[Reprinted from THE JOURNAL OF NERVOUS AND MENTAL DISEASE, Vol. 117, No. 1, Jan. 1953]

PERCEPTION OF SIMULTANEOUS TACTILE STIMULI BY MENTALLY DEFECTIVE SUBJECTS*†

MAX FINK, M.D.‡

MARTIN A. GREEN, M.D.§

AND

MORRIS B. BENDER, M.D.

In studies of the perception of two tactile stimuli applied simultaneously, it has been demonstrated that patients with diffuse brain dysfunction make errors. They persist in making errors either in reporting only one of the stimuli (extinction) or in mislocalizing one or both stimuli (displacement). When errors are made in simultaneous stimulation of face and hand (the face-hand test) (1), the errors are in the recognition of the stimulus applied to the hand. The percept in the cheek is correctly reported. This "face-dominance" is apparent on initial test trials of normal adults. Similar results have been obtained in tests of young children.

Children under the age of six years respond to simultaneous tactile tests almost with the same frequency of errors as do patients with diffuse brain dysfunction. With these facts before us, it soon became apparent that mental age was a factor in the perceptual response. Therefore, a study of the responses of mentally retarded adults with mental ages of young children was undertaken. Simultaneous tactile tests were applied to a group of mentally defective patients, and three aspects were studied: their responses to the tests; the order of dominance; and the relation, if any, to standard psychometric tests.

SUBJECTS AND METHOD

Fifty-seven mentally retarded adults from the wards of Letchworth Village, New York were examined. They ranged in chronological age from 13 to 41, and in mental age from two years, six months to nine

*From the Department of Neurology and Psychiatry, New York University College of Medicine and the Neurologic Service of Bellevue and the Mount Sinai Hospital, New York.

†Read before the Seventh Annual Convention and Scientific Program, Society of Biological Psychiatry, Atlantic City, May 11, 1952.

‡This work aided in part by a Fellowship from the National Foundation for Infantile Paralysis.

§Post-Doctorate Fellowship, United States Public Health Service. Work aided, in part, by a Grand-in-Aid #MH-139 from the United State Public Health Service, National Institutes of Health.

years, eight months. The figures for mental ages were those recorded in hospital records reflecting performance on Stanford-Binet tests; and in each instance, the most recent estimate was used.

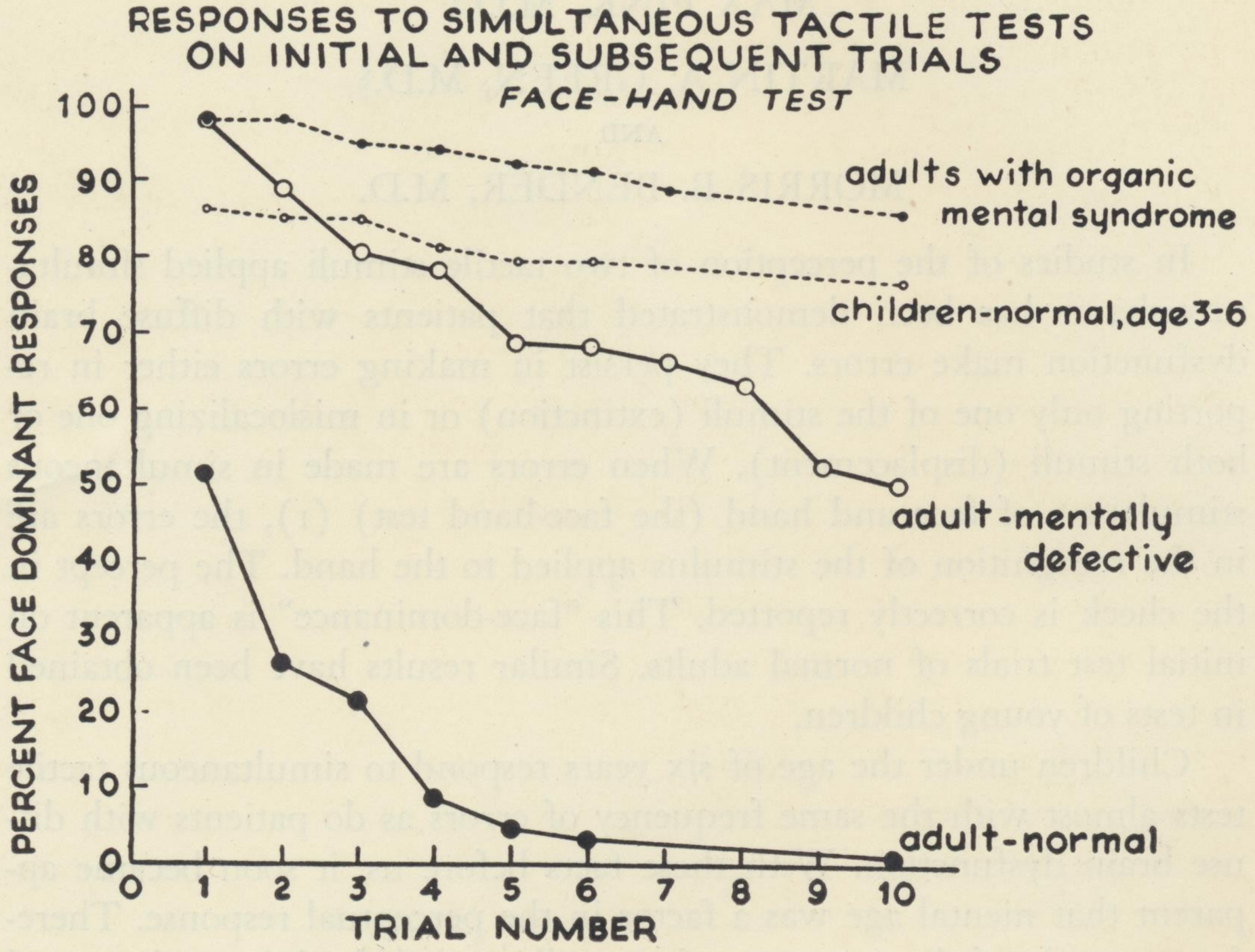

FIG. 1.—Graph showing responses to simultaneous tactile tests on initial and subsequent trials of the face-hand test in adults with organic mental syndrome, normal children of three to six years, mentally defective adults, and normal adults.

The subject was asked to close his eyes. Following this, he was simultaneously touched on the right cheek and the dorsum of the left hand. The examiner asked: "What did you feel?" If there was no response, the examiner said "Did you feel me touch you" and "Point to the place where I touched you." After this test the subject was again asked to close his eyes and the left cheek and left hand were stimulated, and the reports recorded. Subsequent tests included stimulation of left cheek and right hand, right cheek and hand, both cheeks, and both hands. This sequence of six trials was then repeated so that a total of 12 tests involving the cheek and hand combinations were carried out.

Subsequently, tests of other body parts, as hand-foot, cheek-shoulder, thigh-foot, shoulder-thigh, cheek-foot, and shoulder-hand were introduced—four trials of each asymmetric combination and one trial each of the symmetric body parts. The entire sequence of tactile tests was completed with a repetition of trials of the face-hand test.

Results

On the initial trial, 98 percent of mentally retarded subjects reported the stimuli incorrectly. Eighty percent reported the face percept only, omitting the percept to the hand, a type of sensory extinction.* The remainder localized the face percept correctly, but mislocalized the second percept to the opposite cheek, a type of sensory displacement. No subjects reported the stimulus to the hand alone or mislocalized the cheek stimulus to the hand. These responses are expressions of "face dominance."

Face dominance was also apparent on subsequent trials of the face-hand test. Fifty percent of the subjects failed to localize the two stimuli correctly during the first ten trials. They repeatedly failed to report the hand stimulus or repeatedly mislocalized it. The phenomenon of extinction was manifest in all subjects; while in 46 percent, displacement of percepts were also reported. A smaller number (38 percent) showed perseveration of responses, i.e., reported previous stimuli even though new stimuli had been applied to different parts of the body. The phenomenon of allesthesia (mislocalization of a stimulus across the midline to the opposite side of the body) (2) was occasionally observed. Only one patient demonstrated exosomesthesia (the displacement into extrapersonal space) (3).

Half of the subjects succeeded in localizing and identifying the two stimuli during the initial ten trials. Their ability to localize the stimuli in the face-hand tests was carried over in the subsequent testing of other body parts. A few subjects, however, after correctly identifying the stimuli of the face-hand tests, made occasional errors during the testing of other body parts. These errors were almost exclusively in a failure to report one of the stimuli; neither displacement or perseveration was manifest.

In all subjects simultaneous stimulation of homologous regions, e.g., cheek-cheek, or hand-hand, were interspersed throughout the testing. Errors were infrequent on such tests, even in those subjects who made persistent errors on stimulation of asymmetric regions, e.g., cheek-hand. Such errors were observed in 15 subjects (26 percent) but only on occasions were the errors in a pattern as seen in a patient with a hemisensory syndrome due to a focal cerebral lesion.

Relation to Mental Age.—There was a definite relation between the incidence of persistent errors and the mental age of the subjects. Table I presents subjects grouped according to mental age (as determined by standard Stanford-Binet testing) and their responses to simultaneous tactile tests. It will be noted that there is a gradual fall

*For convenience in writing we will call this type of response under conditions of double simultaneous stimulation *extinction*.

in the incidence of persistent errors on simultaneous tactile tests as mental age increases.

TABLE I

Mental Age Group (year–month)	*No. of Subjects*	*Persistent Errors*	*Correct By 10 Trials*
2–6 to 3–11	10	10	0
4–0 to 4–11	10	7	3
5–0 to 5–11	10	4	6
6–0 to 6–11	12	5	7
7–0 to 7–11	11	2	9
8–0 to 9–6	4	1	3

Relation of Body Parts.—During the initial ten trials, face dominance was manifest in all subjects. In the subsequent tests of other body parts, additional patterns of "dominance" appeared. This was represented in the subject's inability to identify and localize one of the stimuli or to mislocalize one percept in the direction of the second stimulus. As already intimated previously, the locus of the stimulus which is correctly reported is said to be "dominant." In tests of cheek and shoulder, and cheek and foot, face dominance was observed (Table II). In tests of foot and hand, and shoulder and hand, both foot and shoulder are dominant over the hand. In the relationship of thigh and foot, and shoulder and thigh, both foot and shoulder are dominant over the thigh.

TABLE II.—Responses on Multiple Simultaneous Tactile Tests in 57 Mentally Defective Subjects

*Body Combination**	*Total No. of Tests in All Patients*	*Incorrect Responses*	*Correct Responses*
		face or hand	face and hand
FACE–hand	576	315	252
		face or foot	face and foot
FACE–foot	163	36	128
		face or shoulder	face and shoulder
FACE–shoulder	184	64	105
		shoulder or thigh	shoulder and thigh
SHOULDER–thigh	170	45	113
		shoulder or hand	shoulder and hand
SHOULDER–hand	151	63	85
		foot or thigh	foot and thigh
FOOT–thigh	170	42	111
		foot or hand	foot and hand
FOOT–hand	231	58	140

*Capitalized letters (under Body Combination) indicate dominant part as manifest by t-test value of 5 percent or less.

The differences in the incidence of errors in different body combinations are largely due to the order of testing and the factor of learning.

Discussion

These results when compared with those obtained in previous experiments show that there is a striking similarity in the performances of patients with organic mental syndrome due to diffuse cerebral disease or dysfunction (4a), to normal children below the age of seven years and to mental defective adults with a low mental age. The similarity lies in the types of responses, the persistence of errors, and in the order of dominance.

Extinction and displacement phenomena are frequent in all three groups. The responses are apparent on the initial and on subsequent trials. In addition, allesthesia and exosomesthesia are occasionally observed.

The subjects in each group manifest an inability to identify and localize asymmetric stimuli, that is, cheek and hand. Symmetric stimuli, however, as stimuli applied to both hands, are well localized, even by the most mentally retarded subjects, by patients with severe brain dysfunction, and by the youngest normal child.

In every group the errors of localization persist through many trials of simultaneous tactile tests. The subjects are unable to localize the two stimuli despite verbal clues offered by the examiner, such as asking whether there had been another stimulus. The errors are present even when the subjects are tested with eyes open. The persistence of errors on repeated trials in the mentally deficient adult, in the patients with mental changes, and in normal young children is in marked contrast to the ease with which normal adults correctly localize and identify the stimuli. The performances of these subjects are illustrated in the graph (Fig. 1) which compares the percentage of errors during the initial ten trials of the face-hand test. It should be noted that the curve for the mentally defective adults includes 15 subjects who have a mental age of seven or more years (Table I). This will account for the curve being below that of normal children whose average mental age was rarely above seven years.

Furthermore, the order of dominance observed in mentally retarded subjects is similar to that reported for patients with organic mental changes (4b). Face dominance is seen in all subjects, while the hand dominance is hardly manifest. The other body parts are between these limits.

As in patients with organic mental changes or very young children one may be inclined to explain the inability of the retarded adults to localize the two stimuli as due to "confusion" or "inattention." Such an explanation is unwarranted because these subjects can perceive and localize symmetric stimuli and the errors are not haphazard. The

errors show in a pattern so that almost all errors are in stimuli to the hand and none in stimuli to the face. Furthermore, this pattern persists in tests of other body areas and is similar to patterns described for other groups of subjects (5).

A comparison of the observations in normal young children and in the mentally retarded adults reveals a striking similarity in performances when the mental ages of each group are compared. In both groups, there is a change in performance about the mental age of six years. It may be concluded that the face-hand test reflects the same performance ability as the Stanford-Binet test. The face-hand test has validity as a convenient approximation of performance above and below a mental age of seven years.

Summary

The face-hand test and simultaneous tactile tests of other body parts were applied to 57 mentally defective adults. Their chronologic ages ranged from 13 to 41 years and their mental ages as determined by Stanford-Binet testing ranged from two years, six months to nine years, eight months.

On the initial trial 98 percent failed to localize both stimuli and on subsequent trials 50 percent made persistent errors beyond the tenth trial. The errors were made in stimuli to the hand whereas stimuli to the face were correctly reported. Extinction, displacement, allesthesia, and exosomesthesia were observed. These performances of the mentally defective adult to the face-hand test are strikingly similar to the responses of patients with diffuse brain disease and of normal children of six years or less.

Furthermore, there is a definite relation between the persistence of errors and the mental age of the subject. It is concluded that the face-hand test reflects the same performance as the Stanford-Binet and has validity as an approximation of performance above and below the mental age of seven years.

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1150 Park Ave.,
New York 28, N. Y.

Submitted JNMD
July 1, 1952.

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Children under the age of six years respond to simultaneous tactile tests almost with the same frequency of errors as do patients with diffuse brain dysfunction. With these facts before us, it soon became apparent that mental age was a factor in the perceptual response. Therefore, a study of the responses of mentally retarded adults with mental ages of young children was undertaken. Simultaneous tactile tests were applied to a group of mentally defective patients, and three aspects were studied: their responses to the tests; the order of dominance; and the relation, if any, to standard psychometric tests.

SUBJECTS AND METHOD:

Fifty-seven mentally retarded adults from the wards of Letchworth Village, New York were examined. They ranged in chronological age from 13 to 41, and in mental age from two years-six months to nine years-eight months. The figures for mental ages were those recorded in hospital records reflecting performance on Stanford-Binet tests; and in each instance, the most recent estimate was used.

The subject was asked to close his eyes. Following this he was simultaneously touched on the right cheek and the dorsum of the left hand. The examiner asked: "What did you feel?" If there was no response, the examiner asked "Did you feel me touch you" and "Point to the place where I touched you." After this test the subject was again asked to close his eyes and the left cheek and left hand stimulated, and the reports recorded. Subsequent tests included stimulation of left cheek and right hand, right cheek and hand, both cheeks,and both hands. This sequence of six trials was then repeated so that a total of 12 tests involving the cheek and hand combinations were carried out.

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On the initial trial, 98% of mentally retarded subjects reported the stimuli incorrectly. Eighty per cent reported the face percept only, omitting the percept to the hand, a type of sensory extinction.* The remainder localized the face percept correctly, but mislocalized the second percept to the opposite cheek, a type of sensory displacement. No subjects reported the stimulus to the hand alone or mislocalized the cheek stimulus to the

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SHOULDER-hand	151	Shoulder 63	or	Hand 3	Shoulder and Hand 85
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foot-hand	231	Foot 58	or	Hand 33	Foot and Hand 140

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The differences in the incidence of errors in different body combinations is largely due to the order of testing and the factor of learning.

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compares their per cent errors during the initial ten trials of the face-hand test. It should be noted that the curve for the mentally defective adults includes 15 subjects who have a mental age of 7 or more years, (see Table I). This will account for the curve being below that of normal children whose average mental age was rarely above 7 years.

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Figure 1. Graph showing responses to simultaneous tactile tests on initial and subsequent trials of the face-hand test in adults with organic mental syndrome, normal children, age 3-6 years, mentally defective adults and normal adults.