NEUROFEEDBACK OF THE EVENT BINDING EEG RHYTHM (40 HERTZ) IMPROVES AUTISTIC ISSUES

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A New Rapidly Effective Brainwave Biofeedback Training System for Autistic Issues at Home or Clinic

ABSTRACT

BACKGROUND: Forgotten research from the early '90s by Rudolpho Llinas and colleagues found a 40 Hertz (cycles/second) MEG and EEG rhythm which binds together inputs and memories to form an event. It originates in the intralaminar nucleii of the thalamus and scans the brain 40 times a second, bringing the most relevant information back to the thalamus to be integrated (bound) into an event.

I hypothesize that disorders of this event binding system, which vary individually, are the basic flaw leading to many autistic issues.

We call this system "Neureka!" due to its role in discovery and new learning. We have developed a measurement of the particular 40 Hertz rhythm, the Neureka! Protocol, which isolates it from other 40 Hertz rhythms and EMG artifact, and developed a professional brainwave biofeedback system, the Peak BrainHappiness Trainer. This uses neurofeedback designs which combine training to enhance control of Neureka! and single pointed Focus—the InhibitAll protocol. The Neureka! level controls the size of the video or DVD playback, while Focus enhances the brightness. Low levels of either stop the playback.

OBJECTIVES: We tested its effectiveness in autistic teenagers in several studies. Its success led us to simplify the Trainer and create a home and clinical training system, the Socialize ACE, for the PC, which I will demonstrate. This provides the advantages of more frequent, less expensive sessions, which should improve learning.

METHODS: The most recent study built on previous published work, and tested the design's effectiveness as part of our Peak BrainHappiness Trainer, training two to three times a week during the summer instead of once in previous studies. It is ongoing at the University of South Carolina in Greenville.

RESULTS: After 18 sessions of training, the first 8 subjects showed very significant improvements of parent ratings on the Achenbach scales for problems with Depression (p = .009), Attention (p = .001), Oppositional Defiant Behavior (p = .002), and p = .09 for Anxiety. The group average for each of these scales started out in the abnormal range and finished below the normal cutoff. The mean total score on the Social Responsiveness Scale-2 decreased very significantly (p = .006), or 51% toward the normal zone boundary of 59. These results appear to be better than the previously published work.

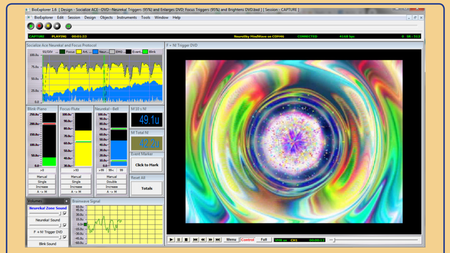
The training improves the user's mood and they are very motivated to continue.

CONCLUSIONS: There is mounting evidence that the combination of 40 cycle Neureka! training and the InhibitAll Focus Training produces real and rapid improvements in several autistic issues. Also, a published study in normal subjects found significant gains in their memory and attention, and a significant improvement in happiness that lasted at least four months after only 12 sessions.

The results of the studies support the hypothesis that disorders of the 40 cycle Neureka! system, as well as focusing problems, may be important in the etiology of ASD.

DESCRIPTION OF SOCIALIZE ACE

The Socialize ACE is an improved and simplified method of brainwave biofeedback training for single-pointed Focus, and the 40 Hertz (cycles/second) EEG rhythm we call Neureka!, since it is a neural response to Eureka! Experiences. The client wears a headband which detects brainwaves from the center of the forehead and the left ear (using convenient dry electrodes) and sends them to a customized computer program. In addition to traditional bar charts and numerical displays, the program changes the size and brightness of a chosen DVD or video to reflect the user's Focus and Neureka! measurements, creating Neurovideofeedback. It also tracks the user's performance over time.



THIS IS THE SOCIALIZE ACE DVD TRAINING SCREEN. NEUREKA! (BLUE) CHANGES THE SIZE OF THE PICTURE WHILE FOCUS (YELLOW) CONTROLS THE BRIGHTNESS. IF EITHER GOES TOO LOW, IT STOPS.

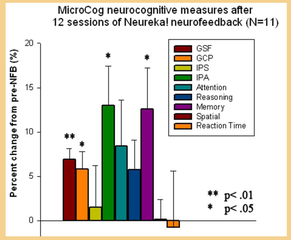
SINGLE-POINTED FOCUS NEUROFEEDBACK

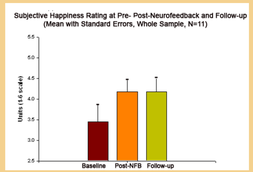
This measures how we focus our attention, from wide to single-pointed (higher). Our early studies indicated that it increased quickly during training with ADD/ADHD, while measures of attention improved. In fact the F value for 18 subjects over 12 sessions was 32.39, p < .00001, while the more traditional measures of theta/beta ratio was F = 7.49, p < .0001 and theta/alpha ratio was F = 19.74, even though these were not trained directly. Measures of attention also improved quite significantly.

The Focus measure was included in all the studies of autism, but the threshold for success was set lower, since our intention was to use it to keep the subjects engaged. However, it was significantly improved.

NEUREKA!, ATTENTION, MEMORY, HAPPINESS, AND HEALTH

Studies in normals showed significant improvements in memory on the MicroCog, and in attention on the IVA-2.





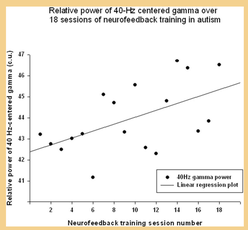
Their increased happiness lasted for at least four months. Enhanced happiness is related to better success and long-term health.

EEG CHANGES AFTER TRAINING

Training autistics with Focus and Neureka! neurofeedback just once a week for 18 sessions produced very substantial changes, particularly in these measures, but also in traditional measures of progress with ADD.

Changes in EEG Measures

EEG changes from training	Pre-post differences	T-scores	P values
Neureka!	3.68	2.34	.031
Focused Attention	2.29	4.32	.001
Gamma	.22	.76	.456
Theta/Low Beta	-1.72	-2.15	.046
Theta/High Beta	-1.48	-2.23	.039
Theta/ Beta	-1.26	-2.16	.045

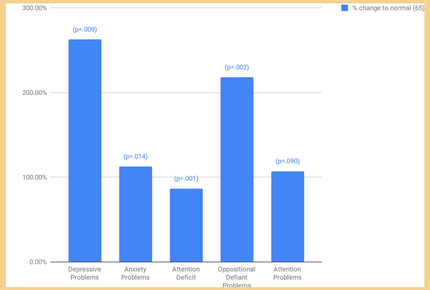


IMPROVEMENTS AFTER NEUREKA! AND FOCUS TRAINING IN HIGH FUNCTIONING AUTISTICS

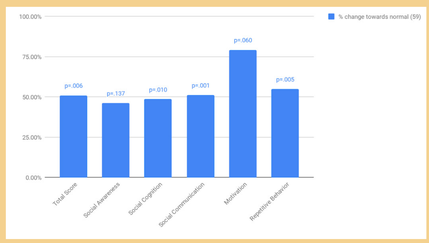
Training once a week with Focus and Neureka! neurofeedback for 18 sessions of 25 minutes each (n = 18), created a significant reduction in Lethargy/Social Withdrawal Subscale of the Aberrant Behavior Checklist rated by parents, p < .005. Changes in Lethargy/Social Withdrawal scores showed a positive correlation with relative gamma power changes (r = 0.43, p = 0.041),and a negative correlation with the theta/low beta (r = −0.43, p = 0.043) and theta/high beta ratios (r = − 0.45, p = 0.033). This substantiated a relationship between EEG improvements and changes in behavior.

Hyperactivity scores also showed a decrease, p = 0.021.

More frequent training—two or three times a week for 25 minutes--and improved measures may be responsible for the more powerful normalization of symptoms seen in the more recent study. Most scores moved below the "normal" cutoff for the ASEBA scales.

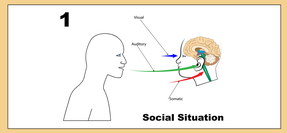


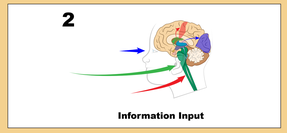
The improvements in the Social Responsiveness Scale-2 averaged over 50% towards the normal range.

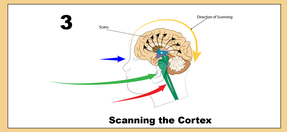


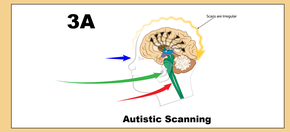
We have set up a home-training experiment and are seeking participants to observe the further improvements after more sessions. We are also seeking clinical research collaborators.

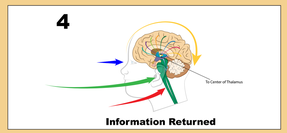
A HYPOTHESIS ABOUT DEFICITS IN THE NEUREKA! SYSTEM IN AUTISM LEADING TO CONFUSED UNDERSTANDING OF EVENTS

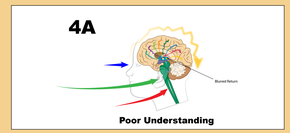


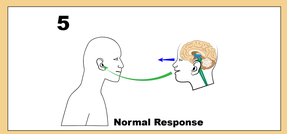


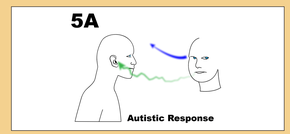












1. In a conversation, people perceive sounds (), visual (), and somatic () information.

2. This travels to areas of the cortex through the outer thalamus and other paths.

3. The center part of the thalamus scans ()the cortex 40 times a second, front to back.

3A. This scanning system ( ) does not work effectively in autism, causing numerous problems.

4 & 4A. The information from the cortex returns () to the center of the thalamus, where it is assembled into a perceived event and further scanning produces a response. This processing is scrambled ( ) in autism.

5 & 5A. The normal response is unusual in autistic individuals.

SUMMARY

The Socialize ACE (www.socializeace.com) is a new type of highly effective brainwave biofeedback system which is based on two unusual types of neurofeedback, single-pointed Focus and Neureka!, both of which improve the control of attention. Results indicate highly significant and meaningful improvement in 18 25-minute sessions, which are also very enjoyable, leading to excellent compliance with treatment. The Socialize ACE is simple enough to be used at home three or more times a week on a Windows PC, and featuring dry electrodes, although starting off with clinical assistance may be helpful to some caretakers. Further research in both settings is welcomed.

Neureka! feedback is based on detecting and improving one type of 40 Hertz brain scanning rhythm, which creates events from brain inputs. This system is hypothesized to be defective in ASD.

DESCRIPTIONS OF THE SOCIALIZE ACE