Tech Talk: An Interview With Dr. Jon Cowan

Michael Gismondi, MA

The training of attention control has a long history in our field, both with clinical and "peak performance" populations. The research of Barry Sterman with NASA and the US Air Force, some of the output of Joel Lubar's lab over the years, and the work of Les Fehmi come to mind. In the spirit of his predecessors, Jon has focused over the last 10-plus years on the wedding of what we know about the neurophysiology of the brain's attention control systems and how it interacts the human EEG with the design of training protocols and hardware that permits the reliable enhancement of cognitive performance. In 1998, Dr. Cowan released the first version of his "Peak Achievement Trainer" (PAT), giving the neurofeedback (NFB) community it's first special purpose, easy-to-use training tool or "appliance" for attention control. Since that time, the PAT has growth in its capabilities, recently incorporating 40 Hertz amplitude training in a "real time", multimedia, highly portable wireless environment utilizing the capabilities of the BioExplorer protocol and screen development system. He has found a loyal and ever-increasing customer base that includes the US Federal Government Office of Personnel, the US Army, Olympic Training Centers, and a host of others as documented on his website (www.peakachievement.com).

On a more personal note, I was impressed by Jon's ability to tenaciously bring together the worlds of neuroscience and EEG research with their implications for the design of useful NFB systems. In this interview I set four goals: (1) to describe the history and evolution of the PAT, (2) clarifying what the three main programs in his system can do, (3) describe how the PAT is being received in the marketplace, (4) suggest how the PAT fits into the bigger picture of NFB and its future.

MG: Jon, how did you develop the PAT?

JC: The PAT reflects my view of how the brain works, and how we might make it work more efficiently. In 1996, I realized that the work of Barry Sterman, Joel Lubar and Siegfried Othmer contained three critical pieces to an important puzzle, namely, what can EEG tell us about the high performance brain, and

how can we train people to enhance their performance in sports, in school and the world of work. In his work with NASA and US Air Force fighter pilots, Barry made it clear that you see a inhibition of many brainwave amplitudes, including beta frequencies, when people focus intently on a challenging task. Sig Othmer and David Kaiser did a large "N" study which showed that ADHD improved primarily to the extent theta was inhibited, rather than in response to any up-training of SMR or low beta. Joel Lubar had been drawing our attention to the neuroimaging work of Michael Posner concerning the executive attention network, particularly as it involves the anterior cingulate. At that time (1996-97) I had an older NFB unit that had a real time spectrogram. I noticed when pre-frontal theta was inhibited, most spectral activity was inhibited as well. All of these ideas and observations lead to my development of my wideband suppression (AKA "squash") programs. One of my driving principles is to understand the EEG as it is impacted by known principles of neurophysiology and electrical current flow.

I realized that what we really pick up with EEG are the rhythms of the thalamocortical loops, NOT the cortical-cortical loops that go across the cortex. Those loops all sum to zero since the current has to flow back to where it started, and we are measuring basically perpendicular to the loops, in a direction where their electrical vector is nil. What we can measure are the idling rhythms of the thalamocortical re-entrant circuits and the 40 Hertz thalamocortical resonance rhythm. These are going in the right direction towards the scalp. Each pacemaker cell in the reticular nucleus of the thalamus sets off a macrocolumn of over 1000 axons, so there is a lot of amplification. The EEG is also tracking the Reticular Activating System (RAS) as it communicates with these pacemaker cells and then the pyramidal cells in the cortex.

MG: Didn't Dan Maust make a similar discovery around the time you did?

JC: Dan had been developing some similar procedures involving inhibition across the spectrum, but he hadn't integrated his ideas with the importance of doing the inhibiting at or near FPz in the frontal area referenced to an ear electrode; that was the piece that was inspired by Posner's work with the anterior cingulate. When I showed him my system, he was amazed by the accuracy and precision of the feedback…how well it tracked selective attention and concentration or "one-pointed" focus.

MG: A little later on in your work you spoke of the practical need to not do a lot

of simultaneous inhibiting and enhancing for the simple reasons that it makes it needlessly challenging to the beginner AND it can confound the feedback you are giving.

JC: Right. I had the goal of giving the client clear, unambiguous and "real time" feedback of one crucial cognitive function, call it selective attention or "one – pointed" attention. A lot of the feedback that others do presents contradictory demands to the thalamocortical system and also adds in a lot of subjective confusion. The vast majority of naïve people understand our feedback for both Focus and Alertness within the first three minutes. Its fascinating to watch their reaction!

MG: It seems to me the most successful NFB practitioners are able to get a positive and meaningful outcome in the first or second sessions.

JC: Yes, if clients have to wait around for 10-15 sessions before they experience any meaningful improvement there can be considerable drop-out.

MG: Let's go straight to a description of the three main programs in your system.

JC: The three main programs, which are like skills that build on each other, are "Focus", "Alertness" and the newest program, "Neureka!". We have already been speaking about the first program, the focus program, which utilizes wideband suppression. It teaches the client how to narrow down an attentional focus, and block out all competing stimuli or distractions. This has been called in the past the "InAll" or "inhibit all" program.

MG: What do you see as the primary benefit of your "Focus" program? Personally, when I tried your more recent PAT software in 2004, I was amazed how well the Focus program "busted" me when I was the least bit distracted.

JC: Being able to narrow down your focus and to keep your attention on that one focus for increasing periods of time, is THE first step in flexible attention control. From there, we always want to teach the control of this ability by going back and forth between focusing and letting go. We use a taped exercise to train this microbreak and then integrate the microbreak with our Focus training. Different levels of Focus are optimal for particular aspects of a task. The attention system functions like one of those MiniMag flashlights with a variable beam. Both strengthening and controlling the beam are important goals.

This leads us to the second program, which I call the "Alertness" program. Here, I am concerned with developing the ability to "pace" or modulate your mental energy, since it impacts your ability to focus for long periods of time. We are isolating the output of the RAS, as it affects the cortical EEG. I want to enable teaching the skill of being able to use just enough mental energy as the task at hand requires and to save the rest for when you really need it. For example, there will be times when you face a novel task and you need to expend a great deal of energy to keep the focus narrow and sustained until the problem is solved. But what about the task of sitting through a three hour lecture or business meeting and not expending all available mental energy in the first hour because you were focusing too intently and burned-out? Ideally, you would like to maintain just enough intensity or narrowness of focus to monitor what you need to, saving your more intense focus for when it is necessary. Once the client learns how to separately narrow down an intense focus, and then learn how to modulate or pace their expenditure of mental energy, the tasks are combined into a simultaneous task called the "Focus/Alert" protocol. There are actually 12 different ways in which the Peak Achievement Trainer can be used to train Focus and Alertness. These are listed on our website at http://www.peakachievement.com/factsheet.htm.

I believe that every expert at a particular task has developed a number of sequences of Focus and Alertness to optimize their performance. I think that by using the simultaneous video recording capability of our software we can discover and train these sequences in experts and trainees.

MG: How did your third program, "Neureka!", the 40 Hertz program, get developed, and what does it do?

JC: Quite by accident! (Laughs) I was advising a student in a study at St. Lawrence University. He got rapid and rather dramatic results with this protocol (see www.peakachievement.com/articles/NeurekaReport.htm). It took me several years to figure out why the active placebo group did so well. Basically, I had found a way to train the 40 Hertz rhythm at frontal sites with minimal artifact. This type of training supports the ability to be self-aware or observe yourself during a task or performance--noticing when you do something right so that you can do it again. It puts together the whole picture so you can use the information to survive. It may also kick in or when things are ging terribly wrong and you need to switch strategies immediately, but we haven't tested this yet.

MG: Isn't that akin to Sterman's "post reinforcement synchronization"?

JC: Yes, but Barry was looking at the lower frequencies, not high beta and gamma. These higher frequencies should actually be better at enhancing memory consolidation since they create more calcium influx into the neuron, which starts the chain of events for consolidating memory.

MG: Certainly the Thompsons and others have stressed the importance of developing metacognition skills..interesting. And Sterman has been recently pointing out at ISNR and AAPB how SMR rhythm is associated with memory consolidation. We also know that LD clients have diminished 40 Hertz activity.

JC: Right, and Richie Davidson presented data recently that suggests when 40 Hertz activity increases in his Tibetan Monks study, there are reports of increased mental clarity correlated with it. The correlations are high only in the prefrontal lobe.

MG: I could use some more of that…let me ask you about who is using PAT and getting the best results with it.

JC: Dr. Louis Csoka has been making amazing strides with West Point, the US. Army, the US Federal Government and Fortune 500 companies. He may be the single most successful peak performance trainer in the world that utilizes NFB and biofeedback tools. Go to http://www.peakachievement.com/apex-performance-page.htm for an in-depth discussion of that.

MG: Finally, Hershel Toomim has in the last few years been adapting his HEG system for attention training; any comments?

JC: Hershel, Jeff Carmen and I sat down at the ISNR meeting in North Carolina and compared our systems. It was clear that Hershel and Jeff get results, and they train at the same location we do, FPz, but it is also clear that the PAT provides much more detailed "real time " feedback, and not surprisingly, is much faster at getting lasting results than HEG.

MG: Thanks for your time, Jon, and best of luck!