

Electrodermal Activity

Wolfram Boucsein

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Second Edition

 Springer

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Foreword to the Second Edition

As noted by David Lykken in the foreword to the first edition of this book, electrodermal activity was observed for the first time in Germany. A quarter-century later the scientific study of psychology also originated in Germany. Over time, however, the focus of psychological research, including the then new field of psychophysiology, shifted to the United States and Great Britain. This trend to the dominance of the United States and Great Britain was prolonged by the devastation of World War II and its aftermath in Germany (and elsewhere in continental Europe). Slowly at first and then more rapidly, German psychological science, including psychophysiology, recovered. For several decades German psychophysiologicalists have been a major force in psychophysiology. With the publication of the first English edition of this book in 1992, it became essential for electrodermal researchers worldwide again to learn from our German colleagues.

When I came into psychophysiology in the mid-1960s, electrodermal activity was the most common system studied. Because of its popularity, a large literature had emerged on the physiological mechanisms producing these changes in the electrical properties of the skin and on the best methodology for recording them. Major reviews and/or chapters had been published or soon were to be published by Peter Venables and Irene Martin, Robert Edelberg, and David Lykken. Later reviews and articles were published by Venables and Margaret Christie, and by me. A chapter in 1990 by Michael Dawson, Anne Schell, and Diane Fillion was especially noteworthy for its coverage of the psychological applications of electrodermal measures.

Note that all these publications were journal articles and chapters and that most of them focused almost entirely on mechanisms and methodology. The publication of this book, first in German and then in English, provided the first *book* on electrodermal activity, and one that extensively covers psychological applications as well as mechanisms and methodology. Again to quote David Lykken back in 1992, “The return of German scholarship to what I shall loftily call the high table of psychophysiology is exemplified by this fine book, the most comprehensive treatise on the electrodermal system to appear in any language . . .” I completely agree with

that evaluation. Professor Boucsein's outstanding scholarship has produced a book of such breadth of coverage and depth of knowledge that it stands in a class by itself as *the* standard reference source on electrodermal activity. Even without a second edition the book would still constitute the definitive coverage of the topic. With the incorporation of new developments and addition of some new areas, the second edition is of even greater value. Professor Boucsein has provided a great service to the field by bringing all of this literature together in one comprehensive review.

Wolfram Boucsein was educated at the University of Giessen and later became Professor of Physiological Psychology at the University of Wuppertal. He has published extensively in the area of psychophysiology.

Iowa City, USA

Don C. Fowles

Preface to the Second Edition

After being now 20 years old, the present handbook needed an update, mainly because of new developments in electrodermal recording and scoring, but also because a great number of scientific papers on the application of EDA in various fields appeared. Not only emerged new possibilities such as recording EDA within a fMRI setting, but in addition new applications such as in decision making, biofeedback, and ergonomics, have been enlarged since the first edition appeared back in 1992. Hundreds of original papers and reviews were scrutinized and incorporated if applicable.

The general structure of the book has been retained, in order to allow the reader who is familiar with the first edition an easy detection of additional material. The following sections are entirely newly written: ambulatory monitoring (Sect. 2.2.3.4), recently proposed mathematical solutions for evaluating overlapping responses (Sect. 2.3.1.5), the use of EDA in decision making (Sect. 3.1.3.3), in human-computer interaction (Sect. 3.5.1.1), in marketing and product evaluation (Sect. 3.5.1.3), and in certain neurological diseases (Sects. 3.5.4.2 and 3.5.4.3). Other Sections were substantially updated and/or rewritten: central origins (Sect. 1.3.4.1), electrode arrangements (Sect. 2.2.6.4), significance of the orienting response (Sect. 3.1.1.1), classical conditioning (Sect. 3.1.2.1), biofeedback (Sect. 3.1.2.3), lateralization and hemispherical asymmetry (Sect. 3.1.4), multidimensional arousal modeling (Sect. 3.2.1.2), diurnal variations and sleep (Sect. 3.2.1.3), the use of EDA in emotion and stress (Sect. 3.2.2), in anxiety, psychopathy and depression (Sect. 3.4.1), in traffic and automation (Sect. 3.5.1.2), and in the detection of deception (Sect. 3.5.2), just mentioning the major ones.

The author thanks the following persons who helped him editing the book, with respect to both language and content: Mark Handler, John J. Furedy, John A. Stern, Andrew Munn, Florian Schaefer, Nathalie Fritsch, and Peter Kirsch. Appreciation for technical support is given first and above all to Janine Gronewold, but also

to Sabine Hackenberg and Marie Drüge. I am very grateful to my wife Lilo who supported and encouraged me in the years during which I worked on the present book.

Wuppertal, Germany

Wolfram Boucsein

Foreword to the First Edition in 1992

Electrodermal activity was observed for the first time more than 150 years ago in Germany where, a quarter-century later, the scientific study of psychology also originated. Well into the twentieth century, English-speaking psychologists all read German and, if they could, made pilgrimages to Leipzig and Heidelberg and other seats of German scholarship. Then gradually the focus of psychological research, including the new field of psychophysiology, shifted to the United States and Britain. Studies of electrodermal activity, in particular, originated mainly in North America. As a student in the early 1950s, I learned about what we then called the Galvanic Skin Response or GSR by reading C.W. Darrow, G.L. Freeman, R.A. Haggard, R.A. McCleary, and H.G. McCurdy, all in American English.

The current renaissance of German science has made it necessary for psychologists, once again, to attend to and learn from the work of their Teutonic colleagues. Fortunately for us monolingual Americans, English has become the lingua franca of our field; German scholars speak our language fluently when they visit the United States and understand us when we go to them. The return of German scholarship to what I shall loftily call the high table of psychophysiology is exemplified by this fine book, the most comprehensive treatise on the electrodermal system to appear in any language and now available in English.

In 1971, in the eighth volume of the journal *Psychophysiology*, Lykken and Venables commented, "Of all psychophysiological variables, the GSR can lay reasonable claim to being the most popular in current use. In spite of years of searching study, we are still surprisingly uncertain about the function, not to say the mechanism of this phenomenon. . . . Nevertheless, the GSR seems to be a robust sort of variable since, in hundreds of experiments, it continues stoutly to provide useful data in spite of being frequently abused by measurement techniques which range from the arbitrary to the positively weird." Now, more than 20 years later, the findings collected and integrated by Professor Boucsein should make it possible for future investigators to address this "robust sort of variable" with standardized technique and the respect that it deserves.

Wolf Boucsein was educated at the University of Giessen and is now Professor of Physiological Psychology at the University of Wuppertal. He has published extensively in the areas of psychophysiology and differential psychology. In the present volume, he has provided what should become the standard reference on the topic of electrodermal activity.

Minneapolis, USA

David T. Lykken

Preface to the First Edition

Since the discovery of the galvanic skin response over 100 years ago, recording of electrodermal phenomena has become one of the most widely used methods of measurement in various fields of psychophysiology. This book provides, for the first time, a comprehensive summary of perspectives and histories from different scientific disciplines as well as a complete outline of methodological issues, and a review of results from different areas of electrodermal research.

The book is divided into three parts. Part I (Chaps. 1.1–1.5) focuses on the anatomical, physiological, and biophysical origins of electrodermal phenomena. Peripheral and central nervous system mechanisms are discussed, and fundamental biophysical principles are provided together with an extensive discussion of the current electrical models of electrodermal activity.

Part II (Chaps. 2.1–2.6) outlines principles and methods of electrodermal recording, scoring techniques, and the action of internal and external influences on the signal, and describes statistical properties of the different electrodermal parameters. It ends with a summary of recent discussions on the advantages and disadvantages of the different methods.

Part III (Chaps. 3.1–3.6) reviews applications of electrodermal recording techniques within psychophysiology, personality research, clinical and applied psychology, and medical disciplines, for example, dermatology and neurology. Areas such as orienting and habituation, classical and instrumental conditioning, information processing and storage, multidimensional arousal, sleep, and stress research are considered with respect to the theoretical modeling of vegetative concomitants of central nervous system phenomena. Aspects of specific validity of electrodermal measures are discussed within the framework of neurophysiological and psychophysiological systems.

The present volume is conceptualized as a handbook. A reader who is not especially interested in the signal's origin may start with Part II, after having read

the introductory Sect. 1.1.1 and the summary in Chap. 1.5. Readers having fundamental knowledge in electrophysics may skip Sect. 1.4.1, and also Sects. 2.1.1 and 2.1.2. Since the book contains numerous cross-references to the different sections, starting from any point is possible without loss of content. Several chapters and sections end with summaries that provide the appropriate highlights (Chaps. 1.5 and 3.6, and Sects. 2.1.6, 2.2.7, and 2.3.5).

Appreciation for adding to the book's content is given to my coworkers Rüdiger Baltissen, Jörn Grabke, Peter Kirsch, and Florian Schaefer as well as to Mike Dawson, Bob Edelberg, and John Furedy. I would also like to thank Ulrike Hillmann, Marlies Knodel, Brigitte Kapanke, and Boris Damke for doing the text editing, and Sebastian Boucsein, Katrin Boucsein, Martina Promeuschel, and Timothy Skellett for helping with figures, references, and language editing. In addition, I would like to thank Cecilia Secor, Judith Ray, and especially Alex Vincent, who helped tremendously to improve my English, the latter one also for making several proposals that added to the content. Finally, appreciation is given to the series editor, Bill Ray, who performed a great job getting the present volume published.

Wuppertal, Germany

Wolfram Boucsein

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