An Objective Measure of Recovery*

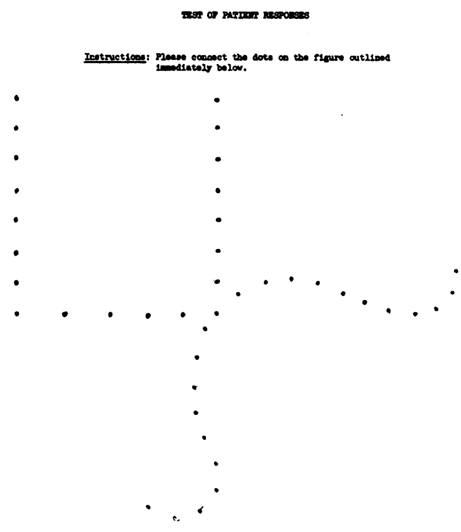
Norman Trieger, D.M.D., Michael G. Newman, James C. Miller, Ph.D.

Effective ambulatory anesthesia is based on a predictable pattern of recovery. This, of course, varies with the agent used, the inherent differences in how patients metabolize or detoxify a drug, as well as the duration and dosage of the drug administered. The development of a straightforward objective test to measure recovery accurately was undertaken in an effort to provide reliable and reproducible data.

Other methods of measuring psychomotor performance have been used. These include testing special sensory functions such as vision and hearing,[1] various verbal, drawing and bead threading parameters,[2] as well as the use of a complex reaction timer developed by the American Automobile Association.[3] Other studies of recovery from methohexital anesthesia have involved measuring waking time, the ability to speak rationally and coherently,[4] as well as the use of a driving simulator.[5] Porteus mazes and "'draw a person test" have also been proposed. All available methods are very involved, and require special equipment or personnel.

The Bender Motor Gestalt Test, a series of drawings developed by Lauretta Bender in 1938, was copyrighted in 1946.[6] This test is used on children and adults as a maturational test involving visual-motor gestalt function. The main aim of the test is to determine the individual's capacity to experience visual-motor stimuli (gestalten). It has been used to explore mental retardation, regression, loss of function, organic brain damage and personality deviations. Clinical psychologists made extensive use of the Bender tests in cases of neuroses in World War II Army medical installations. Both fatigue and central nervous system depression tend to magnify the sensory-motor disturbances seen in the performance of the Bender Motor Gestalt Test.

One of the figures of the Bender Test was selected and modified. Dots were substituted for the continuous lines and spaced approximately 12-13 mm. (See Fig. 1.) In this way, fine



motor coordination and perception of the entire outline form could be measured.

*From the Departments of Oral Surgery, School of Dentistry and Department of Psychology, at the University of California at Los Angeles.

Procedure:

Patients admitted to the Oral Surgical Clinic were requested to carry out the drawing test, to provide their own pre-operative, pre-anesthetic baseline. Patients were asked to simply "connect the dots in Figure 1." All patients in this study received either intravenous sedation consisting of pentobarbital sodium or hydroxyzine and meperidine hydrochloride, with scopolamine hydrobromide or atropine sulfate and/or general anesthesia (methohexital) in addition to a local anesthetic. (No oral or intramuscular pre-medications were administered). Ten patients who received only local anesthesia served as one control.

This same drawing test was then repeated at appropriate intervals before and after the anesthesia experience to evaluate recovery. Patients were observed and timed in their performance of this test. Their position, cooperativeness and general attitude were noted and scaled.

Immediately following the operation, as soon as the patient became conscious and responsive, a second test was administered. Ten minutes later a third test was given. The decision to discharge the patient was made by the doctor and was based on his clinical assessment of recovery. At that time, the final drawing was administered.

Results:

Scoring: Data processing was done on the IBM 7094 computer. Pearson Correlation Coefficients with 50 variables in Matrix form; variances and standard deviations as well as multidimensional analysis of variance and quadratic and linear trends were computed and analyzed, and are reported elsewhere.[8]

1. Each drawing was scored for error by using a transparent, ruled, plastic grid over each drawing to measure the deviations. The number of dots missed; the distance in millimeters; extraneous lines, and the experimenter's subjective evaluation of the drawings were recorded.

2. With the first test serving as baseline, each subsequent test score was subtracted from the baseline, giving deviations from the original drawing.

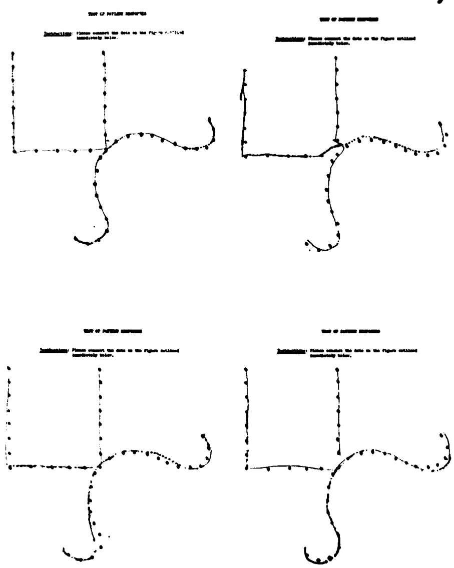
3. Twelve randomly selected subjects underwent a similar battery of drawing tests while placed in the four most common chair positions, from sitting to supine, to serve as a control for effect of position on patients' drawings. All scores were then adjusted for chair positions.

Recovery was taken as the period from awakening to discharge for those patients who received general anesthesia; or from the end of the surgical procedure to discharge for those patients receiving only intravenous sedation.

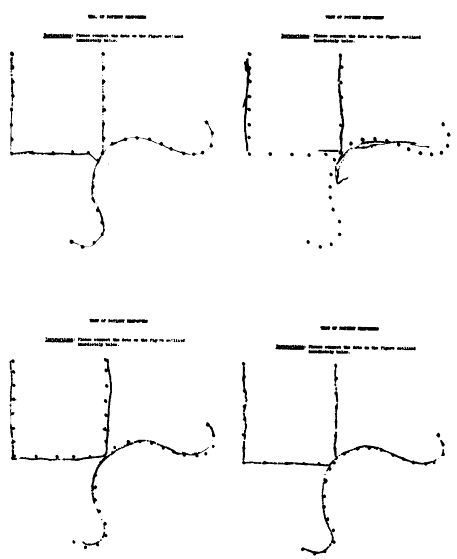
Conclusions and Clinical Cases:

It was determined that performance of this test is directly and significantly related to recovery time. Connecting the series of dots, proved to be a reliable and reproducible index of psychomotor performance. (Subsequent studies of drug effects, utilizing this modified Bender test have repeatedly demonstrated its validity and reliability.)

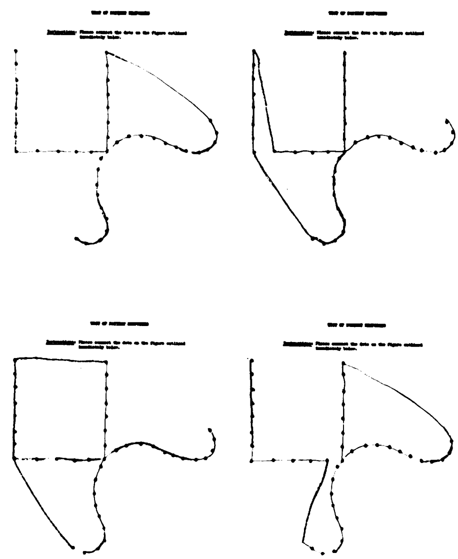
Visual-motor incoordination appears most frequently in the production of sweeping, uninhibited lines, the substitution of dashes for lines, exaggeration or minimization of curves, and fragmentation.[7] These aberrations, together with the psychological trauma resulting from the surgery and drug infusion, become evident in the patient's performance. The following illustrations demonstrate the obvious deviations in performance and eventual return to baseline with recovery.



Case 1 (Fig. 2) shows a normal progression of drawings. Subject returns to baseline score in progressive administrations.



Case 2 (Fig. 3) shows results of a brain damaged child's efforts with this test. It will be noted that the brain damaged child returns towards his own baseline score.



Drawings show, in Case 3 (Fig. 4), the performance of a 20-year-old schizoid female. Her lines do not conform with the "reality" of the test pattern and no regression toward baseline can be noted. The doctor may be alerted and readily forewarned by such abnormal pre-anesthetic drawings.

Summary:

This study provides statistical and clinical evidence in support of the validity of a simple, direct, self-administered, objective test to measure recovery time from ambulatory anesthesia. This test measures sensory-motor performance, which is a critical determinant of recovery. With the aid of this test, the patient's return towards his own pre-anesthetic baseline becomes more evident and objective. It may also serve as a helpful medical-legal record of recovery from anesthetic influence.

Postscript: Detailed data generated from this experiment were published in *Anesth. & Analg.*, 1969.[8] This simple drawing test has been effectively used since its development, in subsequent studies which involve comparison of various anesthetic and pre-anesthetic agents. It may provide a helpful tool for both the researcher and the clinician in anesthesiology.

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