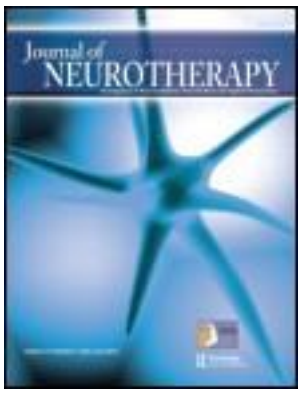

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Clinical Perspectives of 19-Channel Z-Score Neurofeedback: Benefits and Limitations

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CLINICAL PERSPECTIVES OF 19-CHANNEL Z-SCORE NEUROFEEDBACK: BENEFITS AND LIMITATIONS

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Z-Score neurofeedback has expanded to include 19-channel models (19ZNF) such that clinicians now have the option to use from 1 to 19 electrodes in a *z*-score neurofeedback protocol. Benefits and limitations of this new model are discussed from the clinical perspective of an early adopter of 19ZNF who has more than 4 years of experience with this modality after having several years of experience with QEEG-guided NF (QNF). Comparisons between QNF and 19ZNF are discussed. It has been suggested that 19ZNF can bring about positive clinical outcomes in fewer sessions than traditional NF, which matches the author's experience (average of 38 with QNF vs. an average of 11 with 19ZNF). Unique implications of 19ZNF that have not yet been discussed in the literature, such as the advantage of once-per-week sessions, or questions about whether there could be times when change can occur too fast, are introduced. Directions for future research to further evaluate 19ZNF are suggested.

Over the last few years, a relatively new model of neurofeedback (NF) has emerged, which has generally become known as *z*-score NF (ZNF). The original design included four channels in 2006 and was expanded to incorporate 19 channels (19ZNF) 3 years later. Descriptions and reviews of ZNF in general, and 19ZNF specifically, are reported elsewhere in the literature (Collura, 2008; Collura, Guan, Tarrant, Bailey, & Starr, 2010; Collura, Thatcher, Smith, Lambos, & Stark, 2009; Stoller, 2011; Thatcher, 2008, 2013); therefore, this article is not an overview of the technical considerations, nor is it a commentary on the different versions developed by various manufacturers. However, after several years of conducting QEEG-guided NF (QNF), and then as a clinician who was an early adopter of 19ZNF (having employed it for more than 4 years to date), I present my clinical impressions and observations of this new *model* from that perspective. Also of note, although the information in this article focuses primarily on the *surface* formulation of 19ZNF, the observations generally apply equally to the low-resolution electromagnetic tomography (LORETA) variation of ZNF.

PRACTICAL MATTERS—USE OF UP TO 19 ELECTRODES

To be clear, although the technique is framed in the context of *19 channels*, if one selects a linked-ear montage it is not necessary to always use all 19 electrodes; one can simply target the desired number of electrode sites in a protocol. However, the use of the Laplacian montage or LORETA ZNF does require all 19 channels to be acquired at the same time. Yet, to reap the full benefits of 19ZNF, use of all sites, usually by way of an electrode cap, has typically become the

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norm among those who use this model. Thus the advent of 19ZNF has ushered in the practice of using an electrode cap at each session. Although some neurotherapists have expressed hesitance with this due to a perception of the cap setup being overly cumbersome, with time and practice most clinicians are able to learn to apply the cap in as little as 10 minutes. My experience has shown that it takes about the same time to attach eight separate/individual electrodes as it does to apply the electro-cap. The discussion here is geared toward the use of all 19 electrodes in each session.

BENEFITS

The 19ZNF model is different in two primary respects—the first is session parameters, and the second is the ability to gather full QEEG data in each session; there are benefits and limitations to both differences.

Session Parameters

With my implementation of 19ZNF, session parameters are different from traditional NF in terms of number of sessions for case completion and session frequency. Although my prior experience with QNF shows a track record of number of sessions to case completion being an average of 38 over a 6-year period (nonpublished data); with 19ZNF the average is 11 sessions to case completion over a period of 3 years (Wigton & Krigbaum, 2012). In addition, with 19ZNF I have moved to a model of session frequency being once per week, with training time being as little as 20 minutes per session. This paradigm shift results in several implications. Although it is easy to focus on the benefits of completing a case in a range of 10 to 15 sessions, perhaps more significant is the session frequency of *once per week*. Although both contribute to a higher probability of case completion, having to schedule only one session in a week is substantial in that it leads to more consistent session attendance (fewer cancelations) and less chance of the clients getting burned-out on perceived tedious training parameters, which results in less resistance from clients who perceive NF as ''boring.'' Many neurotherapists are likely familiar with the scenario of the client getting bored with the training screens available for the NF session. A case example here is a male adolescent who found NF to be incessantly tedious, yet remained polite enough to not resist the process. At one point during his treatment, two sessions per week were scheduled during a school break. This proved to be extremely taxing on his patience and demonstrated how a session frequency of more than once weekly would have proved disastrous to the overall case success. Thus by coming only once a week, and for fewer sessions total, most clients are frequently able to achieve treatment goals before the risk of burnout becomes a factor in the case.

The other notable advantage of fewer sessions is the resulting lower cost to the client. This not only makes 19ZNF more accessible by being more affordable but also contributes to a reduced likelihood of terminating treatment prematurely. In reviewing my case histories, with the QNF model 42% of clients terminated treatment early, whereas only 12% of 19ZNF clients have prematurely ended neurotherapy; thus, even though the primary reasons for early termination are the same for both models (financial and/or scheduling), completion rates appear improved with 19ZNF.

Another additional benefit of 19ZNF is the reports of how it can bring a certain degree of clinical symptom improvement in only a handful of sessions (Rutter, 2011; Wigton, 2009; Wigton, 2010b). This may be advantageous in that it appears possible that clients can *move down the road* in terms of symptom resolution, and then come back at a later time to progress farther in the treatment. Although this is not the ideal condition for 19ZNF success, this can be beneficial for clients of limited resources (financial or time). One case comes to mind where the gentleman initially presented with anxiety symptoms. His baseline Beck Anxiety Index (BAI) was 57, and after six sessions (in as many weeks) he reported his symptoms had greatly improved and his BAI had improved to 35. A year later he came back hoping to do more 19ZNF but was only able to complete one

session. At his posttreatment 1-year follow-up, his BAI had improved slightly to 33. He returned again 9 months later, and although he was able to complete only a couple of sessions, his BAI had remained at 33 at the 21-month follow-up. Thus illustrating, in this case, not only did six sessions of 19ZNF improve symptoms, but the gains attained held for nearly 2 years after the initial treatment. Therefore, in this case and others where session attendance was intermittent, gains nonetheless were still achieved, demonstrating how even those with inconsistent session attendance may still gain benefits from 19ZNF.

QEEG Data in Every Session

With QNF the typical model is to collect the QEEG data, process the EEG after the data-collection session, later develop the NF protocol, then repeat the exact same protocol for the next 20 or so sessions, then repeat the QEEG to assess for change. However, with 19ZNF not only can the full QEEG be collected and processed, but a tailored protocol can be developed based on the QEEG data of that day—all in one session. Thus it is possible to tailor changes not only in the NF protocol individualized to the person, but with the most current QEEG data available for that session. This also means that QEEG data can be tracked from session to session, as well as plotting the topographical images on a chart for both the clinician and client (or parents of client) to see. Being able to see QEEG topographical images from session to session provides a more tangible sense of change (as well as progression toward the mean) and has become a very popular part of the session. Most clients really enjoy seeing how their QEEG has changed from the prior week. Moreover the accumulation of per session QEEGs provides actionable data for research and study. Where QNF allows for observations of QEEGs at time points only of pre-, perhaps mid- (i.e., 20 sessions), and sometimes posttreatment (likely 40+ sessions, if the client is willing), 19ZNF provides a window to observe the changes in the QEEG from session to session throughout the treatment process. It remains to be seen if various patterns of QEEG changes are revealed/discovered that have not been available to study prior to 19ZNF.

LIMITATIONS

Yet even as advantageous as 19ZNF is, it is not without limitations. Perhaps the greatest limitation is that 19ZNF has a fairly steep learning curve for the neurotherapist. In addition to knowing how to develop, setup, and run a 19ZNF session, the clinician must also be proficient in acquiring, processing, and interpreting QEEG data. This also means that to fully leverage the potential of 19ZNF, someone with *clinical expertise* needs to develop the protocol for each session. Even when variously available symptom checklist options are employed, clinical judgment is still needed to agree or overrule an automatically developed protocol. Thus more clinician training and expertise is needed to fully gain the benefits of 19ZNF. Consequently, the expanded use of 19ZNF will likely require models wherein technician-level personnel in multistation clinics can run protocols.

With respect to the change in session parameters, 19ZNF is more time and labor intensive within the individual sessions. Although it can be done, the clinician is still somewhat challenged to complete the electro-cap setup, acquire, process, and interpret the QEEG data, develop and set up the protocol, and run the protocol—all in one session. Moreover when the clinician opts to manually create a new protocol in each session, this requires additional session time as well. Fortunately, because as little as 20 minutes of 19ZNF actual training time is sufficient, there is more time for the other setup elements in the session. However, a clinician would be wise to dedicate time for reviewing the accumulated session and QEEG data between sessions to ensure proper tracking and treatment planning throughout the process. Finally, because fewer sessions means lower cost for the client, it may also call for a restructured business model as it means a potential of less overall income *per client*. However, some clinicians see clients every 30 min, thus seeing two clients in an

hour. The 19ZNF model requires at least a 50-min session, particularly with requirements for cleaning electrode caps afterward. In this case, having to charge double the price for 19ZNF may eliminate the financial advantages of fewer sessions. In addition, there is an increase in supplies and equipment cost. First, the necessity of having a 19-channel amplifier, as well as a companion reference database package, also necessitates a higher initial capital outlay. Then, there is the need for multiple electrode caps and associated supplies, all of which need occasional replacement and/or maintenance. Consequently, for all the aforementioned reasons, many clinicians find it reasonable or necessary to adjust fees to more adequately address these financial concerns. However, even with a higher per-session fee to the client, the overall cost for the entire course of 19ZNF treatment provided by therapists who are already conducting 45- to 50-min-long sessions can still be more affordable than the 40+ session framework of traditional NF.

With respect to fewer sessions, an important point to note is that although one may initially think there could be no downside to achieving faster clinical improvement, I would propose it may be possible to bring about change too quickly in some situations. A case in point involves one adult female client who had experienced lifelong severe medication-resistant anxiety. This was a case early in the 19ZNF implementation process, and sessions were scheduled for twice per week in accordance with traditional models. However, in only four 19ZNF sessions, over the course of 2 weeks, this client had almost complete remission of all anxiety symptoms. This sudden change in her affective state, however positive, was a somewhat difficult adjustment for her. As a result it was necessary to temporarily cease the 19ZNF sessions while she addressed adjusting to the change in psychotherapy sessions. Thus this case is a good example that although bringing about clinical improvement faster than traditional NF is desirable, affecting that change in a relatively gradual time frame can have merit. Although this is but a single example, the implications are worthy of consideration. For example, in cases where the patient is on psychotropic medication when starting 19ZNF, rapid changes could present therapeutic challenges when accounting for the potential of overmedication effects. Thus, 19ZNF clinicians would be wise to attend to these elements as part of the treatment planning process; however, here too, the once per week paradigm appears advantageous.

The ability to acquire and collect full QEEG data at each session also has limitations. There can be a sense of data overload where the neurotherapist can be challenged to know how to maximize the use of the increased data acquired from each session. Further, the clinician may struggle to fully account for the complete QEEG data during the real-time confines of the 19ZNF session. Each QEEG record produces metrics such as absolute power, relative power, coherence, phase, and power ratios for the linked-ears, Laplacian, and average-reference montages; and if LORETA is also employed this adds an expanded level of data as well. Thus it is important to learn which metrics are essential to focus on for each client. In addition, there is a practical matter that acquiring more data requires more computer hard-drive storage space as well as attention to data management practices (i.e., backup, etc.).

FUTURE DIRECTIONS FOR RESEARCH

Clearly, as has been the case with NF since its inception, there is a need for further research, and particularly controlled research, with 19ZNF. Although NF has recently gained more acceptance regarding efficacy, much of the supporting literature, by way of meta-analyses and reviews, is largely concerning the theta/beta ratio and slow cortical potential models (Arns, de Ridder, Strehl, Breteler, & Coenen 2009; Brandeis, 2011; Gevensleben, Rothenberger, Moll, & Heinrich, 2012; Lofthouse, Arnold, Hersch, Hurt, & DeBeus, 2012; Niv, 2013; Pigott, De Biase, Bodenhamer-Davis, & Davis, 2013). Regarding 19ZNF, although there have been a handful of conference talks and poster presentations

(Koberda, Moses, Koberda, & Koberda, 2012b; Rutter, 2011; Wigton, 2010a, 2010b; Wigton & Krigbaum, 2012), as of the writing of this article, there are only two peer-reviewed empirical reports published addressing (surface) 19ZNF (Hallman, 2012; Koberda, Moses, Koberda, & Koberda, 2012a), and both are single case studies. Thus there is much that needs to be addressed with 19ZNF research. Starting points for research would be empirical evaluations of efficacy of 19ZNF (does it lead to positive clinical outcomes) as well as comparison studies between traditional NF and 19ZNF models (does 19ZNF consistently yield results in fewer sessions or result in comparable, or even stronger, clinical outcomes). Moreover, comparisons between different implementations of 19ZNF (surface vs. LORETA, or between various software platforms) would be helpful, and an examination of how QEEG data changes and/or how *z*-scores progress toward the mean as a result of 19ZNF would be advantageous. Also important would be research evaluating long-term follow-up data to determine if the benefits of 19ZNF, with fewer sessions, produce comparable maintenance in comparison with other NF models.

CONCLUSION

In this brief review of 19ZNF there are clearly both benefits and limitations; however, in my professional experience it has shown that the benefits clearly win out. My experience with 19ZNF to date has been very positive in that it allows me to see more clients (thereby impacting more lives) and help them achieve treatment goals faster, with a more affordable modality, involving less tedium than traditional NF. However, limitations such as a steeper learning curve, higher start-up costs, longer sessions, and the potential for data overload may hinder some neurotherapists from pursuing this model. Moreover, in the rush to decrease the number of sessions it will be important to consider in which situations it may be prudent to bring about changes somewhat gradually. Ultimately, though, I believe the potential for improved cost to the client and streamlined (yet data-rich) session parameters, show promise to build a better public perception of NF as well as lead to improved NF research studies.

REFERENCES

Arns, M., de Ridder, S., Strehl, U., Breteler, M., & Coenen, A. (2009). Efficacy of neurofeedback treatment in ADHD: The effects on inattention, impulsivity and hyperactivity: A meta-analysis. *Clinical EEG and Neuroscience*, *40*, 180–189.

Brandeis, D. (2011). Neurofeedback training in ADHD: More news on specificity. *Clinical Neurophysiology*, *122*, 856–857.

Collura, T. F. (2008, April). Whole-head normalization using live Z-scores for connectivity training. *NeuroConnections*, 12–15.

Collura, T. F., Guan, J. G., Tarrant, J., Bailey, J., & Starr, F. (2010). EEG biofeedback case studies using live *z*-score training and a normative database. *Journal of Neurotherapy*, *14*, 22–46.

Collura, T. F., Thatcher, R. W., Smith, M. L., Lambos, W. A., & Stark, C. R. (2009). EEG biofeedback training using live z-scores and a normative database. In T. H. Budzynski, H. K. Budzynski, J. R. Evans, & A. Abarbanel (Eds.), *Introduction to quantitative EEG and neurofeedback: Advanced theory and applications* (2nd ed., pp. 29–59). Burlington, MA: Elsevier.

Gevensleben, H., Rothenberger, A., Moll, G. H., & Heinrich, H. (2012). Neurofeedback in children with ADHD: Validation and challenges. *Expert Reviews of Neurotherapeutics*, *12*, 447–460.

Hallman, D. W. (2012). 19-channel neurofeedback in an adolescent with FASD. *Journal of Neurotherapy*, *16*, 150–154.

Koberda, J. L., Moses, A., Koberda, L., & Koberda, P. (2012a). Cognitive enhancement using 19-electrode z-score neurofeedback. *Journal of Neurotherapy*, *16*, 224–230.

Koberda, J. L., Moses, A., Koberda, P., & Koberda, L. (2012b, September). *Comparison of the effectiveness of z-score surface/LORETA 19-electrodes neurofeedback to*

standard 1-electrode neurofeedback. Oral presentation at the 20th Annual Conference of the International Society for Neurofeedback and Research, Orlando, FL.

Lofthouse, N., Arnold, L. E., Hersch, S., Hurt, E., & DeBeus, R. (2012). A Review of neurofeedback treatment for pediatric ADHD. *Journal of Attention Disorders*, *16*, 351–372.

Niv, S. (2013). Clinical efficacy and potential mechanisms of neurofeedback. *Personality and Individual Differences*, *54*, 676–686.

Pigott, H. E., De Biase, L., Bodenhamer-Davis, E., & Davis, R. E. (2013). *The evidence-base for neurofeedback as a reimbursable healthcare service to treat attention deficit/hyperactivity disorder*. Retrieved from http://www.isnr.org/uploads/nfb-adhd.pdf

Rutter, P. (2011, September). *Potential clinical applications for 19-channel live z-score training using Percent ZOK and ZPlus protocols*. Oral presentation at the 19th Annual Conference of the International Society for Neurofeedback and Research, Carefree, AZ.

Stoller, L. (2011). Z-Score training, combinatorics, and phase transitions. *Journal of Neurotherapy*, *15*, 35–53.

Thatcher, R. W. (2008, April). Z-Score EEG biofeedback: Conceptual foundations. *NeuroConnections*, 9–12.

Thatcher, R. W. (2013). Latest developments in live z-score training: Symptom Check list, phase reset, and LORETA z-score biofeedback. *Journal of Neurotherapy*, *17*, 69–87.

Wigton, N. L. (2009). First impressions of Neuroguide real-time z-score training. In J. Demos (Ed.), *Getting started with dynamic Z-score training*, (pp. 81–89). Westminster, VT: Neurofeedback of S.VT.

Wigton, N. L. (2010a, September). *Case studies overview of multi-channel z-score neurofeedback*. Poster presentation at the 18th Annual Conference of the International Society for Neurofeedback and Research, Denver, CO.

Wigton, N. L. (2010b, September). *Laplacian z-score neurofeedback: A unique option in the realm of multi-channel z-score neurofeedback*. Plenary session oral presentation at the 18th Annual Conference of the International Society for Neurofeedback and Research, Denver, CO.

Wigton, N. L., & Krigbaum, G. (2012, September). *Insights gained from over 3 years of 19-Channel z-score neurofeedback: Towards new paradigms*. Poster presentation at the 20th Annual Conference of the International Society for Neurofeedback and Research, Orlando, FL.