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## PHYSIOLOGICAL PATTERNS: A DIAGNOSTIC TEST PROCEDURE BASED ON THE CONDITIONED REFLEX METHOD

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### ABSTRACT

*A diagnostic test procedure based on the use of the eye-blink technique which has been theoretically correlated with the contemporary neurophysiological frame of reference is described. Results of the application of this test procedure in ten subjects are presented.*

Since Pavlov's original behavioral observations on animals, there has been considerable growth in the knowledge of the electrophysiological correlates of conditioning. Workers in the field, such as Gastaut, Eccles, Jasper, Magoun, Moruzzi, and others, have greatly enlarged our understanding of the working of the central nervous system. These latter experimenters have increased the original Pavlovian hypothesis and have provided comprehensive data for the setting up of a further operational hypothesis.

The problem of assessment and validation of clinical change in psychiatric patients has been in the forefront of research activity in research centers throughout the world. There is general dissatisfaction with currently available methods of evaluation of clinical change. Psychological tests such as Q-sorts, projective techniques, rating scales and simple observation have not provided sufficiently scientifically measurable data for validation of clinical change.

During the last several years, work has been directed at the Allan Memorial Institute towards investigation of other parameters for measurement of these changes in psychiatric patients. Previous publications<sup>1, 2</sup> have dealt with the use of movie analysis, electronic voice

analysis and GSR recordings. The purpose of this paper is to describe a diagnostic test based on current knowledge of conditioned reflex theory to provide measurable evidence of change in patients exposed to any treatment regime. In this first report, we are describing part of the total design of a test battery for diagnostic and evaluation purposes.

In this procedure, applying the eyelid closure conditioned reflex technique, eight parameters are investigated as follows:

1. the extinction of the orienting reflex
2. formation of the primary conditioned reflex
3. the extinction of the primary conditioned reflex
4. conditioned stimulus generalization
5. differentiation of positive and negative conditioned stimuli
6. the formation of retarded conditioned reflex
7. the secondary conditioned reflex formation
8. the mobility of the conditioned reflexes.

The experiment was conducted in the Conditioning Laboratory of the Allan Memorial Institute. The subject was seated comfortably in an armchair separated from the experimenter by a one-way screen. An Offner 8-channel standardized EEG machine was used for simultaneous recording of the unconditional stimulus (a puff of air), conditioned

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stimuli (tones), and of the subject's response (eye blinks). The subject had two Grass electrodes fixed by bentonite, one immediately above and one immediately below his right eye. An air pipe was placed  $\frac{1}{2}$ " away from the cornea of the left eye. All controls were regulated from the experimenter's observational chamber on the other side of the one-way screen.

The unconditional stimulus consisted of an air puff, 1.5 litres per square inch pressure. The conditional stimuli were 400 CPS and 1000 CPS tones produced by an audio-oscillator transmitted through earphones fixed to the subject's head. Stimuli were transmitted at random ranging from 20 to 40 seconds. Both conditioned stimuli and unconditional stimulus were presented on five consecutive occasions. On the sixth trial, only the conditioned stimulus was presented. The test trial was occasionally administered on the fifth or seventh occasion to provide variation. Testing was carried out on five consecutive days over periods lasting from 35 to 45 minutes. The programming was as follows:

- First day : Measurement of the extinction of the orienting reflex, primary conditioned reflex formation, and extinction of the primary conditioned reflex.
- Second day: Generalization of conditional stimuli together with differentiation of positive and negative conditional stimuli.
- Third day : The formation of retarded (delayed) conditioned reflex.
- Fourth day: Secondary conditioned reflex formation.
- Fifth day : Mobility of the conditioned reflexes recorded.

The criterion for the establishment of any of these reflex phenomena was the appearance of the appropriate response on at least three consecutive occasions during the test trial. To avoid exhaustion of the organism, test administrations were restricted to 100 stimulations at each session.

Results are demonstrated in the plates presented here.

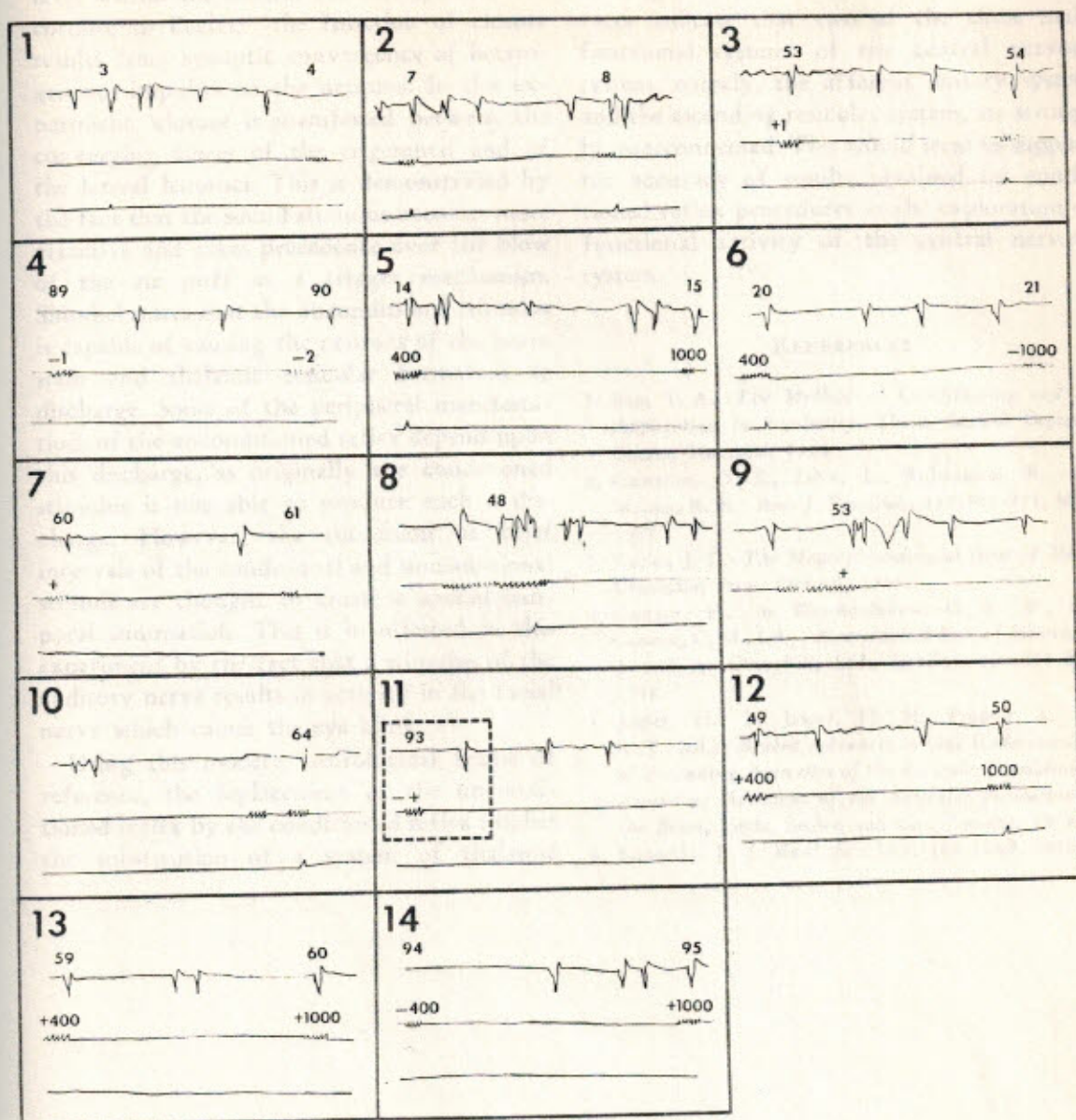
#### EPICRISIS

According to the experimental observations presented in this paper, all the eight physiological parameters based on Pavlov's original experiments on animals can be established in a five-day experiment on human subjects by using the eyelid closure technique—using 100 stimulations daily. There is a significantly weak startle reaction or negative orienting reflex under physiological circumstances. The conditioned reflex can readily be established and distinguished. One notices that generalization of the conditional stimuli is present before differentiation takes place. It is possible to obtain retardation of the conditioned reflex as well as the formation of secondary conditioned reflexes.

Another significant observation in regard to the mobility of the conditioned reflex is that under physiological circumstances formation of the positive conditioned reflex from the negative precedes the extinction of the conditioned reflex which was formerly positive.

Based on the findings of Moruzzi and Magoun, the conditional or unconditional stimulus at the level of the brain stem reticular formation stimulates these structures and blocks all cortical rhythms seen in desynchronization of all the induced cortical rhythms. According to this working hypothesis, in the eyelid closure test the conditional stimuli is conducted by the lateral lemnisci. In any conditioning procedure the activity of the thalamic reticular formation supersedes the brain stem reticular formation (Gastaut<sup>4</sup>). Jasper<sup>5</sup> states that the stimulation of different parts of the ventral thalamic system acts only upon the corresponding region of the cerebral cortex. This indicates that the conditional and unconditional stimuli act principally on a localized part of the thalamic reticular formation. However, the function of closure may take place at any





The recording was done on 3 channels. On the upper channel the subject's eye blink, on the middle, the administration of the sound, and on the lower channel, the administration of the air puff was recorded.

1. The response to the 1.5 liter/sq. in. air puff (unconditional stimulus) and the response to the first administration of the 400 CPS sound (conditional stimulus) is recorded. There is no startle reaction or there is a negative orienting reflex.

2. Primary conditioning trials. An eye blink response to the 1010 milliseconds 400 CPS tone overlapped with 50 milliseconds by the 150 milliseconds air puff.

3. The established primary conditioned reflex — an eye blink response to the 400 CPS tone.

4. The extinguished primary conditioned reflex. No eye blink response to the 400 CPS sound.

5. Conditional stimulus generalization. After reinforcement of the positive conditioned reflex to the 400 CPS sound, there is a positive response to the 1000 CPS sound, which has never been associated with an air puff.

6. Intermediary stage in differentiation. There is no eye blink response to the 1000 CPS tone.

7. Differentiation is established. Positive response to the 400 CPS tone and negative to the 1000 CPS tone.



level within the central nervous system. According to Eccles,<sup>3</sup> the function of closure results from synaptic convergence of heterogeneous impulses on the neurons. In this experiment, closure is manifested between the converging fibres of the trigeminal and of the lateral lemnisci. This is demonstrated by the fact that the sound stimulus becomes more effective and takes precedence over the blow of the air puff as a trigger mechanism. Shimbil states that the unconditional stimulus is capable of causing the neurons of the brain stem and thalamic reticular formation to discharge. Some of the peripheral manifestations of the unconditioned reflex depend upon this discharge, as originally the conditioned stimulus is not able to produce such a discharge. However, the succession at brief intervals of the conditional and unconditional stimuli are thought to create a spatial-temporal summation. This is manifested in this experiment by the fact that a stimulus of the auditory nerve results in activity in the facial nerve which causes the eye blink.

Using this modern neurological frame of reference, the replacement of the unconditioned reflex by the conditioned reflex implies the substitution of a system of thalamic

alerting for one of mid-brain alerting. These facts indicate that two of the three main functional systems of the central nervous system, namely, the afferent sensory system and the ascending reticular system, are strongly interconnected. This would seem to support the accuracy of results obtained by conditioned reflex procedures in the exploration of functional activity of the central nervous system.

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8. Conditioned reflex retardation. The first administration of the 8 1/2 seconds 400 CPS tone at the end with a 50 milliseconds overlapping 150 milliseconds air puff. Several eye blinks during the time of the lengthened conditional stimulus are seen. The first coincides in time with the primary conditioned reflex.

9. The conditioned reflex retardation is established. There is an eye blink only at the end of the lengthened conditional stimulus.

10. The secondary C.R. formation: the 400 CPS reinforced conditional stimulus is preceded by a 1000 CPS secondary conditional stimulus. The time interval between the primary and secondary conditional stimulus

is 4-1/2 seconds.

11. Secondary conditioned reflex is established. The eye blink occurs at the time of the primary conditioned reflex.

12. Testing of mobility of conditioned reflexes. Positive response to the non-reinforced 400 CPS tone and the association of the 1000 CPS tone with the air puff.

13. Intermediary stage in changing of stimuli. Positive response to both conditional stimuli.

14. Changing of stimuli established. Negative response to the non-reinforced 400 CPS sound and positive response to the 1000 CPS sound.