Brain Quotient and Neurofeedback Technology Center

Case Study_01

Symptoms:

A 7-year-old girl presents with multiple symptoms as suspected ADD/ADHD has parents seeking to use neurofeedback training as an alternative approach to medication. The child studies in primary one of a Hong Kong local school. As she has short attention span and is easily distracted, she encounters problem focusing on learning in most lessons. She is also very impulsive and talkative. She constantly moves around and looks very restless. She also experiences severe anxiety when her parents, particularly when her mother is not by her side.

BQ Report Summary

She completed a BQ report analysis on 17 May 2013, from the scores and data obtained, the following observations noted:

Analysis Quotients	**Observations**
Basic Rhythm Quotient (BRQ) *Frequency Age Standard: 7 Hz The girl's score: The various dominant peak frequencies when eyes closed: 5 Hz – L: 12 times; R: 10 times 7 Hz – L:7 times; R: 10 times 9 Hz – L:13 times; R: 11 times	✓ 9 Hz is the most dominant peak frequency. Though balance but both ahead Right (+2), Left (+2) which corresponds to 3-4 years faster in development. Hence in most occasions, she would react and respond to external stimuli or social cues by balancing rational and causal relationship of the situations in a speedy manner. Since her Age Standard score is 128, she is potentially gifted. However, this is also an indicator that she becomes highly/over sensitive to comments made by people around her. Suspected Gifted but ADHD. ✓ Furthermore, there are also occasions for dominant peak frequency of 5 Hz which is behind kids of her age, hence her behaviors or cortical processing may become childish e.g. exhibit emotional impulsive responses or reject to accept reasoning, and unable to comprehend causal relationships well enough. ✓ When eyes closed, unable to regulate changes in delta, theta, SMR, low and high beta. While Alpha

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	resting amplitude – eye closed fluctuates mostly between 5-35 mV, too high and too vigilant. Energy recharge is not good or steady.
Self Regulation Quotient (SRQ) ***Ideal range should be:** **20-25% (Average)** **26-30% (Desirable)** **Weighting: 6-7** **MD: within 5** The girl's score: Relaxation: 25^5 Attention: 16^2 Concentration: 13^2 Maximum Deviation (MD): 12	A relatively better relaxation condition at Active Brain Scan (alpha wave – 25^5) while attention below marginal range (SMR wave – 16^2) and concentration is far below average and highly unstable (beta – 13^2). With insufficient SMR and concentration percentage, indicates she has significant difficulties in maintaining attention while learning, may frequently make careless mistakes or miss details. With low percentage of beta wave, she is unable to sustain focused for a lengthy period. With the scores for all three conditions being imbalanced and unevenly distributed (MD 12), the brain fails to function at optimal.
Attention Quotient (ATQ) *Standard: Level of Tension: 10 Level of Distraction: 1-1.5 The girl's score: Level of Tension: L – 62.98 R – 59.2 Level of Distraction: L – 4.2 R – 3.6	Level of Tension over by L – 52.9 and R – 49.2 and very high above standard, so she will constantly experience physical anxiety. Further, Level of Distractions also over for both left and right (L – 2.7; R – 2.1), indicating unstable in motor control (e.g. fidgeting) and suspected ADHD.
Anti-Stress Quotient (SQ) The girl's score: L – 23.5; R – 27.7	Indicates high tensions in eyes or physical stress; may cause memory difficulties and deficit in attention. Her scores are at the very poor scores range (Under 40). Bodily tension, anxiety and over excitement will in the long run weaken immunity functions.
Correlation Quotient (CQ) The girl's score: Symmetry: 48.39 / 50 standard Synchrony: 0.692 /1 standard	Left and Right brainwaves are about 30% not at same pace, so she may display mood dysregulation and cognitive processing impairments as well as bodily imbalance in some physical or mental tasks.

Related Research on Neurofeedback Training

The origins of neurofeedback for the treatment of clinical disorders can be directly traced to the first systematic demonstration of EEG operant conditioning in general (Sterman, 1996). Through visual and auditory feedback, a trainee's brainwave activities are governed and provided with real-time signals, hence one can learn how to adjust own brain's functions.

Research on the use of Neurofeedback training to help reduce attention deficit or treat hyperactive disorder symptoms have nearly 38 years of history (Lubar & Bahler, 1976). From important updates to the Diagnostic and Statistical Manual of Mental Disorders (4th ed., text rev.; DSM-IV-TR; American Psychiatric Association, 2000) suspects with Attention deficit / hyperactivity disorder display symptoms of poor attention span; become overactive and easily distracted. Encounter higher physical and mental stress.

Lubar (1997) employed EEG scans and found that attention deficit / hyperactive disorder patients have unusual brainwave activity, with excessive slow wave (Theta wave) appearing in the frontal cortex location. Neurofeedback training by elevating SMR waves (12-14Hz) can reduce the symptoms of hyperactivity (Lubar & Shouse, 1976). Referring to studies conducted in foreign countries, teachers and parents pointed out that neurofeedback training can improve students' attention and reduce hyperactive / impulsive behavior (Lenis, Goth, Hinterberger, Klinger, Rumpf, & Strehl, 2007; Monastra & Monastra, 2002).

In Korea, among many of the studies that employed the instrument Neuroharmony brainwave neurofeedback training, a study that observed the pre and post brainwave measurement of 50 primary students suggested neurofeedback training has positively affected the subjects' mental state and attention-deficit characteristics (Bak, Yi & Park, 2007). Other studies indicate neurofeedback training can enhance intelligence (Thompson & Thompson, 1998). Neurofeedback training as compared to effects of using drug therapy, for example Methylphenidate, has been shown to achieve similar positive effect (Fuchs, Birbaumer, Lutzenberger, Gruzelier, & Kaiser, 2003).

According to Sherlin, Arns, Lubar and Sokhadze (2010), neurofeedback training is a safe and efficacious treatment intervention for ADHD, meeting the rating of Level 5: Efficacious and Specific. Furthermore, neurofeedback in the treatment of ADHD has been shown to have long-term effects and can be utilized in combination with a medication regimen.

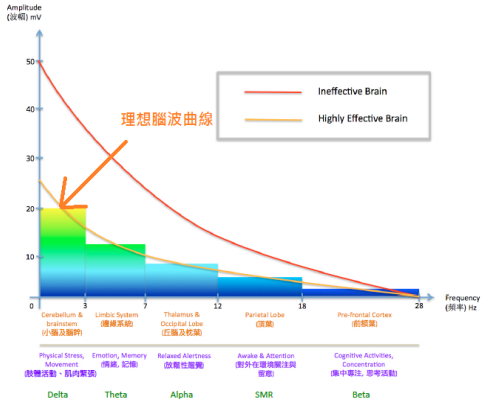
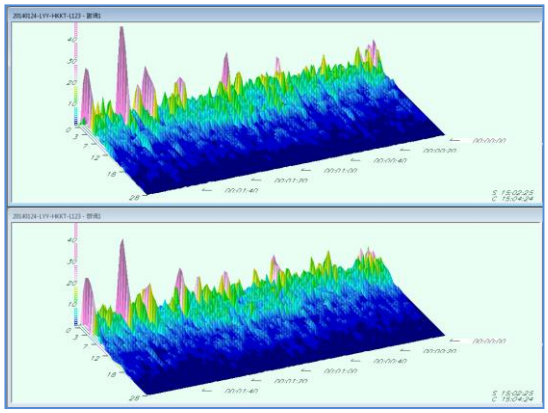
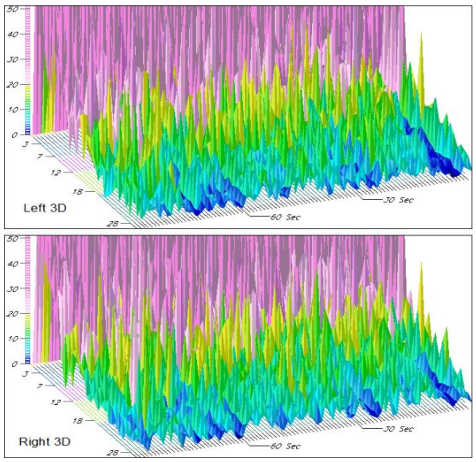
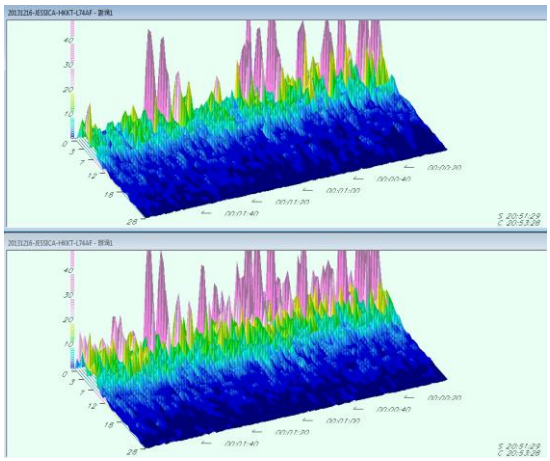
Neurofeedback Training and Observations of Progress

She has completed 2 phases of Neuroharmony neurofeedback Training and is now in 3rd phase training.

Static 3D Brain Graphic Differences

From BQ test to Phase 3 beginning session

She received 28 lessons of prefrontal Alpha (Relaxation) training at FP1, FP2 (from 24 May to 30 July 2013), then 44 lessons of prefrontal SMR (Attention) training (from 01 August to 11 December 2013)

Standard 3D Brainwave Graph	**Normal/Desirable Pattern**
	
The girl's Static Measurement of 3D Brain Graph during 1st BQ test on 17 May 2013  All five brainwaves activities at eyes-open and eyes-closed measurement are under highly arousal state.	**The girl's Static Measurement of 3D Brain Graph after Lesson 74 on 16 Dec. 2013**  All five brainwaves activities at eyes-open and eyes-closed measurement are closer to the desirable curve.

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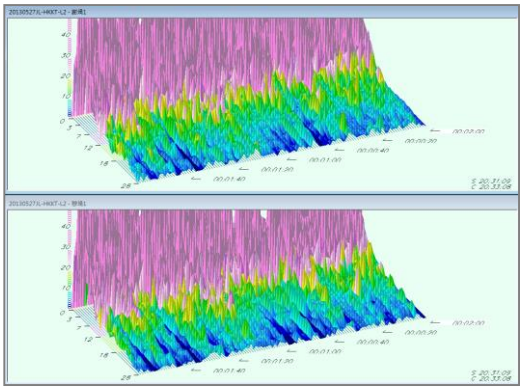
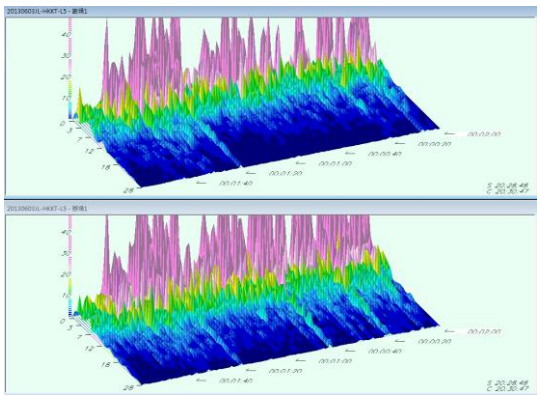
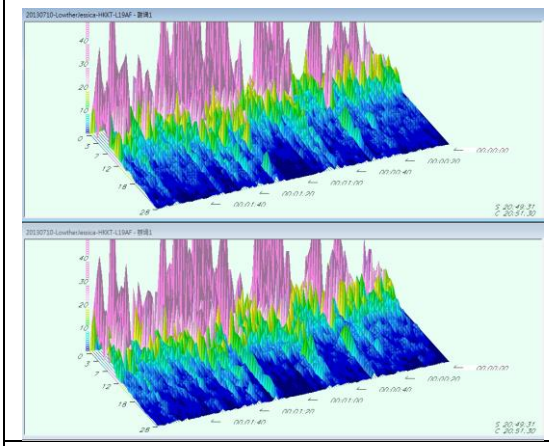
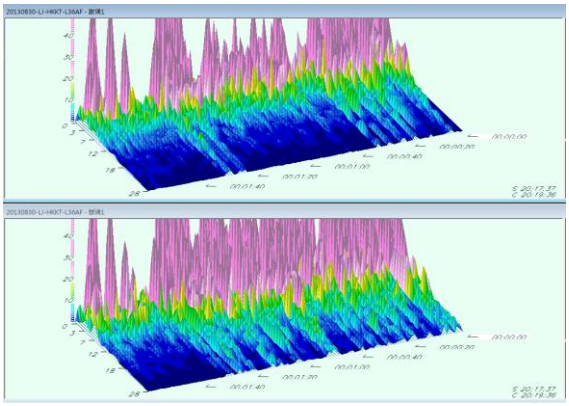
1. Static Brain Graphs Differences from 1st and 2nd phases Neuroharmony neurofeedback training

At the Onset of the training – L2	At the initial stage of phase 1 training – L5
	
L1-L3, high amplitude delta wave sec by sec, SMR or beta also over normal amplitude. L4, L5** show first significant calming of beta and SMR activity at open & close eyes state. L6-8, notable delta (less amount and amplitude between 30-40 mV) and theta reduced in amplitude at close eyes sit-resting state. Irregular patterns occur again in L9-10-11 high arousal in all 5 brainwaves, not desirable/stable.	

Progressively from L10-20, the below is L15	More significant improvements L19-L36, the below is L36
	
L10 – change to alpha 02 training and L15 onwards brain wave for theta and alpha show stable amount and at desirable amplitude (mostly between 20-30 mV). L29-30 illustrate first significant and consistent reduction of delta, theta when open and close eyes, most importantly at L36** the first sign of alpha block appearing in left hemisphere.	

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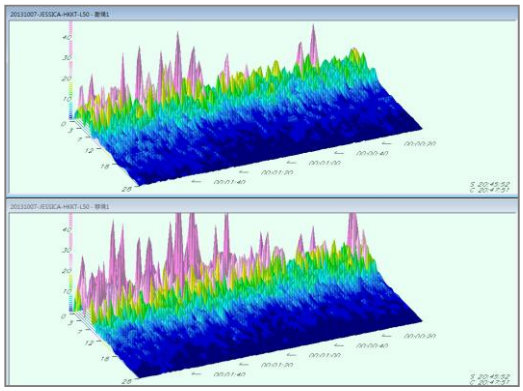
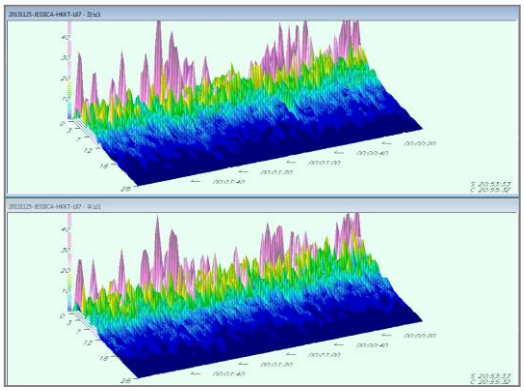
Progressively from L37 to L44	**More significant improvements L50 to L72**
	

As she enters a new phase of SMR training from L39 onwards, over 70% of her 3D static brain graphs resemble normal pattern.

L37, 39, 42 & 44 comparatively stable, alert and calmer activities in all 5 brainwave bands. At eyes closed or open state, the slow delta wave amplitude seldom exceeds 30 mV. Theta and Alpha amplitude at open or closed eyes state also stay within 10-15 mV.

From L50 to L72 onwards, frequency of desirable static scan is more dominant.

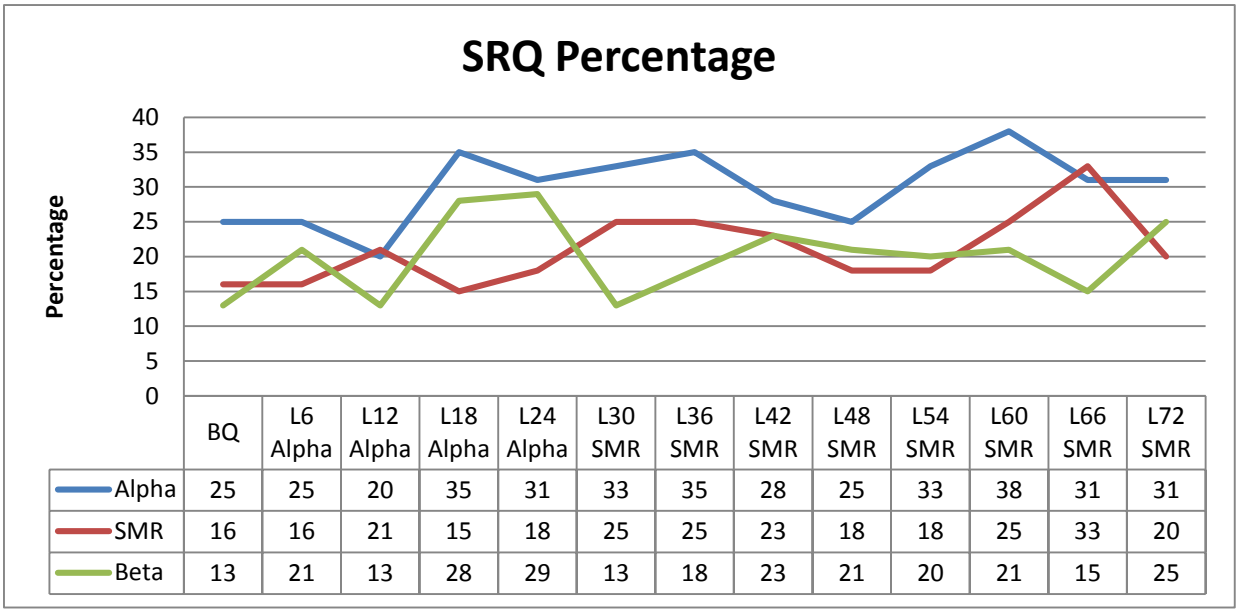
At this stage, behavior improvements are also more consistent. Please refer to the before and after training observations by parents and trainers (p. 8).

2. Self-Regulation Quotation Differences

	Date	R	A	C	MD
BQ	17/05/2013	25^{5}	16^{2}	13^{2}	±12
L6 Alpha	05/06/2013	25^{5}	16^{3}	21^{4}	±9
L12 Alpha	21/06/2013	20^{1}	21^{2}	13^{0}	±8
L18 Alpha	08/07/2013	35^{7}	15^{3}	28^{4}	±20
L24 Alpha	22/07/2013	31^{6}	18^{2}	29^{2}	±13
L30 SMR	05/08/2013	33^{7}	25^{3}	13^{2}	±20
L36 SMR	30/08/2013	35^{8}	25^{5}	18^{2}	±17

	Date	R	A	C	MD
L42 SMR	**13/09/2013**	**28^{9}**	**23^{3}**	**23^{4}**	**±5**
L48 SMR	02/10/2013	25^{1}	18^{4}	21^{3}	±7
L54 SMR	21/10/2013	33^{5}	18^{1}	20^{5}	±15
L60 SMR	**04/11/2013**	**38^{11}**	**25^{4}**	**21^{6}**	**±17**
L66 SMR	**22/11/2013**	**31^{7}**	**33^{9}**	**15^{2}**	**±16**
L72 SMR	**11/12/2013**	**31^{6}**	**20^{1}**	**25^{3}**	**±11**

Linear Graphic tracing the increase in percentage of all three states: Relaxation (Alpha), Attention (SMR) and Concentration (Beta) at Active Brain Scan after every 6 sessions training.



	BQ	L6 Alpha	L12 Alpha	L18 Alpha	L24 Alpha	L30 SMR	L36 SMR	L42 SMR	L48 SMR	L54 SMR	L60 SMR	L66 SMR	L72 SMR
Alpha	25	25	20	35	31	33	35	28	25	33	38	31	31
SMR	16	16	21	15	18	25	25	23	18	18	25	33	20
Beta	13	21	13	28	29	13	18	23	21	20	21	15	25

From Phase 1 training, Attention (SMR) and Concentration (Beta) scores show increase percentage to between 20 and 28 yet unsteady, occasions of fluctuations and percentage of below 20 is still obvious.

From Phase 2 training, Relaxation (Alpha), Attention (SMR) and Concentration (Beta) with more desirable and steadier increase, L42, L60 and L72 show the 3 states all fall within the range of 20 to 30 percent. Weighting and Dispersion still require further training to reach more optimal performance.

3. Observable Behavioral Changes:

Observer	Before Training	After Training	Associated Brainwave Type (s)
Parents	**Physical or Body Stress** · Frequently fidgets and unable to sit still for a lengthy period · Bites Things or own lips **Emotional Stress** · Constantly talking and seeking for adults' recognitions · Poor sleeping conditions - frequently tosses and turns or sleep talk · Encounters great anxiety when mother is not by her side **Attention Problem** · Very short attention span (less than 1 min) · Easily distracted · Unable to notice fine details **Highly curious** · Show strong interest in a lot of things or people around and unable to prioritize · Constantly restless	**Physical or Body Stress** · Better control of body movement/motion · Able to sit still for 3-5 minutes · Reduced lip-biting **Emotional Stress** · Improved sleeping conditions – calmer sleep states · Less frustrating emotions or returns to positive emotional state more quickly, better mood regulation **Attention Problem** · Capable of noticing fine details more · Provides more precise descriptions · Able to maintain focused in things/events for a longer period	 Alpha Alpha Alpha Alpha Alpha, Beta SMR SMR SMR, Beta
Trainers	**Physiological/Body Stress** · Uncontrolled motor actions, e.g. frequently kicking things or chair when seated, always changing posture or turning head around to talk to trainers · Unable to maintain proper sitting posture for even a minute · Unable to self-correct inappropriate behavior and with poor internal supervision	**Physiological/Body Stress** · Greatly reduced body motion – less fidgeting, sucking of fingers or playing with the computer cable · Enhance self-control and behave more quietly and cooperative during training. · Does not move around so often · Able to tell what are the expected right behavior and attitude during training and promise to do better in upcoming sessions	 Alpha, Beta Beta Alpha Beta

	• Love drawing other people's attention and when failing to complete training games will yell out she has finished, which does not match with actual fact • Impatient and sometimes humming during the training	• Follow trainer's instructions to use abdominal breathing while completing training games	SMR, Beta
	Highly Curious • Repeatedly asks the same question over ten times • Strong demands for mother to accompany her training, and unable to stop asking questions • Often initiates other children to chat with her during training • Unable to stop looking around	**Curious** • Repeatedly ask the same question but reduced to about 2-3 times • Able to complete training on her own and even when trainers are not by her side, she can stay calm and quiet • Still show strong interest to communicate with others, e.g. will ask trainers to guess her sister's name • Form a better habit that after asking for trainer's name, will write down other's response in notebooks, she develops a more serious attitude in ideas/details that she finds out	Beta Alpha, Beta SMR SMR, Beta
		Emotional Stress • Does not require mother to accompany her during neurofeedback training • When noticed own brain-graphs show improvement, feels very happy to be praised by trainers and takes picture of brain-graphs home to show parents	Alpha Alpha

Concluding Analysis at this stage

The present study is another authentic testimony that demonstrates the efficacy in enhancing improvements of a child with attention deficits and high physical stress disorder using an outcome approach.

From longitudinal and regular static and active brainwave data collected during the neurofeedback interventions, both data and observations by parents and trainers confirmed positive changes helping the child to reduce inattentive, impulsive and

stressful behaviors after 72 or more sessions of neurofeedback training. It is worth noting the child has not been given any medication through-out all the training sessions.

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