

Thomas A. Ban: Neuropsychopharmacology in Historical Perspective  
Lehmann Collection 26

**Heinz E. Lehmann: Types and Characteristics of Objective Measures. Of  
Psychopathology\***

Not many years ago psychopathology was a field in which only psychiatric clinicians were interested. Today representatives of many research disciplines are interested in psychopathology and among the most knowledgeable and productive are psychologists, both theorists and experimentalists.

I hesitated for some time before accepting the invitation to speak at this meeting, and I still feel somewhat ill at ease as a research clinician in the company of so many experimental and theoretical researchers. Rather than trying to compete with the reporting of sophisticated investigations, I shall limit myself to a brief and general review of the methodological concepts and boundaries involved in the objective approach to psychopathology. Let me then simply ask you to look with me at some of the basic principles of what we are discussing here – basic principles which we all know very well, but which we do not always keep explicitly in mind when we discuss the conclusions and implications of our research findings.

Aspects of Psychopathology

Psychopathology as a scientific discipline can be considered under four different points of view. It may be looked upon as a quantitative deviation from the mean, as an excess or a defect symptom – for instance, in considering hypermotility or amnesia. Psychopathology may also be approached in terms of special phenomena or symptoms which can be described only qualitatively, e.g., as hallucinations, delusions or behavior mannerisms. A third way of dealing with psychopathology is through the analysis of syndromes, e.g., manic states, deliria or depressions. Finally – and most ambitiously –

the focus of psychopathology might encompass whole nosological entities, such as involuntional melancholia or schizophrenia.

### Pointer Readiness – Criteria or Indicators?

When psychopathology is concerned with syndrome, it is concerned with both quantitative measures and qualitative measures. When whole nosological entities are under study, the research method of the psychopathologist is determined by the nature of the psychiatric disease being investigated. If it is based on organic brain disease - for instance, senile psychosis - the search for objective psychopathology centers on physical criteria. If the diagnosis concerns a functional psychosis - for instance, schizophrenia - then the best a psychopathologist can do when searching for objectivity is to look for indicators - not criteria - of the psychosis which as a nosological entity is really only a hypothetical construct.

Things are so much simpler and clearer in physical pathology. Physical pathology is either structural e.g., a tumor or functional e.g., diabetes. Centuries ago, physicians would often recognize and diagnose physical pathology by subjective methods: the toxic look of the patient; the special odor of the body; the sweet taste of the urine. Today all physical pathology is operationally defined and the criteria can be determined and measured by pointer readings of instruments. If there remains any doubt about the nature of his pathology while the patient is still alive, all uncertainty can usually be removed by an autopsy.

Psychopathology, by its very nature, is never characterized by physical, structural abnormalities. Its deviations are always functional and always related to social, behavioral and experiential norms. Consequently, psychopathology can never be fully expressed through pointer readings and all instrumental exploration of psychopathology per se must to some extent remain fragmentary.

Does this mean that psychopathology can only be studied through subjective methods? Of course not. This very conference is a lively testimony to the invaluable contribution objective methods are making to psychopathology today. However, we must realize that all direct and fully objective measures of psychopathology are related only to its physical expression - e.g., movement, noise, etc. - or to its physical substrate, for instance, the serological, EEG or biochemical findings in dementia paralytics,

epilepsy or phenylketonuria. Psychopathological symptoms, syndromes and nosological entities as such, if they are of a functional nature, cannot be measured objectively.

Are we then, in these areas, restricted to subjective judgements? No, but we must remember that what we can measure objectively with all our ingenious and sophisticated methods are only indicators, that is, variables, which are related to or correlated with the phenomena of psychopathology. The phenomena themselves cannot be measured objectively. They always remain separated from a true criterion measurement by an inferential residue. Perhaps a very small residue – but a residue, nevertheless.

I have always been intrigued by some of our friends in another science, the meteorologists, who are up against much the same problems as we are. They are faced with a tremendous array of different variables which are in constant dynamic interaction. It is not possible to pin all the variables down simultaneously, yet the meteorologists have to come out with a definite prognostication of one very complex thing – the weather. Now, weather does not mean barometric pressure or direction of the wind, for nobody is interested in that. People are interested in how much the sun will be shining and in the degree of cloudiness and how warm and how humid it will be – weather is all this in combination, fair weather or foul weather.

Meteorologists also depend on indicators. For instance, I came across one that allows a layman to make predictions of the weather based on nice operational definitions. If the barometric pressure happens to be between 30.0 and 30.2 inches and the wind is coming from the west and the barometer is falling slowly, then the weather will be fair and warmer, but under the same conditions, with a rapidly falling barometer there will be rain. Or, if everything else remains steady and just the wind blows from the west, it will be fair and warmer, whereas with easterly winds there would be rain. In other words, the meteorologists use indicators which by themselves have really very little to do with what we are interested in, this very complex phenomenon of the weather. By using four observational variables – the initial level of barometric pressure, the direction of change of barometric pressure up or down, the rate of its rise or fall and the direction of the wind, meteorologists can infer the occurrences of several entirely different variables. In principle this is not different from using the indicators of an immunological test of the spinal fluid positive for syphilis, Argyll-Robertson pupils and a slurred speech for the diagnosis of dementia paralytica (GPI).

### The First Objective Indicator of Psychopathology

Let me remind you of the story how Maskelyne, the director of the astronomical observatory at Greenwich in 1795, fired one of his otherwise quite capable assistants because he was always about half a second late in recording the meridian transits of stars across the hairline of his telescope. This was followed up by other astronomers, who observed similar deviations among themselves. Finally, Exner (a physiologist in Vienna) at the end of the last century called this individual delay in a subject's reaction to stimuli, "reaction time" and this became one of the tests on which modern psychology was founded in Wundt's laboratory, preparing himself for his life work in psychiatry, did some early work in psychopharmacology and used reaction time as the dependent variable.

Psychology has come a long way since this truly interdisciplinary undertaking which was carried out by astronomers, physiologists and psychiatrists. Following the early experimental enthusiasm many disillusionments have led to the realization that simple sensory or psychomotor functions have very little direct value in the assessment of complex personality factors and the holistic approach has replaced the atomistic approach.

However, simple as the observation of a delayed reaction time might be, I think it allows us to venture forth with some diagnostic speculation on the hapless young man who was fired from Greenwich observatory a few years after the French Revolution. I have been unable to find his name, but he is described as a young, quite capable man. So he was almost certainly not very depressed or very dull, nor affiliated with an organic brain disease. Half-a second delay of reaction time is quite a gross deviation and I would venture the diagnosis that the young astronomer was probably suffering from hypothyroidism. If he had taken thyroid at the time, his metabolism would have risen and his reaction time would probably have shortened and he might have stayed at the observatory and we should not have had the discovery of reaction time as an indicator for psychopathological diagnosis until much later. In any case, the point I wish to make is that such a simple and apparently unrelated measure as reaction time does allow us to make informed guesses about quite complex diagnostic and personality factors.

### A Sliding Scale of Objectivity

One may conceive of a continuum extending from entirely subjective diagnostic methods, which relate directly to psychopathological phenomena and “hypothetical constructs,” to the other extreme of fully objective measures which are only correlates of the physical substrate of psychopathology (Table 1).

Subjective methods of diagnosis would include the traditional clinical interview and other, even more subjective ways of obtaining immediate knowledge of the patient’s psychological condition, for instance through empathy or the so-called “praecox feeling.” What I would call a focused approach is adopted by projective test procedures, which are really interviews that stimulate specific areas of the subject’s mental processes and evoke enhanced and more structured responses in those areas. Rating scales, structured interviews and personality inventories are among the systematic approaches to diagnosis of psychopathology; they are not really any more objective than the impressionistic methods of clinical observation but are more orderly and more comprehensive (Lehmann, Ban and Donald 1965). Performance and other behavioral tests – e.g., psychophysical procedures like measuring reaction time or critical flicker fusion frequency and also cognitive tests – I would call semi-objective in nature. Moreover, I would propose to call psychophysiological – e.g., GSR or heart rate – as well as conditioning procedures quasi-objective methods.

A truly objective method should be capable of being fully automated. This means that it would not require, nor allow any conscious activity on the part of either the observer or the observed. Objective test procedures should be limited to the use of instruments and physiological processes which are characterized by their entirely involuntary and unconscious nature. Only neurophysiological measures, such as the EEG and evoked potentials, would fall into this category.

### Reasons for Objectivity

Why are we searching for objective indicators of psychopathology? Certainly not only because we are searching for more valid and reliable test procedures, for a good psychiatric clinician can make valid and reliable diagnoses with adequate consistency. The most important reasons for our preferring objective indicators of psychopathology are twofold:

- 1) we need to provide uniform criteria for psychopathological conditions

- 2) we need to provide uniform standards of making valid and reliable diagnoses.

Although there are probably many clinicians who are good diagnosticians, they often have different basic concepts and criteria of the pathological conditions they diagnose, for instance, schizophrenia or manic-depressive disorder. Furthermore, these clinicians are often not capable of making explicit the processes by which they arrive at their diagnostic conclusions, and because of this failure to communicate their processes of decision making, they are not capable of transmitting them effectively to others and thus fail to make them available for general application in teaching.

The problem of fully objective criteria for diagnosis is similar to that of a real “cure” for a disease. Curing a disease is only possible if the essential cause of the disease is known and if, therefore, the cause can be – potentially or actually – removed. Diagnosing a disease by entirely objective means is only possible if an objective cause of the disease is known and can – at least potentially – be detected.

Many times we are chasing a will-o-the-wisp, if we are looking for 100% objectivity in our diagnostic methods in psychopathology. All we can and need to achieve is the establishment of more uniformity of valid and reliable diagnostic methods, even if they are not entirely objective.

In general, only two types of measures are fully objective, to be used either as direct criteria or as correlational indicators of psychopathology. They are:

- 1) physical or physiological measures which are taken while the individual is in an “idling” state, e.g., x-rays of the brain, biochemical, immunological or findings of a similar nature (Brazier et al. 1945; Lehmann and Kral 1951; Mann and Lehmann 1952; Busfield and Wechsler 1963; Sugarman, Goldstein, Murphres et al. 1964; Bergen, Grey, Pennell et al. 1965; Bunney and Fawcett 1965; Peck 1966).
- 2) physiological measures, taken under a test lead, e.g., evoked potentials or other EEG patterns (Shagass and Jones 1958; Shagass 1965; Sutton et al. 1965; Jones, Blocker and Callaway 1966; Honegger and Speck 1966; Lidsky, Yokorem and Sutton 1967).

### Interfering Variables (Experimental Noise)

Every behavior (performance) test is the psychomotor output of the processing of perceptual input. To this extent it always represents the product of higher nervous activity, e.g., integrative or cognitive processes. This is, of course, also true for conditioning.

We must remember that while conditioning is an objective procedure in animals, it is not necessarily so in humans, because human subjects have the ability to abstract to a much higher degree than animals; they also have – in contrast to animals – the capacity for introspection and self-reflection. In our laboratory we are presently engaged in a major project of utilizing certain standardized conditioning procedures for making psychiatric diagnoses. While conditioning is certainly a more objective method than the use of free or structured psychiatric interviews, or the use of standardized behavior rating scales, we remain keenly aware of the fact that conditioning in human subjects provides only an approximation to objectivity. Having been a subject for our conditioning test battery myself, I was impressed with the considerable amount of my conscious “on-line” hypothesizing, conscious anticipation, conscious attempts at manipulation of my own responses, conscious learning – and often inextinguishable one-trial learning. All of these responses were intermingled with truly involuntary responses. Such observations may explain some of our apparently paradoxical findings. We observed, for instance, that some conditioned responses in mentally defective subjects were of “better” quality than those in normal controls.

The capacity for introspection is species determined and is a powerful “interfering variable,” similar to the variables of affect and motivation. On the other hand, affect and motivation in a test situation are not determined by differences of species, but by differences in the three dimensions of: 1) personality; 2) cultural background and 3) the experimental environment. Another interfering variable is adaptation, i.e., the effects of practice, learning, habituation or satiation.

Ideally, an objective indicator of psychopathology must be as free as possible of hidden, interfering variables – of experimental “noise.” The problem is how to reduce this experimental noise to a minimum. This is, of course, the old problem of finding culture-free or, in Zubin’s terminology, culture-fair psychological test procedures (Zubin 1967).

We have, in the past, attempted to approach objectivity in our diagnostic indicators by concentrating on these tests which induce a minimum of emotional

responses, require a minimum of personal motivation, cooperation and intellectual ability and are least likely to be influenced by practice effects or other effects of adaptation. To get around the disturbing effects of introspection and cognitive elaboration we have selected tests that call for extremely simple and rapid responses. (Csank and Lehmann 1958).

In the same vein, Zubin has expressed the opinion that test responses occurring in the first one thousand milliseconds are probably, for all practical purposes, culture-free. He and his co-workers have successfully circumvented the motivational problem, at least in reaction-time testing, by an ingenious cross-modal presentation of stimuli (Sutton and Zubin 1965).

However, if all these precautions are taken into consideration there remain only comparatively few psychological tests that can be utilized as quasi-objective or semi-objective diagnostic indicators of psychopathology.

It is generally assumed that specific test leads – e.g., treatment with a specific drug – interest with the type of test procedure and that the final score is the result of these two factors (Zubin 1958). Some years ago we could demonstrate, however, that certain personality types tend to show an increment of their test scores under any kind of a lead – regardless, for instance, whether they were given sedatives or stimulants – while others exhibited an equally consistent tendency toward decrements of their test performance, also regardless of the type of pharmacological load under which they were performing (Lehmann and Knight 1961).

More recently, a number of investigators have demonstrated the effects of various other unspecific personality factors, e.g., the socio-economic status, on the behavioral and clinical reactions to psychotropic drugs. There is little doubt that such unspecific personality factors would also interfere with individual test performances and thus would have to be considered as other interfering variables which create experimental noise in test performance (Heninger, Dimasolo and Kiernan 1965; Riekels 1967).

It has been possible to grade a number of different psychophysical, performance and cognitive tests for their placebo-awareness or placebo resistance. This means that certain indicators of psychopathology, mainly of the semi-objective type, are less reliable when a placebo is administered than when under no treatment or when an active drug is given (Lehmann and Knight 1960).



Certain psychophysical, performance and cognitive tests show a higher test-retest reliability if they are administered on the same day regardless of the hour, while other tests are more reliable when they are administered at the same hour even if they are given on different days (Lehmann and Knight 1961b).

We have also been able to establish a rank order of the suitability of a number of performance tests for the measurement of increments or decrements in test performance. Critical flicker fusion, for instance, is a highly sensitive test for the detection of functional decrements, but has a few potential for detecting increments of function, while the opposite is true for some psychomotor tests, for instance, Track Tracer (speed component) and the Strep Test (Lehmann and Knight 1961a).

Recently we have screened a number of rating scales, personality inventories, psychophysical performance and cognitive tests, as well as psychophysiological measures and conditioning procedures (altogether 141 different variables) for their diagnostic value in seven different clinical conditions: no evident psychopathology; personality disorders; neurotic depressions; psychotic depressions; schizophrenia; organic brain syndromes; mental deficiencies. We found that it is possible to arrange different tests – from the systematic to the quasi-objective – in a rank order of diagnostic significances. For depressive states, for instance, the amplitude of the unconditioned stimulus response ranks first, the error score of the cancellation test third, the D-scale of the MMPI sixth and simple auditory reaction time ninth, in the order of their overall discriminative power in the diagnosis of depressive conditions.

However, if one examines closely this discriminative power, most of the tests we studied exhibit an individual pattern. The error score of the cancellation test differentiates well between neurotic and psychotic depressions and between acute and chronic depressive conditions but is not very useful for screening depressive conditions from normal or for differentiating them from other psychiatric conditions. The MMPI D-scale is excellent for screening depressed patients from normal controls but is not effective as an instrument of differential diagnosis between depressions and other forms of psychopathology, nor does it distinguish effectively between neurotic and psychotic depressions. Auditory reaction time is useful solely as a measure of change within a depressive condition, i.e., for the differentiation between acute and chronic depressive conditions. Only the unconditioned stimulus response is equally effective in screening depressed patients from normal, in differentiating depressive conditions

from other psychiatric disorders, in differentiating between neurotic and psychotic depressions and in distinguishing between acute and chronic depressive conditions (Lehmann 1968).

### Conclusions

It is obvious that we will have to refine our ideas and expectations of objective measures of psychopathology. In the future we will have to have a clear notion of the degree of objectivity of our criteria and indicators of psychopathology and, accordingly, of the possible impact of hidden interfering variables – of experimental noise – which may be present. In addition to the well-known variables of motivation, affect, adaptation and introspective elaboration, we will also have to consider the personality type, the socio-economic status of the subject and other unspecific factors. Finally, it is no longer sufficient to study the diagnostic significance of objective indicators of psychopathology simply in regard to a given pathological condition. It will be necessary in the future to be more specific about the discriminative role of such an indicator and to clarify whether it is to be used to distinguish between pathological and normal conditions or between different pathological conditions or between different degrees of severity or chronicity within a given pathological condition.

Table 1

Distribution of Different Indicators and Criteria of  
Psychopathology on a Subjective – Objective Continuum

	Empathy
Subjective	“Process Feeling”
	Traditional Psychiatric Interviews and Observations
Focused	Projective Tests
	Structured Interviews
Systematic	Personality Interviews

	Behavior Rating Scales
	Cognitive Tests
Semi-Objective	Behavior (performance) Tests
	Psycho-Physical Tests
Quasi-Objective	Conditioning Procedures
	Psychophysiological (extensis) Resource
Objective	Neurophysiological Resource

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