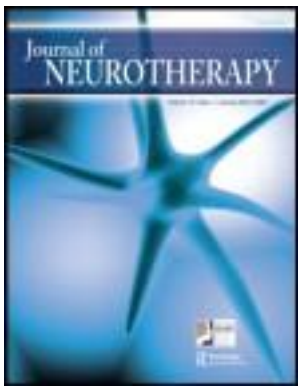

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Clinical Corner

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CLINICAL CORNER

D. Corydon Hammond, PhD, Editor

The purpose of the Clinical Corner is to provide responses to clinically oriented questions which may not, in many cases, have been evaluated yet by research. Therefore, the personal opinions expressed in the column are exactly that, the opinions of the individual authors, often based on their clinical experience. The opinions shared belong to the authors and are not necessarily those of SNR or the Journal of Neurotherapy. Nonetheless, it is hoped that the diversity of opinion expressed in this column will stimulate thought and the further exchange of ideas.

Readers are invited to send questions for consideration to: D. Corydon Hammond, PhD, University of Utah School of Medicine, PM&R, 30 North 1900 East, Salt Lake City, UT 84132-2119. E-mail address: D.C.Hammond@m.cc.utah.edu

ARE THERE INDICATIONS OR CONTRADICTIONS IN USING AND DOING NEUROFEEDBACK UNDER TASK CONDITIONS?

QUESTION: Are there any indications or contraindications in using and doing neurofeedback under task conditions?

RESPONSE: Judith O. Lubar, LCSW, Southeastern Biofeedback and Neurobehavioral Institute, 101 Westwood Drive, Knoxville, TN 37919.

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Since the 1970s I have been working with children and adults with attention deficit disorder and learning disabilities. I have found that training individuals under task conditions greatly enhances not only their ability to improve the various manifestations of this disorder but also results in long lasting changes in EEG and in academic performance. My approach usually involves taking a baseline without feedback for several minutes followed by a combination of pure feedback conditions involving auditory and visual feedback and feedback conditions combining either auditory or visual feedback appropriately with reading, listening, mathematics, writing, drawing, or other academic tasks. These academic tasks are chosen on the basis of pre-testing for learning disabilities or other school related problems. The whole concept is a combination of classical and operant conditioning; it involves having the person engage in the task–for example, reading–and reinforcing when they produce the appropriate wave form in their EEG signal through auditory feedback. I also verbally focus their attention on their success with emphasis on the positive memory benefits which occur when the patient meets EEG criteria and stays on task. This can be further reinforced by asking questions about the material read at the end of the segment. Eventually the contingency or pairing between the appropriate EEG signature and the task allows the probability of the EEG signature to increase and enhances the possibility of transfer of training so that the individual will be able to produce that EEG pattern or signature in school and in homework situations when they engage in a similar task such as reading, listening, math, spelling, etc.

There is also another advantage to adding one or more task segments to the session. This can be seen in about 15 to 20% of the patient population. What I see (and to do this it is important to graph success on each task) is that on session 25 to 35 when a natural tendency of the patients is to get tired or bored, the segments which include the school tasks and the biofeedback segments between the tasks improve while the other biofeedback segments may stagnate during that period. By session 40 to 45 all the segments come together again and the treatment is successful. However, I believe that those patients may and would have stopped treatment at the time when the non-task oriented conditions were stagnating if they did not see success in the task oriented segments. I have never found this approach to be disadvantageous in any way, although it is true that during certain tasks there may be more artifact produced, such as eye movement during reading. This can be handled by using artifact inhibit for the appropriate band passes. I have also found that by including academic tasks during training that the values obtained dur-

ing baseline without feedback of any kind shows a learning curve. That is, the probability of the reinforced signature during learning also increases during baseline since the individual has learned to transfer the training to a non feedback situation. I have also tested individuals after they have been trained, asking them to produce certain EEG patterns such as alpha, beta, theta and other. They can do this reliably, particularly when they are associated with academic tasks and when they develop a perception of what these different EEG states are like. I therefore strongly encourage people who are working in the area of attention deficit disorders and learning disabilities to incorporate learning strategies during the feedback conditioning to strengthen the overall approach for long lasting results.

RESPONSE: Lynda Thompson, PhD, Executive Director, ADD Centres Ltd., 50 Village Centre Place, Mississauga, Ontario, L4Z 1V9, Canada.

The practice of neurofeedback has its roots in research labs. It draws on both learning theory and empirical observations concerning outcomes. Each practitioner also brings his own background and knowledge into play. With my experience as an educational psychologist and owner of three learning centres at the time we began the ADD Centre almost a decade ago, it felt natural to add the teaching of metacognitive strategies to neurofeedback training. Combining neurofeedback with the teaching of strategies and academic tasks is also supported by learning theory principles and outcome studies, as discussed below.

Neurofeedback is a type of learning since it involves the operant conditioning of brain wave activity. As Sterman points out in his writings (Sterman, 2000), Thorndike's Law of Effect, which states that behaviors which are rewarded have a higher likelihood of recurrence, is at the core of what we do. Operant conditioning, carefully developed by B. F. Skinner, grew out of Thorndike's trial and error learning experiments. When we reward the production of certain EEG patterns with information about success, using visual displays and auditory feedback from the computer, we increase the probability that the client will produce that pattern again. We do not know the precise mechanisms (perhaps a change in neurotransmitter release, or in receptor sites at the synapse, or structural changes involving greater dendritic arborisation over time) but we do observe EEG changes in people who learn the task (Lubar, 1997; Thompson & Thompson, 1998).

When you pair an academic task with the state of being relaxed yet focused you are adding classical conditioning to operant conditioning.

Classical conditioning, whose principles were elucidated by Ivan Pavlov through his experiments with dogs and their digestive systems, involves presenting a neutral stimulus (the conditioned stimulus) just prior to presenting a stimulus that elicits a reflexive response. Pavlov rang a bell before giving meat powder and, after a few pairings of bell and meat powder, the bell elicited salivation even if no food was given. In our work with clients who have ADD, where the goal is to improve concentration, we first use operant conditioning to train the state of being relaxed while sustaining alertness and focus. The feedback comes to reliably elicit this state so that it is like a reflex. (Remember, only reflexive, autonomic responses can be trained with classical conditioning. You use operant conditioning to train voluntary responses.) The feedback now acts like an unconditioned stimulus that produces the response of the desired physiological state (relaxed yet focused). If you now present metacognitive strategies and an academic task along with the feedback, this academic work is the conditioned stimulus that, after enough pairings, will also elicit the relaxed, yet alert and focused state.

At the ADD Centre the academic tasks are done with an emphasis on metacognition; that is, executive thinking skills that monitor and guide how we learn and remember things. Examples include active reading strategies, techniques for organizing written work, and tricks for remembering multiplication facts. (For a fuller discussion, see Sears & Thompson, 1998.)

Metacognition is particularly important for students with ADD because they are not naturally reflective: they do not plan their approach to tasks, are not good at time management, fail to make study notes, and they always underachieve. Good students, on the other hand, seem to just naturally apply metacognitive strategies (Palincsar & Brown, 1987). To have the greatest impact, you cannot just do tutoring along with neurofeedback because there is not enough time to cover much content when you see a person for two one-hour sessions a week: the main focus is on getting focused. But there is time to teach one strategy and then try to apply it to an academic task. The next session you can review that strategy and either reinforce it with more practice or move on to a new one. It is a great advantage to be teaching something when you know (from the neurofeedback) that the person is paying attention. Thus you want the feedback to continue both when you are coaching the person concerning a strategy and when they are trying to apply it. If they are reading it will be the auditory feedback that is giving the information. If the feedback indicates they have tuned out, you simply stop the task and let them return to focusing on the feedback until they get back in the

zone. Learning principles tell you that you do not want to pair new learning with a tuned-out state of mind.

What are the logistics of fitting in the strategies? First, obviously, you want the client to be in the right mental state before you start. Thus you pair the task with neurofeedback once the feedback is reliably eliciting the desired mental state. The timing will differ from client to client, both in terms of which session first includes strategies and when during each subsequent session they are introduced. If the client is not performing well one day, maybe due to having an infection and being on antibiotics, you might just do feedback for that session. Another day the same client might be very much in the zone and more strategies and academic work would be covered. Typically, in practice, the first twenty minutes or so are usually spent doing pure feedback–paying attention to paying attention. This is not twenty minutes uninterrupted; indeed, it may be ten two-minute segments with a client who is struggling to maintain focus. Always respect individual differences and tailor the feedback, and the strategies, to that client and how they are performing that day. Once the client is reliably producing the desired mental state, the metacognitive strategies and their application to an academic task begins. Now they must think about thinking; that is, be aware of how they learn and remember things and apply it to an actual task.

The answer to the question of why bother with strategies/academics in the first place has to do with generalization. Generalization of a response is another concept from learning theory. It means that similar situations (or stimuli) will elicit the same response that was learned during training. In Psychology 100 you perhaps learned that when John Watson conditioned fear of a white rat in little Albert in his (in) famous experiment early in the last century, Albert also came to fear cotton wool and even Watson's white hair. With Pavlov's dogs, a bell with a different tone could still elicit salivation. When we have paired being focused on doing an academic task while receiving neurofeedback, the expectation is that the student will also get focused when they pick up a book to read at home. The student may also use metacognition, recalling the active reading strategies taught in the session. As he thinks about applying them, they should also trigger the relaxation and sustained concentration that was his physiological state when the strategies were learned. Although some of the learning that occurs with neurofeedback is clearly unconscious, we also want to encourage generalization (some of which is also unconscious) with the conscious application of strategies. Parents are impressed if they see their child calmly reading and doing

schoolwork during a training session and they are even more impressed when their child starts doing this at home.

Parents seeing changes bring up the second underpinning of neurofeedback, namely, empirical observations. A further reason for pairing academic coaching with neurofeedback is that it has been observed to work. The results at our centre (Thompson & Thompson, 1998) showed statistically significant gains not only in behavior (measured by TOVA and parents questionnaire data) but also in academic performance and IQ scores. These results parallel those of Lubar (1995; also reviewed in Lubar & Lubar, 1999), which is not surprising since the Lubars are pioneers in this field. They advocate a session structure that has five conditions: feedback alone, feedback plus reading, feedback alone, feedback plus listening, feedback alone. This approach follows the principle of getting the person focusing before you introduce the academic task.

In summary, adding metacognitive strategies and applying them to academic tasks makes sense when working with clients who want to improve their concentration, organization, and academic or work performance. The reasons for doing so are derived from learning theory principles involving operant conditioning, classical conditioning, and generalization of behavior. The combined intervention is also supported by empirical observations of favorable outcomes. Furthermore, there is perceived value to the client because metacognitive strategies can be applied immediately in other learning situations even before the EEG changes are consolidated. It remains an open question, however, whether adding the academic component improves outcomes and which measured outcomes are affected. It could be argued that time spent on strategies detracts from learning the EEG task. It would make a great doctoral dissertation to compare neurofeedback alone, metacognitive strategies alone, and the two in combination. Until we have such data, I will use the combination because I am a clinician concerned with achieving the best possible outcome for every client and I am comfortable with an approach that utilizes established learning principles and published empirical research.

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