PSYCHOPHYSIOLOGY

Vol. 12, No. 2
Printed in U.S.A.

PSYCHOPHYSIOLOGY

SPR Award, 1974

For Distinguished Contribution to Psychophysiology: Robert Edelberg

At the Fourteenth Annual Meeting of The Society for Psychophysiological Research, the award for Distinguished Contribution to Psychophysiology was made to Robert Edelberg by his colleague, John Lacey.

Following is the text of the citation given at the meeting October 26, 1974.

Consider the single largest autonomically innervated organ of the body — the skin, roughly some 18,000 cm² in extent. Consider further that this organ serves the important function of demarcating, both physiologically and psychologically, the boundary between the "me" and the "other," and between the organism and its chemical environment, in amoeba, cat, rabbit, frog, dog, Koala bear and man, to name but a few organisms. This demarcation, early in evolution, promoted only individuality and the regulation of chemical interchange between the organism and its environment, but it has come to subserve a variety of specialized biological adaptations: adaptations for protection against alien toxins and bacteria; adaptations for thermoregulation; adaptations for tactile sensing and perceiving; adaptations for control of water and solute concentration; adaptations for motor control, both gross and fine; adaptations for locomotion and defense.

Consider further that these adaptations have attracted the attention of, and constituted the objects of study by, a variety of disciplines, each unfortunately with its own tools, concepts, and hidden assumptions. The skin, and particularly its electrical activity, is studied intensively in neurology, neurophysiology and neurosurgery; by pharmacologists and dermatologists; by psychologists and physiologists interested in the senses; by students of thermoregulation and students of electrolyte balance; by investigators of the properties of cell membranes; by psychologists who want magical indices of poorly defined and perhaps mythical concepts; as well as by physiological psychologists who want to understand and manipulate the "black-box." Consider that each of these disciplines has contributed something to our knowledge, but that to integrate them requires

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a linguistic and scientific skill that characterizes few among us.

Consider further that in psychophysiology and psychology, no other physiological measure has been subjected to such conceptual and technical abuse as has electrodermal activity; nor has any other measure been the focus of so many studies. "When Féré (1888) demonstrated that rapid fluctuations of skin resistance could occur in response to emotional stimulation," to quote Edelberg, "the translucent integument was transformed into a transparent window for looking into inner experience . . . ." In so doing, Féré unleashed a torrent of energy, that still is not dissipated. Some 1500 papers, as a conservative estimate, have been published in which electrodermal activity is related to behavior. Many of these papers are trivial and inconsequential, but some make save-worthy contributions. It takes discrimination to separate the good from the bad, and to build only upon the good. Edelberg has shown such discrimination, to an exquisite degree.

Further, consider that these adaptations, functions, and correlations have *evolved,* and are today manifested somewhat differently in cat, monkey, and man; that they are mediated, regulated and controlled from a variety of central neural structures, from brain stem to cortex, from archipallium and neopallium, with confusing and currently inexplicable interactions. Their electrical manifestations particularly are subject to inhibitory and facilitatory processes that ultimately determine — and from a simplistic point of view, distort — the amplitudes, latencies, and wave shapes of the epiphenomenal electrical activity upon which we try to hang our psychophysiological interpretations. Consider, too, that in subserving these specialized adaptations the epidermis and the sweat glands are not static structures that are just *there,* constantly performing their appointed tasks, but that they are dynamically regulated, and change in regional expression, in their relative contributions to the total response, and in their quantitative range of operation — all in response to specific and situationally defined organism-environment interactions.

Consider still further, that sweating activity is something of a neurophysiological monster: Anatomically sympathetic, but pharmacologically cholinergic. And, lacking dual innervation, the sweat gland must provide its own feedback and homeostatic regulation by peripheral means only, such as poral self-closure when hydration levels become excessive.

Consider finally that these few hopefully evocative and provocative paragraphs are not in any sense the creation of the speaker. They are for the most part pallid and imitative, but hopefully correct, paraphrases and condensations of Edelberg's own writings. It is Edelberg's writings that bring these diverse strands together into one exciting fabric. Bob Edelberg has not only made his own innovative experimental contributions at many of the levels of investigation I've touched upon, but he has *integrated* them, has created bridges and landfills between islands of knowledge where nobody really knew bridges and landfills were either needed or potentially useful. He has made technical and conceptual advances of which nobody today in psychophysiology dare to be unaware. Consider all this, and you may begin to appreciate the magnitude of the achievement and the stature of the man we honor today. Perhaps you may also want to know something about the man himself, his training, his intellectual roots, his motivational structure.

Bob Edelberg, fired by Paul de Kruif's "Microbe Hunters" knew, as a young man, that he *had* to be a microbiologist. His junior year at Rutgers allowed him his first real contact with the field, and in a very short time he concluded that bugs were not for Bob. But this was the time when physiology was being transformed by the beginnings of chemical and electronic understanding, and the mysteries of the cell membrane became a focus of interest. Bob too decided to focus on the cell membrane. But Hitler's adventures called a halt to Bob's academic aspirations, and this gentle and scholarly man switched his interests once again, this time from the molecular world of the cell membrane to the molar and brutal world of the military aviator. A fighter pilot would Bob be! Fortunately, he failed. He was washed out in primary training, because he lacked a sense of orientation and direction. Given this serious spatial lack, he was immediately re-classified by the Aviation Psychologists as — a navigator! (I must say, parenthetically, that Bob's long-held conviction that I personally was responsible for this brilliant maneuver is totally unfounded. At the time I was assigned to the Western Training Command, and Bob was somewhere in the South.) But Bob successfully navigated B-24's

over the hump. Presumably it was there that he made contact with the friendly astral bodies that have so successfully guided his career since.

He emerged intact, went to the University of Pennsylvania which was and still is a major center for biophysics and physiology, and engaged, appropriately enough, in the biophysical and physiological study of the cell membrane. So it was that almost exactly 25 years ago, in 1949, that Navigator Edelberg became Robert Edelberg, Ph.D., physiologist and biophysicist, with a doctoral thesis entitled "Investigation of the structure of the erythrocyte membrane with tannic acid." This topic may strike you as being something less than central to the concern of psychophysiologists, but you are wrong. It is from this thorough grounding in two of the sciences that should be, but unfortunately rarely are, basic to psychophysiology that Edelberg's fruitful career evolved.

He then served for 2 years as a teacher, at Long Island University, of physiology and histology. The Armed Forces, in what turns out to be for us a stroke of fortune, recalled him to active duty. He served as a research and development officer in the field of acceleration physiology from 1951-1955 at the Wright-Patterson Air Force installation, 18 miles from my laboratory. (The astral bodies continued to promote Bob's development for they saw to it that we never met during this phase of his career!) He published many papers in the field of cardiovascular physiology, later secured a patent for an indirect blood pressure recorder, and in 1955 Major Edelberg was retired.

It was our colleague Neil Burch, who had worked with Bob at the Wright Air Development Center, who then guided Bob to our field. Neil asked Bob to join him in the Department of *Psychiatry* to work as a *biophysicist* on the EEG and the GSR. In this milieu, Bob conducted his first basic investigations in electrodermal activity. I remember clearly giving a colloquium at Baylor, and being urged — no, commanded — by Bill Lhamon to visit and talk with a young and brilliant biophysicist. I did. There, in a corner of a big laboratory, was the same gentle, diffident scholar we know today, albeit somewhat younger. It was an humbling experience. Bob showed me things I had never seen before — the spurt of sweat under low power magnification from an isolated sweat gland, the intimate and varying histological structure of the gland — and he talked with erudition and conviction to an non-understanding visitor about the implications of his initial studies of the results of applying different cations in varying concentrations to the epidermis. Thus began the series of studies for which Bob is justly so famous. Thus began his brilliant elucidation of the interrelationships between resistance and potential measurements, of the differential significance of the positive and negative components of the skin potential. From this derived his studies of the biological and psychophysiological adaptations of the skin, particularly of the sweat gland and the epidermis. Given the setting and Bob's eager curiosity and desire for understanding, it is easy to understand — or to think we understand — Bob's shift to an analysis of the human stimulus-response system.

The government intervened again, and Bob obtained a 5-year Senior Research Fellowship from NIH to increase his familiarity with the behavioral sciences. He continued his career first at the University of Oklahoma Medical Center, and now at Rutgers Medical School. He developed his electric models of the behavior of the skin. Of the many that have been proposed, his, I think, is currently the best. His supplementary mosaic model, interrelating the epidermal and sweat gland contributions to skin potential and skin resistance changes, withstood the test of experiments using electronic and hydraulic models, and finally, the functioning skin itself. He developed his epidermal re-absorption hypothesis, he gave new significance to and clearer definition of the recovery limb of electrodermal activity. He engaged in his studies of situational specificity and goal directed behavior, and clarified his 2-component theory of electrodermal activity. He patiently and with great objectivity and impartiality forged new techniques and new concepts, and exposed for all to see the deficiencies and merits of the approaches, techniques and models developed by his predecessors and contemporaries, and, characteristically, of the deficiencies and merits of his own approaches, techniques, and models. His experimental and conceptual contributions are innovative and important.

The half-life of citation of a paper in the behavioral sciences is, I understand, something under 10 years. In the more mature sciences, it is less, far less, for new facts and

concepts yield rapidly to newer facts and better concepts. Only a few papers are so seminal, so lasting that they continue to be cited, and continue to form the basis for further work. Prediction is hazardous, but I will make two predictions. The half-life of citation of Bob's experimental papers will be long, not because no further good work will be done; many people are doing such good work. His works will continue to be cited because they are seminal and basic. I make the second prediction because to me, his most important and most durable works are his lengthy reviews, in Brown's *Methods in Psychophysiology*, in Greenfield and Sternbach's *Handbook of Psychophysiology*, in Steller and Sprague's *Progress in Physiological Psychology*. These papers, I predict, will long continue to be cited and to be used, and they will become classics. In these papers, the various Edelbergs — the histologist, physiologist, biophysicist and psychophysiologist — are merged in a breathtaking and successful effort to bring order and significance where chaos reigned before. These papers must be read and re-read to be believed. They display an enviable breadth of scholarship, erudition, understanding, and creative organization and exposition. They are marked by an extraordinary impartiality and objectivity, the same characteristics we note whenever Edelberg discusses a paper from the floor — an activity in which he frequently engages, and for which we are always thankful.

Bob admits to no single mentor. He was not formed and molded by any single powerful and authoritative master. He says "My teachers have for the most part been my peers." I deny this. *He* has taught his peers. He has generated within himself the drive and energy and dedication to make important advances in an uncommonly difficult area of investigation.

I think I have made him uncomfortable, for he is above all a modest individual. In his own writings, he seems always to insert a statement that his insights and recommendations and findings are preliminary and tentative and subject to revision. Of course they are! But revisions to come will come in large part because of the incisiveness of his analyses of the problems, and will come from his own laboratory as often as from the laboratories of others.

He is amused and surprised, I think, at the development of his career. He recently wrote to me: ". . . at one time I couldn't even spell sycrophyseology and now I *are* one." He are indeed! He are a model scientist, a model psychophysiologist, and a model person. It is with affection and admiration and, I must admit, an unsavory touch of envy and jealousy, that I serve as the agent to transmit to Robert Edelberg the 1974 award for Distinguished Contribution to Psychophysiology, an award that symbolizes the esteem in which he is universally held.

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