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OPINION

Neurofeedback, Where Are We and Where Are We Going? Three Critical Issues for Consideration: Perspective from 25 Years of Practice

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For those of you who do not recognize the Swingle name, I am a neuro-brat, generation 2.0. I did not find the field, the field found me, or rather was just there . . . I grew up with the clicking and flipping of switches and amusing myself soldering in my father's university lab, mostly wire sculptures, bracelets, and such (my mother was an artist, after all), but also the odd connection or two on what were then wall-to-wall computers. Being a neuro-brat also meant I matured professionally in the frenetic energy of innovative minds. It took 25 years or so, and some digressions into other fields, namely, art, fashion, and education, but I was eventually drawn in fully at a Winterbrain conference in the 1990s.

These were fascinating years wherein I mostly observed and listened to the great minds that rooted us, great minds that clashed (as titans do) as much as they drove the profession forward. In these cerebral jousting matches, however, I fear many were left behind. Over time I have witnessed fewer and fewer people pick up the excitement of research and exploration and more wanting a road map, finding the paths of their forefathers and foremothers (our pioneers) harder than expected to follow. As this brilliant first generation slowly leaves us to retirement and beyond (the Budzynskis, Tooman, Judith Lubar, Michael Thompson, Stu Donaldson, Larry Klein, Joe Kamiya, and a few more), their legacies should be accessible and foundations strong for us to continue to build upon. It might also be time to put down the swords, to address conflicts that no longer push us forward before we fracture further, not through loss of persons, but loss of standards, knowledge, and skill.

To preserve and move neurotherapy forward, three things are critical for our discipline to address: (1) conflict and division, (2) the red herring of the double-blind imperative and its little cousin the placebo effect, and (3) perhaps most important, practice and equipment standards.

Part A: Evolution

Electroencephalogram (EEG) biofeedback, brainwave biofeedback, brain biofeedback, applied psychophysiology, psychoneurophysiology, neurofeedback, and now neurotherapy: Ours is discipline under many names. It is also an extremely powerful, ever-evolving modality whose advances, successes, and failures are fully reliant upon a delicate balance of equipment knowledge and practice skill.

The advancement of the science and practice by proxy have always been, and I argue will remain, fully contingent upon the reliability and validity of our methods, our tools, and our ability to wield them. Systematic demonstration of this through continued research and practice standards is one of our field's greatest oversights, an Achilles heel that continues to haunt us despite otherwise ground-breaking advances. It is also a mounting source of conflict within the profession as well as a barrier to wider professional acceptance.

Like many disciplines, burgeoning advances in technology from the late 1990s onward catapulted the capacity, and therefore the scope of practice, of electroencephalographic (EEG/QEEG) modalities to ever greater heights. Yet, despite neurotherapy's seminal beginnings in seizure studies, attention-deficit/hyperactivity disorder (ADHD), addiction, and depression (see the lifework of Sterman, the Lubars, Monastra, Penniston, Davidson, Kimya, the Budziyskis, and many others), and subsequent tracks in Parkinson's, stroke, migraines, traumatic brain injury (TBI), fibromyalgia, obsessive-compulsive disorder, conduct disorder, sleep disorders and anxiety, the modality has remained largely on the sidelines.[1]

[1]See Hammond & Novian (2021–current) and Kerson (2021) for extensive lists of research publications and resources.

Until very recently, a great portion of those seeking neurotherapeutic services were what we refer to as last-resort or antipharma clients. Those whose conditions and ailments eluded the usual solutions of Western medicine were dismissed by Western medicine, did not respond well to the standard stock of evidence-based interventions of psychology, or were sought out by individuals who rejected pharmaceutical approaches (e.g., seeking an alternative to methylphenidate for ADHD, benzodiazepines for anxiety, or SSRIs for depression).

When we opened our clinic doors in Vancouver, Canada, in 1997, we were the only practice in town and arguably one of only three in all of Canada (along with the Thompsons[2] and the Donaldsons[3]). Similarly in the U.S. and abroad, very few were practicing outside of select university labs (most notably UCLA, Berkeley, and the universities of Tennessee and Washington), all led by charismatic researchers, masters of their trade. As disciples gathered, however, and neurofeedback started to seep out of the universities, it lost its research and publishing imperative. Equipment development and a zeal for practice started to override research and publishing. Methods began to splinter and, rather than push the profession to greater breadth, depth, and acceptance, served to augment confusion and stymie broader recognition of EEG-based therapies within the medical and psychological/neurological community. Somewhat disparaging conflict soon began to supersede the once healthy (albeit heated) cocritique and debate on means and method—the usually positive mainstay of the advancement of science and practice.

Now almost 25 years later we are one of many providers. Like high-rises in our fair city, a new neurotherapy practice is seemingly popping up on every street corner. Word is spreading and the discipline is crossing over into the mainstream. This is a double-edged sword.

Despite professional associations and certification bodies such as AAPB, ISNR, BFE, BCIA, and IQCB,[4] in 2021, the field is still largely unregulated, and our scope of practice remains fully reliant upon complementary competence. This leaves us wide open for both legitimate informed critique as well as ignorant or otherwise biased censure.

[2]ADD Centre and Biofeedback Institute of Toronto, Mississauga, Ontario, Canada.
[3]Myosymmetries, Calgary, Alberta.
[4]Association for Applied Psychophysiology and Biofeedback, Inc. (AAPB), International Society for Neuroregulation and Research (ISNR), Biofeedback Federation of Europe (BFE), Biofeedback Certification International Alliance (BCIA), International QEEG Certification Board (IQCB).

Part B: What To Do About It—State of Practice

As things stand, I fear we are our own worst enemy. We need to *align and discriminate rather than divide and demean*. To do this, we need to recognize our individual professional limitations along with our vocation's unparalleled trail-blazing accomplishments. To our colleagues in other disciplines (e.g., neurology and psychiatry), we need to stop saying "they don't get it" and "get on it." We need to publish more, clear the flash and jargon, reduce anecdotal and increase data-driven commentary, and get back to talking about the science that underlies our art. This includes clear, nonesoteric terminology when communicating to lay people and those unfamiliar with our field. Last, but certainly not least, we need to classify ourselves.

In proper hands, with proper education and training, strong ethics, and a good dose of scientific curiosity, EEG-based assessments and therapies have the potential to be one of the most advanced and powerful modalities in the cross-disciplinary realm of psychology and medicine (and all of the subfields directly and indirectly under their purview; e.g., performance and education). In untrained, poorly trained, overconfident, or otherwise uneducated hands, it can be ineffective, imprecise, and potentially harmful. Power goes both ways (see Hammond & Kirk, 2008).

As hinted at above, key in all success and advancement is recognizing limitations: limitations of a method or modality, limitations of a person or practitioner, and limitations of a tool or technology. Perhaps most critical, however, is our discipline's awareness and direct attention to the interplay of the latter two. In our profession, how we differentiate, or otherwise choose to have said interplay inform both our scope of practice and our clinical decisions, is paramount.

Who We Are, What We Do, and What We Do It With

In all EEG-based therapies, technology and clinical and practical knowledge ride in tandem. We would be nowhere without our ability to read and map the brain (efficient and inefficient function and structure as well as typical and atypical function and structure). Equally, we will go nowhere without clinical (medical, psychological, physiological) acumen. In the current status of our field, however, the balance is unclear, lacking the demarcation present in many other disciplines.

When working with technologies, I argue that it is imperative to know *who* or *what* is in the driver's seat and why. Is the technology in full control, the clinician in full control, or a mix? In sum, *who* or *what* is wielding the

therapeutic process and what is the weight of each? And what is the clinical or scientific rationale for the chosen balance?

Equipment: The Role of Technology. As we ask who or what is guiding (or directing) our EEG interventions (the therapeutic interface with the brain), we are consistently confronted and affronted by a value dispute that I frame within an artificial intelligence versus assisted intelligence position—or AI versus AI debate (see M. K. Swingle, 2019).

By now we are all familiar with artificial intelligence. It is a technology that functions fully on its own. A program, system, or piece of equipment is initially programmed or informed by human input (e.g., data, research, a guiding algorithm or principle) but thereafter becomes self-sufficient, or rather self-reliant. Assisted intelligence, however, is highly sophisticated and potentially functionally independent technology, but still under the purview of the human mind. With assisted intelligence, direction and—perhaps most importantly—judgment of the machine intelligence or technology are overseen by independent professional and sentient knowledge.

Some argue that artificial intelligence, in its capacity for data manipulation, choices, and direction, can, has, and will surpass the human minds that design and program it. Others argue that it is most dangerous to trust a machine or program with unvetted control over our well-being, in this case our brains. We need convergent and divergent, linear and lateral, and sentient (psychological and emotively invested—aka caring) thinking that goes beyond machine manipulation and machine learning. We need input updates and variant explorations, not just the data mining, melting, and assimilation capacities of most of our current tech (M. K. Swingle, 2019).

Regardless of which AI (artificial or assisted) one champions, no one can argue against the fact that output is based upon input. And in the case of EEG therapies, input is based upon further input (looping or interface with the brain). This requires data selection (choosing what is looping and why). From where I stand, I do not yet see EEG machines and programs that have the required sensitivity or intricacy to effectively interface fully independently with an instrument at once so sophisticated, yet fragile, as the human brain (the human person).

A full discussion of the AI versus AI dilemma is beyond the scope of this article (see M. K. Swingle, 2019). But let it suffice to say that the field of EEG (as many others) would benefit from looking and learning within the present, yet not dismissing the past, while it builds and aspires to the future. We should not be blinded by a future yet to come. Despite many brilliant applications, other efforts across multiple fields (e.g., policing, education, medicine, and employment) have, and are currently, producing unreliable and—in extreme cases—corrupt data based upon both narrow (overly select), and indiscriminate (overly broad) or simply biased input. Algorithms, and programs in general, can produce glaring loopholes, most often securing and thereafter exaggerating biases. As an age-old saying in statistics goes: garbage in, garbage out. Given that EEG therapies are literally looping (feedback-based), somebody—or somebodies—should be explicitly examining or otherwise have purview over input and output (M. K. Swingle, 2019).

If you are not looking, you will not see. The importance of data selection and data reading: examples from my work and how I came to my perspective. Apart from the potential to harm or be inefficacious, what is lost when we are not in the data? The primary cost of not being in the data is precision. The second loss is discovery—discovery, which contributes to the advancement of experimental practice and research.

Treatment efficacy and precision work in concert. I am from the school that advocates the more precise the treatment, the more efficacious the treatment and the better the outcome. For the client, this can be the difference between few sessions (as few as 10) versus rather a lot (more than 200). Simple examples of how to hone precision are the selection of automatic versus manual thresholds, specific location choice(s) on the international 10/20 system, and discriminant bandwidth selection. For example, regarding threshold, I have found that some clients benefit most from a set reward threshold of 60% during feedback (operant conditioning based upon amplitude or ratio change), while others feel stress and anxiety counter to the purpose of the protocol at such levels. Hence, 80% reward (and fully manual no-delay manipulation) is the way to go. Others still become bored with such high reward and need tighter thresholds to engage. The sweet spot to move from baseline tends to be 70% for most, but definitely not all. Thus, if I always choose 70%, based upon a measure of central tendency, not considering the patient-specific objective (numbers) and subjective (client commentary) feedback (client-specific data), I lose my precision. I lose the ability to enhance efficacy and maximize the treatment effect.

More complex examples of precision and efficiency involve assessment (baselines and mapping), location, and bandwidth selection, as well as some knowledge of brainwave behavior (plasticity). Some brainwaves are

considerably harder to train than others, which should not predict client success or failure per se, but rather direct protocol choice and treatment planning. Regarding assessment, baselines and location sensitivity are also often paramount: A child with the same (standard DSM-5) diagnosis of ADHD could benefit from theta down-training at CZ or alpha down-training at F3/F4 for focus itself. In complete contrast, beta down- or theta up-training at O1 can often help with ADHD that is really classroom performance or test anxiety masking under the umbrella classification of DSM ADHD. And of course, the standard Lubar protocol theta/SMR at C4 still holds weight to this day for both quieting and attention. Here seeing baseline data from an intake brain map is not only helpful, it could also be critical.

Even more complex examples are number of sites such as single-site, dual/bipolar, or 19-channel plus (full cap) work; "pure" amplitude and ratio training versus *z*-score, phase, or coherence training; and cross-hemisphere or same-hemisphere training. This is where normative versus clinical databases come into play: Namely, are you choosing to train your client to normative or away from clinical, and why? Knowing how far (objectively) your client has moved or needs to move from their specific baseline (stochastic measurement) is also potentially relevant. Here, too, one must ask if a client might benefit more from active neurofeedback (operant conditioning) or passive neurotherapy (classic conditioning). (Yes, there is a difference in the often-interchanged terms.) Yet again, is training from readings on the upper layer of the cortex more than sufficient, or would a client's aliment, condition, or symptoms benefit from looking to deeper structure?

And lastly, discovery. In my own work, I have found it critical to look at raw EEG signals to inform numerical conversions before artifacting or setting threshold levels (including for artifact itself). I come by this honestly. In my early years, I worked almost exclusively with children actively tasking (e.g., reading out loud or writing) as I administered variations (e.g., braindriving) of theta/beta or theta/SMR protocols for cognitive priming. I also worked extensively with what I affectionately called the wiggly pigglies (very young or otherwise kinetic children for whom sitting still was torture—those who give new definition to the "H" in ADHD!). This is where I learned to work with what I call dirty data (data full of artifact or EMG). Here I found the monitoring of artifact to be equally important to the monitoring of cortically generated or recorded EEG. (Of note: This is also potentially important when working with those with systematic nonvolitional tics and tremor—e.g., those with Tourette's, Parkinson's, tardive dyskinesia, TBI, or stroke). Here artifact itself can sometimes provide the most valuable information.

It was also thanks to artifact that I made one of my key discoveries: What may initially look like electrical interference or muscle artifact may be something else entirely. For me it was a high-amplitude spindling pattern in the alpha range, eyes-closed condition (M. K. Swingle, 2015, 2016, 2017). This discovery in 2012 on the role of alpha in screen addiction would have been lost had my eye not caught an atypical pattern I could not identify, one that my artifacting partner thought to edit out, and that an artifacting program surely would have. *If we are not watching, we will not see*.

We continue to learn so much about and from brainwave morphology. For me, this was particularly true of large (amplitude) spikes and patterns (e.g., spindles). It would be sad to miss out on a discovery, but tragic to miss an epileptiform spindle. There is power in knowing and choosing what data should be included, and hence what data will inform our assessments and drive our feedback treatment, and our curiosity leads to discovery. All this said, we need to be able to read the data.

Disclaimers and Warnings. I do not claim to be a master on raw EEG. Not even close! My talent lies in deciphering patterns within and across numerical conversions. I also am not an expert on deeper structure. I find exceptional power in EEG readings sampled from the top layers of the cortex and largely wield my craft there. But I know enough to know what I don't know, including when to get back to the books or refer. There are also many current (and accessible) talents from whom to learn more on morphology, imaging, and deep structure, including Jay Gunkelman, Penijean Gracefire, Penny and Doil Montgomery, Cynthia Kersen, Lynda Thompson, Nicholas Dogris and Tiff Thompson, Robert Turner, Robert Thatcher, Joel Lubar, Leslie Sherlin, Jonathan Walker, James Evans, Tom and Terri Collura, and of course Barry Sterman.[5]

What irks me, however, are those who dismiss the esteemed expertise of others because they either do not know, do not understand, or can't be bothered to learn the art of reading EEG themselves. Comments the like of, and I paraphrase, "You do not need to know how to read EEG to work with it" or "Reading EEG is like reading tea leaves" and "We do not need (or want) research on our equipment or what we do" (AAPB listserv, February 2021) are not only gross insults to master researchers and practitioners, they are

[5]This is not an exclusive list. Many are still actively writing, presenting, teaching, mentoring, and consulting. Please see BCIA, IQCB, etc. for lists of active mentors, including level of specialization and qualification(s).

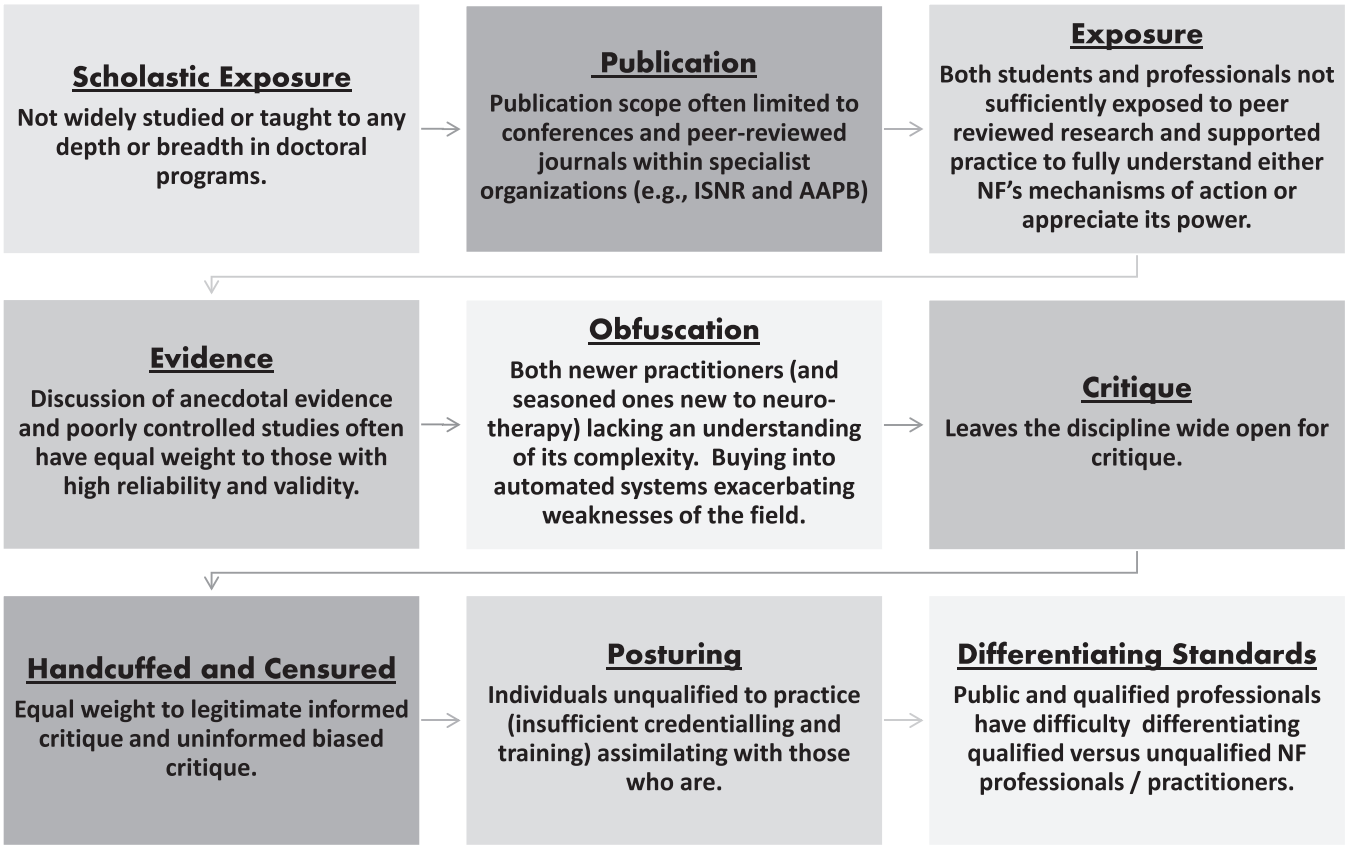

Figure 1. Summary of compounding issues facing the discipline of neurotherapy.

also an assault on our very profession. I am also offended by those who spew jargon or show pretty color pictures and graphs (brain imaging, including topographies and deep pathway graphics), *z*-scores, and bell curves to obfuscate their lack of knowledge or skill, or merely to impress a client. Without prejudice, I state: *If you do not know how to read basic raw EEG or converted measures (numerical or pictorial), are not actively learning, and are not under the supervision of someone who does, then you should not be in the business, or practice, of EEG-based therapies.* Period. Yes, unfortunately a glint of a sword here.

Do not get me wrong, there is a solid place for automatic programs, prescribed protocol administration, and even fully self-sufficient programs, but these cannot be at the expense of assessment, precision treatment, and support of the minds (and research) that advance the discipline. I argue very strongly that the data and the client or patient objective should lead the treatment and the forward movement of the discipline, not our (preferred) equipment or our business plans.

This is not beating a war drum. It is a simple fact. We will not be accepted or respected as a discipline if we cannot show or will not show what we are doing (clinical data) and why (selected methods) and that it works (research) (see Figure 1).

Part C: Research: Type and Standards

Red Herrings: The Double-Blind Imperative and the Placebo Challenge

Our industry keeps being cut off at the knees by professionals who discredit our work for lack of empirical evidence as demonstrated by double-blind studies. This is a red herring. Double-blind studies are an unrealistic burden of proof imposed by one of the most profitable commercially, capitalistically driven industries on the planet—one that not so ironically drives home how much our discipline is *not* understood. Double blind is a pharmaceutical paradigm that simply does not apply to physiological process (including psychoneurophysiological process). Ar-

guably it also does not apply to psychological treatment process (e.g., a cognitive-behavioral therapy [CBT] or eye movement and desensitization and reprocessing [EMDR] study cannot be done double blind either). Unfortunately, many of our colleagues become spun around by the widely propagated standards of the pharmaceutical industry, becoming counterdismissive and no longer bothering to explain to those with single vision (or who otherwise refuse to listen). Unfortunately, this further isolates rather than assimilates our branch of psychology and medicine from that of our colleagues in other disciplines.

We need to rewrite the script to fit the paradigm, not try to adjust a psychoneurophysiological paradigm to fit an inappropriate pharmaceutical script. In sum, stop trying to fit square pegs in round holes.

The most successful active neurofeedback (underline neuro*feedback* as opposed to neuro*therapy*) is conscious operant conditioning wherein the client's volition and hence participation are part of the process. Here double blind dismisses the underlying principle of becoming acquainted with the macro and micro processes of one's brain and body. We need to respect, not try to dismiss, hide, or camouflage, the human biological experience. Functional biology is often conscious biology, or biology over which we can potentially develop conscious control. That should not be a bad thing. In fact, it might just be a central flaw of Western medicine propagated over the past 200-plus years. One we fortunately are starting to question and address.

Over the past decade or so, Western medicine has started to fully embrace concepts that were formally in the purview of Eastern medicine, or traditional cultural approaches. Mind-body awareness in the form of mindfulness for anxiety reduction, for example, is now widely promoted. Such conceptual and cultural broadening in Western medicine should make many of the fundamental principles underlying many EEG-based therapies easier for many professionals (and lay people) to now grasp. We are, however, at a considerable advantage. Not only is what we do concurrently based in brain science and neurology, it can also be objectively measured. Here we are full circle back to the need for objective data and the ability to read it, and therefore analyze it, in its pure form. We are also on to the next critique: placebo.

Placebo, the Little Cousin of Double Blind

First, what is a placebo or the placebo effect? Placebo is operationalized belief. It is belief in oneself, belief in a process, belief in an object or a substance that is operationalized to help, heal, or otherwise improve. Its mechanism cannot be seen and is often interlaced with faith. Faith can be hope and belief itself. It can also be attributed to another, for example, a healer or a deity. Placebo has no inherent negative meaning but gets its negative connotation from those who manipulate it, or otherwise use it deceitfully for gain or profit.

In sum, placebo is not a dirty word, but it has been significantly tarnished by people who extort or negatively manipulate free will. It has also lost its beneficence and neutrality, having been appropriated in its negative, or spurious sense only, by the pharmaceutical industry. Much like double blind, the pharmaceutical industry has made placebo their central burden of proof. For the pharmaceutical industry, this makes complete sense, as they need to prove the efficacy of an object (pill), formula, or substance. But for EEG therapies, it should not apply. EEG therapies are a process or procedure that directly influences the electrical activity of the brain. In critical difference to chemically based pharmacology, all EEG-based therapies can be electrically measured.

If I am permitted a slight digression here, the pharmaceutical industry's frequently sidestepped flaw here is rather apparent. Most psychiatric patients are not tested chemically (e.g., MDs and psychiatrists do not measure serotonin levels before prescribing an SSRI). Prescriptions are given based upon presumptions based upon symptoms and checklists (e.g., serotonin or dopamine are presumed to be high or low in various DSM conditions). Hence, the standard trial-and-error approach both with medication types and dosages, which (given the bases of the critique of EEG-based therapies), most ironically, is widely accepted in Western pharmacology, psychiatry, and psychology. Mechanisms of action in pharmaceuticals are also frequently not known or understood. (Listen to disclaimers in advertising and you will often hear this explicitly stated.)

Not to let a cat out of the bag here, but a glaring second irony is that EEG biomarkers in fact have shown great promise predicting the efficacy of some pharmaceuticals (Gunkelman, 2014). Again, this is because EEG overtly measures the electrical activity (synaptic activity) directly responsible for the release and uptake of many neurotransmitters (brain chemicals) that speak to states and traits of brain efficiency and inefficiency. As such, EEG can further have diagnostic precision that has potential to defy DSM classification (Gunkelman, 2006; P. Swingle, 2015).

Speaking of cats, when countering the placebo argument (with data), one can also reference Sterman and his seminal work on epilepsy, SMR, and cats (see Sterman et al., 1967). Sterman's early lab work clearly demonstrates that placebo is not involved with EEG training. His proof simple: Cats do not know what they are doing or are being asked to do. The

placebo argument is moot. (He also has some pretty black-and-white numbers, including raw data samples, to back things up.)

This once again underscores the absolute need for measurement in EEG-based therapies. EEG-based therapies that do not have, or use, baseline measurements do not monitor treatment or outcome data, cannot make any of the above claims, or use the above arguments regarding double blind or placebo. Without measurement and data (stochastic or otherwise), the rationale to dismiss the validity of the false imperative of double-blind studies and attribution of EEG's success(es) to placebo does not apply. It is not valid.

Placebo: Effect Versus Influence—Don't Dismiss It, Wield It. Unlike the pharmaceutical industry, if we can prove or otherwise differentiate a neurotherapy effect from a placebo effect, we are free to wield it. As the work of Morales-Quezada (2020) clearly outlines, placebo is not only a very real biopsychological process, it is a very powerful one. It can explain or claim from 10% to 30% of (positive) change. Hence, it would make perfect sense to not dismiss it, but to wield it. Openly.

Something unique to our field is indeed the potential to capture placebo along with EEG conditioning or training. Flipping the argument, wielding placebo does not detract from EEG training—it supports it. Anything that potentiates EEG therapy, client wellness, or improvement should not be dismissed—it should be harnessed.

Again, this is not new. Sport psychology, for example, is an entire subdiscipline that clearly and openly wields belief to potentiate physical and mental achievement. A great portion of an elite athlete's functional success is belief. But we do not call that great shot a placebo effect. And we also surely know that all the belief in the world will not ensure said great shot. Belief builds upon formal training (muscle, coordination, precision, etc.). So, too, with belief and EEG training. Knowing this, when working with a belligerent adolescent dragged into EEG treatment by a parent, I clearly and directly share with said adolescent that this will work better if they are on board … but they do not have to be. The EEG intervention has sufficient power without wielding placebo.

Rounding out this section, a little note on double-blind, placebo-controlled studies for EEG: First, I bow to the 26 members of The Neurofeedback Collaborative Group (including Drs. Arns, Kersen, Lubar, and Monastra, and many others) for their mammoth effort and contribution of a large-scale double-blind, placebo-controlled, randomized clinical trial of neurofeedback for ADHD (2020). With all due respect, however, this study may be better described as yoked. The reason I point out this subtlety is twofold, and intertwined.

First, because biological process cannot fully be fooled (see discussion above), it needs to be shammed, which means, in order to simulate EEG training, the study had to show or pretend to train something. This implies, perhaps, that the study might have been training that *something*, rather than the pharmaceutical control value of *nothing*. This may also be the case for other studies wherein both sham control groups and neurofeedback groups have gains as per results on objective performance testing (see Schönenberg et al., 2017).

Second, by trying to sham double blind, we are bending to a position that does not value, respect, or understand the underlying mechanisms of psychoneurophysiology. Round pegs–square holes again.

Here I come back to my continued curiosity on artifact, specifically muscle and movement artifact. My early experience working with dirty ADHD data leads me to postulate that muscle and movement artifact are part of the picture and, when unquantified as with (unmeasured) placebo, not necessarily mutually exclusive. Some of us were (inadvertently and overtly) training EMG/movement and muscle artifact (bound with theta) back in the days of CAP SCAN, to great ends.

Future studies might do well to explore triangulating, including looking at what might be dependent, rather than independent, variables. Outcome measures might also overtly include medication sensitivity, changes in EEG, EMG, and objectively measured functional symptoms (e.g., Connors CPT as in Schönenberg et al., 2017) as well as subjective symptom checklists—the standard for both diagnosing and prescribing methylphenidate and the like. With a wink at the pharmaceutical industry, we still might end up saying it works but we do not know why—but not for our lack of trying or complacency.

Roadblocks to Research in a Practice-Oriented Field. Here I acknowledge I am as guilty as those I implore, having my nose more in practice than in publishing, as well as having troubles circumventing (established) research control standards that do not apply or work in the treatment chair (e.g., how to objectively quantify said dirty data). In sum, real-time practice or treatment data rarely stand up to the standards of research data (controlled design). For many of us, this is a real consideration. Not having a university affiliation (and therefore a university paycheck), all research and publishing is on our own time and dime.

Acknowledging challenging roadblocks and limitations, however, is a far cry from dismissing the research

imperative. The critique that our field is "dominated by poorly controlled experiments" (Rogala et al., 2016, Discussion, para. 3) and anecdotal evidence has validity. As long as factions within our ranks denigrate and dismiss the value of and need for data and research, so it will remain. We need to get back into the universities that fund research, get students curious, and fully educate and train generations to follow. This means not only having but also implementing and enforcing discipline-appropriate practice and research standards.

Part D: Practitioners and Providers

Finding Neurotherapy's Place Outside the Labs

Since neurotherapy left the labs, it has been fumbling. Being a cross-disciplinary field with its own unique paradigm, it has struggled to find its proper place in the larger map of physical health, mental health, and education. It needs its place, or places.

Having such a broad actual and potential scope of influence, neurotherapy attracts individuals from all disciplines and all levels of skill and practice: special education teachers, physiotherapists, neurologists, MDs and psychologists, artists, coaches, and business people. Many professions have seen the light. Clearly, however, they do not have the same knowledge base(s), aptitudes, or credentialing.

This is actually a compliment. That such a broad band of individuals want to jump on board the neurotherapy bandwagon should speak highly of the modality, not denigrate it. But it also continues to beg the most rational of questions: not just *what* should be working on our brains (see technology discussion above) or *how* (see data and research discussion above) but *who* (practitioners and providers)? If this modality is so powerful, should it not be in equally powerful, and at the very least, qualified hands?

This brings us full circle back to who should be is in the driver's seat of EEG-based assessment and treatment intervention. A technology, a program, or a person? And why? Equally important, who (persons), or what (businesses), should be sold EEG equipment or granted a driver's license for treating the brain? Pushing the metaphor further: what class of license: tricycle, tandem bicycle, family car, taxi, passenger bus, MAC truck, or high-speed train? And what level of license: learner's, new driver, or independent? Plainly put, neurotherapy needs to implement and honor gatekeeping standards with or beyond BCIA, BCN, IQCB, and the like.

Education

Our primary challenge is education (see Figure 2): education of ourselves and of the public. Despite EEG/QEEG being an extremely powerful assessment (measurement) tool and efficacious treatment modality, it is barely touched upon, never mind widely studied or taught to any breadth or depth in undergraduate or doctoral programs. Apart from select conferences and peer-reviewed journals within specialist organizations (again, BFE, ISNR, and AAPB), both students and professionals alike tend not to be sufficiently exposed to peer-reviewed research and supported practice either to fully understand its mechanisms of action or appreciate its power. This contributes to assumptions that EEG-based therapies are simple, not validated, or both, once again leaving the discipline wide open for uninformed and otherwise biased critique. It also leaves the field open for posturing wherein those who are untrained, insufficiently trained, or unqualified to practice with any level of independence fully assimilate with those who are and do. The result is that too often neither the public nor otherwise very qualified professionals can tell the difference between the bona fide research practitioner, the trained practitioner, the naive (insufficiently trained) but otherwise well-intended practitioner, the fully ignorant, and the spurious business person. Position papers are written (e.g., Hammond et al., 2011), accolated, and debated, yet here we still are a full 10 years later defending the practice against both valid and invalid criticism and unqualified practitioners. As the old expression goes: The more things change, the more they stay the same.

Part E: Proficiency Standards—Fractioning Versus Discriminating

In 2018, the AAPB applied to the American Psychological Association (APA) to have Biofeedback and Applied Psychophysiology reinstated and recognized as a specific proficiency in professional psychology. To that end, the AAPB Board of Directors produced a comprehensive document clearly outlining the established record of our field, including the practice and proficiency standards of biofeedback and neurotherapy. My contribution was a three-tiered classification system (see Figure 3) outlining the practice qualifications of persons as well as the tools of our trade. Specific proficiency status was granted by the APA for the period 2019–2026.[6]

[6]Author's Note: Many thanks to Ethan Benmore for his countless hours spearheading the APA Proficiency Standards Application project to fruition.

Many professions, broad and narrow, have tiers, specialties, and hierarchies of practice, including medicine (e.g., surgeons, specialists, general practitioners, nurses, technicians, and care aides) and dentistry (e.g., restorative surgeons, cosmetic dentists, and hygienists). The genres of individuals involved in our field are not dissimilar from other professions. What is different in our field, however, is that despite certification efforts, we have not unambiguously classified either ourselves or our equipment (see Figure 3).

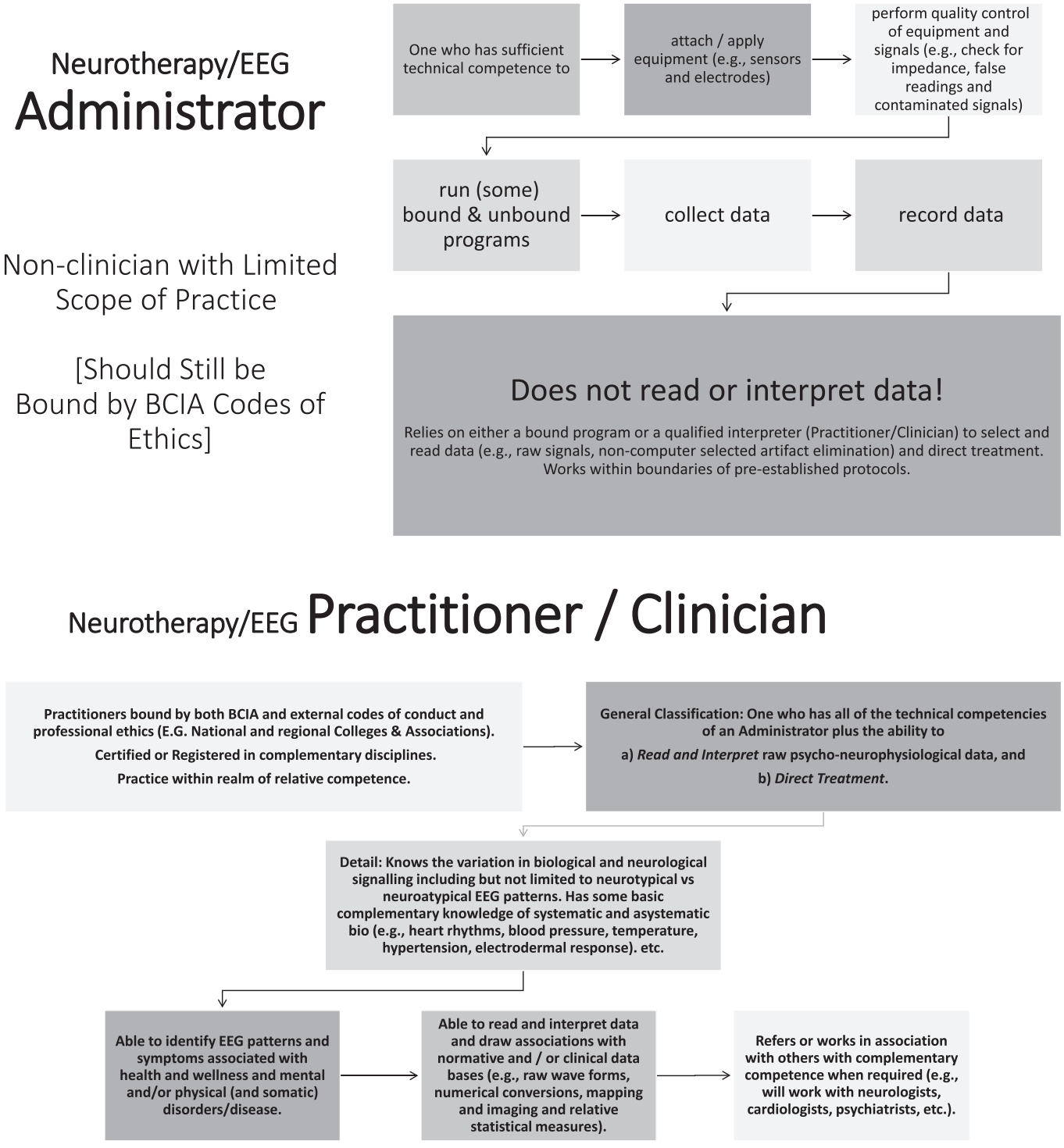

Figure 2. Updated classification system.

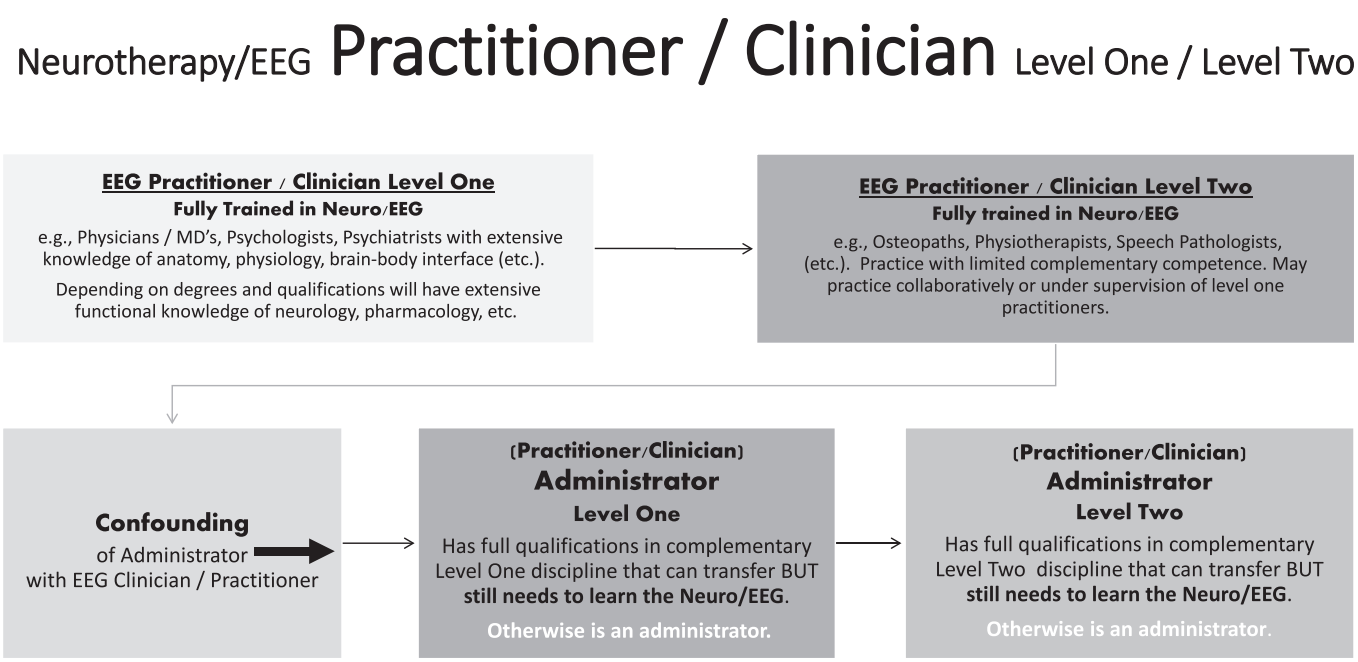

Figure 2. Continued.

Final Comments

Proficiency standards start with knowing who we are, knowing what we are doing, and knowing what we are doing it with. We must counter the uncomfortable truth that the field of neurotherapy is increasingly polluted by individuals who do not understand the fundamental principles of EEG itself, never mind EEG-based therapies. They frequently use the jargon, reference our pioneers' research in advertising, and use technologies that are protected, advertised, or sold as self-sufficient programs,

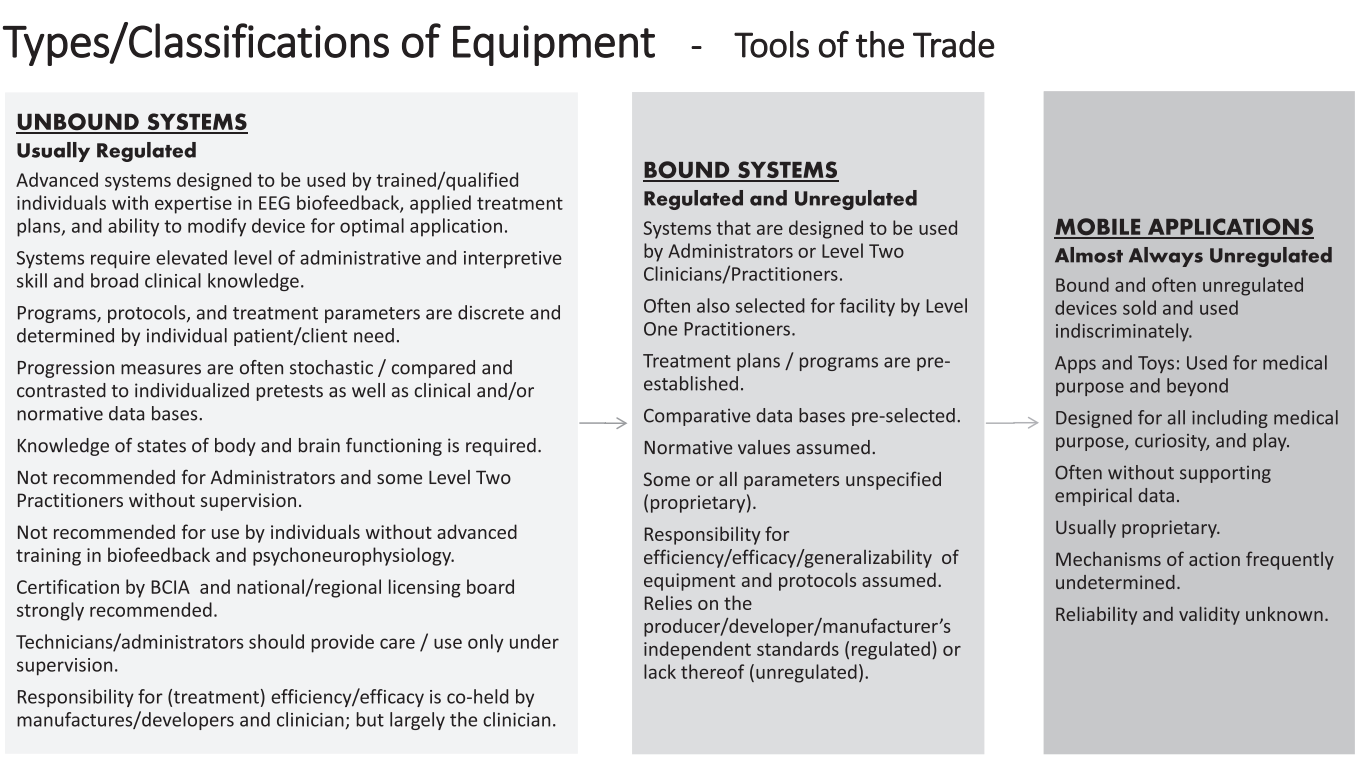

Figure 3. Types and classifications of equipment: tools of the trade.

therefore permitting the acceptability of "I don't know" or—perhaps more threatening to our science and practice—"I don't need to know." We need to clean the waters: Equipment should aim to have safety and testing standards, and individuals working within the field should operate within both their professional *and* EEG competence levels. As we build our research and publishing record, we should expel the term "alternative" and speak of "evidence-based" and "experimental" therapies. I also propose that we start using the terms EEG-based assessment and EEG-based therapies (as I have introduced in this opinion article). My rationale: Many of our terms (e.g., neurotherapy and neurofeedback) are now used as umbrella terms, having also lost their differentiated value. Last and not least, we should classify ourselves and our equipment: Let's align and discriminate rather than divide and demean. If you do not know what you or your equipment are doing, someone else should, and there should be transparent evidence of such. Patent and propriety should not obfuscate science, limit practice, or have potential to harm. Pardon the repetition, but power goes both ways.

With all due respect to some of my colleagues, there is a big difference between objectively choosing between treatment and equipment modalities based upon personal-professional scope of practice, abilities, and limitations, and not knowing what you are doing or why. To paraphrase a now infamous quote of Dr. Sterman: *We need to make choices*. I argue informed choices.

I don't care if it works if I don't know what I am doing. I don't care what I am doing as long as it works. Make your choice.—Sterman, 2019

Honoring our origins, let us not take the scientist, the researcher, and the qualified practitioner out of the maverick entrepreneur.

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