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Clinical Applied Psychophysiology

Edited by
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A. Ronald Seifert, and
Neils Birbaumer

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To the memory of Hisashi Hirai
Professor, Department of Psychology, Sophia University, Tokyo, Japan.
His international efforts in self-regulation and health,
and his gentle humanity, will be greatly missed.

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Foreword

Although the injunction "Know thyself" was inscribed over the site of the Delphic Oracle, the concept is of much more ancient lineage. Thousands of years ago, the wise men of the East had learned to exert authority over a broad range of bodily experiences and functions using techniques that are still taught today. But it is only in the past few decades that the West has become aware once again of the range of control that the central nervous system can maintain over sensation and body function. Medicine has moved slowly in integrating these concepts into the classic medical model of disease despite a growing body of evidence that links emotional state, thought, and imagery to immunocompetence, tissue healing, and bodily vigor.

It is precisely the role of a volume such as this, reflecting a fascinating conference in Munich, to emphasize and reemphasize these ideas. We are fortunately well beyond the sterile behaviorism of Watson with its complete negation of the significance of mental operations. But many still consider suspect those forces and mechanisms, however powerful, that seem to originate from brain–mind activity. The chapters in this book, with their emphases on the mind–body continuum as a bridge to self-regulation and health, provide a modern "School of Athens" in bringing these concepts to wider acquaintance.

One of the necessary bridges to such an appreciation is a growing understanding of the structure and modes of function of the nervous system. The neural substrates for our ability to self-regulate experience and body function are becoming less mysterious. If it can be shown that the structures and mechanisms are present and describable, even the skeptic must eventually see the possibilities.

One of the more powerful insights into such candidate neural connections has emerged from study of the relations among prefrontal cortex, nucleus reticularis thalami, and thalamocortical projections. Neuroanatomical, neurophysiological, and immunocytochemical studies have confirmed the role of the n. reticularis thalami as a filter or gating system,

sitting athwart all sensory communication between thalamus and cortex. En route to cortical receptive areas, sensory thalamic activity activates localized neuron clusters of the n. reticularis thalami. Short, high-frequency bursts of these n. reticularis cells then play back onto the thalamus, causing brief periods of profound thalamic cell inhibition. Each thalamocortical burst thus selectively closes reticularis gates during the period of its activation, thereby delimiting and emphasizing its own content—temporally and spatially.

In contrast, ascending connections from the mesencephalic reticular formation exert a strong inhibitory bias on the cells of the n. reticularis thalami, effectively opening the gates. This is undoubtedly the system that is activated in a period of stress or maximal emergency (e.g., when someone shouts "Fire" in a crowded theater). The sudden voluminous opening of n. reticularis gates tends to flood the cortex with information, powerfully stimulating some individuals and totally paralyzing others (i.e., freezing them in a panic state).

There is a third series of connections to this gating system, which is most relevant to our interest. The prefrontal cortex projects to the intralaminar nuclei of the thalamus and indirectly to the mesencephalic reticular core. Through these pathways, neurons of the n. reticularis can be driven or inhibited by prefrontal activity. Although the prefrontal cortex remains one of the more functionally enigmatic areas of the entire brain, it is increasingly seen as an executive area for decision, focus, and projection. It is at once the head end of the keel-like fronto–septo–hypothalamo–tegmental axis and a source for connections to the entire cerebral cortex, basal ganglia, and thalamus. As closely as one can make such an analogy, it is simultaneously the site of the decisionary "I" involved in conscious choice and life planning and the ultimate source of modulation over hypothalamus-controlled visceral activity. In the latter case, the demonstrated immunocompetence of the nude mouse may correlate with a thinner, less developed frontal cortex. Similarly, experimental destruction of the murine left frontal cortex also results in diminished immunocompetence. In humans, devastating life experiences (e.g., loss of mate, child, or job) have equally destructive effects on the immune system. And guided imagery may enhance immunocompetence for the cancer patient.

In making conscious choices, such imagery helps shape our plans for the evening or for our career. And it is undoubtedly the ultimate agency involved when we "think positively," "determine to get well," or enter a psychophysiological program to diminish chronic pain, control hypertension, and so forth. The mechanisms are just as valid for the Hindu fakir lying calmly on his bed of nails as for our own attempts to attain greater relaxation during stress or to diminish the pains of migraine.

The remarkable ability of the prefrontal cortex, operating through the thalamic intralaminar system and the brainstem reticular core to open or close the multiple gates of the n. reticularis thalami, provides the control mechanism we seek. Our conscious decision to effect change is apparently impressed on the neuronal substrate through these connections, and with repetition (the Hebb paradigm), the links are reinforced and the technique of control is learned.

This volume and the clinical research organization that it represents serve an invaluable function in highlighting the various phenomena and the therapeutic potential inherent in appropriate utilization of this neural system. Their efforts represent medically relevant education at its highest level.

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Preface

The collection of papers in this volume represents a broad spectrum from the invited presentations in a series of symposia and keynote addresses at the Second International Conference on Biobehavioral Self-Regulation and Health. The conference was held at the University of Munich, Germany, September 15–20, 1991, in accordance with plans announced at the first of these conferences (in Honolulu, Hawaii, 1987). A third conference in the series is planned (to be held in Japan in 1993). The advisory committee for the Munich conference—Niels Birbaumer (Germany), the late Hisashi Hirai (Japan), M. Barry Sterman (United States), and Holger Ursin (Norway)—was coordinated by the Chairmen of the International Committee of the Association of Applied Psychophysiology and Biofeedback, A. Ronald Seifert (United States) and John G. Carlson (United States). The advisory committee and chairs together developed the program and solicited presentations from six keynote speakers and thirty-one individual symposium presenters, all eminent and internationally known researchers representing eleven countries. The invited presentations at the conference were organized into eight topical areas, including the applied psychophysiology of epilepsy, cardiovascular disorders, sleep disorders, exercise, pain, breathing, stress in the workplace, and man in hazardous environments. In addition, in these and other content areas, thirty-five posters were contributed and presented at the meeting, the authors of which represented eight countries (Carlson & Seifert, 1992).

This collection of papers represents the second volume from these international meetings, the first also published in the *Plenum Series in Behavioral Psychophysiology and Medicine* (Carlson & Seifert, 1991). That collection was focused mainly on pure and applied research in the field of self-regulation and health. In this volume, the focus is more on clinical applications of psychophysiological principles and methods. The fifteen chapters largely comprise outstanding selections from the conference oral presentations, organized into those that discuss disorders of the central nervous system (two chapters), the cardiovascular system (three chap-

ters), the applied psychophysiology of breathing (four chapters), the neuromuscular system (two chapters), and long-term stress (two chapters). These papers should be an asset for the applied psychophysiologist-clinician who keeps abreast of the latest developments and techniques of the field. Additional details on the individual chapters and the Munich meeting are to be found in the Introduction (Chapter 1).

Sincere thanks for efforts that helped to make this second meeting a successful one are due to many individuals—foremost, the presenters themselves. The many formal and informal exchanges at the meeting were always lively and packed with fascinating and new approaches and data. Behind the scenes, the local coordinator, Ulrich Birner, and his always helpful and gracious assistants, Barbara Steinkopf and Ida Kukarski, all of the University of Munich, provided invaluable organization and attention to details. Various forms of financial support for the meeting were provided by the Association of Applied Psychophysiology and Biofeedback, the German Research Society, and the European Space Agency.

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