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THE ROLE OF SET IN THE PERCEPTION OF SIMULTANEOUS TACTILE STIMULI

By HYMAN KORIN and MAX FINK, Glenn Oaks, Long Island

The influential role of 'mental set' in determining a subject's response to a perceptual task has been well documented.[1] In studies of the perception of simultaneous, tactile stimuli, various patterns of response have been observed which seemed to be the result of a set induced by suggestion. This investigation was undertaken to determine the relation between different conditions of 'set' and the frequency and type of perceptual error elicited in tests with simultaneous, tactile stimuli.

Recently the advantages of the simultaneous stimulation of different body-parts in tests of tactile perception have been stressed.[2] Simultaneous stimulation may elicit perceptual errors under conditions in which successive single stimulations are correctly perceived. When two stimuli are applied to body-parts at the same time, only one stimulus may be reported —an error referred to as 'extinction'; or one stimulus may be perceived correctly and the other mislocalized—an error called 'displacement.' Occasionally, if a single stimulus is interspersed in the testing-sequence, it may be reported correctly, but an additional, extraneous stimulus may also be reported—an error of 'confabulation.' Such errors of extinction, displacement, and confabulation are significantly increased in patients with brain dysfunction.

When errors of extinction and displacement occur, they are elicited in a consistent pattern. Thus, on stimulation of the hand and face, the stimulus to the face is usually reported correctly, while that to the hand is mislocalized or not reported. By testing various combinations of body-parts, an 'order of dominance' may be determined in which stimuli to the face and genital areas are most often perceived and those to the hand are

* Received for publication September 23, 1958. From the Department of Experimental Psychiatry, Hillside Hospital, Glenn Oaks, Long Island, New York and aided in part by Grant M-927, National Institute of Health, U.S. Public Health Service.

[1] J. J. Gibson, A critical review of the concept of set in contemporary experimental psychology, *Psychol. Bull.*, 38, 1941, 781-817; Robert Leeper, Cognitive processes, in S. S. Stevens (ed.), *Handbook of Experimental Psychology*, 1951, 730-757.

[2] M. B. Bender, *Disorders in Perception*, 1952; M. B. Bender, M. A. Green, and Max Fink, Patterns of perceptual organization with simultaneous stimuli, *A.M.A. Arch. Neurol. & Psychiat.*, 72, 1954, 233-255; Fink, Green and Bender, The face-hand test as a diagnostic sign of organic mental syndrome, *Neurol.*, 2, 1952, 46-58.

least often perceived. Between these extremes, stimuli to the shoulder, foot, buttock, breast, back, thigh and abdomen are perceived in a gradient.[3]

Theories involving factors of rostral dominance,[4] maturation,[5] inattention,[6] and inherent body-image,[7] have been advanced to explain the organization of these perceptual patterns, but no one theory has adequately explained all the facts. We have ascribed significance to the relative intensity of the stimuli and the threshold-value in the frequency and the pattern of the 'extinction' error, when electrical stimuli are applied at threshold and suprathreshold intensities.[8]

The present study was undertaken to assess the relation between 'set' induced by suggestion and errors of 'confabulation' and 'displacement.' The specific problem studied is whether an 'inquiry' into the testing procedure is significantly related to the frequency and type of these errors. Since these errors are most prominent in *S*s with cerebral dysfunction, patients undergoing convulsive and subconvulsive therapies were studied.

Subjects. The *S*s were 61 consecutive psychotic patients referred for electroconvulsive therapy. Their ages ranged between 21–67 yr., mean age being 46 yr. Thirty-seven of them received convulsive therapy; 14 first received subconvulsive therapy and then convulsive therapy; and 10 received subconvulsive therapy alone. The *S*s were selected for convulsive or subconvulsive treatment on a random basis by the supervising psychiatrist.

Procedure. Two model S-4B Grass square-wave stimulators were synchronized to deliver either single or simultaneous electrical stimuli. An isolation unit was connected with each stimulator to eliminate artifacts and the output was visually monitored by an oscilloscope. A switch-box was inserted in the circuit to permit independent selection of the various parts of the body. The active and indifferent electrodes for each part were small ⅜-in. steel disks, placed 1-in. apart and secured with tape. Bentonite electrode paste was rubbed into the skin of each area before the electrodes were applied.

The patient was placed on a couch in a relaxed and supine position. To alleviate undue anxiety, the nature of the testing was described. It was emphasized that a slight tap-like sensation would be felt. The electrodes were then placed on (a) the dorsum of the hands, (b) the mandibular area of both cheeks, and (c) the medial aspect of the calves of the legs.

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[3] Bender, Green, and Fink, *op. cit.,* 233-255.

[4] R. Cohn, On certain aspects of the sensory organization of the human brain: I. A study in rostral dominance as determined by ipsilateral simultaneous stimulation, *J. nerv. ment. Dis.,* 113, 1951, 471-484; II. A study in rostral dominance in children, *Neurol.,* 1, 1951, 110-122.

[5] Louis Linn, Some developmental aspects of the body image, *Int. J. Psychoanal.,* 36, 1955, 1-7.

[6] Macdonald Critchley, The phenomenon of tactile inattention with specific references to pariental lesions, *Brain,* 72, 1949, 538-561.

[7] Bender, *op. cit.,* 77-88.

[8] Hyman Korin and Max Fink, Role of stimulus intensity in perception of simultaneous electrical cutaneous stimuli, *J. Hillside Hosp.,* 6, 1957, 241-250

Thresholds for the various body-parts were first determined. At a frequency of 0.3 cycles per sec. and a pulse-duration of 50 m.sec., the voltage was increased in uniform increments of 5 v. to the hands and 1 v. to the cheeks every 6.7 sec. (2 pulses) until *S* perceived 100% of the stimulations. After a 10-sec. interval, voltages were decreased until the sensation was no longer reported. After another 10-sec. interval, voltages were increased by 1 v. every 6 sec. until the patient again reported 100% of the stimulations. This reading was considered the minimal voltage required to produce threshold-sensation.

After thresholds were determined, testing with a random series of 4 single and 6 double simultaneous stimulations followed. The body parts tested were the right hand and left cheek (heterologous stimulation) and the right cheek and the left cheek (homologous stimulation). Stimuli were applied either simultaneously or to one part singly, in a mixed order, for 10 trials. The order of presentation of the heterologous and homologous stimulation was alternated.

Failure to report the interspersed single stimuli served as an index that the perceptual threshold had changed. At such times the threshold was again determined, and the 10 test-trials were repeated. Threshold changes, however, occurred infrequently during testing.

The patients were tested in two groups: an 'inquiry' group and a 'no-inqury' group. The 'inquiry' group, consisting of 24 convulsive and 9 subconvulsive *S*s, was asked the question "anywhere else?" after each response to a stimulation. No question was asked of the 'no-inquiry' group, which consisted of 27 convulsive and 15 subconvulsive *S*s. (The total number of *S*s exceeds 61, since 1 *S* in the 'inquiry' group and 13 *S*s in the 'no-inquiry' group were included both in the convulsive and the subconvulsive series.)

Electroencephalograms were obtained weekly, on a day following a treatment. These records were quantitatively measured for the degree of induced slow-wave (delta) activity.[9] Both the convulsive and the subconvulsive treatments were administered three times weekly on alternative days.

Results: (1) Errors of confabulation. A response was scored as a confabulation if two stimuli were reported when only a single stimulus was applied. The observations are noted in Table I.

In the 'inquiry' group, confabulatory errors were elicted before treatment from both types of *S*s—convulsive and subconvulsive. During treatment, the mean error increased from 0.08 to 0.72 among the 'convulsive' *S*s and from 0.22 to 0.70 among the 'subconvulsive' ones. After treatment, the mean number of confabulations persisted in the 'subconvulsive' *S*s (1.00) but declined in the 'convulsive' ones (0.10); the difference 0.90 being significant at better than the 5% level.[10] In the 'no-inquiry'

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[9] Max Fink and R. L. Kahn, Relation of EEG delta activity to behavioral response in electroshock: Quantitative serial studies, *A.M.A. Arch. Neurol. & Psychiat.*, 78, 1957, 516-525.

[10] The Mann-Whitney 'U'-test was used to test the significance of these data and those that follow as the scores were not drawn from a normally distributed population. Since the 'U'-test is based on rank-order of the scores, the differences between means are only grossly related to level of significance.

group, few confabulations occurred at any interval of testing for either the convulsive or the subconvulsive *S*s.

Before treatment, the subconvulsive, 'inquiry' *S*s made significantly more confabulatory errors than the subconvulsive, 'no-inquiry' *S*s. In a comparison of the 'inquiry and 'no-inquiry' procedures during treatment, the differences were significant both in the convulsive and subconvulsive groups of *S*s. The differences during treatment are based on the substantial increase in the number of confabulations of the 'inquiry' group. After treatment, the confabulations of the convulsive, 'inquiry' group decreased to the pretreatment level, and the differences between the convulsive, 'inquiry' and 'no-inquiry' groups were not significant. Though the mean

TABLE I

Mean Number Errors of Confabulation

Period	Inquiry: convulsive (N=24)	Inquiry: subconvul. (N=9)	No inquiry: convulsive (N=27)	No inquiry: subconvul. (N=15)	Diff. between inquiry and no-inquiry: convulsive	Diff. between inquiry and no-inquiry: subconvul.	Diff. between convulsive and subconvulsive: inquiry	Diff. between convulsive and subconvulsive: no-inquiry
Pretreatment	.08	.22	0	0	.08	.22‡	.14	0
Treatment	.72	.70	.11	.05	.61†	.65†	.02	.06
Post-treatment	.10	1.00	.06	—	.04	—	.90*	—

* $p<0.05$; † $p<0.03$; ‡ $p<0.01$.

number of errors of the subconvulsive, 'inquiry' *S*s increased after treatment, a comparison between the 'inquiry' and 'no-inquiry' subconvulsive *S*s could not be made. Data were not obtained after treatment from the subconvulsive 'no-inquiry' *S*s because they were transferred to convulsive treatment and were not available for testing.

(2) Errors of displacement. A response was scored as a displacement if the locus of one of two stimuli was reported correctly and the other incorrectly. Displacements were rarely elicited from the *S*s in any of the groups (Table II). The mean number of displacements tended to increase during treatment for the convulsive *S*s, but the differences from the pretreatment period lack significance.

(3) Errors of extinction. An error was scored as an extinction if only one of two simultaneously applied stimuli was reported. The difference in the number of errors of extinction between the 'inquiry' and 'no-inquiry' groups was not significant at any period during the course of therapy both for the convulsive and subconvulsive *S*s (Table III). During treatment, the mean number of extinctions decreased in all groups. At this period,

the difference between the convulsive and subconvulsive, 'inquiry' *S*s was significant. After treatment the errors of all the groups decreased further.

(4) Errors of confabulation and changes in EEG. An analysis was made of the number of confabulatory errors elicited in convulsive *S*s in relation to the degree of electroencephalographic change. 'Inquiry' *S*s with high degrees of delta activity made significantly more confabulatory errors than inquiry patients with moderate and low degrees of delta activity (Table IV), while few errors were reported by the 'no-inquiry' *S*s regardless of the change in the *EEG*. The mean scores of the moderate and low *EEG* among the 'inquiry' *S*s was similar to the mean scores of the 'no-inquiry' ones.

No *EEG* slow-wave activity or low degrees of such activity occurred in

TABLE II

MEAN NUMBER ERRORS OF DISPLACEMENT

Period*	Convulsive		Subconvulsive	
	inquiry	no-inquiry	inquiry	no-inquiry
Pretreatment	.06	.07	0	0
Treatment	.09	.10	.02	.01
Post-treatment	.08	.02	.06	0

* Inter- and intra-group differences are not significant at any period.

the subconvulsive *S*s. As had been indicated, however, the number of confabulatory errors of the subconvulsive group increased significantly during and after treatment. This increase resulted from increasing confabulatory errors in four of the nine patients.

Discussion. Errors of displacement, confabulation, and extinction are elicited when sequences of multiple and single tactile stimuli are applied to various parts of the body. In clinical tests with touch stimulation, these errors are most prominent in patients with cerebral disease.[11] Theories which have been advanced to account for the occurrence of such errors have therefore emphasized endogenous factors involving the central nervous system. Numerous studies of the role of set in perception indicate, nevertheless, that the frequency and type of response to a perceptual task may be markedly altered by the immediate aspects of a situation.[12] In this study the stimulus-situation has been varied to bring about differing conditions of mental set. The endogenous factors have not, however, been

[11] Fink, Green, and Bender, *op. cit.,* 46-58.

[12] Leeper, *op. cit.,* 752-757; Max Pollack, W. S. Battersby, and M. B. Bender, Tachistoscopic identification of contours in patients with brain damage, *J. comp. physiol. Psychol.,* 50, 1957, 220-227.

neglected and the relation between the effects of different degrees of brain dysfunction has also been determined.

In the course of convulsive therapy a marked increase in the number of confabulatory errors is brought about by the *E*'s query: "anywhere else?" which followed every stimulation. Of the convulsive *S*s who were asked this question, confabulations were elicited primarily in the group with high degrees of *EEG* slow-wave activity (marked cerebral dysfunc-

TABLE III

Mean Number Errors of Extinction

Period	Inquiry		No inquiry		Diff. between inquiry and no-inquiry		Diff. between convulsive and subconvulsive	
	convulsive (N=24)	sub-convul. (N=9)	convulsive (N=27)	sub convul. (N=15)	convulvulsive	sub-convul.	inquiry	No inquiry
Pretreatment	2.16	1.67	2.76	2.37	.60	.70	.49	.39
Treatment	2.03	1.14	1.71	1.27	.32	.13	.89*	.44
Post-treatment	1.37	.89	1.44	—	.07	—	.48	—

* $p<0.05$.

TABLE IV

Relation between *EEG* Delta Activity and Mean Number of Confabulatory Errors

Group	Degree of Delta activity			
	high	moderate-low	Diff.	Signif.
inquiry	.81 (N=9)	.19 (N=10)	.62	$p<0.05$
no inquiry	.10 (N=21)	.07 (N=6)	.03	N.S.

tion) and not in the group with low and moderate degrees (minimal cerebral dysfunction). The importance of the inquiry is emphasized by the consideration that, regardless of changes in the *EEG,* there was little tendency for confabulatory errors to occur among the convulsive *S*s when no inquiry was made. Thus both inquiry and high degrees of *EEG* delta activity provided the milieu favorable to evoking confabulatory errors in the convulsive therapy *S*s.

Subconvulsive *S*s present a different picture. Although virtually no delta activity is induced by subconvulsive therapy, the number of confabulatory errors of four of the nine subconvulsive *S*s queried increased substantially during the treatment. Furthermore, while the confabulatory errors of these four subconvulsive *S*s persisted and even increased following the course of therapy, the errors of the convulsive *S*s queried, in contrast, decreased to the pretreatment level. Patterns of reversible error manifested by convulsive *S*s have been reported in the various studies of the effects of electroshock on different types of mental functioning.[13] It was expected, however, that confabulations would not be elicited in subconvulsive *S*s at any period, in view of earlier observations that cerebral dysfunction is not induced in these patients.[14]

An explanation for the differences between the 'convulsive' and subconvulsive 'inquiry' *S*s is that their therapies had differing effects on the factor of practice. In 'convulsive' *S*s, treatment diminished the practice-effect, including those both with low and high degrees of slow-wave *EEG* activity. For each test-interval, it was as if the 'convulsive' *S*s were starting anew. Under these conditions, only *S*s with high *EEG* delta activity manifested a confabulatory set within a single test-period. After the course of therapy, with the disappearance of the delta activity, convulsive *S*s were performing at the pretreatment-level. In the 'subconvulsive' *S*s, the set established in the pretreatment-interval was reinforced during each test-period during treatment. Thus the subconvulsive *S*s made even more confabulatory errors after treatment.

The results for the subconvulsive group of *S*s indicate that certain of them may make confabulatory errors without an alteration of brain-function. Such *S*s are apparently influenced by the *E* and may be described as being suggestible or acquiescent. The failure of the convulsive *S*s to establish a set which persisted for prolonged intervals of time, as did the subconvulsive *S*s, suggests a basis for the therapeutic effect derived from convulsive therapy. If *S*'s symptoms are regarded as a pathological, mental set, such an interpretation is particularly appropriate. From the point of view of concepts of mental set, the effect of induced convulsions is to bring about a disruption of maladaptive patterns of behavior.

The number of displacement-errors remained the same regardless of whether an inquiry was made. These errors occurred much less frequently than confabulations. During treatment, approximately 30% of the convulsive *S*s of both the 'inquiry' and 'no inquiry' groups responded with at least one displacement. This finding compares closely with the results of 33% with displacements obtained in a study of a similar population of

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[13] Hyman Korin, Max Fink, and S. Kwalwasser, Relation of changes in memory and learning to improvement in electroshock, *Conf. Neurol.*, 16, 1956, 88-96; Max Fink, R. L. Kahn, and Hyman Korin, Effects of diffuse altered brain function on perception, *XV Conf. of Psychol. Proceed.*, 1958, 238-239.

[14] Fink, Kahn, and Green, Experimental studies of the electroshock process, *Dis. Nerv. Sys.*, 19, 1958, 113-118.

electroshock *S*s in which touch-stimuli were applied by the clinical method. Errors of displacement are not a prominent type of error in an electroshock population.

With regard to errors of extinction, differences were not significant between the 'inquiry' and 'no inquiry' groups. The high number of errors of extinction before treatment and the subsequent decrease in errors during treatment, noted in this study, is in contrast to the results obtained with clinical tactile techniques. If clinical methods are used, few errors of extinction are elicited before treatment and there is a marked increase in error during treatment. The results obtained in this study are probably related to the initial difficulty experienced by *S*s in perceiving electrical stimuli at threshold and the rapid adaptation to the technique in further testing. These factors play a greater role than the changes induced by the treatment.

In initial studies with threshold electrical stimuli, it was believed that a more sensitive test of changes in brain-function than the clinical tactile method could be devised.[15] For clinical purposes, however, the perceptual patterns obtained with electrical stimulation lack sufficient discriminability as indices of brain dysfunction. In part, the deficiencies of the method may be ascribed to the necessity for using fixed electrodes and limitations in switching arrangements at threshold. For clinical testing, therefore, simultaneous tactile stimuli applied rapidly in a varied sequence remains the best index of altered brain function.[16]

Summary and conclusions. This study of the perception of simultaneously applied tactile stimuli was undertaken to determine the relation between the frequency of perceptual errors to the inquiry made by *E*. The relations among inquiry, perceptual response, and the degree of brain dysfunction were also considered.

In the test-procedure, the threshold (100% point) for square-wave electrical stimuli applied to the hand and cheek of 61 psychiatric patients was determined. Sequences of two simultaneous and single stimuli were applied in a mixed order for the hand and cheek (heterologous stimulation) and both cheeks (homologous stimulation). Heterologous and homologous trials were alternated for each patient. For one group, an inquiry was made following each response to a stimulation, while in a second

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[15] Fink, Green, and Bender, *op. cit.*, 46-58.

[16] Green and Fink, Standardization of the face-hand test, *Neurology*, 4, 1954, 211-217.

group, no inquiry was made. The *S*s were treated either by convulsive or subconvulsive courses of therapy, at three times a week for 12–20 applications.

There was a significant relationship between the frequency of confabulatory errors and the inquiry ('suggestion-induced set') in both convulsive and subconvulsive patients. The confabulatory tendencies of these patients, however, differed greatly. Although the errors for both increased during treatment, errors decreased after treatment for the convulsive group, but in the subconvulsive group errors increased further. The differences between 'inquiry' and 'no inquiry' groups with regard to errors of extinction or displacement were insignificant. In 'convulsive-inquiry' *S*s, the confabulatory errors of those with high degrees of *EEG* slow-wave activity were significantly more frequent than those with a low or moderate degrees of slow wave activity.

The results of this study lead to the following conclusions:

(1) In tests with simultaneous electrical tactile stimuli the number of confabulatory errors is related to an induced set suggested by *E*'s inquiry.

(2) The number of confabultory errors is increased in *S*s with brain-dysfunction in relation to an inquiry, but may also be induced in patients without brain-dysfunction who are acquiescent and susceptible to suggestion.

(3) The frequency of errors of displacement or extinction is not related to the 'inquiry' procedure.

Role of Stimulus Intensity in Perception
of Simultaneous Tactile Stimuli

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Role of Stimulus Intensity in Perception of Simultaneous Tactile Stimuli

In the course of the extensive investigations by Bender and his co-workers (1, 2, 3,) into the perception of multiple simultaneous stimuli, the pattern of failure of subjects to accurately report one of two stimuli led to a concept of an "order of dominance" in cutaneous perception. Since then, the relationship of the observed pattern of dominance to biologic and psychiatric concepts of body image and body scheme has been the subject of considerable speculation (4, 7, 8, 14).

The interrelationship of body areas was initially clearly demonstrated in simultaneous tactile tests of face and hand (2) in which it was noted that the stimuli to the hand were frequently not reported or mislocalized. These phenomena of "extinction" and "displacement" led to the inference that cheek area stimuli were "dominant" to hand stimuli. In subsequent reports, Bender, Fink and Green (3, 10, 11, 12) described a pattern of dominance for tactile stimuli in which the face and the primary genital areas were the most perceptive or dominant body areas; the hand was the least dominant; and the shoulder, foot, buttock, breast, back, thigh, and abdomen fell between these extremes in a mild gradient. These observations were made in normal adults and children and psychiatric patients, but were most clearly discerned in patients with brain disease. Indeed, the major portion of the data relates to a group of patients with severe diffuse brain dysfunction under observation in a general psychiatric hospital.

The basis for these phenomena is unclear. In their review, Bender, Green and Fink (3), after considering hypotheses ascribing significance to anatomic, psychophysiologic, genetic, environmental and neurophysiologic factors, conclude that "no one theory adequately explains the organization of this pattern. Learning and maturation are probably factors, but it appears to be mostly inherent." Cohn (4, 5), in studies of patients with brain disease and normal young children, emphasized the rostral order of dominance and ascribed significance to "an ontogenetic or phylogenetic thalamic residue in the sensory organization of the human brain." He noted specifically, also, that this pattern was primarily associated with "the over-all sentient function of the brain."

A more extensive elaboration of a maturational and developmental explanation of the order of dominance was proposed by Linn (14). Taking the infantile patterns of sucking and feeding as a model, Linn ascribes face dominance to its primitiveness in the development of the body image; the dominant role of the genital area to the intensity of pleasurable sensation that the infant elicits from masturbation; and the subordinate position of the hand to its role as an exploring and tension-relieving appendage wherein it holds second place in awareness to its stimulation of the more exciting mouth and genitalia.

A neurophysiologic view was advanced by Critchley (6, 7), who after expressing a preference for the term "tactile inattention" instead of "extinction," emphasized the rostral order of dominance. He stated that "strong stimulation of the healthy side suppresses the attentuated sensations on the impaired side," and concluded that "tactile inattention in parietal patients is probably no more than an instance of local neglect or disregard, which may be demonstrated at times in many other spheres of consciousness besides the tactile - whether motor, visual or spatial."

A psychophysiologic explanation was eschewed by Bender and his co-workers (10, 11), who found no relation between the order of dominance and tactile threshold for touch or pin prick. Denny-Brown, Meyer and Horenstein (8), however, insisted that these patterns were only apparent when there was an alteration or loss of two-point discrimination. They further demonstrated that the extinction of the hand stimulus by a stimulus to the leg could be overcome by four stimuli to the hand. The dominance of the cheek to the hand could not, however, be altered by ten stimuli to the hand.

The following data further emphasizes psychophysiologic factors. These studies represent the initial report of an investigation into the application of the technic of simultaneous tactile stimulation tests to the problem of measurment of the alteration in brain function induced by electroshock therapy. In the course of this study electrical stimuli were applied to the cheek and hand of psychiatric patients. Stimuli were either at threshold or supra-threshold levels.

Two aspects of the data are presented:

(a) The effect of alteration of relative strength of stimulus in the order of dominance on face-hand tests; and

(b) Relation of perceptual thresholds to the order of dominance.

SUBJECTS AND METHOD:

The subjects were 34 consecutive psychiatric patients referred for electroshock therapy. The range of their ages was between 21 and 65 and the mean age was 45. Eleven patients were diagnosed as involutional melancholia, thirteen as manic-depressive, depressed, eight as schizophrenia, and two as psychoneurosis mixed type. All testing was done prior to a course of electroshock therapy and no patient had clinical or EEG evidence of altered brain function.

Two model S-4B Grass square-wave stimulators were synchronized to deliver either single or two simultaneous electrical stimuli. An isolation unit was connected to each stimulator to eliminate artifacts and the output was monitored visually by an oscilloscope. A switch box inserted in the circuit permitted independent selection of the various body parts. An active and an indifferent electrode required for each body part were small 3/8" steel discs placed 1" apart and secured with tape. Bentonite electrode paste (Medcraft) was rubbed into the skin of each area before the electrodes were applied.

The patient was placed on a couch in a relaxed and supine position.. To alleviate undue anxiety the nature of the testing was described. It was emphasized that only a slight tap-like sensation would be felt. The electrodes were then placed on (1) the dorsum of the hands, (2) the mandibular area of both cheeks and (3) the medial calf area of the legs.

In the testing procedure, thresholds for the various body parts were first determined. At a frequency of .3 cycles/second, and a pulse duration of 50 milliseconds, the voltage was increased in uniform time increments of .67 seconds (2 pulses) monitored from the oscilloscope, until the subject perceived 100 percent of the stimuli. Increments of 5 volts were applied to the hand and increments of 1 volt to the cheeks. After a ten second interval, the voltage was decreased until sensation disappeared. After another ten second interval, the voltage was gradually increased by 1 volt each 6 seconds until the patient reported 100 percent of the stimuli again. This reading was considered the minimal voltage required to produce threshold sensation.

After the thresholds were determined, testing with a series of single and double simultaneous stimuli followed. The body parts tested were the right hand and left cheek (heterologous stimulation) and the right cheek and left cheek homologous stimulation). Both parts were stimulated simultaneously or one part singly in a mixed order for ten trials for each of the following conditions:(1) threshold (2) suprathreshold (10 percent above the threshold), (3) one body part at suprathreshold and the other at threshold and (4) the reverse (3). The order of presentation of conditions (1) and (2) was alternated for different subjects and the same was done for conditions (3) and (4). Similarly the order of presentation of the heterologous and homologous stimulation was alternated.

Single stimuli were introduced as a control. Failure to report the single stimulus indicated that the threshold had changed. When this change occurred, stimulation was increased until a new threshold was determined and 10 trails were started anew.

RESULTS:

A. Threshold Values.

The threshold stimulation for perception was determined for the hands, cheeks and legs. (Table I).

TABLE I

Mean Thresholds and Standard Deviations of Body Parts

	Right Cheek	Left Cheek	Right Hand	Left Hand	Right Leg	Left Leg
Mean Threshold (volts)	6.76	7.85	29.25	22.35	24.50	19.52
Standard Deviation	4.47	4.86	14.88	13.60	13.99	13.64

The threshold values for the hands and legs are 3 to 4 times higher than the thresholds for the cheeks. While the threshold values in the legs are less than in the hands, these differences lack statistical significance. Variability of the threshold is considerably greater in the hands and legs, than in the cheeks. There is virtually no overlapping of thresholds, however, where the cheeks and the hands are concerned.

B. Extinction Patterns:

The difference between the number of extinctions of the right hand or the left cheek on stimulation of both parts with either threshold or suprathreshold stimuli was not significant (Table II). Also, when both cheeks were stimulated with either threshold or suprathreshold stimuli, there were no differences in the number of extinctions in each cheek . (Table III).

In contrast to these observations, stimulating one body part with a suprathreshold stimulus and the other at threshold, resulted in a significant increase in the failure to report the body part stimulated at threshold. Thus the cheek was dominant over the hand, or the hand was dominant over the cheek depending on the body part to which the stronger stimulus was applied (Table II). Altering the relative strength of the stimuli applied to the cheeks resulted in a similar predictable change in the pattern of dominance (Table III).

Further analysis of the data in Table II indicates that the hand was dominant over the cheek with greater mean frequency (2.08) than the cheek was dominant over the hand (1.04) for the threshold - suprathreshold condition. This tendency is also evident when both parts were stimulated at suprathreshold. If it is considered that the mean threshold for the hands

TABLE II

Mean Extinctions of Cheek and Hand for Varying
Conditions of Threshold and Suprathreshold Stimulation

	Mean Extinctions of Cheek	Mean Extinctions of Hand	Difference	Significance
Hand and Cheek at Threshold	1.55	1.56	.01	N.S.
Hand and Cheek at Suprathreshold	1.02	.59	.57	N.S.
Hand at Suprathreshold and Cheek at Threshold	2.30	.22	2.08	$p < .01$
Cheek at Suprathreshold and Hand at Threshold	.32	1.36	1.04	$p < .01$

TABLE III

Mean Extinctions of Both Cheeks for Varying Conditions of Threshold and Suprathreshold Stimulation

	Mean Extinctions of Left Cheek	Mean Extinctions of Right Cheek	Difference	Significance
Both Cheeks at Threshold	.39	.45	.06	N.S.
Both Cheeks at Suprathreshold	.18	.37	.19	N.S.
Right Cheek at Suprathreshold and Left Cheek at Threshold	.96	.14	.82	$p < .05$
Left Cheek at Suprathreshold and Right Cheek at Threshold	.03	1.28	1.25	$p < .01$

is approximately 30 volts, while for the cheeks the threshold is 7 volts, the difference in incidence of extinction may be explained. Suprathreshold stimulation was set at ten percent above the threshold value. The hand stimulus was therefore increased by 3 volts and the face stimulus by only 1 volt above the threshold value. Such an increase, although proportionately equivalent, appears to have given greater relative strength to the hand stimulus.

C. Incidence of Extinction:

Regardless of pattern, the mean total of the number of extinctions was greater when heterologous body parts were stimulated at threshold than when these parts were stimulated with suprathreshold stimuli (Table IV). For these same conditions of stimulation the differences between the mean number of extinctions obtained on homologous stimulation of the cheeks lack statistical significance but the results are in the direction which indicate that a greater number of extinctions occur when two body parts are stimulated at threshold (Table IV). The failure to obtain a significant difference in the latter instance is partly due to the fact that relatively few extinctions are elicited when homologous parts are stimulated. These findings on the total number of extinctions are in agreement with previous observations (2).

TABLE IV

Mean of Combined Number of Extinctions

For Varying Conditions of Threshold

and Suprathreshold * Stimuli

	Both Parts at Threshold	Both Parts at Suprathreshold	A - Suprathreshold B - Threshold	A - Threshold B - Supra-Threshold
A - Cheek B - Hand	3.11	1.63	1.68	2.43
A - Left Cheek B - Right Cheek	.85	.56	1.31	1.10

* Differences between the mean number of extinctions at threshold and the other three conditions of stimulation are significant for the cheek and hand but are insignificant for both cheeks.

DISCUSSION:

The pattern of extinction following stimulation with threshold and suprathreshold stimuli has been determined. In contrast to the findings of Bender, Fink and Green (2), face stimuli were not reported more frequently than hand stimuli when either simultaneous threshold or suprathreshold stimuli were applied. Under these conditions, neverthless, it is clear that the pattern of extinction for any two body parts can be readily altered by varying the relative strength of the stimuli. Thus, a suprathreshold stimulus applied to the hand tends to obscure a threshold stimulus applied to the cheek and when these stimuli intensities are reversed, the cheek tends to obscure the hand.

Theories which hold that dominance of the cheek over the hand is due to an inherent factor, perceived body image, rostral dominance, developmental principle, or a learned factor, are not supported by these observations. If any of these factors were involved, a pattern of face dominance should have been elicited when the hand and cheek were stimulated with equivalent stimuli at threshold and suprathreshold intensities.

Although, more recently, Bender (3) has advanced an inherent factor theory, he previously attributed the extinction phenomenon to differences in the thresholds of the various body parts and to the intensity of the stimulation used (1). The finding in this study, that differences in the strength of the simultaneous stimuli can alter the pattern of extinction supports a stimulus intensity hypothesis. By inference, differences in threshold also play a significant role.

That an intense stimulus elsewhere could raise the pain threshold as much as 35% has been demonstrated by Hardy, Wolf and Goodell (13). This effect of a relatively intense stimulus on the threshold of another stimulus has also been found by investigators using other stimuli (8, 9). The problem still remains, however, how it is that a pattern of dominance, particularly of the hierarchy determined by Bender and his coworkers, may be elicited when presumably equivalent stimuli are applied by touch of hand.

The results of this study suggest an explanation. Stimuli of differing intensities are required to elicit a threshold sensation for various body parts. When these stimuli are increased 10 percent, the resultant stimuli are proportional and are perceived as equivalent. In contrast, in clinically touching two body parts, the stimuli are disproportionate relative to the threshold value although approximately of equal intensity in their application. Because of the differences in threshold for the hand and cheek, the tactile stimulus to the cheek is proportionately more above the threshold than the stimulus to the hand. Thus the cheek is perceived more frequently than the hand stimulus and has been considered "dominant."

A threshold hypothesis was rejected (3) on the basis that the thresholds obtained by Von Frey (16) for pressure and pain do not strictly correspond to the dominance order elicited by the double simultaneous stimulation tests. Most difficult to reconcile is Von Frey's finding that the pressure threshold of the glans penis, which is second in dominance rank only to the cheek in a group of ten body parts tested, is 111 grams per square millimeter; while the threshold of the hand, which is [redacted] least dominant, is only 12 grams per square millimeter.

Unfortunately, thresholds in the genital area for male and female have seldom been determined. Von Frey's list of thresholds (16) is based on a single subject. His more detailed observations (17), however, indicate that there is virtually no pressure sense in the glans penis or clitoris, although the perception of pain, warmth, and cold is well developed. It is quite possible that the punctate pressure threshold does not correlate with touch where the genital area is concerned but that instead some other sense or combination of senses is involved.

Thresholds for the dorsum of the hand and the cheek obtained by Von Frey and other investigators indicate that the cheek is considerably more sensitive than the hand. These findings are in agreement with the thresholds obtained in this study. In a recent study of thresholds at various body sites Sigel (15) reported that "leg areas including thigh and ankle, also dorsum of the hands and the palm showed a definite tendency for higher thresholds. Scalp, temple, forehead and face tended to have lower thresholds. The anterior chest and upper arm and anterior wrist areas showed a tendency for lower thresholds. Neck areas, abdomen and upper back showed no definite trend." In this statement there is no disagreement with the order of dominance as determined by Bender and his coworkers.

From the experimental results obtained here, it is proposed that the dominance hierarchy elicited under the conditions of simultaneous testing may be explained in rational terms on the basis of the relative strength of the stimuli and the area stimulus threshold, without the invocation of other theoretic constructs.

SUMMARY:

Using square wave electrical stimuli, the threshold for perception in the hands, cheeks, and calves were determined in 34 psychiatric patients. Simultaneous stimuli were applied in random sequence to combinations of cheek and hand and both cheeks, at threshold, suprathreshold and combinations of threshold and suprathreshold intensities.

With simultaneous threshold, or simultaneous suprathreshold stimulation, the differences between the number of extinctions in either part were NOT significant. With stimuli of unequal intensity, however, (one stimulus at threshold and one suprathreshold) there was a significant increase in the failure to report the threshold stimulus.

The total number of extinctions is greater with threshold, than with suprathreshold stimuli; and greater in heterologous than in homologous patterns of stimulation.

CONCLUSION:

The clinically observed order of dominance in simultaneous tactile tests may be explained by psychophysiological phenomena without resort to theoretic constructs. Differences in the threshold of perception in various body parts provide the basis for the observed pattern of errors on simultaneous tactile tests at suprathreshold levels.

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Role of Suggestion-Induced Set in the Perception of Simultaneous Tactile Stimuli

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Role of Suggestion-Induced Set in the Perception of Simultaneous Tactile Stimuli

The influential role of "mental set" in determining subject response to a perceptual task has been well documented (1). In studies of the perception of simultaneous tactile stimuli, various patterns of response were observed which seemed to be the result of "suggestion-induced set." This investigation was undertaken, to determine the relation between different conditions of "set" and the frequency and type of perceptual error elicited in tests with simultaneous stimuli.

Recently the advantages of the simultaneous stimulation of body parts in tactile perceptual tests has been stressed (2). The technique of simultaneous stimulation may elicit perceptual errors under conditions in which successive single stimuli are correctly perceived. When two stimuli are applied to body parts at the same time, for example, only one stimulus may be reported - an error referred to as "extinction"; or one stimulus may be perceived correctly and the other mislocalized - an error called "displacement." Occasionally, if single stimuli are interspersed in the testing sequence, these stimuli may be correctly reported, but an additional, extraneous stimulus, (referred to as a "confabulation") may also be reported. Such errors of extinction, displacement, and confabulation are significantly increased in patients with brain dysfunction.

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When errors of extinction and displacement occur, they are elicited in a consistent pattern. Thus, on stimulation of the hand and face, the stimulus to the face is usually reported correctly while that to the hand is mislocalized or not reported. By testing various combinations of body parts, an "order of dominance" may be described in which stimuli to the face and genital areas are most often perceived and those to the hand are least often perceived. Between these extremes, stimuli to the shoulder, foot, buttock, breast, back, thigh and abdomen are perceived in a gradient (3).

Theories involving factors of rostral dominance (4), maturation (5), inattention (6), and inherent body image (7) have been advanced to explain the organization of these perceptual patterns, but no one theory has adequately explained all the facts. Previously (8) we have ascribed significance to the relative intensity of the stimuli and the threshold value in the frequency and the pattern of the "extinction" error, when electrical stimuli are applied

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8. H. Korin and M. Fink, Role of stimulus intensity in perception of simultaneous electrical cutaneous stimuli, J. Hillside Hosp. 6, 1957, 241-250.

threshold and suprathreshold intensities. The present study was undertaken to assess the relation between "suggestion-induced set" and errors of confabulation and displacement. The specific problem studied is whether an "inquiry" in the testing procedure is significantly related to the frequency and type of these errors. Since these errors are most prominent in subjects with cerebral dysfunction, patients undergoing convulsive and subconvulsive therapies were studied.

Subjects:

The subjects were 61 consecutive psychotic patients referred for electroconvulsive therapy. Their ages ranged between 21 and 67 and the mean age was 46. Thirty-seven patients received convulsive therapy, while fourteen first received subconvulsive therapy and then were transferred to convulsive therapy. Ten patients were treated with subconvulsive therapy only. Patients were selected for the convulsive or subconvulsive treatment on a random basis by the supervising psychiatrist.

Procedure:

Two model S-4B Grass square-wave stimulators were synchronized to deliver either single or simultaneous electrical stimuli. An isolation unit was connected with each stimulator to eliminate artifacts and the output was visually monitored by an oscilloscope. A switch box was inserted in the circuit to permit independent selection of the various body parts. The active and indifferent electrodes for each body part were small 3/8" steel discs, placed 1" apart and secured with tape. Bentonite electrode paste was rubbed into the skin of each area before the electrodes were applied.

The patient was placed on a couch in a relaxed and supine position. To alleviate undue anxiety the nature of the testing was described. It was emphasized that a slight tap-like sensation would be felt. The electrodes were then placed on (a) the dorsum of the hands, (b) the mandibular area of both cheeks and (c) the medial aspect of the calves of the legs.

Thresholds for the various body parts were first determined. At a frequency of .3 cycles per second and a pulse duration of 50 milliseconds, the voltage was increased in uniform increments of five volts to the hands and one volt to the cheeks every 6.7 seconds (2 pulses) until the subject perceived 100 per cent of the stimuli. After a ten second interval, voltages were decreased until the sensation was no longer reported. After another ten second interval, voltages were increased by 1 volt every 6 seconds until the patient again reported 100 per cent of the stimuli. This reading was considered the minimal voltage required to produce threshold sensation.

After thresholds were determined, testing with a random series of 4 single and 6 double simultaneous stimuli followed. In body parts tested were the right hand and left cheek (heterologous stimulation) and the right cheek and left cheek (homologous stimulation). Stimuli were applied either simultaneously or to one part singly, in a mixed order for ten trials (Table I). The order of presentation of the heterologous and homologous stimulation was alternated.

TABLE I

Failure to report the interspersed single stimuli served as an index that the perceptual threshold had changed. Such a change occurred infrequently, and at these times the threshold was again determined, and the 10 testing trials were repeated.

The patients were tested in two groups: an "inquiry" group and a "no-inquiry" group. The "inquiry" group, consisting of 24 convulsive and nine subconvulsive subjects, was asked the question "anywhere else" after each response to a stimulation. No question was asked of the "no-inquiry" group, which consisted of 27 convulsive and 15 subconvulsive patients. This total exceeds 61, since one patient in the inquiry group and thirteen in the no-inquiry group were included both in the convulsive and the subconvulsive series.

Electroencephalograms were obtained in each patient weekly on the day following a treatment. These records were quantitatively measured for the degree of induced slow wave (delta) activity (9). Both the convulsive and the subconvulsive treatments were administered three times weekly on alternate days.

9. M. Fink and R.L. Kahn, Relation of EEG delta activity to behavioral response in electroshock: Quantitative serial studies, A.M.A. Arch. Neurol. & Psychiat. 78, 1957, 516-525.

TABLE I

Order of Presentation of Stimuli

Right Hand Left Cheek	Right Cheek Left Cheek
Right hand-Left cheek	Right cheek
Right hand	Right cheek-Left cheek
Left cheek	Left cheek
Right hand-Left cheek	Right cheek
Right hand-Left cheek	Right cheek-Left cheek
Left cheek	Right cheek-Left cheek
Right hand-Left cheek	Left cheek
Right hand	Right cheek-Left cheek
Right hand-Left cheek	Right cheek
Right hand-Left cheek	Right cheek-Left cheek

Results:

A. Confabulation Error: A response was scored as a confabulation if two stimuli were reported when only a single stimulus was applied. The observations are noted in Table II.

TABLE II

Convulsive vs Subconvulsive: Confabulatory errors were elicited pretreatment both in the convulsive and the subconvulsive patients. During treatment the errors increased with approximately the same frequency. The mean error increased from .08 to .72 in the convulsive treated patients and from .22 to .70 in the subconvulsive treated patients. Post-treatment, however, the mean number of confabulations persisted in the subconvulsive patients (1.00) but declined in the convulsive patients (.10). The difference in number of errors between the convulsive and subconvulsive groups is significant post-treatment, but not in either the pretreatment or treatment periods.

In the no-inquiry group few confabulations occurred at any interval of testing for either the convulsive or the subconvulsive patients.

Inquiry vs No-Inquiry: While the differences in the mean number of errors reported by the subconvulsive and the convulsive patients lacks significance pretreatment, that between the subconvulsive inquiry differed significantly from the subconvulsive no-inquiry patients. During treatment the number of confabulations increased, and this difference is significant in a comparison of the inquiry and the no-inquiry procedures, both in the convulsive and subconvulsive groups. These differences during the treatment interval are based on the substantial incrdase in the number of confabulations of the inquiry group.

TABLE II

Mean Number of Confabulation Errors #

	Inquiry		No-Inquiry		Difference Inquiry, No-Inquiry	Difference Inquiry, No-Inquiry	Difference Convulsive, Subconvulsive	Difference Convulsive, Subconvulsive
	Convulsive N=24	Subconvulsive N=9	Convulsive N=27	Subconvulsive N-15	Convulsive	Subconvulsive	Inquiry	No-Inquiry
Pretreatment	.08	.22	0	0	.08	.22 ***	.14	0
Treatment	.72	.70	.11	.05	.61 **	.65 **	.02	.06
Post-Treatment	.10	1.00	.06	-	.04	-	.90 *	-

* $p < .05$

** $p < .03$

*** $p < .01$

\# The Mann-Whitney "U" test (17) was applied to test for significance for these data and the data which follow. Since the "U" test is based on rank order of the scores, the differences between means are only grossly related to level of significance.

After the course of therapy, the confabulations of the convulsive inquiry patients decreased to the pretreatment level, and differences between the convulsive inquiry and no-inquiry groups at this time were not significant. In contrast, the mean number of errors of the subconvulsive inquiry patients increased. Data for the post-treatment subconvulsive no-inquiry group was not available as these patients were usually transferred to convulsive treatment and were not available for post-treatment tests. A comparison between the inquiry and no-inquiry subconvulsive patients post-treatment cannot be made.

B. Displacement Error: A response was scored as a displacement if one of two stimuli was reported correctly and the other was mislocalized.

Displacements were rarely elicited in any of the groups (Table III). The mean number of displacements tended to be greater, however, during treatment for the convulsive patients but the differences from the pre-treatment interval lack significance.

TABLE III

TABLE III

Mean Number of Displacement Errors

	Convulsive		Subconvulsive	
	Inquiry	No-Inquiry	Inquiry	No-Inquiry
Pretreatment	.06	.07	0	0
Treatment	.09	.10	.02	.01
Post-Treatment	.08	.02	.06	0

Inter and intra group differences are not significant at any interval.

C. Extinction Error: An error was scored as an "extinction" if only one of two simultaneously applied stimuli was reported. The difference in extinction error between the inquiry and no-inquiry groups was not significant at any interval during the course of therapy both for the convulsive and subconvulsive patients (Table IV). During treatment, the mean number of

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TABLE IV

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extinctions decreased in all groups. At this interval, the difference between the convulsive and subconvulsive inquiry patients was significant. Post-treatment the errors of all the groups decreased further.

D. Confabulation Error and EEG Change: An analysis was made of the number of confabulation errors elicited in convulsive patients in relation to the degree of encephalographic change. Inquiry patients with high degrees of delta activity made significantly more confabulation errors than inquiry patients with moderate and low degrees of delta activity. (Table V), while few errors were reported in the no-inquiry patients regardless of the degree of EEG change. The mean score of the moderate and low EEG inquiry groups was similar to the mean scores of the no-inquiry patients.

No EEG slow wave activity or low degrees of such activity occurred in the subconvulsive patients. However, as had previously been indicated, the number of confabulation errors of the subconvulsive group increased significantly during and after treatment. This increase resulted from increasing confabulation errors in four of the nine patients.

TABLE V

TABLE IV

Mean Number of Extinction Errors

	Inquiry		No-Inquiry		Difference Inquiry, No-Inquiry	Difference Inquiry, No-Inquiry	Difference Convulsive, Subconvulsive	Difference Convulsive, Subconvulsive
	Convulsive N=24	Subconvulsive N=9	Convulsive N=27	Subconvulsive N=15	Convulsive	Subconvulsive	Inquiry	No-Inquiry
Pretreatment	2.16	1.67	2.76	2.37	.60	.70	.49	.39
Treatment	2.03	1.14	1.71	1.27	.32	.13	.89 *	.44
Post-Treatment	1.37	.89	1.44	-	.07	-	.48	-

* $p < .05$

TABLE V

Relation Between Degree of EEG Delta Activity and Mean Number of Confabulation Errors

		Degree of Delta Activity			
		High	Moderate-Low	Difference	Significance
Mean Number Confabulation Errors	Inquiry	.81 (N=9)	.19 (N=10)	.62	$p < .05$
	No Inquiry	.10 (N=21)	.07 (N=6)	.03	N.S.

Discussion:

Displacement, confabulation and extinction errors are elicited when sequences of multiple and single tactile stimuli are applied to body parts. In clinical tests with touch stimulation, these errors are most prominent in patients with cerebral disease (10). Theories which have been advanced to account for the occurrence of such errors have therefore emphasized endogenous factors involving the central nervous system. That the frequency and type of response to a perceptual task may be markedly altered by the immediate aspects of a situation is indicated by the numerous studies of the role of set in perception (11). In this study the stimulus situation has been varied to bring about differing conditions of mental set. However, the endogenous factors have not been neglected, and the relation between the effects of different degrees of brain dysfunction has also been determined.

In the course of convulsive therapy a marked increase in the number of confabulation errors is brought about by the examiner's query of "anywhere else?" following each stimulation. Of the convulsive patients who were asked the question, confabulations were elicited primarily in the group with high degrees of EEG slow wave activity (marked cerebral dysfunction) and not in the group with low and moderate degrees (minimal cerebral dysfunction). The importance of the inquiry is thus emphasized by the consideration that regardless of changes in EEG activity, there was little tendency for confabulation errors to occur in convulsive patients when no inquiry was made.

10. Fink, Green and Bender, op. cit., 46-58.

11. Leeper, op. cit., -
M. Pollack, W.S. Battersby and M.B.Bender, Tachistoscopic identification of contours in patients with brain damage, J. Comp. Physiol. Psychol. 50, 1957, 220-227.

Thus both inquiry and high degrees of EEG delta activity provided the milieu favorable to evoking confabulatory errors.

Subconvulsive patients present a different picture. Although, virtually no delta activity is induced by subconvulsive therapy, the number of confabulation errors of four of the nine subconvulsive patients queried increased substantially during the treatment. Furthermore, while the confabulation errors of these subconvulsive patients persisted and even increased following the course of therapy, those of the convulsive patients queried, in contrast, decreased to the pretreatment level. Patterns of reversible decrement manifested by convulsive patients has been reported in the studies of the effects of electroshock on different types of mental functioning (12). However, it was expected that confabulations would not be elicited in subconvulsive patients at any interval, in view of earlier observations that cerebral dysfunction is not induced in these patients (13). ~~For each test interval, it was as if the convulsive patients~~

An explanation for the differences between the convulsive and subconvulsive inquiry patients is that their therapies had differing effects on the practice factor. In convulsive patients, treatment diminished the practice effect in all subjects, including those both with low and high degrees of slow wave activity. For each test interval, it was as if the

12. H.Korin, M. Fink and S. Kwalwasser, Relation of changes in memory and learning to improvement in electroshock, Conf. Neurol. 16, 1956, 88-96; M. Fink, R.L. Kahn and H. Korin, Effects of diffuse altered brain function on perception, XV Conf. of Psychol. Proceed., 1958, 238-239.

13. M. Fink, R.L. Kahn and M.A. Green, Experimental studies of the electroshock process, Dis. Nerv. Sys. 19, 1958, 113-118.

convulsive patients were starting anew. Under these conditions only patients with high EEG delta activity manifested a confabulatory set within a single test period. After the course of therapy, with the disappearance of the delta activity, convulsive patients were performing at the pretreatment level. In the subconvulsive patients, the set established in the pretreatment interval was re-enforced during each test period during treatment. Thus the subconvulsive patients made even more confabulatory errors post-treatment.

The results for the subconvulsive group indicate that certain patients may make confabulation errors without an alteration of brain function. Such patients are apparently influenced by the examiner and may be described as being suggestible or acquiescent. The failure of the convulsive patients to establish a set which persisted for prolonged intervals of time as did the subconvulsive patients suggests a basis for the therapeutic effect derived from convulsive therapy. If the symptoms of the patient are regarded as a pathologic mental set, such an interpretation is particularly appropriate. From the point of view of concepts of mental set, the effect of induced convulsions is to bring about a disruption of maladaptive patterns of behavior.

The number of displacement errors remained the same regardless of whether an inquiry was made. These errors occurred much less frequently than confabulations. During treatment approximately 30% of the convulsive patients of both the inquiry and no-inquiry groups responded with at least one displacement. This finding compares closely with the results of 33% with displacements obtained in a study of a similar population of electroshock patients in which touch stimuli were applied by the clinical method (14)

14. M. Fink, unpublished data.

Displacement errors are not a prominent type of error in an electroshock population.

With regard to the extinction error, differences were not significant between inquiry and no-inquiry groups. The high number of extinction errors pretreatment and the subsequent decrease in errors during treatment, in this study, is in contrast to the results obtained with clinical tactile techniques. If clinical-tactile methods are used, few extinction errors are elicited pretreatment and there is a marked increase in error during treatment. The results obtained in this study are probably related to the initial difficulty experienced by the patient in perceiving electrical stimuli at threshold and the rapid adaptation to the technique in further testing. These factors play a greater role than the changes induced by the treatment.

In initial studies with threshold electrical stimuli, it was believed that a more sensitive test of changes in brain function than the clinical-tactile method (15) could be devised. However, for clinical purposes the perceptual patterns obtained with electrical stimulation lack sufficient discriminability as indices of brain dysfunction. In part, the deficiences of the method may be ascribed to the necessity for using fixed electrodes and limitations in switching arrangements at threshold. For clinical testing, therefore, simultaneous tactile stimuli applied rapidly in varied sequence remains the best index of altered brain function (16).

15. Fink, Green and Bender, op.cit., 46-58

16. M. Green and M. Fink, Standardization of the face-hand test, Neurology, 4, 1954, 211-217.

Summary:

This study of the perception of simultaneously applied tactile stimuli was undertaken to determine the relation between the frequency of perceptual errors to the inquiry made by the examiner. The relation between inquiry, perceptual response and the degree of brain dysfunction was also considered.

In the test procedure, the threshold (100 per cent point) for square wave electrical stimuli, applied to the hand and cheek of 61 psychiatric patients was determined. Sequences of two simultaneous and single stimuli was applied in a mixed order for the hand and cheek (heterogenous stimulation) and to both cheeks (homologous stimulation) Heterologous and homologous trials were alternated for each patient. For one group, an inquiry was made following each response to a stimulation, while in a second group, no inquiry was made. Patients were treated either by convulsive or sub-convulsive courses of therapy, at three times per week for 12-20 applications.

There was a significant relationship between the frequency of confabulation errors and the inquiry ("suggestion-induced set") in both convulsive and subconvulsive patients. However, the confabulatory tendencies of these patients differed. Although the errors for both increased during treatment, errors decreased post-treatment for the convulsive group, but in the subconvulsive group errors increased further. The differences between inquiry and no-inquiry groups with regard to extinction or displacement errors were insignificant. In convulsive-inquiry patients, the confabulatory errors of patients with high degrees of slow-wave activity were significantly more frequent than those of patients with a low or moderate degrees of slow wave activity.

Conclusions:

In tests with simultaneous electrical tactile stimuli the number of confabulatory errors is related to an induced set suggested by the examiner's inquiry.

The number of confabulatory errors is increased in patients with brain dysfunction in relation to an inquiry, but may also be induced in patients without brain dysfunction who are acquiescent and susceptible to suggestion.

The frequency of displacement or extinction errors is not related to the inquiry procedure.