
SPR AWARD, 1998

For Distinguished Contributions to Psychophysiology: David Lykken

At the Third-Eighth Annual Meeting of the Society for Psychophysiological Research (SPR), the award for Distinguished Contributions to Psychophysiology was presented to David Lykken. The following is based on the text of the citation given by Don Fowles on behalf of the Society's Awards Committee on September 26, 1998.

Summarizing the accomplishments of a career as productive, creative, and diverse as David Lykken's presents a challenge. Perhaps the best strategy is to start at the beginning, with his dissertation project on the nature of the psychological deficit in psychopaths. The various aspects of this study defined issues that David was to pursue throughout his career: methods of recording electrodermal activity, psychophysiological assessment of affective responses, the validity of the lie detector, the causes of antisocial behavior, and the contribution of temperament and genetics to important aspects of human behavior.

The most salient aspect of David's dissertation study (published in 1957), and the feature that made this dissertation one of the most famous ever published, was the demonstration of two deficits in psychopaths that could be understood as reflecting a single underlying emotional process. The first deficit employed a classical conditioning paradigm and found that individuals diagnosed as psychopaths (using Cleckley criteria) showed diminished electrodermal responding to a conditioned stimulus (CS) in anticipation of shock as the unconditioned stimulus (UCS). On this basis, David proposed the low fear hypothesis of psychopathy, reasoning that psychopaths fail to develop anxiety in anticipation of punishment and that this deficit contributes to the development of antisocial behavior. This finding of electrodermal hyporeactivity in anticipation of punishment has been replicated extensively by Robert Hare and others. Indeed, this literature is one of the richest in research on psychopathology, and the low fear hypothesis continues to be the major conceptualization of the temperament contribution to the etiology of antisocial behavior.

The second deficit showed psychopaths to be more impulsive than the nonpsychopathic controls with respect to showing passive avoidance deficits. In an approach-avoidance conflict paradigm, a passive avoidance deficit can be attributed to a failure to develop fear in anticipation of punishment, thereby releasing the reward-based approach response. This reward-dominant behavior with insufficient control by potential punishments is a form of impulsivity. Using components from a pin-ball machine, David constructed a 20-step, 4-choice mental maze, which has come to be called the Lykken Mental Maze. One of the choices was correct and advanced the subject to the next choice point, that is, allowed the subject to progress through the maze. Of the three incorrect choices, one was associated with shock. Although psychopathic subjects

learned the correct choices as quickly as the control subjects (showing normal reward-based responding), they were deficient in avoiding the shock—a passive avoidance deficit strongly consistent with the low fear hypothesis. This finding stimulated a great deal of research on passive avoidance deficits in psychopaths and, more recently, undersocialized aggressive conduct disorders in the work of such investigators as Newman, Quay, and Frick. Although the mental maze task has largely been replaced by Newman's go-no go task and Newman's adaptation of Siegel's card playing task, the theoretical import of this currently active literature dates clearly from David's demonstration of a passive avoidance deficit in psychopaths. Thus, the results of the dissertation converged to show poor anxiety conditioning and impulsivity in the form of a passive avoidance deficit.

A third aspect of the dissertation that has had an impact on the field is David's development of the Activity Preference Questionnaire (APQ). Reasoning that the then-currently available personality scales measured neuroticism rather than anxiety, David developed this new self-report measure of anxiety that emphasized the behavioral consequences of anxiety. His data showed that this measure was more related to poor electrodermal conditioning than was the popular Taylor Manifest Anxiety Scale (TMAS). In so doing, Lykken initiated a question as to what constitutes "anxiety" in the self-report domain, as well as in the context of theories of psychopathy. The items in the APQ contributed to the development of Tellegen's second order factor of constraint in the Multidimensional Personality Questionnaire (MPQ). This factor is defined by high loadings from three primary factors of control-versus-impulsiveness, harm avoidance-versus-danger seeking, and traditionalism—indicating that the type of anxiety that is deficient in psychopathy has much to do with inhibitory control and passive avoidance of punishing outcomes. Interestingly, in the MPQ, constraint is uncorrelated with negative emotionality (defined by stress reaction, alienation, and aggression), which many would see as the obvious dimension of anxiety. Thus, Lykken envisioned a behavioral concept of anxiety that was contrary to the traditional neuroticism measures as assessed by the TMAS, Eysenck's Neuroticism, and Tellegen's Negative Emotionality. Interestingly, Lykken's behavioral concept of anxiety bears some resemblance to Jeffrey Gray's subsequent concept of the behavioral inhibition system as the neurophysiological substrate of anxiety—a system that inhibits responses that are likely to result in punishment or failure.

Although David's research largely took him away from psychopathy, in 1995 he returned to the topic of psychopathy in a major way with the publication of his book, *The antisocial per-*

Address reprint requests to: Don C. Fowles, Department of Psychology, University of Iowa, 328 Iowa Avenue, Iowa City, IA 52242, USA. E-mail: don-fowles@uiowa.edu.

sonalities. This book is a brilliant review and critique of the literature on psychopathy and, more broadly, the etiology of crime and violence. David distinguishes between psychopaths, for whom a low-fear temperament contributes strongly to the development of antisocial behavior, and sociopaths, whose criminality is attributable to environmental influences—especially to poor parenting. The book is comprehensive and incredibly rich in critical insights. It is also one of those rare books that is both scholarly and written for a popular audience. As such, it serves as a textbook on psychopathy and other forms of antisocial behavior, on the one hand, and a sounding of the alarm about the negative consequences of poor parenting, on the other hand.

Characteristically, David is now making public policy presentations on parenting, reflecting a major theme of the book. The basic idea is that all too many parents are not competent, and David argues that poor parenting fosters children's risk for delinquency and crime. Although some implications of this position are intensively controversial (as has not infrequently been the case during David's career), David has succeeded in drawing attention to parental competence and promoting the optimistic notion that parenting can be improved. This position was articulated recently in a 1998 chapter in a book on psychopathy and crime edited by Millon; a similar article is to appear in the *Journal of Personality* in 1999.

The dissertation also provided the seeds of David's major contribution to the field of lie detection. As part of the dissertation (never analyzed or reported), David used a short "lie detector" test just to attract the interest of the prison inmate subjects. Then, in 1958, two medical students working in his laboratory expressed interest in the polygraph and lie detection, stimulating David to think more seriously about it. Being skeptical about traditional lie detection tests, David invented what he called the "guilty knowledge test." This quiet beginning launched Lykken on what was to be his most important contribution to public policy: criticism of the uses and abuses of the traditional lie detection test and advocacy of the guilty knowledge test, a sound and safe alternative to the traditional test. This task began with publication of an article on the guilty knowledge test in the *Journal of Applied Psychology* in 1959 and continues to the present day with numerous publications that stimulated public policy debate on this critical topic that affects the lives of so many people, especially through employee lie detection. In 1990, Lykken received the Distinguished Contribution Award for Psychology in the Public Interest from the American Psychological Association (APA). In making that award, the APA noted that he has published 12 articles on polygraphy in refereed journals, chapters in 6 edited volumes, 10 additional invited articles in journals, 5 editorials for national newspapers, "lie detector" entries for two scientific encyclopedias, and a 1980 book, *A tremor in the blood*, which was the first scientific monograph on this topic (now in its second edition). Further, David has testified about lie detector evidence in more than 50 cases in federal, state, and military courts, before a Canadian Royal Commission (a committee of the British Parliament), to legislative committees of several states, and to three committees of the U.S. Congress. One major payoff from all of this: Congress has banned most lie detection from the workplace in part based on Lykken's work and his influence on the work of others.

Thus, Lykken's dissertation research directly inspired work on four themes: low fear in psychopaths as manifest in conditioning of electrodermal activity, passive avoidance deficits in psychopaths, identification of a dimension of anxiety associated with behavioral inhibition, and criticism of many applications of lie

detection. Other aspects of his later work are also related to the themes in his dissertation topic. Two major areas of contributions are his work on the methodology of electrodermal recording and his extensive research on genetic influences in personality, psychophysiology, and psychopathology.

To conduct his dissertation, David had to learn basic psychophysiology on his own and to construct his own electrodes. Undoubtedly, he discovered that, at that time, no one was sure how to record electrodermal activity. To address this deficiency, in 1959 David published a systematic comparison of different electrodes that documented the superiority of the silver-silver chloride electrodes that everyone uses today. Other publications on basic methodology followed, including such esoteric topics as the polarization capacity of the skin and a comparison of resistance and impedance approaches to measurement. This work culminated in the 1971 paper with Peter Venables that provided the badly needed standardization of electrodermal recording. Almost all electrodermal research now uses the methodology they recommended.

A second valuable methodological contribution was the concept of range correction of electrodermal measures. Electrodermal measurements are influenced by a range of physiological and methodological variables irrelevant to the psychologically interesting sweat gland responses. David reasoned that these extraneous factors largely could be eliminated by using procedures to elicit maximum and minimum skin conductance levels and then quantifying levels during experimental procedures relative to the individual's own range of values. Studies documenting the superiority of this approach were published in 1966 and 1971.

From an interest in psychophysiological assessment of psychopaths' low fear temperament, it was a short step to evaluating the heritability of psychophysiological responses. Beginning in the early 1970s, David used twins to demonstrate substantial heritability of various psychophysiological measures, publishing major articles 1974 and 1982. It was not uncommon in these studies for monozygotic (MZ) twin correlations to be very high, whereas dizygotic (DZ) twin correlations were near zero. These findings led David to develop the concept of *emergenesis*, the topic of his Presidential Address to SPR published in 1982. Emergenesis refers to a polygenic mechanism in which several or many independent gene effects combine configurally rather than additively. Because MZ twins have all of these genes in common, they will share such emergenic traits. On the other hand, because these traits depend on complex combinations of genes and because the genes segregate independently during reproduction, these traits do not run in families. Thus, the concept of emergenesis explains the high MZ twin correlations combined with near zero DZ correlations. Emergenesis constitutes an important addition to genetic models, to be considered along with Mendelian and polygenic additive models and the concept of epistasis. More recently, David has published provocative work on the genetics of love, happiness, mate selection, and divorce, for which he has received much media attention.

In addition to these major themes in his career, David has made a number of contributions to various areas of psychological research, almost all of them classics. Three examples will serve to illustrate the impressive breadth of his scholarship.

David's interest in individual differences in electrodermal reactivity to punishment led him to study the phenomenon that he calls *preception*. As it is usually studied, preception is the ability to reduce the emotional impact of a predictable aversive stimulus. That is, human subjects (and rats) show smaller responses (electrodermal, event-related potentials, etc.) to shock preceded by a tone than to unsignalled shock. Preception is a fascinating phe-

nomenon that appears to be associated with both psychopathy and risk for substance abuse (both psychopaths and those at risk for substance abuse are good at it), and of course individual differences in preception show high heritability. The original paper on this topic appeared in 1959, followed by further publications in 1962, 1972, and 1974. The preception paradigm is being used currently in a large longitudinal twin/family study investigating risk factors for substance abuse initiated by David in 1988 and now continued by Bill Iacono and Matt McGue.

David's 1971 article on multiple factor analysis and personality research criticized the use of factor analysis to discover the underlying basic dimensions of personality. Factor analysis assumes that there are a limited number of dimensions (e.g., seven) of temperament, that the sorts of measures we might devise would be such that scores on each one would be linear functions of two or three of these temperament factors, and that personality fits a pyramidal, hierarchical structure in which one or two dozen "source traits" can be factor analyzed to yield a small number of basic dimensions of temperament. He argued that these assumptions are not valid, that what we know about biology indicates that nature is complex and does not fit the assumptions of factor analysis. Thus, it is unlikely that temperament factors correspond closely to underlying neurochemical processes that affect behavior. David illustrated his point elegantly with a couple of examples in which the true structure was known. In the first of these examples, he used capacitors and resistors to build five different filter circuits and then factor analyzed data produced with these circuits. None of

the five factor analyses yielded a factor recognizable as a resistor or capacitor. This article provided a sobering challenge to the attempts, so popular today, to identify a single neurobehavioral system as the biological substrate for each dimension of temperament identified in self-report inventories.

David's 1968 paper in *Psychological Bulletin* on statistical significance in psychological research called attention to the importance of a distinction he made between operational replication and constructive replication. In operational replication, the investigator attempts to follow the original procedures, whereas in constructive replication, the investigator tests the original hypothesis with different methodology. Successful constructive replication provides much stronger support for the hypothesis by demonstrating that support for the theory is not limited to methodologies that are not an intrinsic part of the theory.

This brief description of David's many contributions does not do justice to the quality and depth of his papers. Paper after paper is a classic, offering unusually original insights into, or fundamental methodological contributions to, many different areas of research. In a great many ways, David has made invaluable contributions to our field, as an experimentalist, scholar, idea source, methodologist, mentor, and advocate. He is richly deserving of our Society's Award for Distinguished Contributions to Psychophysiology.

Don C. Fowles
University of Iowa

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