The Cognitive Emotional Checklist: Sources, Validity and Reliability

The items utilized in the checklist were derived from a thorough review of a variety of other checklists commonly used in the clinical setting in neurofeedback. Examples of the types of inventories reviewed were the Brown Inventory for ADHD and the TOVA Checklist as well as various other checklists gathered from private practicing clinicians. Being aware of the impact of emotion on cognitive function we also took into consideration constructs that tapped into the relevant emotional domains that appeared in the literature to affect cognitive function and that we felt should be controlled for in future analyses. Our final conclusion was to organize them by the meta-categories of overarousal (anxiety) and inhibited (depression). These first steps were done to insure good face validity with respect to constructing the question item as well as clinical utility of terms.

The items were then cross referenced to constructs investigated in the fMRI research. This research was drawn from summary resources such as The Human Frontal Lobes (Miller and Cummings, 1998), Subcortical functions in Language and Memory (Crosson, 1992), and numerous Neurology texts such as the Fundamentals of Human Neuropsychology (Kolb and Whishaw, 1996). These sources provided the neuroanatomical rational for understanding locations function relationships. Kaplan & Hammer's (2002) text along with Posner and Raichle's (1997) work provided further insights to structure and function relationships. The insights of Freeman (2009) and others contributed significantly in guiding us in how to relate MRI to EEG. As time passed we were able to confirm previous observations with the additional findings of Bucker et al (2008) and Laird et al (2012) which proved highly supportive. There were additionally a large number of articles resources reviewed too numerous to cite that provided insights to specific site functions and relations. Articles such as Kirk and McKay's explanation of two types of theta networks and their relationship to function provided insight to how different frequency domains within the theta band relate to structure and function. Heller at al (1997) helped us understand the relationship of arousal and anxiety to different cortical activities in the beta frequency domain furthering our understanding of how cortical and limbic structures interface.

A topic of great importance and considerable excitement in the neuroimaging community is connectivity and consideration of how locations work together. For information on these topics we turned to leading authors such as McIntosh (2008), Honey (2007), Bassette (2006), and Meehan (2012) to investigate small worlds connectivity and Rich Club connection patterns. We continue to peruse the research literature as it emerges to confirm our findings and integrate them such as with Laird et al (20 12) and his comprehensive analysis of the MRI literature or the emerging work on the anterior temporal poles (Wong & Gallate, 2012) and the insula (Craig, 2009). These confirmatory efforts have demonstrated to us that we have anticipated findings in the literature on a regular basis and our analysis of the relationship between structure and function continues to be robust.

Once the original analysis was completed, a limited reference chart was released to the public in workshops, on listserves and published in the Book Doing Neurofeedback. These findings were requested by and provided to Robert Thatcher, Jon Walker, Jay Gunkleman, Tom Buzinski, Cory Hammond, and a large number of other leading developers in the qEEG community. Many of these individuals have gone on to utilize this information in the development of their own projects and significantly expanded on our original analysis. For instance Michael Thompson requested this data to assist him in developing a more comprehensive publication for ISNR which is now available for purchase. The idea of correlating symptom to location was gaining considerable momentum at the time and continues to be a strong theme. Special thanks to Cory Hammond who provided me with the exact 10-20 location and Brodmann Area correlations, my first efforts could only estimate the relationship, as he was able to get the exact 10-20 correlations to the Talairach Atlas and associated Brodmann areas from Roberto Paqual Marquee.

In spite all of the attention being focused on symptom to location analysis we have always been more interested in the interaction of these location,s as discussed in Honey et al, Freeman and others. In fact earlier texts, such as Crosson (1992), which was based strongly on the anatomical literature, emphasized the importance of distributed function. Our proprietary chart or matrix contains multiple key locations with related hubs for each construct, such as working memory, and we compute the aggregate value of their individual weighting. I reported this feature at ISNR in my workshop on Activation in 2009, which can be reviewed by watching the video. The concept of hub and node organization of the cortex was enhanced by the work of Buckner (2008) and Hagmann (2008). The recognition that the brain is organized in a scale free Small World connectome that is characterized by Rich Club Hubs and Nodes is central to our analysis process (Meehan, 2012). Consequently we are using a statistical non-parametric rank order weighting system to calculate the contribution of many locations upstream and downstream to the total deviance expected. We are continuing to develop this approach as the research emerges. As mentioned above, recent articles by Laird and Meehan have been very supportive of this approach to functional connectivity and to a lesser degree to effective connectivity. These authors caution, however, that the relationship between the fiber pathways and the network processing pathways is still poorly understood and consequently our efforts can only be a probabilistic estimate with limited accuracy. The results so far have been encouraging at the clinical level. The initial testing of the CEC at the Old Vinyard Behavioral Health lab for neurofeedback, operated by Robert Longo in 2008, were very promising and significantly validated the accuracy of our system. The staff reported the predictive validity of the CEC and the map system was quite high. This theoretical perspective on connectivity was presented at the ISNR 2012 conference and explained the reason for our protocol designs as well.

It should be kept in mind that we have found no simple correlation between EEG deviance and symptom severity. Such an expectation is naïve and unrealistic when dealing with the dynamic complexity of a structure such as the human brain. In addition, functional compensation for abnormally functioning regions occurring within the brain itself, especially across the corpus callosum, is a major confound with respect to relating abnormal brain activity at the physiological level to abnormal cognitive function and behavior. Nevertheless we have been pleasantly surprised by the predictive accuracy of the system and are presently doing extensive statistical analyses with a present N >15000 subjects.

The CEC performs two major functions in the database system at this juncture. Firstly, it inventories key domains of a clients cognitive and emotional function through carefully developed questions that tap constructs correlated with locations in the cortex. Secondly it estimates levels of function in the key dimensions of memory, attention, overarousal and inhibitory regulation and control related to emotional dynamics.

To date our system is the only one that utilizes this research data to generate a standardized qEEG analysis report that has a standardized narrative output and statistically derived protocol output which has been used effectively among several hundred clinics worldwide for over 6 years. Others are quickly following in our path, and a major part of our original intent was to pressure others to follow suit.

The CEC is not intended to be a psychometric or substitute for a neurocognitive battery. It was exclusively developed for the use of neurofeedback practitioners to assist them in better understanding the socio-emotional status of their clients and monitor changes in that status through EEG Biofeedback training.

Predictive Validity: Present Findings

The New Mind Cognitive Emotional Checklist (CEC) has been cross validated with the Test of Variables of Attention (TOVA), the BECK Inventories, the Microcog Memory Subtest, and the ISI Anxiety and Depression subtests and demonstrated excellent convergent and predictive validity. The attention question checklist score is able to significantly predict whether an individual's performance on the TOVA will be in the normal or abnormal range. Adult individuals with a cumulative score above 12 are likely to score in the abnormal range on the TOVA , (N=40) Chi Square= 12.96, $P < .05$. Children scoring above 9 on the CEC Attention Scale are likely to score in the significantly deficit range on the TOVA.

Those Adults scoring above 20 on the CEC Memory Scale are likely to score in the abnormal range on the MicroCog, (N=30) Chi Square=29, $P<.05$. Children scoring above 15 on the CEC Memory Scale are likely to score in the abnormal range on the MicroCog.

Adults scoring over 22 on the CEC Anxiety scale are likely to score in the abnormal range (moderate or higher) on the Beck Anxiety, (N=50) Chi Square = 13.58, P<.05. Children scoring above 19 on the CEC Anxiety Scale are likely to score in the abnormal range.

Adults scoring 8 or more on the CEC Depression Scale are likely to score significantly (Moderate range) on the Beck Depression Inventory, (N=50) Chi Square = 22.35. Children scoring above 14 on the CEC Depression scale are likely score in the abnormal range.

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