

Current Topics in Behavioral Neurosciences

Volume 21

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Electrophysiology and Psychophysiology in Psychiatry and Psychopharmacology

 Springer

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Preface

Psychiatric disorders are highly complex and multifactorial. Moreover, the disorders are characterized by being heterogeneous with a significant degree of both overlap and co-morbidity. All these characteristics render research attempting to unravel the underlying psychophysiological processes rather complex and difficult. The only way forward is the incremental elucidation of physiological aberrations and attempting to identify the clinical correlates of the identified deviations.

Psychophysiological/electrophysiological methodologies have proven very useful in probing the physiological aberrations in psychiatric disorders and guiding towards effective and/or novel interventions. Given the extremely wide scope of psychiatric aberrations from personality deviations and substance dependence to the frank psychoses with both cognitive disintegration and affective dysregulations a rather large volume of research currently exists.

The first 12 chapters in this volume (Part I) provide updates regarding current understanding of the psychophysiological processes seen to be deviant in a particular disorder or in association with a particular set of symptoms within a disorder spectrum. The last five chapters (Part II) focus on techniques and methodologies that are highly promising as tools to further strengthen the impact of psychophysiological investigations on bringing the field closer to a full understanding of the pathophysiologies of the various neuropsychiatric disorders.

Part I of the volume starts with a contribution from Petr Bob focused on disturbances of neural mechanisms of consciousness which, through attentional mechanisms and memory processes, are linked to specific changes that occur in psychiatric disorders. The disturbances of consciousness and mental disintegration are closely connected with influence of stressful experiences and enable us to understand certain psychopathological mechanisms manifesting in a number of disorders. The contribution by Michael Stone provides a neurophysiological view of the spectrum of Borderline Personality Disorder (BPD). In the last two decades neurophysiological data, including MRI and fMRI, have established correlates in various brain regions, particularly those involving the frontal lobes and various limbic structures, that show promise of providing a more substantial basis for diagnosis relying primarily on identified brain changes. This chapter addresses the

possible interrelationships between BPD and Bipolar Disorder. In the next chapter, Tim Outreth, Andrew Kemp and Gin Malhi examine electroencephalogram (EEG) and event-related potential (ERP) measures along with neuroimaging and peripheral physiological measures that both characterize and differentiate Bipolar Spectrum Disorders and their response to treatment. They provide a thoughtful framework for understanding these findings and stress their importance in improving assessment and therapeutic decision making in this population.

The two subsequent contributions are provided by the Galderisi/Vignapiano/Mucci/Boutros group and address, in Chap. 1, the physiological correlates of positive symptoms in schizophrenia. This chapter highlights the findings of electrophysiological studies in schizophrenia dealing with early sensory perception and attention, automatic sensory detection of stimuli changes and cognitive evaluation and integration of information, relevant to the pathophysiological mechanisms underpinning hallucinations and delusions. Results of electrophysiological studies investigating the neural correlates of positive symptoms suggest aberrant intrinsic organization of functional brain networks. The following contribution by the same group highlights the electrophysiological aberrations associated with negative symptoms in schizophrenia. While a number of studies have appeared over the years examining the electrophysiological correlates of the cluster of negative symptoms in schizophrenia, only a few studies have actually focused on the Deficit Syndrome (DS). In this chapter, electrophysiological investigations utilizing EEG, Evoked Potentials (EPs), polysomnography (PSG), or magnetoencephalography (MEG) to probe “negative symptoms”, or “Deficit Syndrome” are reviewed.

Dean Acheson, Mark Geyer and Victoria Risbrough then offer a comprehensive review of the current state of knowledge on psychophysiological outcomes in Posttraumatic Stress Disorder (PTSD), with particular attention to their use as markers of current symptoms as well as markers of PTSD-related processes (e.g. fear extinction), and their sensitivity and selectivity for PTSD symptoms versus other anxiety and mood disorders and co-morbid disorders. They highlight potential future avenues for integrating psychophysiology into emerging areas of PTSD research and discuss the use of new wearable physiological monitoring technologies in treatment outcome studies. Wenzel Schicho and Oliver Pogarell provide a review and commentary on the physiological aberrations in Panic Disorder (PD) with a focus on the less frequently explored contribution of isolated epileptic discharges (IEDs) to symptomatology in the absence of epilepsy. It is not known exactly which role IEDs play in the genesis of behavioural aberrations. In this chapter, attention is directed towards this issue and its relevance to managing psychiatric patients suffering from PD, as well as understanding the complex relationship between IEDs and the pathophysiology of PD. The chapter by Christopher Patrick discusses the constructs of psychopathy and antisocial personality disorder (ASPD), their relations with one another and with violent behaviour, and provides an in-depth review of physiological correlates of psychopathy and ASPD with a focus on the features that these conditions share and those that distinguish them.

The two subsequent chapters address a topic that is not commonly included in standard psychophysiology texts, namely premenstrual and postmenopausal physiological and psychophysiological changes. The first of these, by Inger Sundström Poromaa, focuses on premenstrual dysphoric disorder (PMDD). PMDD is common with onset of symptoms in the late luteal phase of the menstrual cycle and provides an important model for our understanding of the influence of ovarian steroids on mood and anxiety in women. She discusses physiological findings in PMDD women (e.g. altered cardiovascular responses to stress) that appear to represent vulnerability traits for PMDD (i.e. also present in asymptomatic menstrual phases), or alternatively, vulnerability traits for the depressive and anxiety disorders that are commonly associated with PMDD. She also presents a number of state-related findings (e.g. lower luteal phase prepulse inhibition) in PMDD. The next contribution by Robert Freedman addresses postmenopausal physiological changes. The hallmark of menopause is the marked reduction of estradiol levels due to ovarian failure. This, among other factors results in hot flashes, the most common menopausal symptom. This chapter reviews the pathophysiology of hot flashes and highlights the contribution of brain structures like the brainstem, the insula and the prefrontal cortex.

The next chapter, by Ian Kodish, Carol Rockhill and Sara Webb, reviews psychophysiological and neuroimaging findings in Autism Spectrum Disorder (ASD), describing alterations in local brain regions as well as coordination of brain activity during both rest and activation paradigms in ASD. They propose that new drug therapies for ASD should aim to realign ‘trajectories of network specialization across development’ by acting together with behavioural therapies to enhance social and emotional learning by potentiating the effect of experience-induced plasticity on neuronal network connectivity. The last contribution to this part of the volume comes from Timothy Rhoers and colleagues who provided an analysis of the physiological correlates of insomnia. This chapter describes the physiological correlates of insomnia expressed during sleep and during the daytime. Together, the data from nighttime and daytime electrophysiology, event-related brain potential recording, neuroimaging studies, sympathetic nervous system and HPA axis monitoring all suggest insomnia is a 24-h disorder of hyperarousal.

Part II of the volume starts with a contribution from Gregory Light and Neal Swerdlow. They propose a remarkable parading shift (focus more on what is “right” and less on what is “wrong” with the patients) and convincingly argue, with clear examples of more normal-like performance in specific neurophysiological and psychophysiological measures predicting a positive response to specific therapeutic interventions, for an alternative strategy of using psychophysiological measures to identify ‘spared neural and cognitive function’ and then using this information to optimize clinical outcomes in schizophrenia patients. The next contribution to this section comes from Susan Bowyer and addresses connectivity measurements for network imaging. As is well known, communication across the brain networks is dependent on neuronal oscillations. Detection of the synchronous activation of neurons can be used to determine the well being of the connectivity in the human brain networks. Well connected highly synchronous activity can be measured by

MEG, EEG, fMRI and PET and then analysed with several types of mathematical algorithms. A further contribution by Petr Bob provides a review of topics related to nonlinear measures and dynamics in psychophysiology of consciousness that represent important tools to understand certain specific changes in neural systems implicated in psychiatric disorders. These methods enable us to describe various levels of complex interactions that may influence patterns of temporal and spatial disorganization with decreased or increased functional connectivity and complexity that underlie specific perceptual and cognitive changes in psychopathological states. Martijn Arns and Sebastian Olbrich explore the role of pharmaco-EEG in personalized medicine for Attention Deficit Hyperactivity Disorder (ADHD) and Depression. This chapter summarizes recent developments on personalized medicine in psychiatry with a focus on ADHD and depression and their associated biomarkers and phenotypes. Several neuro-physiological subtypes in ADHD and depression and their relation to treatment outcome are reviewed. The final contribution to this volume comes from Nikolaj Bak and Bob Oranje. They describe the benefits of psychophysiology-informed imaging, an approach also advocated by many others in this volume, in particular how a combination of EEG and fMRI complements each other, allowing both high temporal (EEG) and spatial (fMRI) resolution to be achieved. They also discuss various approaches to combine psychophysiology (EEG, EMG) with fMRI and the issues that need to be dealt with when combining the two methodologies.

We hope this volume, with chapters from leaders in the field, will make a valuable contribution to the literature on proven utility as well as future applications of psychophysiological measures, combined with other methodologies, in the context of improved understanding, prevention and effective treatment of neuropsychiatric disorders.

Veena Kumari
Petr Bob
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Contents

Part I Psychophysiology in Neuropsychiatric Disorders and Their Treatment: Past, Present and Future	
Psychophysiology of Dissociated Consciousness	3
Petr Bob	
The Spectrum of Borderline Personality Disorder: A Neurophysiological View	23
Michael H. Stone	
Physiological Correlates of Bipolar Spectrum Disorders and their Treatment	47
Tim Outhred, Andrew H. Kemp and Gin S. Malhi	
Physiological Correlates of Positive Symptoms in Schizophrenia	103
Silvana Galderisi, Annarita Vignapiano, Armida Mucci and Nash N. Boutros	
Electrophysiological Aberrations Associated with Negative Symptoms in Schizophrenia	129
Nash N. Boutros, Armida Mucci, Annarita Vignapiano and Silvana Galderisi	
Psychophysiology in the Study of Psychological Trauma: Where Are We Now and Where Do We Need to Be?	157
D.T. Acheson, M.A. Geyer and V.B. Risbrough	
Physiological Aberrations in Panic Disorder	185
Wenzel Schicho and Oliver Pogarell	

Physiological Correlates of Psychopathy, Antisocial Personality Disorder, Habitual Aggression, and Violence.	197
Christopher J. Patrick	
Physiological Correlates of Premenstrual Dysphoric Disorder (PMDD)	229
Inger Sundström Poromaa	
Postmenopausal Physiological Changes	245
Robert R. Freedman	
ASD: Psychopharmacologic Treatments and Neurophysiologic Underpinnings.	257
Ian Kodish, Carol M. Rockhill and Sara J. Webb	
Physiological Correlates of Insomnia	277
Timothy Roehrs, Valentina Gumenyuk, Christopher Drake and Thomas Roth	
Part II Psychophysiology Measurements and Analytical Tools: New Perspectives	
Neurophysiological Biomarkers Informing the Clinical Neuroscience of Schizophrenia: Mismatch Negativity and Prepulse Inhibition of Startle.	293
Gregory A. Light and Neal R. Swerdlow	
Connectivity Measurements for Network Imaging.	315
Susan M. Bowyer	
Nonlinear Measures and Dynamics in Psychophysiology of Consciousness	331
Petr Bob	
Personalized Medicine in ADHD and Depression: Use of Pharmacoo-EEG.	345
Martijn Arns and Sebastian Olbrich	
Psychophysiology-Informed (Multimodal) Imaging	371
Nikolaj Bak and Bob Oranje	
Index	387