any brain rhythm above 30 Hertz. We now know that the brain produces a wide variety of gamma rhythms, up to hundreds of cycles per second. These gamma rhythms have been difficult to detect for several reasons, so they are not as well known as the alpha, beta, theta, and delta rhythms. There is now a large amount of evidence that many of these gamma rhythms, especially the 40 Hertz rhythm, are the key brain rhythms involved in understanding and learning about new experience. They power the Neureka! System that gathers information.

We have developed a way to clarify the 40 Hertz rhythm and minimize the effects of other brain rhythms (including other gamma rhythms) as well as interference from tensing forehead muscles (technically known as EMG). We call this method the Neureka! Protocol and the number that results the amplitude (or level) of Neureka! In

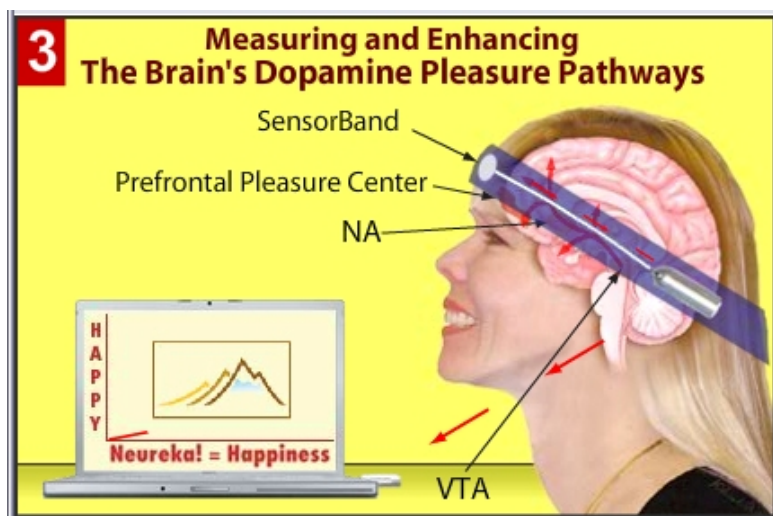
the Peak Brain Happiness Trainer, we use this level to provide Neureka! neurofeedback, as we will describe later.

Once the information about an event is forwarded to it, the limbic system, together with specialized areas in the cortex, evaluates its importance. If it is important, then these areas create an emotional response and direct the release of appropriate chemicals like dopamine and norepinephrine to make sure it is remembered. These neurotransmitters and neuromodulators act to enhance memory by using various mechanisms, including increasing “long-term potentiation”. They also make you more aware of the event and get more of the brain regions involved. For our purposes, the most important part of this response is activating the Reward/Approach pathway, which floods key areas of the brain with dopamine made in the NA and VTA. The dopamine then acts as a neuromodulator to increase the magnitude of the 40 Hertz signals and perhaps others, and to enhance positive feelings so that you will continue to learn.

The Principle of the Peak Brain Happiness Trainer

Here’s the key point for understanding the Peak Brain Happiness Trainer’s Neureka! neurofeedback. If you ask the brain to increase the amount of the 40 Hertz rhythm detectable on the surface of the Prefrontal Cortex, it can do so in at least two different ways—by increasing the output from the observation post in the thalamus, or by increasing the amount of dopamine that is released in the Prefrontal Pleasure Centers, which amplifies the signals that are received from the observation post. When you do Neureka! neurofeedback, you sense any small increase in the amount of this 40 Hertz rhythm and ask the brain to do more of whatever just succeeded. The brain soon learns to respond to the request by enhancing the 40 Hertz rhythm by both of these methods. Your success is rewarded by pleasant feelings and more dopamine release, which further enhances the 40 cycle rhythm and the Neureka! level. It’s no wonder that people learn this so quickly.

Measuring the Prefrontal Pleasure System with the Neureka! Protocol



This enhanced 40 Hertz rhythm can be detected by the SensorBand, which has a Sensor right over the medial Prefrontal Cortex, right in the middle of your forehead. This is where we have been placing the Sensors of the Peak Achievement Trainer for many years. The Sensor sends the electrical signal to the small

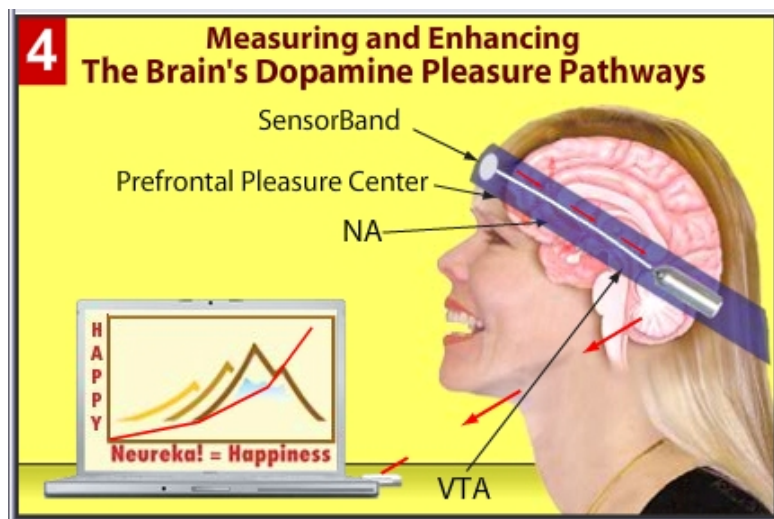
Transmitter module mounted on the SensorBand, which amplifies it and converts it to a wireless digital signal.

The computer receives the signal and the (included) neurovideofeedback program analyzes it to calculate Neureka!, as well as the Focus and Alertness measures provided by all Peak Achievement Trainers.

The Peak Brain Happiness Trainer Measures and Displays the Pleasure Centers' Activation

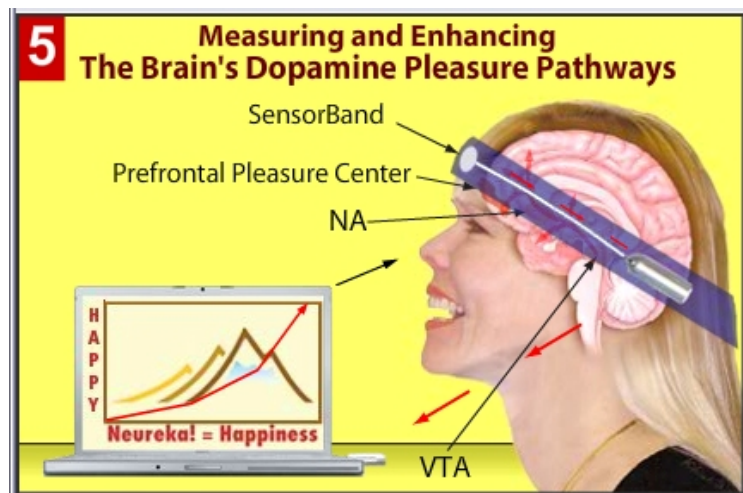
The computer displays your level of Neureka! or (more simply put) Happiness visually on the screen, and also changes the sound of bell, raising it to a higher pitch.

The Trainer helps you along by showing you enjoyable videos and/or playing happy music to keep your emotions going in a positive direction. When you get happier, the size of the video picture increases and the sound gets louder, so you can understand what you are doing without having to look at the bar or line graph on the screen. This also enhances your absorption in these pleasant experiences, creating a positive feedback loop--the better you feel, the bigger or louder it gets, and the more you feel the positive stimulation.



The User Learns to Enhance Their Happiness and Pleasure Via Neurofeedback

The result is that when you start to feel even the slightest increase in pleasure, you will know it. So when you start to feel pleasure, you can both see and hear it. Before long, you will learn to enhance it and see the results instantly. Then you can quickly learn to improve your skill and instantly see your progress. Since the Prefrontal Cortex is involved in conscious control, training that area to

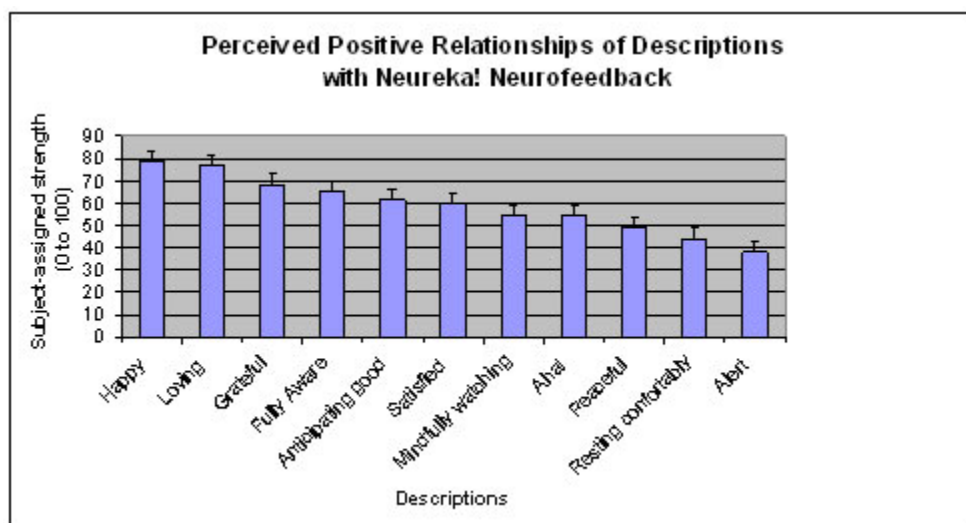


increase and maintain the Neureka! signal brings conscious control to this process of producing happiness. Then, as you feel better and better, the picture gets bigger and the sounds get louder. You can select your own inspiring videos to encourage you to achieve even stronger feelings of happiness, love, satisfaction, and peace.

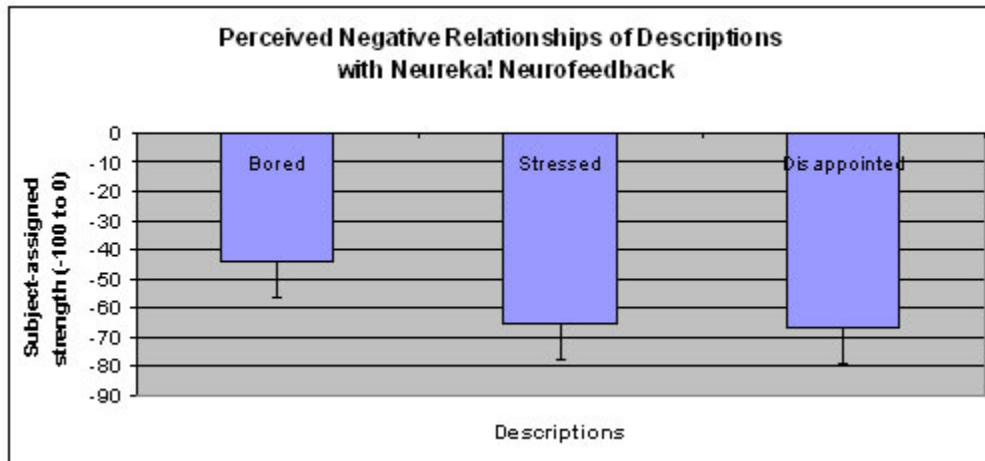
The Experiment That Showed Neureka! Measures Positive Feelings

A new study established that the Neureka! brainwave biofeedback protocol, which is used in the Peak BrainHappiness Trainer, is able to give users instantaneous, clear information about these brainwaves related to these positive feelings. It showed that brainwave signals associated with feelings of happiness, love, satisfaction, gratitude, full awareness, mindfulness, peace, and the absence of stress can now be measured. The study also found that Transcendental Meditators™ with over 10 years experience could enhance this brainwave pattern associated with good feelings much more powerfully than subjects who did not meditate, although both groups learned to increase this pattern in just one session.

Both meditators and controls were asked to try to create particular positive and negative experiences by following given descriptions for two minutes each, while they were looking at the Neureka! feedback signal. They rated the relationship between momentary changes in the experience and the Neureka! measure along a -100 to +100 scale, with 0 representing no relationship, 20 a mild relationship, 40 a moderate association, 60 a strong one, 80 a very strong relationship, and 100 an extremely strong connection. Eleven of the 16 adjectives showed very strong positive relationships, just as we predicted they would:



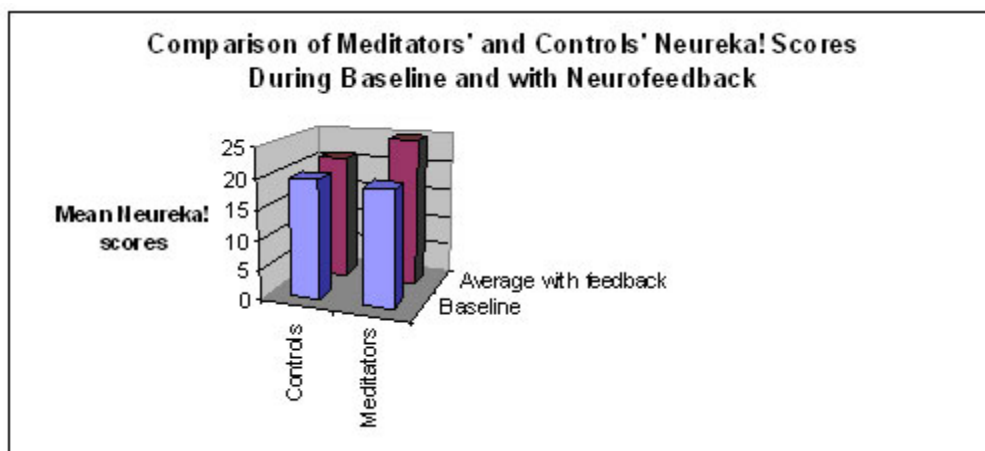
On the negative side, 0 to -100, there were three adjectives that were strongly related to the Neureka! measurement, indicating that as these feelings increased, Neureka! went down.



There were no differences in these relationships between meditators and controls.

Many of these adjectives seem to describe the qualities that Dr. Fisher associates with the Explorer personality type. The overlap could probably have been improved if Dr. Rubik had used the exact words from Dr. Fishers book, but it wasn't available when the study was designed.

Interestingly, the meditators were far better able to reach the Neureka! state quickly upon request, indicating that practicing Transcendental Meditation™ prepared them to have these positive experiences.



The Peak BrainHappiness trainer also includes several MeditAider Protocols, designed to help those who are having trouble meditating to keep calm and focused, and to enhance their Neureka! levels.

Dr. Beverly Rubik, the President of the Institute for Frontier Sciences, who conducted the study states, "From numerous studies in mind-body science and medicine, we know that happiness is a root cause of good health. Now you can choose to engage your

brain in the Neureka! experience using the Peak Brain Happiness Trainer to elevate yourself mentally and physically.”

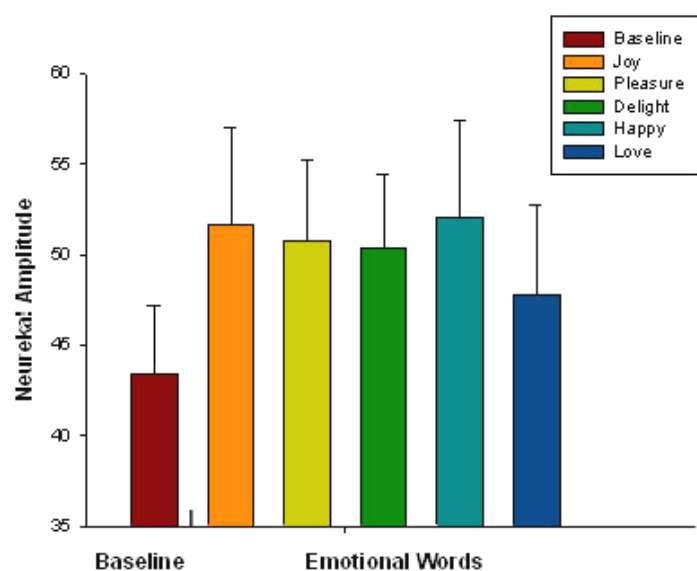
Dr. Rubik holds a Ph.D. in biophysics from the University of California at Berkeley. She has published over 80 papers and 2 books. Dr. Rubik presently serves on the editorial boards of Journal of Alternative & Complementary Medicine; Integrative Medicine Insights; and Revision. She is adjunct professor in Integrative Health at California Institute of Integral Studies; adjunct faculty member in Integrative Health at Saybrook Graduate School; and a holistic health practitioner to clients at Health Medicine Center in Walnut Creek.

The research in the next two studies, performed by Dr. Estate Sokhadze at the University of Louisville Department of Psychiatry, shows the brain produces a higher level of Neureka! brainwaves when the person feels good.

In the first study, researchers read words related to positive emotions to subjects who were asked to feel that way for just 6 seconds. The researchers used the Peak BrainHappiness Trainer neurofeedback system to measure and record the levels of the Neureka! brainwave output for the subjects as they felt these emotions. With all of the positive words, the test subjects showed a significant increase above the baseline levels in their Neureka! output,. The highest increases in Neureka! values were for the words “happy” and “joy”.

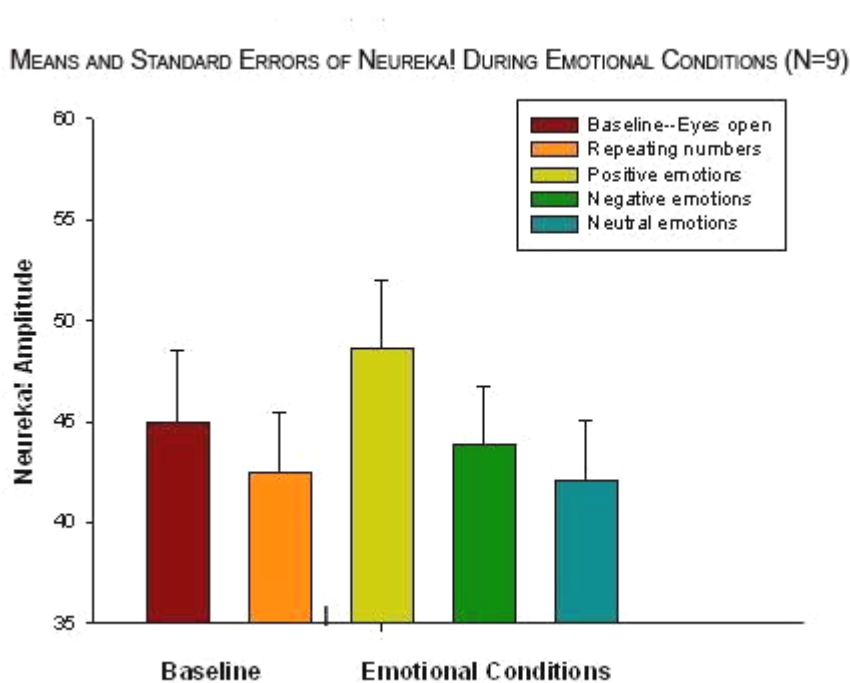
The baseline they used was taken 2.5 – 3 minutes after the positive words were over. Dr. Sokhadze knew that anticipating something good caused the Neureka! output to go up at the start of the study, so the baseline from early in the experiment couldn’t be used.

MEANS AND STANDARD ERRORS OF NEUREKA! DURING EMOTIONAL WORDS (N=15)



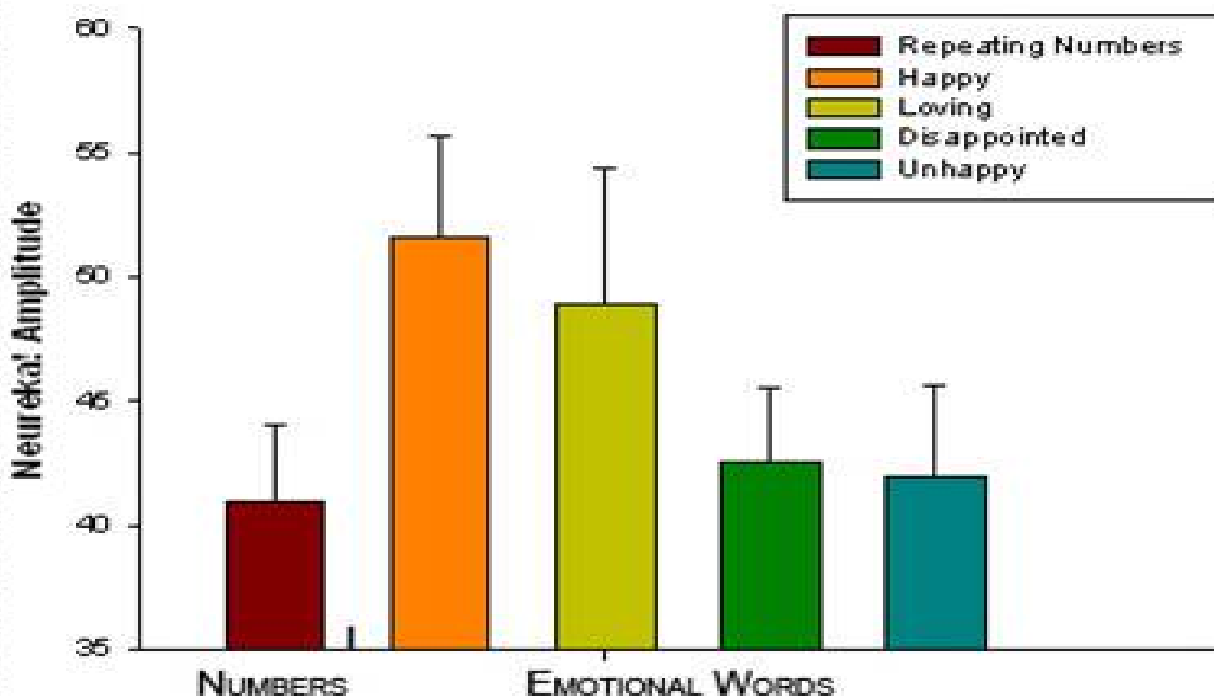
The brain produced more Neureka! output when the subject felt positive emotions. The narrow lines above the bars are the standard errors of each measurement. The values for each of the positive feelings were statistically significantly better than baseline.

In the next experiment, researchers read emotionally positive, negative and neutral words to the subjects. The subjects created the feeling of each word inside themselves for 20 seconds this time, and their Neureka! output was measured by the Peak BrainHappiness Trainer neurofeedback system. After each group of words, the subject repeated a 3-digit number for 20 seconds to help the brain calm down. Using this clearer baseline as a comparison, the positive emotions raised Neureka! higher than baseline, while the negative and neutral emotions didn't. The Neureka! associated with positive emotions was significantly higher than the Neureka! during negative or neutral emotions.



This graph shows the Neureka! output level when feeling positive feelings compared to negative or neutral ones. The Neureka! values during positive feelings were significantly better than during the repeating numbers and the negative and neutral emotions.

MEANS AND STANDARD ERRORS OF NEUREKA! DURING EMOTIONAL WORDS (N=9)



This graph shows the difference between the subject's reaction to two words with a high Neureka! output level, compared to the two words with lower level of Neureka! output. This indicates how much and how quickly the brain can change when different types of feelings happen.

These experiments establish that the Neureka! protocol can measure a variety of positive feelings, in as little as six seconds.

Study Demonstrates That Training with Neureka! Enhances Happiness, Decreases Depression, and Improves Cognitive Function and Memory

A study performed by Dr. Estate Sokhadze at the University of Louisville showed all of these positive changes from only five hours of training with the Peak BrainHappiness Trainer. A follow-up survey taken after the study showed the subjects had effortlessly remained just as happy for 4 months.

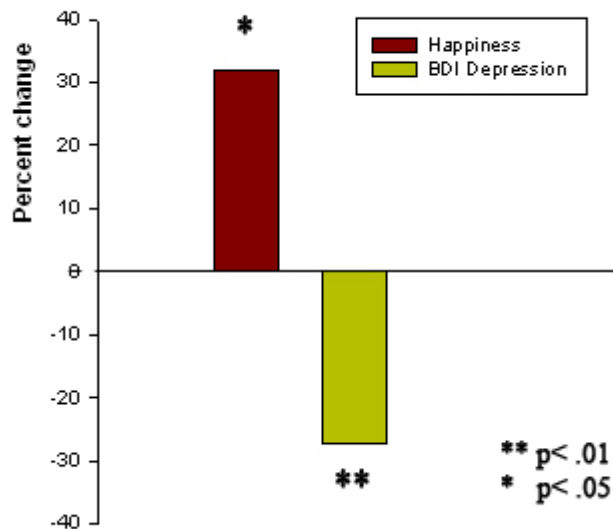
There were two goals for this preliminary study. One aim was to compare the results of potential substance abusers (who had been in legal trouble for substance use but did not meet the criteria for substance abuse used by psychiatrists) with normal controls (university staff and students). It turned out that the results from the five potential

substance abusers were no different from the 6 normal controls. The results from both groups were combined and used to measure the effects of 12 sessions of the Neureka! training in the Peak BrainHappiness Trainer, the second goal.

Training sessions were conducted approximately once a week and lasted approximately 25 minutes. The subjects viewed DVDs with beautiful scenes from the BBC series, Planet Earth, during the training sessions. When their Neureka! values increased, the size of the DVD picture that was displayed also increased proportionately until the screen was full. They were asked to increase the picture's size as much as possible.

Happiness enhancement. The study used a question about happiness that was drawn from the Household Income and Labor Dynamics in Australia Survey, so that we could relate the results to those in an article about how happiness improves

Happiness self-report and BDI depression scores after 12 sessions of Neureka! neurofeedback

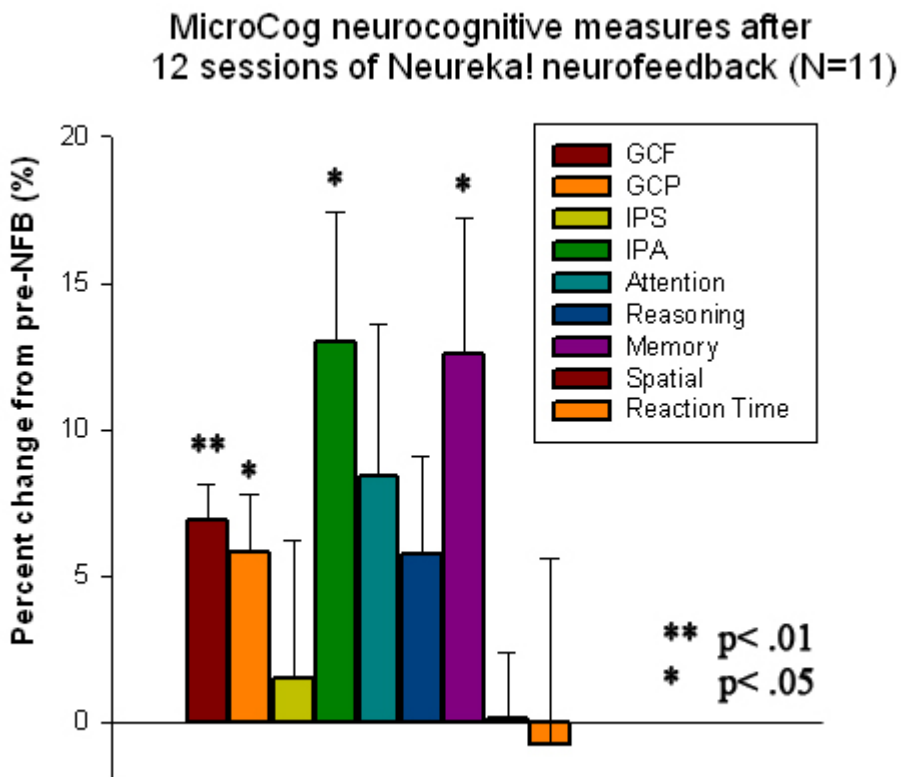


subsequent health: "During the past four weeks, have you been a happy person?" The six responses and their scores were: (6) all of the time, (5) most of the time, (4) a good bit of the time, (3) some of the time, (2) a little of the time, and (1) none of the time. The mean happiness rating for the group increased from 3.45 to 4.18, or by 21%. If you average the individual percentages, the increase was 32%, as shown in the graph. This may actually underestimate the effect, because 4 of the 11 subjects started out with happiness ratings of (5) most of the time. Since very few people

will ever say they are happy all of the time, they had no way to show any improvement. If we eliminate those 4 people, the improvement in happiness was 44%, from 2.57 to 3.71, or 50% by the other method. More on happiness and health below.

Lower depression scores. The Beck Depression Inventory is a very well known and accepted measure of depressed mood, which is filled out by the client and yields a score that increases with the degree of depressed mood. The scores before training averaged 8.45, with three subjects at or above the cutoff for a clinical diagnosis of the illness of depression* of 15. After training, the average was 5.45, a highly significant 35% improvement, or 27% by the other method, shown in the figure. None of the scores were above 15. The highest (worst) score improved from 21 to 13.

Cognitive performance and memory. The MicroCog is a brief computerized assessment of cognitive functioning, developed at Harvard and primarily intended to screen for impairments in thinking. It produces an overall summary score, General



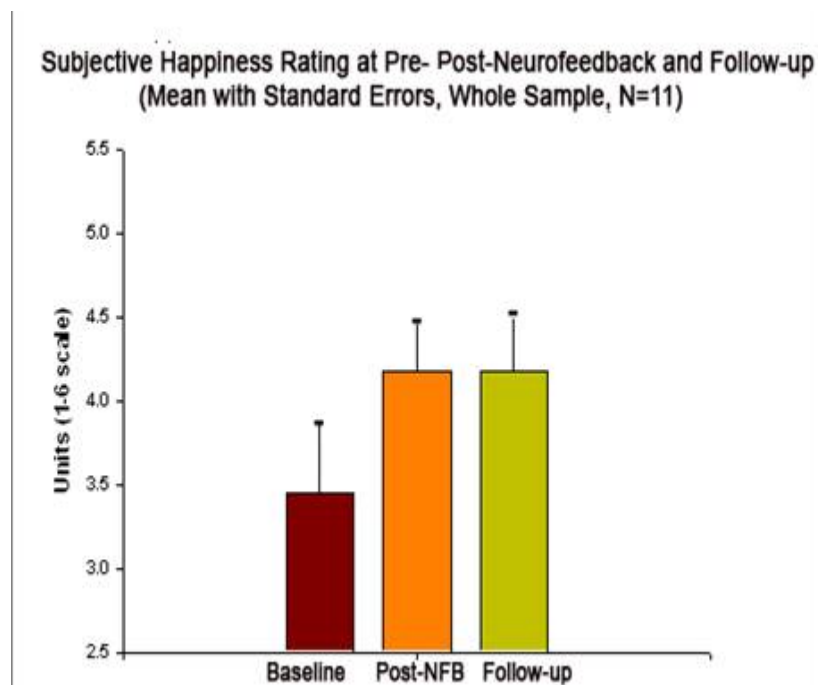
Cognitive Functioning, combining processing speed and accuracy measurements for all the tests it offers. After only five hours of training, there was a very significant ($p < .001$) 7% increase. General Cognitive Processing was increased by 6%. The next level of summary indicated that the improvements were all due to better Information Processing Accuracy (13% increase, $p < .05$) rather than Information Processing Speed (1.5% change). More specifically, the largest increase was in memory (13%), significant at the $p < .05$ level. There were two improvements--Attention/Mental Control and Reasoning--that were almost significant. The other two categories, Spatial Processing and Reaction Time, were not improved at all in the combined sample. [However, Reaction Time was significantly ($p < .05$) faster in the normal controls.] This indicates a very selective improvement in brain function, particularly centered around memory accuracy. It is consistent with the hypotheses we made several years ago when we wrote [the Neureka! manual](#).

Current Happiness and Future Health

A recent review by a well-respected professor and researcher found that 157 of 160 studies showed that those who are happier at present are more likely to be healthier later in life. Another review shows they are also more likely to be successful.

A press release from the University of Illinois on March 2, 2011 stated: "Happy or positive people tend to have better health and live longer than their counterparts who are unhappy, U.S. researchers say. Ed Diener, professor emeritus of the University of Illinois at Urbana-Champaign, and colleagues reviewed more than 160 studies involving humans and animals under stress." The UPI [article](#)* quotes Dr. Diener: "All of these different kinds of studies point to the same conclusion: that health and then longevity in turn are influenced by our mood states. Happiness is no magic bullet, but the evidence is clear and compelling that it changes your odds of getting disease or dying young." Dr. Diener, who is one of the major researchers in positive psychology, posted the full **article** on his website.

The most thorough [study](#) was done by the Department of Labour in Australia and analyzed and published in the American Journal of Health Promotion by Siahpush, Spittal and Singh. They looked at two representative population-based samples of 9981 people surveyed in 2001 and 2004. They examined the relationship between happiness in 2001 and their health in 2004. In 2001, they used the question about happiness that we copied, and corrected their calculations for health problems noted in that year. The survey data from 2004 found that the odds of reporting good (or better) health were 50% better for those who were happy most or all of the time in 2001. Similarly, the odds of having no limiting, long term health conditions were 53% better.



Putting the two studies together supports the idea that training with the Peak BrainHappiness Trainer may produce long-term improvements in health. We know that the improvements due to neurofeedback are typically long-lasting, if not permanent, after a sufficient number of sessions, and we expect that Neureka! training is no exception. However, the most prudent approach to improving happiness and health would be to continue to do Neureka! training sessions

on a regular basis. You may continue to improve with more sessions. Our choice of 12 sessions was just an arbitrary one, but after later review it was discovered that 12 sessions appeared to be sufficient to produce a major improvement.

This Direct Approach Complements and Enhances

Indirect Approaches to Increasing Happiness

There are many techniques and exercises for increasing happiness based on positive psychology which are taught in a number of recent popular books. Some of them, such as the Gratitude Letter taught by Dr. Martin Seligman, may be quite powerful, but they are usually appropriate within a particular limited context—you can't spend your entire day writing Gratitude Letters. Furthermore, these exercises require a lot of mental effort and time set aside for ongoing practice.

In contrast, once you learn to switch on the Prefrontal Pleasure Centers with a few sessions of really enjoyable Peak Brain Happiness Training, you can repeat it again without any real effort. The repetition builds a habitual way of functioning, increasing the functioning level of the brain's Neureka! System. This will improve your awareness and memory as well as enhance the range of your positive feelings. You can make the Peak Brain Happiness Trainer more powerful by wearing a reminder—a small timer called an Invisible Clock, on your belt or in your pocket. Set it to vibrate every few minutes and remind you to shift your mental state by practicing Neureka! enhancement without the Trainer. That's all it takes. Of course, you can add the techniques and exercises from these books if you wish.

The optimal solution to enhancing happiness is to use several techniques in the combination that works for you. This powerful psychophysiological system should definitely be considered as key part of your effort. We believe that the widespread use of the Peak Brain Happiness Trainer will help many people reach and maintain a healthy state of well being.