

CONSISTENT DYNAMIC Z-SCORE PATTERNS OBSERVED DURING Z-SCORE TRAINING SESSIONS

Charles Stark, MD

SESSION PROTOCOLS

We use 4-channel z-score training and the 4 electrode placements at 10/20 sites usually form a square, rectangle, parallelogram, rhombus, or trapezoid depending on our interpretation of head maps and connectivity figures derived from NeuroGuide analyses. Our training sessions last about an hour, which includes electrode placement. We execute 10 or 11 'runs,' each lasting 3 minutes with variable pauses between 'runs' for brief discussions with clients. We set a 2-second void between audio/visual rewards and we record Standard Deviation (SD), % z-scores required within the SD target (%ZIT), and the % time in reward (%TIT) for each 'run' on paper data sheets for each session. We use this scoring system as well as available BrainMaster session data and periodic QEEGs to follow training progress.

AVAILABLE Z-SCORE DATA

Anyone who has done 4-channel z-score training will be familiar with the data ar-

ray present throughout the training session. It consists, in part, of text number displays for the SD settings, the % z-scores required within the SD target in order for the client to receive an audio/visual signal that the criterion has been achieved, and the % time in target (in our paradigm the % time in target for the 3-minute run) shown in the upper left screen area. To the right of those numbers the client and trainer see a line graph showing the SD setting line, the time line for the 'run,' and a line that traces time-in-the-SD-target across the 3-minute 'run.' To the right of that graphic display the client and trainer see a number showing the % time in the SD target.

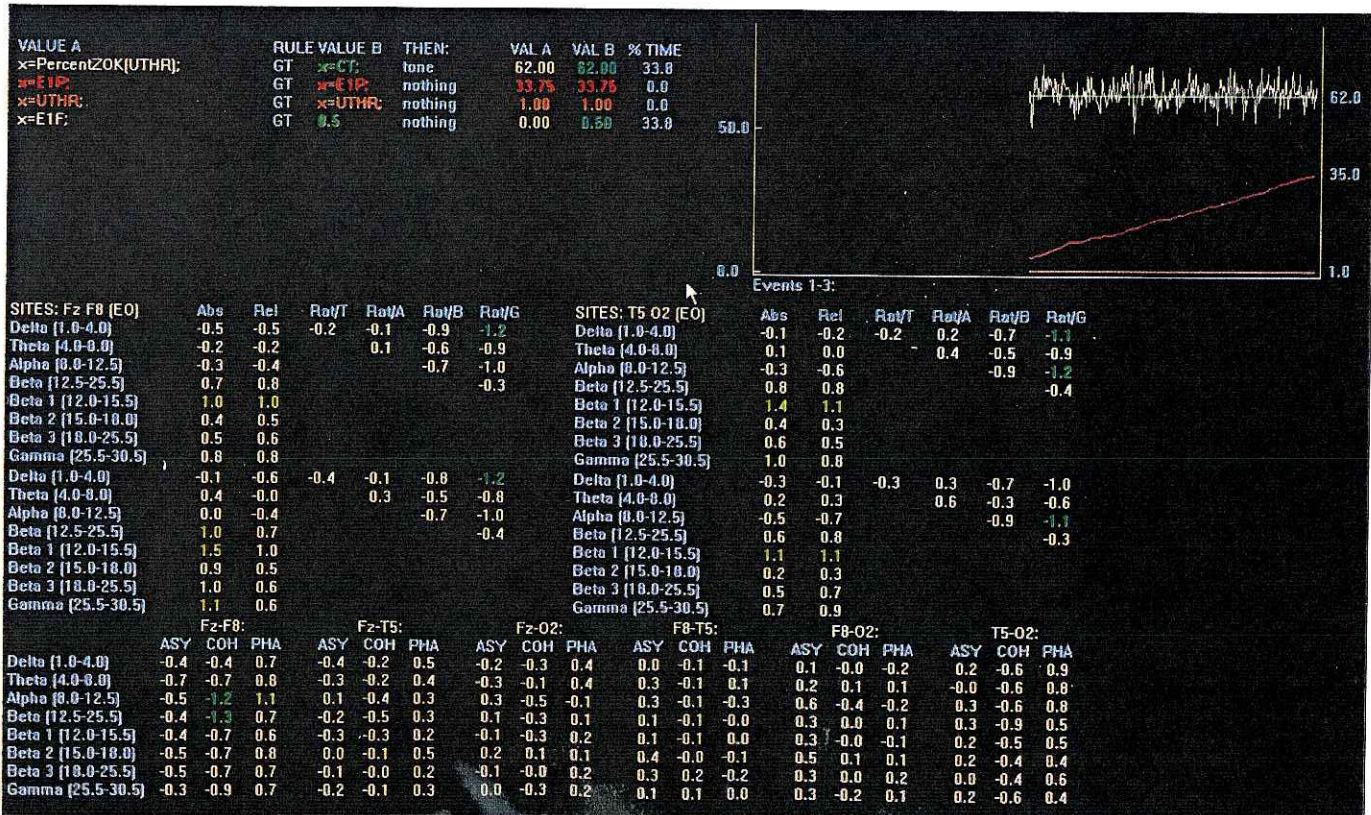
Just below the above-mentioned numbers and graphic display the client and trainer see large z-score arrays for channels 1 and 2 on the left side of the screen as well as channels 3 and 4 on the right side of the screen. For each channel pair and each channel within the pairs the arrays show z-scores for absolute power and

relative power for delta, theta, alpha, beta, beta 1, 2, 3, and gamma frequency bands as defined in NeuroGuide software. To the right the display shows z-score values for various ratios for delta, theta, alpha, beta, and gamma frequency bands as defined in NeuroGuide software.

A third array band along the screen bottom shows z-scores at each frequency band for each possible two-electrode combination. Three columns under each two electrode combination show z-scores for asymmetry, coherence, and phase as defined in NeuroGuide software at each frequency band.

In all, the client and trainer see 248 z-scores that change instantaneously according to instantaneous changes in brain function. At first this number mélange appears as a baffling, apparently randomly changing number array. After watching it intently for

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run after run and session after session, however, the number changes reveal patterns that follow systematic changes (shaping) in the % z-scores-in-the-SD-target (independent) variable (%ZIT).

THE OBSERVATIONS

For the 40+ training sessions that I have conducted over the past several months I have noted several very consistent, dynamic, recurring z-score patterns. When I raise the %ZIT, a challenge that asks the client to alter brain function toward the comparison population z-score mean, a consistent, dynamic change pattern flows through large z-score subsets of the total 248 z-score array. Typically, for any given electrode or electrode pair I see immediate z-score increases in absolute power, to levels above 2 SD, in delta and other frequency bands, but frequently only in the delta band. Sometimes the relative power array follows suit with less abrupt and less dramatic changes. Almost always the power increases start in the delta band and progress to higher frequencies but occasionally absolute power "turns on" at all frequencies and then decreases from higher toward lower frequencies as a run progresses. Absolute delta power may stay high for long time periods but relative power usually returns to normal first.

After the absolute and relative power display changes, the ratio z-score array may show aberrations. Usually, the ratio aberrations return to normal (white) before any other aberrations. Shortly after the absolute power, and sometimes relative power increases in any given electrode, the phase z-score in the connectivity array with that electrode in it turns to red (the z-score exceeds 2 SD) at any given frequency that has registered an aberrant coherence z-score. After that, the aberrant coherence z-score may change to a more 'normal' value, or it may not change. If it does not change in a more 'normal' direction, the 'power cycle' described above may repeat or it may not repeat. If the power cycle does not repeat, I find that raising % ZIT, i.e., challenging the client's brain to change in the desired direction, may re-awaken the power cycle and, ultimately after several challenges and several power cycle re-awakenings, the aberrant z-score coherence may normalize. Thus, by noting the power cycles and associated connectivity changes the trainer can pace specific shaping maneuvers to maintain steady progress in converting specific aberrant connectivity z-scores to normal.

I have also observed that retreating, lowering %ZIT (sometimes drastically) and then escalating %ZIT as rapidly as the client can maintain adequate reward response rates, can 'tell the client's brain' the right direction to change and ignite a significant positive change in brain function as measure by z-score changes and clinical responses. Absolute %ZIT levels do not seem to count as much as giving the client's brain a hint about the right direction to go (I may be wishing that to happen more than it actually happens---more study needed).

Follow up QEEGs show changes consistent with the conclusion that the techniques used have validity. Further, more rigorous study will add needed validity. Meanwhile, I would like to hear from anyone willing to duplicate the set up and techniques described. Adding confirmatory anecdotal data to anecdotal data has considerable strong-inference power if enough clinicians pay attention to enough details and if the findings replicate often enough across widely different clinical conditions. Please contact me at dickstark@mac.com if you want to try to replicate these findings. 