PICTURE OF THE MONTH: NEW TRANSISTOR DESIGN MIMICS MIND’S PLASTICITY

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PUBLICATIONS OF INTEREST THIS MONTH


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HPEN BLOG OF THE MONTH

EEG/ERP Resting State & Genetic Psychophysiology
by: Nick Nichiporuk, HPEN Member

Gene psychophysiology (GP) is an interdisciplinary field that intersects neuroscience, genetics, and psychophysiology. The primary goal of the researchers in this field is to understand how genes influence behavior, with the important underlying assumption that genes influence behavior in as much as they influence the brain. In order to define the neural pathways and mechanisms that mediate the link between genes and behavior, the researchers utilize methods including EEG/ERP, linkage studies, and association studies. Importantly, ideas generated from this line of research may be of use to many of those who study the mind and behavior.

GP involves studying the brain and its function, genes, and behavior to contribute to an integrative understanding of the nature of individual psychological differences. An example of research that may be useful for any neuroscientist is the research on resting-state EEG. Utilizing a series of converging methodologies (monozygotic, dizygotic, and familial analysis), a large number of studies suggest a high heritability of resting EEG spectral band power. Interestingly, of the different EEG frequency bands, alpha band power (8-13 Hz) yielded the highest heritability estimates. The author concludes that the influence of genetic factors on resting-state EEG characteristics is one of the most heritable of human traits. The author not only reviews the evidence for a substantial heritable component for resting-state EEG characteristics, but also presents evidence for a genetic influence on frontal EEG asymmetry (FA), individual differences in alpha-band frequency, EEG coherence and the “small-world” network, individual differences in the effects of alcohol on mood and behavior, and sleep structure and quality. The research is not limited to resting state EEG, however, as genetic factors influencing event-related brain potentials (ERPs) are discussed as well. Of interest, the author presents evidence for a significant estimate of heritability for P300 amplitude as elicited in oddball tasks, mismatch negativity (MMN), sensory gating (p50), error-related negativity (ERN), ERPs in response inhibition (Go-NoGo) tasks, and face-related ERPs.

The idea that resting-state EEG activity has a significant heritable component is important for several reasons. First, the author reviews evidence from studies utilizing Amsterdam twin data. The studies suggest that genetic influences on P300 amplitude are mediated in part by spectral properties of baseline, resting-state EEG. It is important to note that the results also showed a significant residual genetic influence on P300 amplitude that was not shared with the resting EEG. The author concludes that the implication of this research is that a significant proportion of genetic variability in P300 is accounted for by resting-state brain neurophysiology rather than neural correlates of cognitive processing. A recommendation is made to include resting-state EEG characteristics as covariates when analyzing ERPs in order to isolate the “true” ERP-specific variance. This recommendation needs to be studied further given the plausibility of alternative explanations for the observed results.

In summary, the author reviews evidence for genetic influences in resting-state as well as ERP research, outlines the methodology of studying pathways and mechanisms by which genes influence human behavior, lists limitations of said methodologies, and discusses future directions.