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## **QEEG Px Water-based Products Preliminary Study**

Report of QEEG findings prepared by

Juan Acosta-Urquidi, PhD, QEEGT

Stone Mountain Center, 310 River Rd. Ext., New Paltz, NY 12561

### **Recording and Analysis Procedures:**

The electroencephalograph (EEG) was digitally recorded (256 samples/sec) utilizing 19 electrodes with the International 10/20 System of electrode placement. Electrode impedances were reduced to below 5Kohms. The EEG was recorded continuously in the awake state with eyes closed and eyes open and may have included additional tasks. The raw EEG has been visually inspected and ocular and muscle artifacts rejected before generating the Neurometric analysis report.

This QEEG assessment reveals locations of dysfunction in the brain and quantifies the degree of deviation (Z-scores) from a normalized database. This data is helpful for the detection and localization of brain pathologies and/or dysfunctions (dysregulations). This information may assist in the differential diagnosis and in guiding the selection of treatment protocols and appropriate medications.

There are 2 reports (each a separate file), generated with Neuroguide software ([www.appliedneuroscience.com](http://www.appliedneuroscience.com)), labeled:

EP427EC..... eyes closed condition (Baseline)

EP427Dev3.....eyes closed condition (.87ml BPx Water topically applied)

Pages 1- 2 are subject and technical information.

Page 3 is Z-scored FFT summary information. This is overall results for EC or Dev3 file. Labels at the top of each column show the EEG frequency bands: Delta, Theta, Alpha, Beta and High Beta as shown on Pages 14 - 17.

From page 3: The two top rows show colored brain topographic maps (topos, the dots indicate the 10-20 scalp electrode placements) for Absolute and Relative Power. Power is computed as the signal amplitude squared.

**Absolute power** is the total power computed for each frequency band in  $\mu V^2$ .

**Relative power** is obtained by dividing the power in each band by the total power across all the bands (the sum of the power in each of the bands listed). Relative Power is therefore a % power value.

The color scale below the Alpha topo (Relative Power row), indicates the **Z-scores** derived from a comparison to the Normative database (RW Thatcher). This database compares the client's EEG values to an age and gender matched cohort and assigns a **Z-score** to indicate the degree of deviation from normal. Medium green is  $Z=0$ , normal values; positive Z-scores are light green, yellow, orange and red, indicating +1, +2, +3 values. Negative Z-scores are dark green, light blue to dark blue, indicating -1, -2, -3 values. Z-scores  $\pm$  greater than 2.6 are statistically significant and  **$\pm 3.0$  or greater are considered highly statistically significant (red and blue respectively at each end of the scale).**

The 15 remaining topos, labeled: Amplitude asymmetry, Coherence and Phase are also known as **connectivity maps**, because they describe QEEG metrics related to brain functional connectivity. Note the Z-score is now indicated by the thickness of blue (negative values) and red (positive values) lines of varying thickness that connect pairs of dots (i.e recording sites). The software calculates these metrics for all paired combination of cortical sites. Medium and thick lines are Z-scores  $\geq$  (greater than or equal to) 2.58 and  $\geq$  3.09, respectively.

## Definitions

**Coherence** - The percentage of brain wave activity that is time-related between two locations. A measure of the coupling between two signals with a constant phase relationship at different locations. The normal coherence between all regions is around 60%.

**Hypercoherence** indicates hyper synchrony between two locations or regions and a loss of local, differentiated activity.

**Hypocoherence** indicate poor synchrony, reflecting impairment in the connection between two locations or regions.

For example, we measure coherence by comparing the stability of phase differences of the brainwaves at two different locations (e.g.FP1 and FP2). If, according to normative databases, there is too much similarity between two locations, there is hyper-coherence. The opposite of this is hypocoherence, where there is excess dissimilarity. Coherence is a measure of the extent to which two brain locations share activity or work together. In hyper-coherence there is too much sharing of information, meaning that the two brain areas are not sufficiently differentiated for optimal performance of whatever task they are sharing. Hypocoherence on the other hand, means that the two brain areas are too independent of each other. They do not cooperate to the extent required by the task at hand. Abnormal coherence patterns are seen commonly in cases of Traumatic Brain Injury and Post Concussion Syndrome.

**Phase Lag** . Based on the calculated phase angle, converted to ms (milliseconds), between all connected pairs of scalp locations. An excess (Z+2,3 or higher) phase lag translates to slowing of neural signal transmission (reduced conduction speed) between connected sites

Below is the International 10-20 system of scalp electrodes placements.  
**F** frontal, **C** central, **T** temporal, **P** parietal, **O** occipital

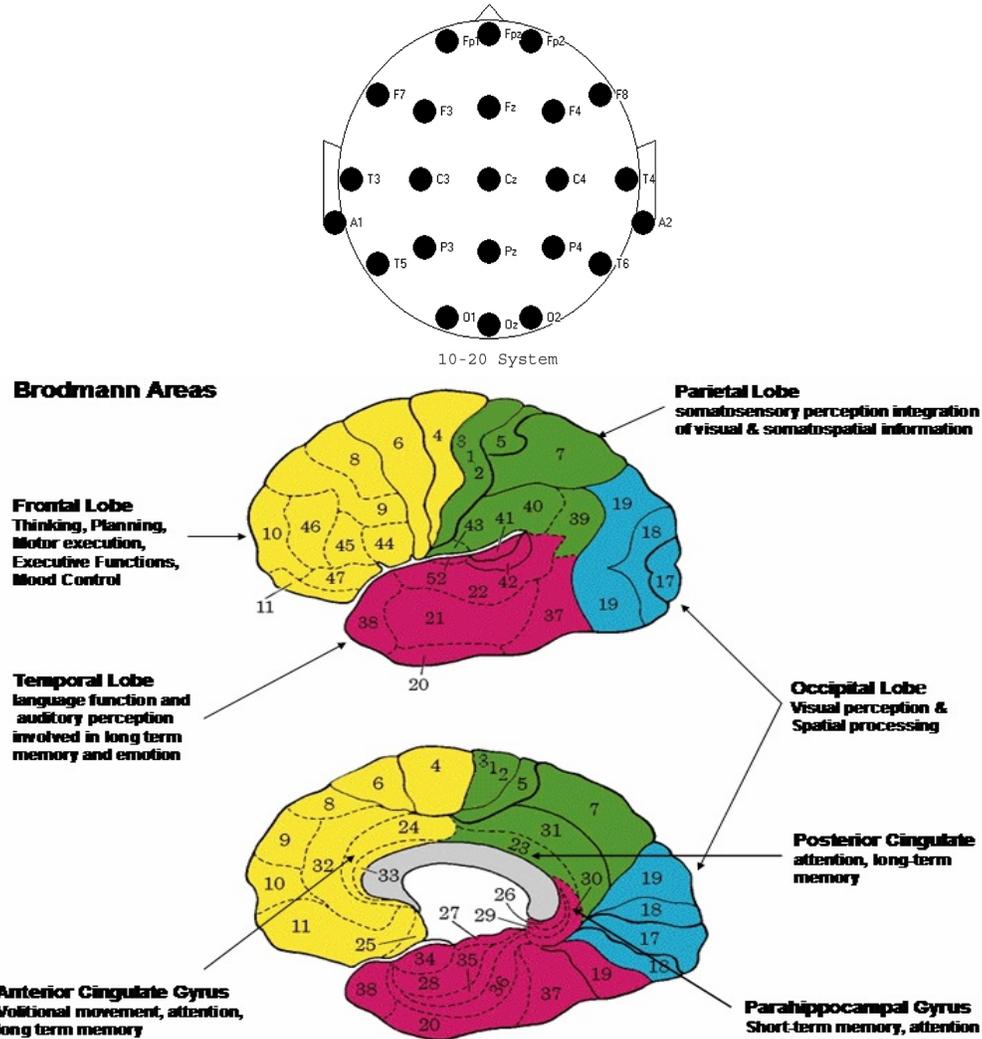


Illustration of Brodmann areas (Brodmann, 1909) linked to particular functions. Brodmann areas operate at the macroscopic level as measured by the QEEG with spatial areas of common functional cytoarchitecture that range in size from about 1 cm<sup>3</sup> to 6 cm<sup>3</sup>. The goal is to link a patient's symptoms and complaints to deregulation or deviation from normal in brain regions known to be related to specific functions. QEEG also provides high temporal resolution so that measures of dynamic connectivity and phase reset can also be evaluated with respect to an age match normative database. Treatment then follows.

## SUBJECT Scored FFT Summary - Baseline/Px Comparison

Page 3

Baseline in Delta and Theta frequency Relative Power indicate a notable degree of deviation from normal. Baseline recording also indicates a **highly statistically significant** degree of deviation from normal in Alpha and Beta Absolute Power and Alpha Relative Power.

Baseline recording also indicates a degree of deviation from normal in Delta Amplitude Asymmetry and Coherence; Theta Phase Lag; Alpha Coherence and Phase Lag; Beta Amplitude Asymmetry with a highly statistically significant degree of deviation from normal in Beta Coherence and Phase Lag.

With the application of Px, an immediate trend towards normalization is noted within the Delta Amplitude Asymmetry and Coherence; Theta Phase Lag; Alpha Coherence and Phase Lag; and Beta Amplitude Asymmetry, Coherence, and Phase Lag. These value changes indicate normalizing effects with Px application.

### FFT Absolute Power (uV Sq) - Baseline/Px Data Comparison

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	Delta	Theta	Alpha	Beta	High Beta	Beta 1	Beta 2	Beta 3
<b>BASELINE</b>	3 - 17	2.3 – 10.6	1.3 – 4.7	1.7 – 4.8	.34 - .81	.4 – 1.8	.37 – 1.25	.77 – 1.75
<b>Px</b>	4 -19	2.8 – 12.5	1.5 – 5.5	1.9 - 5	.32 - .88	.6 – 1.9	.45 – 1.33	.8 – 2.2
<b>BASELINE MEAN</b>	10	6.5	3	3.3	.58	1.1	.81	1.26
<b>Px MEAN</b>	11.5	7.7	3.5	3.5	.6	1.2	.89	1.5
<b>+ or - % Mean Change</b>	<b>+ 15%</b>	<b>+ 18%</b>	<b>+ 17%</b>	<b>+ 6%</b>	<b>+ 3%</b>	<b>+ 9%</b>	<b>+ 10%</b>	<b>+19%</b>

The chart above (quantifying the images on page 4) indicates shifts in **Absolute power** which is calculated as the total power computed for each frequency band in uV2. Comparing the second and third rows in the chart, it is evident that the range of numbers is changed. For instance the Alpha Baseline ranges from 1.3 to 4.7 and the addition of the Px instigated a change of range from 1.5 to 5.5 within the subject; while the Alpha Mean Absolute Power (bottom row) is increased by 17%. Notice on the images provided on page 3 that the Alpha Absolute Power images show a trend towards normalization from dark blues to light blues and green with the application of the Px. This increase is often found with devices that promote wellbeing. The Alpha and Beta Baseline measurement may be indicative of Traumatic Brain Injury or Post Concussion Syndrome. Following the application of the Px, the shift in Alpha and Beta shows that this technology is

initiating an improvement in this frequency range towards normalization. The increased Alpha state is indicative of a state of “relaxed awareness”.

The Mean Beta frequency changes with the application of Px show increases ranging from 3% to 19% thus are worthy of note. Beta frequencies represent brain activity, focus and concentration; often called “the brain on task”. Beta, High Beta and Beta 1, 2, and 3 increases are typically quite small because Beta is a very small amplitude.

These quantitative comparisons indicate that Px has shown to increase mean FFT Absolute Power across the entire spectrum of frequency ranges and indicate a minor trend towards normal values, especially in the Alpha and Beta spectrums.

### **Z Score FFT Absolute Power - Baseline/Px Data Comparison**

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These images identify the incremental Hz ranges; 1 through 30. Where Delta ranges between 1 to 4 Hz; Theta ranges between 4 to 8 Hz; Alpha ranges between 8 to 12 Hz; Beta ranges between 12 to 25 Hz, and High Beta ranges between 25 and 30Hz. Within the 7 Hz through 22 Hz, 29 Hz and 30 Hz Baseline images the subject shows 1 to 3 value standard deviations (Z Scores) too little Absolute Power. These deviations are improved with the application of the Px, as the Px map shows a 1 to 3 Z Score value normalizing trend in all of these images. These maps indicate that the application of Px incites calmer mental activity combined with relaxed awareness while normalizing statistically abnormal values.

### **Z Score FFT Relative Power - Baseline/Px Data Comparison**

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These images identify the incremental Hz ranges; 1 through 30. Where Delta ranges between 1 to 4 Hz; Theta ranges between 4 to 8 Hz; Alpha ranges between 8 to 12 Hz; Beta ranges between 12 to 25 Hz, and High Beta ranges between 25 and 30Hz. Highly statistically significant Z Score values are displayed in the Baseline 5 Hz and 6 Hz ranges. These high values are reduced (less red and orange, more yellow and green) with the application of Px. Alpha 9 Hz and 10 Hz showed a decrease in Relative Power and Alpha values 8 Hz and 12 Hz trended towards normalization (dark blue to light blue and green) values with Px application. Additionally, Beta values within the 21 Hz through 29 Hz were shifted towards normal values (blues to greens) with the application of Px.

## Absolute Power (uV Sq) - Baseline/Px Data Comparison

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Baseline

### FFT Absolute Power (uV Sq)

#### Intrahemispheric: LEFT

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP1 - LE	5.78	3.87	1.42	1.70	0.45	0.49	0.37	0.84
F7 - LE	5.73	3.68	1.46	2.19	0.55	0.84	0.50	1.05
F3 - LE	8.94	7.11	2.17	2.58	0.68	0.70	0.53	1.32
T3 - LE	4.73	4.38	2.27	4.03	0.65	1.37	1.05	1.60
C3 - LE	10.48	7.71	2.49	2.99	0.79	0.96	0.65	1.38
T5 - LE	7.34	6.40	3.86	4.76	0.62	1.76	1.25	1.75
P3 - LE	11.15	7.65	3.65	3.33	0.63	1.17	0.81	1.35
O1 - LE	10.43	6.79	4.70	3.53	0.55	1.30	0.90	1.33

#### Intrahemispheric: RIGHT

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP2 - LE	5.79	3.87	1.53	1.81	0.45	0.52	0.40	0.88
F4 - LE	9.40	7.00	2.28	2.41	0.60	0.73	0.52	1.16
F8 - LE	5.70	3.58	1.53	1.99	0.35	0.70	0.50	0.79
C4 - LE	12.26	7.71	2.73	2.78	0.61	1.02	0.63	1.13
T4 - LE	3.83	2.37	1.31	2.10	0.37	0.70	0.56	0.84
P4 - LE	16.24	8.10	3.83	3.16	0.71	1.10	0.78	1.27
T6 - LE	6.64	3.63	2.33	1.91	0.38	0.64	0.49	0.78
O2 - LE	9.73	5.74	4.62	2.82	0.52	1.02	0.69	1.11

#### Intrahemispheric: CENTER

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
Fz - LE	10.74	8.98	2.62	2.58	0.63	0.75	0.54	1.29
Cz - LE	14.35	10.51	3.23	3.01	0.81	0.89	0.67	1.45
Pz - LE	12.60	8.61	4.00	2.84	0.69	0.92	0.69	1.23

## FFT Absolute Power (uV Sq)

### Intrahemispheric: LEFT

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP1 - LE	6.07	4.80	1.70	1.99	0.39	0.62	0.46	0.92
F7 - LE	5.94	4.10	1.67	2.28	0.44	0.70	0.56	1.02
F3 - LE	11.21	8.47	2.71	3.48	0.60	1.07	0.84	1.58
T3 - LE	4.43	4.42	2.38	4.89	0.88	1.50	1.28	2.11
C3 - LE	13.14	8.98	3.00	3.91	0.74	1.39	0.93	1.59
T5 - LE	7.55	7.21	4.45	4.91	0.59	1.80	1.32	1.79
P3 - LE	12.51	9.37	4.52	3.85	0.59	1.40	1.03	1.42
O1 - LE	10.60	8.63	5.46	3.74	0.49	1.37	1.03	1.34

### Intrahemispheric: RIGHT

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
FP2 - LE	6.70	4.78	1.76	2.18	0.43	0.63	0.52	1.03
F4 - LE	11.04	8.34	2.70	3.24	0.56	1.06	0.76	1.41
F8 - LE	5.88	4.20	1.70	2.20	0.32	0.74	0.59	0.87
C4 - LE	13.81	8.54	3.07	3.53	0.62	1.33	0.85	1.35
T4 - LE	4.10	2.81	1.59	2.56	0.58	0.86	0.77	0.93
P4 - LE	16.34	9.88	4.85	3.82	0.66	1.34	1.01	1.47
T6 - LE	6.75	4.76	3.12	2.08	0.34	0.72	0.56	0.81
O2 - LE	10.78	7.57	5.09	2.95	0.45	1.07	0.80	1.09

### Intrahemispheric: CENTER

	DELTA	THETA	ALPHA	BETA	HIGH BETA	BETA 1	BETA 2	BETA 3
Fz - LE	13.89	10.36	3.22	3.64	0.57	1.17	0.86	1.61
Cz - LE	18.98	12.42	3.81	4.41	0.80	1.49	0.99	1.93
Pz - LE	15.76	11.08	4.75	3.60	0.67	1.26	0.91	1.43

The Baseline charts above display low Absolute Power values in the Alpha electrode measurements which show improvement with the application of Px; for instance the Left Intrahemispheric changes from baseline with Px application are; +19.7% (FP1), +25% (F3), +20% (C3), +15% (T5), +23.8% (P3), +16% (O1). Concurrently Beta values are also increased in nearly all measurements with the introduction of the Px; 20.4% (FP2), 34% (F4), 27% (C4), 22% (T4), 27% (Pz) etc.

**Conclusion:**

Baseline imaging indicates a degree of deviation from normal in Delta Amplitude Asymmetry and Coherence, Alpha Coherence and Phase Lag; Beta Amplitude Asymmetry with a highly statistically significant degree of deviation from normal in Beta Coherence and Phase Lag. Additionally a degree of deviation from normal is shown in High Beta The Delta, Alpha, and High Beta Amplitude Asymmetry, Coherence, and Phase Lag.

Indications of hypocoherece (Delta and Alpha) indicate poor synchrony, reflecting impairment in the connection between two locations or regions, while hypercoherence (Beta) suggest a loss of local, differentiated activity. Baseline value measurements may be indicative of Post Concussion Syndrome.

With Px topical application, immediate value changes indicate a trend towards normalization in all Coherence and Phase Lag values.

Additionally, with the Px application, the Delta, Theta, Alpha, Beta, High Beta, and Beta 1, 2, 3 frequency measurements of Absolute Power Mean values were increased by 15%, 18%, 17%, 6%, 3%, 9%, 10%, and 19% respectively. This increase in values is often found with devises that promote wellbeing.

**Summary:**

**The Baseline maps may be indicative of Post Concussion Syndrome. Px topical application showed to incite immediate value changes trending towards normalization in all Coherence and Phase Lag values suggesting that Px facilitates the extent to which two brain locations share activity or work together along with an improvement of neural signal transmission; increased conduction speed between connected sites. Moreover, with Px application comparative Absolute Power Mean values with Baseline measurements indicate increases up to 19% across all frequency amplitudes from Delta through High Beta. This increase in values is often found with devises that promote well-being. The increased Alpha state is indicative of a state of “relaxed awareness” while the Beta, High Beta and Beta 1, 2, and 3 frequency changes are worthy of note as they represent brain activity, focus and concentration; often called “the brain on task”. The immediate effect of the Px technology upon brain activity and the trending towards normalization it incites, warrants further study.**