

DOCTORAL DISSERTATION SERIES

PUBLICATION: 7646

AUTHOR: Harold Swan Edmondson, Ph. D., 1954
University of Michigan

TITLE: THE SEASHORE MEASURES OF MUSICAL
TALENTS AS A PROGNOSTIC GUIDE IN
LANGUAGE REHABILITATION FOR
PERSONS WITH APHASIA

University Microfilms, Ann Arbor, Michigan

THE SEASHORE MEASURES OF MUSICAL TALENTS
AS A PROGNOSTIC GUIDE IN LANGUAGE
REHABILITATION FOR PERSONS WITH APHASIA

by
Harold S. ^{Ward} Edmondson

A dissertation submitted in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy in the
University of Michigan
1953

Committee in charge:

Professor H. Harlan Bloomer, Chairman
Associate Professor Anna S. Elonen
Assistant Professor George Herman
Associate Professor Merle Lawrence
Associate Professor D. E. Morley
Associate Professor Gordon Peterson
Associate Professor Ralph D. Rabinovitch

THE SEASHORE MEASURES OF MUSICAL TALENTS
AS A PROGNOSTIC GUIDE IN LANGUAGE
REHABILITATION FOR PERSONS WITH APHASIA

by Harold S. Edmondson

The purposes of this study are: 1) to study factors prognostic of speech recovery in patients with aphasia, and 2) to use the Seashore Measures of Musical Talents as a possible guide in determining the ability of adult aphasics to progress in language re-training. The basis for the study lies in the fact that improved prognostic tools are needed to plan for the general care of the patient, language therapy, and vocational training.

The plan of research is as follows:

1. Administration of the Seashore Measures of Musical Talents to an experimental group of aphasics.

The tests were given at the beginning of a twelve-week training session, and again at the end of the session.

2. Collection of criterion data showing how the experimental group of subjects succeeded during training.

3. Analysis of the relation between test scores and success in training.

Success in training was determined by the independent ratings of progress by two speech experts. Each of the twenty-two subjects was rated on a seven-point scale of progress in the following language functions: spontaneous speech, reading, writing, calculation, and auditory verbal comprehension.

In order to evaluate the factors of motivation and post-morbid intelligence as prognostic factors among aphasics, the two judges rated each subject according to evidence of motivation in

training, and, in order to obtain a measure of intelligence, each subject was given the Non-Language Multi-Mental Test by Terman, McColl, and Lorge.

Using the Pearson product-moment correlation coefficient, the Seashore scores, motivation ratings, and estimates of intelligence were analyzed in terms of their relationship to the progress of aphasic patients in language re-training.

Data of the study support the following conclusions:

1. Aphasics as a group achieve scores on all six Seashore Tests which are considerably lower than could be expected from a random sampling of the normal population.
2. There is evidence of a positive relation between the Seashore scores of aphasic patients and ratings of progress in language skills.
3. There is a small positive relation between ratings of motivation and progress in language skills, and between intelligence scores and progress in language skills. In each instance, the correlation is so small as to be clinically insignificant.
4. Aphasic scores on the Seashore Battery are not improved by re-test or by language training.
5. The Seashore Test for time discrimination is the only one of the six Seashore Tests that distinguishes among aphasic patients according to abilities in language functions.
6. The Seashore Test for time discrimination offers prospects of being valuable both in diagnosis of aphasia and estimations of prognosis with aphasic patients.
7. The Seashore Test of time and the language rating of

spontaneous speech each have prognostic value. These factors, in conjunction, offer good potential as a prognostic index.

ACKNOWLEDGMENTS

I wish to express my sincere appreciation to Professor Harlan Bloomer, Dr. D. E. Morley, and Mrs. Marion Knight, with whom I have worked for several years and whose association has been so valuable to me. For their numerous contributions to this study I am deeply grateful to Drs. Anna Elonen and George Herman. To Drs. Merle Lawrence, Gordon Peterson, and Ralph Rabinovitch, I am indebted for their guidance through trying periods.

The time and service given by Dr. Irwin Brown, my friend and associate, were invaluable contributions to this study.

Finally, I wish to thank those members of the Aphasia Division of the University of Michigan Speech Clinic, without whose wholehearted cooperation this study would not have been possible. Their courage is a source of inspiration to me.

TABLE OF CONTENTS

	Page
LIST OF TABLES	iv
 Chapter	
I. REVIEW OF LITERATURE DEALING WITH PROGNOSIS FOR LANGUAGE RECOVERY IN APHASIC PATIENTS . .	1
II. THE SEASHORE MEASURES OF MUSICAL TALENTS . .	25
III. PROCEDURE AND EXPERIMENTAL DESIGN	31
IV. RESULTS	43
V. DISCUSSION AND RECOMMENDATIONS	51
Discussion of Respective Relation- ships Suggested by Each Hypothesis	
VI. SUMMARY AND CONCLUSIONS	65
APPENDIX	67
BIBLIOGRAPHY	71

LIST OF TABLES

Table		Page
1.	Correlation Coefficients Between the Independent Language and Motivation Ratings of Two Speech Experts	36
2.	Correlation Coefficients Between Pre-Training Seashore Scores, I.Q., Pre-Training Motivation Ratings, and Pre-Training Language Ratings	44
3.	Correlation Coefficients Between Pre-Training Seashore Scores, I.Q., Pre-Training Motivation Ratings, and Language Ratings of Progress	46
4.	Correlation Coefficients Between Pre-Training Language Ratings and Ratings of Progress in Language Skills	47
5.	Table of t for Significance of Difference Between the Means of Pre-Training and Post-Training Seashore Scores	50

CHAPTER I

REVIEW OF LITERATURE DEALING WITH PROGNOSIS FOR LANGUAGE RECOVERY IN APHASIC PATIENTS

Introduction.--Forecasting the probable outcome of an aphasia is one of the more difficult problems in the fields of medicine and language rehabilitation. What physician or speech therapist has not had feelings of inadequacy when anxious friends and relatives of the patient ask the familiar questions, "Will he get better? How soon?" Our best prognostic tools allow us to answer these questions in only a general way. We need to know more about the factors which influence the aphasic's ability to relearn language processes that have been impaired. However, the clinician is not entirely lacking in knowledge of manifestations which contribute to success in therapy. Since 1940, increased research in therapy and rehabilitation has contributed information which affords the present-day clinician improved accuracy in predicting the chances for aphasic patients to regain their premorbid levels of performance. Much has been learned by comparing the early nature and symptoms of the illness with the course of events that follow. This pattern of research has been fruitful and should continue to increase our accuracy of analyzing aphasia. To date, however, it is

evident that improved prognostic indices are needed to plan for the general care of the patient, speech therapy, and vocational training. This investigation proposes to study factors prognostic of speech recovery in patients with aphasia.

Prognostic considerations.--A set of factors which some authorities believe to be important prognostic signs will be discussed below. The list of prognostic factors is not complete, but the ones which have been advanced by recognized authorities will be discussed. The review will include a discussion of the loss of specific functions which provide a rationale for the use of the Seashore Measures of Musical Talents in the study of aphasic people.

Extent and location of the brain lesion.--In summing up the literature on localization, it is important to note that there are great differences of opinion as to the importance of and the extent to which localization of damage affects language functions. Most of the authors who have published in this field agree that lesions in certain areas of the dominant hemisphere inhibit or disturb speech in the majority of cases. There is general agreement, also, as to the relationships of specific brain areas to the performance of normal visual, auditory, and tactile functions. The greatest differences of opinion occur, as Brown and Schuell point out (8), in the study of the comprehension and formulation of language, and the relation of these functions to anatomical structure.

Concerning those authorities who hold to the concept

of localization, a review of their contributions can begin with those of Broca (5 and 6), who, in 1861, first presented his views which directed thinking and research for years, that various language processes have precise anatomical localization in the cortex. Then came Bastian (4), who, in 1869, defined areas for localizing auditory and visual word centers, as well as the centers for the control of the tongue and hand. Wernicke (49), in 1873, described sensory centers or receiving zones of the brain, and in so doing, established the concept of aphasia due to difficulty of the receiving mechanism of the cortex. He was followed by Charcot (10), who, in 1883, described the writing center of the cortex. Charcot observed differences in behavior which existed among individuals suffering from similar neurological defects. He proposed, from this, that some individuals were visual minded, and some auditory minded. (11) Damage to areas in the dominant hemisphere was believed to cause greater impairment than damage to the non-dominant hemisphere. Henschen (26), Nielsen (34, p. 28) and others have postulated specific locations within the brain that subserve specific functions. These authors maintain that the extent and location of the brain lesion is of prime importance in determining not only loss of function but also the individual's chances for improvement. One of the difficulties with this point of view is that the localization of lesion is hard to determine exactly. These people usually rely on the speech symptoms in part to help define

and locate the lesion, and then draw inferences about the speech, based on the assumed lesions.

Opposed to this are those who hold that the concept of total integration is of primary importance in prognosis. A careful review of the literature indicates to the writer that the majority of recent publications discount the significance of extent and location of brain lesion both in diagnosis of symptoms and in prognosis.

Weisenburg and McBride (47) have said:

It is widely believed now that mental functions, even the simpler speech processes, cannot be related to any strictly defined cortical areas but involve unified activity of many areas, if not of the whole brain.

Eisenson (15) based the following statements, relative to prognosis, on his personal observations of aphasics in army hospitals:

The young aphasics observed showed no reliable correlation between type of language dysfunction and the site of their brain injury.

Except in cases where the amount of brain injury was extremely great, and involved both brain hemispheres, the extent of brain injury seemed to have little bearing on the patient's progress and improvement.

Speaking on clinical cases of brain injury, Cobb (12) stated:

In understanding such clinical phenomena one must start with the fact that no two human brains are alike. Lesions destroying exactly the same areas in two different brains would not cause exactly similar symptoms. This is because the life experience of each person has conditioned and changed the brain so that it is unique.

Goldstein (18, p. ix) has pointed out that the actual localizations found in postmortems, frequently in apparently very similar cases, differ greatly as to locality and severity of the brain lesion. Goldstein also stated (19, p. 45) that only very gross localization distinctions could be made, and that the classic theory of localization could hardly be maintained in view of present day knowledge.

Premorbid I.Q.--Relative to the premorbid intelligence as a prognostic factor, Wepman's study (48, p. 75) points out that there is some predictive value in pretraumatic intelligence test scores. According to Wepman, "More successful resolution of the language problem can be expected when the I.Q. level at the pre-injury state is high." In addition, Wepman states that patients tend to make lower scores on intelligence tests after injury than before, but with recovery of language processes, patients improve their intelligence test scores to a level that approximates pretraumatic ability.

Nielsen and others (35), Simon (41), and Huber (27) also give testimony as to the importance of premorbid intelligence as a prognostic factor. Eisenson (15), on the other hand, stated:

An average or higher premorbid intelligence was more frequently associated with aphasia and with the maintenance of aphasic disturbances than was below average intelligence.

From this one might assume that it would be a disadvantage to have high intelligence before an injury which resulted in aphasia. This observation, however, seems contrary to the reports of most authorities.

Postmorbidity I.Q.--Considerable mention is made of postmorbidity intelligence, impaired intellectual functioning, etcetera, as factors important in prognosis. Wepman (48, p. 72) states that some indication of success in therapy can be based on post-traumatic intelligence scores. He points out, however, that such scores are less accurate as predictors of success than educational achievement and intelligence scores based on records made before the injury.

Nielsen (35), Symonds (42 and 43), and Huber (27) among others, have made generalized references to an evaluation of intelligence as a factor that affects the patient's chances of relearning.

Those who have tried to evaluate the intelligence of aphasics are aware of the many problems in this area. It is difficult to get a reliable intelligence quotient for an aphasic patient. Knight¹, in a personal communication, has pointed out that intelligence scores for brain injured adults do not correlate well with their general ability to handle personal problems, make decisions, etc. Mrs. Knight states that she has observed patients who scored 125 or better on the Weschler Performance Scale whose performance

¹Mrs. Marion Knight is clinician in charge of the Aphasic Training Program at the University of Michigan Speech Clinic.

in the clinic and outside was on a low level. Conversely, those with low scores could often take responsibility, make decisions for themselves, and handle their personal affairs successfully.

Such widespread confusion exists about the concepts of impaired intellectual functions among aphasics that a brief discussion of the problem seems warranted.

Goldstein (19, p. 17), Weisenburg and McBride (47, p. 462), and Head (24, p. 211) have indicated that the use of standard intelligence tests with aphasic patients is objectionable. Objections are based on the concept that deviations in aphasic performance cannot be explained as an intellectual defect.

Head (24, p. 211) felt that brain damage did not necessarily impair intelligence. Weisenburg and McBride stated:

Aphasia is first and foremost a disorder of speech...a particular deterioration, not a defect of general intelligence. (47, p. 462)

Goldstein felt that reliable scores for standard tests were impossible because aphasics could not perform the tests in a definite, invariable way, as normal subjects are required to do. Aphasics, according to Goldstein, show peaks of success and failure on standard tests since they can solve some problems in a roundabout way by utilizing undamaged capacities.

Goldstein explains performance deviations, impaired intellectual performance, and aphasic behavior in general

by an impairment of the abstract attitude,¹ or by an impairment of the faculties in a particular field. He concludes by saying that "To speak of the condition of intelligence in aphasic patients in general--its maintenance or defect--is impossible." (19, p. 117)

Goldstein, however, has encountered much opposition to his theory of impaired abstract performance as an explanation of aphasic behavior. Wechsler (46), Aita (1), Weisenburg and McBride (47), Eisenson (15), Wepman (48), Halstead (23) and Hebb (25) all express varying objections to Goldstein's theory. References in the literature are made to many cases of aphasia which do not give evidence of impaired abstract behavior. The literature indicates that the ability, among aphasics, to perform on an abstract level varies along the entire range from complete loss of abstraction to no impairment of ability to perform on abstract levels.

It appears to this writer that evidence is not sufficient to discourage the use of mental tests as evaluative measures among aphasics, but that the test limitations should be recognized.

¹The concept of abstract and concrete behavior is one of Goldstein's signal contributions to the understanding of aphasic manifestations. An excellent summary of this concept can be found in Brown's doctoral thesis (7). Goldstein's detailed statement as to the concept can be found in the Psychological Monographs. (19)

Premorbid educational level as a prognostic factor.--

In making an estimate of prognosis, Simon (41) writes on the importance of the patient's intellectual ability and success in life. He states, "The greater his ability and success in life, the better the prognosis." Anderson (3), Huber (27), and others have made fleeting references to the premorbid educational level as one of the many factors to be considered when prognosticating. Wepman (44, pp. 54, 55, 60, 64, 65) reports on an analysis of correlation between pre-injury educational level, post-injury educational level, and post-training educational level. His correlations are based on the relative rank order of educational achievement before and after the injury, and after a period of training. His findings are summarized as follows:

The correlation between the two sets of data (pre-and post-injury educational levels) indicates a slight tendency for the relative rank order of ability to remain the same. This is seen to be only a mild tendency, however, and the predictive value for any individual in the group would be low. This most probably means that no very accurate general prognostication concerning post-traumatic educational level can be made from a patient's pre-injury educational history.

There was noted a low positive correlation between the pre-traumatic educational status and the post-injury educational achievement level.

Regarding the relative rank order of educational achievement for the three stages (pre-injury, post-injury, and post-training) Wepman summarizes:

There was a continuous tendency for the groups to maintain somewhat the same relative rank order at the three stages. This tendency is slight, however, and while it may serve to indicate that as a group the better educated show a higher pre-training level as well as a higher post-training level, almost nothing could be said about the position that an individual member of the group might take.

Wepman's study casts serious doubt on the validity of pre-injury educational level as a prognostic factor for improvement in therapy. On the basis of the aforementioned study, a prediction as to the gain a person would make were he to sustain a brain injury would be hazardous at best.

Premorbid personality and constitution.--Experience with aphasia since World War II has led to an increasing awareness of the importance of the premorbid personality and constitution as a significant factor in prognosis. Authors who listed many prognostic factors in passing, often stressed the vital importance of the qualities within the person as determinants of later success. For example, Aita (1) emphatically stressed the importance of personality relationships and personal experiences as factors which have bearing on future progress. He also warned against the traumas which can be induced from circumstances surrounding the illness and the hospital experience. The following quotation from Aita (1, p. 245) should serve as food for thought to all those who may influence some brain injured person during the acute stage.

The modern spirit of rehabilitation recognizes physician-induced traumas (iatrogenesis). In follow-up we found patients were impressed frequently with the feelings of hopelessness

expressed by doctors who cared for them. This appeared to stem from a diagnosis of known brain injury. The knowledge that intracranial foreign bodies or scars and EEG disturbances existed appeared to render many doctors impotent. Yet there remains much to be done with the host to build up psychological resistance and to immunize against apathy, stagnation and inefficient modes of adjustment. These men must be shown their own resources in recovery. Likewise they must learn of their own limitations and liabilities and how these may be offset by motivation, industriousness, re-education, and experience of increasing success. Each must come to recognize certain symptoms as an expression of his own anxieties rather than permanent organic brain alteration. Each must be brought gradually to face his own task of re-adaptation.

Symonds (42) commenting on personality in prognosis, stated that the pre-traumatic constitution as measured by the family and personal history was of first importance in estimating prognosis. He continued:

The well endowed, well knit, stable personality stands even severe head injury well. A family or personal history which includes a liability to affective disorder, a previous history which indicates a hysterical disposition, a record of poor adaptation to the stresses of ordinary life, a timid, anxious, or dependent disposition--these are the features which lead one to expect persistent and often disabling sequelae.

According to Anderson (3), who gave a list of important factors in prognosis, "The most outstanding single cause of success or failure in the linguistic re-training of aphasic patients is personal potential or the 'x-factor'."

Huber (27) states that the resolution of personality abnormalities deserves the utmost consideration if a person with dysphasia is to profit from therapy. In the same vein,

Eisenson (15) reports that "Premorbid personality traits of an undesirable nature were highly important factors which had to be considered in the retraining and recovery of the patients."

Demands of the environment.--In a study under the direction of Denny-Brown (14), two hundred cases of closed head injuries at Boston City Hospital were observed for six months or longer. Closed head injuries were defined as those from external injuries to the head which did not result in a penetration of skull bone or external object into the brain tissue. Only a small percentage resulted in aphasia but the report of prognostic factors is held to be significant for this study. The author generalized that poor prognostic factors, for the 200 cases of closed head injuries, could be arranged in two chief groups, those relating directly to brain injury, and those associated with the environment. In the former, prolonged disorientation, abnormal neurological signs, blood in the spinal fluid and electroencephalographic abnormality were of pathological significance. In the latter, sources of anxiety derived from the injury, the initial emotional disturbance, the circumstances of employment which instigated worry over compensation, and circumstances which bred anxiety as to personal or family security, correlated highly with inability to return to work. The author concluded that the environmental factors accounted for disability even more than the factors which indicated severity of injury.

Symonds (42), who worked with aphasics during World War II, commented that:

In civil life, it is the question of compensation which is often most important. In service cases, the comparable issue of return to full duty or something more comfortable may take its place. Separation from friends, loss of promotion, anxiety as to future capacity for service or civilian employment are also common sources of trouble.

Motivation.--Motivation has long been held to be an important operating factor in determining success. Its importance in aphasia therapy seems to have been recognized by most authorities. Nielsen and others (35), commenting on the treatment of veteran aphasics, held that patients with definite goals worked harder in the therapy program. In the same article, the authors stated that in the aphasic patient motivation is not the dominant problem which it is in the teaching of the more normal individual. The average aphasic's desire to recover his ability in language will in itself prove sufficient intrinsic motivation, although in many instances the patient has post-traumatic personality changes and requires motivation of a more extrinsic nature.

Simon (41) held that the greater the drive and determination of the patient, the more favorable the prognosis. Anderson (3), on control of motivation, made the following comment: "Motivation is strongest and progress most sure when therapeutic techniques are adapted to the patient's greatest interests and to his usual activities."

Diagnosis of specific type of aphasia.--There is

evidence that the kind of aphasia suffered by an individual is important as a prognostic tool. Wepman concluded from his study (48, p. 79) that "The type of aphasia that an individual aphasic adult exhibits is of considerable value in prognosticating the degree of recovery, since the study shows that the various types tend to improve in different degrees." Wepman's comments agree with those of Weisenburg and McBride with regard to classification of aphasia according to chances for improvement. The order of recovery after trauma, for the four types of aphasia, starting at the top, seems to be:

1. Expressive aphasia
2. Receptive aphasia
3. Expressive-receptive aphasia
4. Global aphasia

No exception to this evidence was found in the literature.

Brown and Schuell (8) in an article entitled "A Preliminary Report on a Diagnostic Test for Aphasia" have reported an investigation based on comparing results in training with the original diagnosis of language difficulties. Relative to prognosis, the authors stated that their findings tend to suggest that the kinds of initial disabilities may have greater prognostic value than age.

This preliminary report was followed up with an article by Schuell (38), in which she reports on the prognostic value of a series of tests for understanding spoken language. Schuell reports that these tests were given to 138 aphasic patients, 107 of whom recovered functional speech. Of the 31 patients who did not recover functional speech,

all showed impairment of ability to recognize names of familiar objects when spoken by the examiner. "This disability," according to Schuell, "appears to represent a fundamental breakdown of symbolic processes and, when present, prognosis is guarded." Schuell summarizes with:

It appears, from working with a large number of aphasic patients, that there is a correlation between the type of impairment affecting comprehension of spoken language and the amount of improvement accomplished by therapy. This correlation depends less upon the degree of impairment than upon the specific kind of receptive difficulty present. Thus, it appears that receptive language disturbances do not constitute an entity, but that individual components operate selectively in relation to prognosis.

This writer is of the opinion that the research, pursued by Brown and Schuell, that of comparing progress in therapy with the specific kinds of aphasic impairment, offers the most fruitful results in the search for increased accuracy in prognosis. The kinds of aphasic impairment must, however, be determined by careful examination and not by superficial and limited observations of the patient's behavior.

Time therapy begins.--The best time to begin therapy seems to be an important point in which there is excellent agreement among the experts in the field. The principle followed is that the re-education process should begin as soon as possible after the injury. Experimental data is available to support this theory, as for example, the studies by Butfield and Zangwill (9) and Wepman (48). Prognosis seems to diminish with the increasing lapse of time

between injury and the beginning of speech therapy.

Kind of therapy offered.--If there is one well established principle in the study of the behavioral manifestations of aphasia in relation to environment, it is that: Aphasia can be treated successfully. It is almost universally agreed that it (aphasia) must be treated if recovery is to be expected. It is only very rarely that one encounters the opinion that aphasics, if left alone, will approach maximum recovery spontaneously.

The following evidence favors the concept that therapy is of primary importance in the recovery from aphasia:

Frazier and Ingham (17) reviewed the progress of over 200 cases of gunshot wounds of the head. Those with aphasia (number not stated) received aid in speech, reading and writing, the results of which were summed up by the statement:

Although we have seen no evidence of the development of new language centers on the normal side of the brain, improvement has been marked in every patient of this group, the aphasic symptoms of some of whom had previously remained stationary for several months.

This writer's review of the literature disclosed no disagreement with the principle of rendering therapy for recovery after brain injury. Among the publications reviewed, there was general agreement as to the kind of therapy needed. This can best be summed up by the statement from Wepman's study (48, p. 79) whose test results indicate that at the end of the training period all except six of the

sixty-eight subjects were able to take their places in society in a useful capacity.

The dysphasic needs more than a formal re-education in skill functions; he needs a total rehabilitation, a program taking into account re-education, rapport, moral, motivation and personal adjustments.

Age.--Although generalized references to age as a prognostic factor are frequently made, very little experimental evidence on the subject can be found. The work by Symonds (42) and Russell (37) bear out the general feeling that as age increases, the prognosis becomes more restricted.

Some of the outstanding prognostic factors have been explained above. Numerous other factors are revealed by writers who make reference to a list of factors without an explanation for the basis and validity of each. The following quotations are of value in giving the reader an appreciation of the numerous factors which are reported to have bearing on prospects for recovery.

Nielsen and others (35) state:

The basic criterion for the possibility of retraining is the existence of an intact motor speech area on the minor side (usually the right), wherein engrams for motor speech have previously been laid down. General factors that affect the person's chances of relearning are the length of time elapsing between the injury and the beginning of retraining, the patient's former educational and intellectual level, and his present degree of orientation.

Anderson (3), who feels that personal potential is the most important cause of success or failure in linguistic retraining, also lists: (1) the active cooperation of the

patient, (2) the former training of the patient, (3) the patient's morale, and (4) the resolution of economic, personal and social problems attributable to the patient's illness and residual disabilities--as factors which seem proportional to success in retraining.

A quotation by Huber (27) gives an indication of important prognostic factors from the view of neurologists:

Neurologists have pointed out that the extent to which the aphasic may profit by re-education is influenced by the following factors: the site and severity of the cortical injury, the conditions of the brain as a whole, the general health of the individual, the amount of energy present for the use of the function, and upon the intelligence, former linguistic habits, education, and experiences of the patient.

Huber also states that:

Favorable results of training are very largely dependent upon the environment of the patient and the demands made upon him.

Symonds (43) stated that the physician or surgeon, in estimating the prognosis in closed head injuries, must consider the severity of the cerebral injury and any evidence of focal damage, the measurement of intellectual impairment, the estimate of personality disorder, the psychological stability and stamina of the individual before the injury, and a methodical examination of cerebrospinal fluid and EEG, may sometimes provide valuable information.

Symonds concluded with a statement to the effect that present prognostic criteria is inadequate and that a final prognosis often cannot be made until the patient is

observed in his normal mode of living and occupation.

Symonds, in another article (42), gives an interesting view of the prognostic factors in cases of brain injury. As to prognosis, the basis for judgment is a complete neuro-psychiatric examination according to Symonds. Symonds feels that about ten days should be devoted to observation of behavior and examination of mental function in order to decide whether the patient is likely to return to normal life within a reasonable time. The author lists the pre-morbid constitution and personality, age, and the situation arising out of the injury as important factors in prognosis. Symonds summarizes his views by saying:

The general impression of the patient as summed up after ten days' observation is the most important of all. If the recent story is that of improving symptoms, and he is ready and willing to accept the prospect of return to duty, the outlook is relatively good. A hostile, resentful or despairing attitude which proves unamenable to simple psychotherapy carries the reverse prospect.

The Seashore Measures of Musical Talents as a possible prognostic guide in the study of aphasia.--Schuell (38) has shown that perceptive channels may have strong bearing on prognosis. Her data indicate that the ability to comprehend single, spoken words is paramount to recovery of functional speech. If this is true, we would profit from an investigation of the possible ways in which the complex process of understanding speech may be disturbed.

Goldstein (19, p. 90-91) describes the different steps of difficulty in comprehension of heard language. He

gives the different possibilities of disturbance in the following order, starting with the most severe:

1. The patient may not react to speech sounds at all. He may differentiate speech sounds from other noises, but under severe impairment, will not recognize them as speech.

2. The patient may understand the sounds as language, but will not be able to understand the words or repeat them.

3. The patient may recognize some words if they are spoken slowly and in a manner of pronunciation familiar to him.

4. In the next step, the patient might perceive the words as being familiar but not understood.

5. Words might be repeated automatically without being understood.

6. On repetition, the word might become understood, only under certain conditions at first.

7. Understanding of the word might become more clear so that the patient summons up other words in the same category.

As the patient begins to understand groups of words, the relations between defects in understanding can no longer be characterized in a general way. Some patients understand words better than sentences, but the opposite is often true. Our inability to explain such divergent possibilities in the perception of language indicates only too well that

knowledge here is incomplete. Localizationists have offered explanations on the basis of a specific relation between the clinical picture and a definite anatomical lesion. Such an assumption, however, is very difficult to evaluate.

For purposes of this study, the following are pointed out:

1. Almost all aphasics exhibit varying degrees of perceptive difficulty.

2. To many authorities these difficulties cannot be explained satisfactorily from a localization point of view.

3. It can be demonstrated that hearing loss to sound intensity is rarely severe enough to have bearing on the problem of comprehending heard language.

Goldstein has stated that the explanation for various perceptive difficulties lies in future research and that there is specific need of knowledge about the relation of heard tones and perceived language. (19, p. 88)

Other prognostic indices involve certain functions but not a breakdown of the nature of receptive loss. Whereas the sum of these indices may have predictive value, they tell very little about the reasons for failure of any one individual. They do not analyze the process by which a factor such as auditory comprehension functions. They don't show us whether in any one individual, or in aphasics as a group, the failure to progress is due to inability to

perform one of the basic functions of auditory comprehension. Does the loss involve language associations primarily or loss of other basic perceptive elements? In answer to this it seems pertinent to undertake a study of auditory perception in aphasic persons which does not employ reception of language.

The Seashore Measures, insofar as they measure hearing capacities among normals which are important in success in the music field, may or may not lead to information among aphasics about specific kinds of perceptive impairment. They can be accepted as an attempt to break down the hearing function into six measurable capacities. The question as to whether these perceptive functions are important to the recovery of language processes is posed by the present study.

Summary.--Several prognostic factors considered to be important to the recovery process could be grouped under the label of anatomic disorders. These factors might also be considered as the ones over which the individual has no control. Included under this classification are:

1. Extent and location of the brain lesion.
2. Condition of the brain as a whole, or the concept of total integration.
3. Prolonged disorientation after injury.
4. Abnormal neurological signs.
5. Blood in the spinal fluid.
6. EEG findings.
7. Existence of an intact motor speech area on the minor side.
8. Spontaneous recovery of the damaged area.
9. Extent to which undamaged areas take over functions previously controlled by damaged brain areas.
10. General health of the patient.

As prognostic factors, the aforementioned group seem to correlate less highly with the extent and speed of recovery than the following group of factors which seem to be related to personality factors and levels of ability:

1. Premorbid personality and constitution.
2. Educational level before injury.
3. Premorbid and postmorbid intelligence ratings.
4. Success in life.
5. Resolution of trauma induced from circumstances surrounding the illness, as for example, worry over loss of employment, anxiety as to the future, etc.
6. Motivation.
7. Active cooperation of the patient.
8. Morale.
9. Former linguistic habits.
10. Success which the patient demonstrates on return to his normal mode of living.

In addition to the above, the following factors were frequently mentioned in the literature as important prognostic indices:

1. Diagnosis of the specific type of aphasia or a description of the kinds of initial disabilities.
2. Lapse of time between the injury and the beginning of speech therapy.
3. Kind of therapy offered.
4. Age of the patient.

In summary, the prognostic factors related to personality and individual abilities seem to receive the support of present day authorities as being more accurate in estimating recovery from aphasia than the factors of anatomic function.

The majority of literary references, relative to important factors in prognosis, have been based on judgments from observations of clinic patients. Few of these

have been based on controlled experimentation. Those who have based their contributions on controlled investigation, as for examples Brown and Schuell (8 and 38), Goldstein (19 and 20), Wepman (48), and Weisenburg and McBride (47) have pointed the way, it seems to this writer, to a pattern of research in prognosis which promises to bear fruitful results, a scientific evaluation of behavior in the early period following injury, and comparison thereof with controlled observation of subsequent behavior.

CHAPTER II

THE SEASHORE MEASURES OF MUSICAL TALENTS

Nature of the Seashore tests.--The Seashore battery consists of six twelve-inch, double-faced Victor records. It consists of two series, A and B. Series A is designed for use with unselected groups. This series covers the full range of talent or lack of talent, i.e. it contains test items which range from "easy" to "difficult." Series A is recommended for use in the schoolroom, for general group surveys, etc. Series A was used in this study.

Series B contains more difficult test items and is designed for testing musical groups or individuals, as in the selection for musical organizations, admission to music schools, etc. Each of the two series measure the same six talents, and each series consists of three double-faced records.

What the tests measure.--Seashore has estimated that it is possible to measure a hundred or more specific features, each of which will throw light on the nature and extent of a person's musical talent. He states:

These may bear on heredity, native capacity, acquired ability, ability to learn, as well as character, rate, and amount of achievement. They may deal not only with sensory and motor capacities, but also with the higher

brackets of ability in the complex musical situation. (39, p. 302)

The first problem is to determine, out of all the features that have bearing on success in music, which are the basic capacities which measure receptivity for the basic elements of music. The answer to this serves as the basis, in large part, for the Seashore Measures of Musical Talents.

According to Seashore (39, p. 2) there are four and only four physical characteristics of the sound wave: frequency, amplitude, duration, and form. He states that "In terms of these we can account for every conceivable sound in nature and art-vocal or instrumental, musical or non-musical." (39, p. 2) The sensory counterparts of these four physical phenomena are pitch, loudness, time, and timbre. These four attributes of sound, according to Seashore, must be apprehended by the musical mind. To this Seashore adds:

But in this apprehending we find an inner screen which is more significant musically, being composed of the four fundamental sensory capacities in complex forms, namely, the sense of tone quality, the sense of consonance, the sense of volume, and the sense of rhythm. These four complex forms of capacity must be evaluated by themselves and not in terms of their elemental components. For example, rhythm depends upon the sense of time and the sense of intensity, as hydrogen and oxygen combine into water; yet water and rhythm are practical entities in themselves." (39, p. 2)

The Seashore battery was formulated to measure the four basic capacities: perception of pitch, loudness, time, and timbre. In addition to these, immediate memory and a sense of rhythm are also tested by the Seashore measures.

The last two are less specific, but very significant in musical interpretation. (40, p. 19)

How the Seashore measures are given.--The records can be played on any good standard phonograph. They should be played with medium loudness, just loud enough to be heard clearly without effort in all parts of the room. Subjects are given the following instructions:

General instructions.--"The purpose of these experiments is to measure some aspect of your ability to hear sounds as they occur in music, in speech, in nature, and in many practical activities."

Instructions for the pitch test.--"You will hear two tones in rapid succession. The second tone is either higher or lower in pitch than the first. You are to mark on the test blank in the proper column whether the second tone is higher or lower than the first. If the second tone is higher than the first one, print H; if lower, print L. There is always a difference; if you are not sure, guess. We shall now give you a little practice without recording until each one understands exactly what you are to do. Ask any questions you desire during the practice."

Instructions for the loudness test.--"You will hear two tones which differ in loudness, or strength. If the second is stronger, print S; if weaker, print W. There is always a difference; if you are not sure, guess."

Instructions for the rhythm test.--"You will hear in rapid succession two rhythmic patterns; the second is

either the same as the first or different. If they are the same, print S; if different, print D."

Instructions for the time test.--"You will hear two tones which differ in length. If the second is longer, print L; if shorter, print S. There is always a difference; if you are not sure, guess."

Instructions for the timbre test.--"You will hear two tones which are either the same or different in timbre, or tone quality. If they are the same, print S; if different, print D. Be sure to hold your head still while listening."

Instructions for the tonal memory test.--"In each trial you will hear a short series of tones played twice. In the second playing, one note is changed. You are to record, by number, which note is changed. In listening count mentally; for example, 1,2,3, in the first playing, and then likewise in the second playing, so you may identify the one that is changed without error."

Scoring.--The score for each measure is the total number of correct answers. The tests for pitch, loudness, time, and timbre contain fifty test items. The tests for rhythm and tonal memory contain thirty test items each.

Norms.--According to the Manual of Instructions and Interpretations, (40, p. 16)

The norms, published herewith make it possible to convert the number of right answers into a ranking order. The highest rank, 1, represents the scores of the highest 10% in a normal unselected community. The next highest, 2, includes scores made by the next 10%, and so on

to rank 10 which includes scores made by the lowest 10% of a normal population.

Other uses of the Seashore Measures of Musical

Talents.--The tests were originally designed as a scientific means of discovering, analyzing, and rating musical talents. Apart from the original purpose they have been used extensively as standard measures in anthropology for comparison of natural capacities in different races and culture levels, for analysis of types of achievement, inheritance of talent, speech disorders, and technical auditory skills. (39, p. 308-310) According to the author, they have been used extensively as class experiments in general psychology, music, and phonetics. Seashore also stated that they are convenient measuring tools for acoustical research in many fields.

They do not, according to the author, measure training or achievement in music, intelligence, feeling, or the will to work.

Why selected for this study.--Tests used in the diagnosis of aphasic patients by and large consist of materials which depend heavily on the visual channel. Information derived from such tests is insufficient for adequate indices of what the outcome of the aphasia will be. Use of the Seashore tests represent an attempt to analyze the hearing function of aphasic subjects according to the capacities represented by the various tests.

In analyzing the auditory channel, tests can be in terms of general loss of hearing, and also in terms of a wide variety of specific abilities such as pitch

discrimination, loudness discrimination, etc. Audiometric tests of aphasic patients indicate that, while many aphasics may have reduced hearing acuity, the overall loss is not great enough to account for the severe inability to comprehend, an inability which is characteristic of those with aphasia. The Seashore measures are thus considered for use as they measure, separately, sensitivity to pitch, intensity, rhythm, time, timbre, and tonal memory, factors which are held to be important in the evaluation of residual, non-linguistic cortical function, and perhaps components of brain function which are important in the recovery process.

CHAPTER III

PROCEDURE AND EXPERIMENTAL DESIGN

Method of research.--This study uses the Seashore Measures of Musical Talent as a possible guide in determining the ability of adult aphasics to progress in language re-training. The method of research is a modification of the steps in prediction research as suggested by Cronbach (13, p. 238). The plan is as follows:

1. Administration of the Seashore Measures of Musical Talents to an experimental group of aphasics.
2. Collection of criterion data showing how the experimental group of subjects succeeded during training.
3. Analysis of relation between test scores and success in training.

Subjects.--Twenty-two adult males, who were enrolled in the Aphasia Division of the University of Michigan Speech Clinic during the twelve-week-spring-training session, 1953, served as subjects for this experiment.¹

Test administration.--The method of administering the Seashore Measures to adult aphasics was determined from the results of the first of two pilot studies which were

¹For detailed subject information, see appendix A.

conducted three months prior to the experiment proper. In this pilot study, the Seashore Measures were given, according to Seashore's instructions for normal subjects, to a group of five aphasic men. The subjects were unable to record their judgments in the time allotted by the tests. The interval between test items was too short. In addition, certain processes, which are considered automatic for normal subjects, were major stumbling blocks for this group of men. It was evident that they had difficulty with one or more of the following processes:

1. The determination of whether there was a difference between the two test tones, i.e. a difference in pitch, loudness, time, etc., according to which test was given.

2. The determination as to the nature of the difference between the tones, i.e. how was the second tone different from the first? Was the second tone higher or lower, louder or softer, longer or shorter, etc.?

3. The decision as to which written symbol to use in recording the answer. For example, in the pitch test, the subject must decide whether the second tone is higher or lower than the first, and then record "H" for higher or "L" for lower. At this point the subjects had difficulty in deciding which symbol to use in order to convey the concept of highness or lowness.

4. Having decided that the second tone was higher or lower, there was the problem of deciding what letter to

use in indicating "high" or "low".

5. Having decided on the letter to use in recording his judgment as to the nature of the discrimination between the tones, the aphasic was then faced with the problem of writing the letter on the scoring sheet.

6. The final problem for each test item seemed to be the decision as to where, on the score sheet, the answer should be recorded.

Clearly, this situation called for ability to perform abstractly as well as the ability to use written symbols. Giving the Seashore Measures under these conditions did not indicate whether the subjects could or could not recognize differences in pitch, loudness, etc.

Revised procedures in test administration.--On the basis of the pilot study it was decided to administer the Seashore Measures according to the following plan:

1. Administer the tests to one subject at a time.
2. Vary the interval between test items according to the time required by the individual in indicating his response.
3. Instruct each subject as to the use of a simple hand signal in indicating his response, thus transferring the burden of writing to the person giving the test.
4. Allow ample practice for each test until it is assured that the subject understands what is required in the test, and the exact nature and meaning of the hand signal to be used.

Varying the interval between test items was controlled by the use of a playback system with a hand-operated lever which enabled the tester to raise the needle from the record at his own discretion, and to lower it in the same groove.

In a second pilot study the Seashore Measures were administered individually to five other aphasic men according to the plan above. Only minor problems were encountered, all of which were held to be negligible in the final results. From this pilot study it was ascertained that, by using the above plan of test administration, aphasics could accurately indicate their judgments for the test items.

For the experiment proper the Seashore Tests were given twice to each subject, once at the beginning of the twelve-week training session, and again at the end of the training session. The routine for giving the tests was held as constant as possible throughout. The tests were given in the same order for each subject. The battery of six tests was given at a single sitting with a five minute break between the third and fourth tests to lessen the effects of fatigue. Two of the subjects seemed to be unable to recognize differences on the loudness and tonal memory tests. In these instances the scores were not considered in the final evaluation.

Language ratings.--If the Seashore Tests were to have predictive value it would be necessary to show some degree of correlation between Seashore scores and progress in

speech therapy. If the Seashore scores correlated highly with success in training, it could be assumed that the Seashore Tests measured whatever it is that is necessary for improvement. Upon completion of test administration, the subjects were evaluated by two raters according to the progress made by each subject during the training session. It was felt that data on success could be determined by independent ratings of speech experts, and that language ratings would be more dependable than criterion data obtained from achievement tests. Both raters¹ had considerable experience working with aphasic patients. They were in daily contact with the subjects, thus assuring an adequate number of observations which could be considered representative of usual performance. Also, the rating scale was decided upon in view of the ease with which it could be treated numerically.

In this study validity of ratings was determined by computing correlation coefficients based on the independent ratings of each judge. The correlation coefficients (Table 1, p. 36) were sufficiently high to indicate that there was no question of the validity of the language and progress ratings.

The problem of determining which language processes should be selected for ratings was based on classifications of language functions by speech authorities. Eisenson (16)

¹The speech experts were Mrs. Marion Knight, Senior Clinician in charge of the Aphasia Training Program of the University of Michigan Speech Clinic, and Dr. Irwin Brown, Instructor in Speech, University of Michigan.

and Knight (29) have written detailed classifications of the language functions. In general, language skills have been classified on the basis of expressive and receptive functions. Five basic language skills, which represent both expressive and receptive functions, were selected for analysis in this study. They were:

1. Spontaneous speech.--The ability to express oneself in ordinary situations, to engage in small talk, to express one's needs, etc.

2. Reading.--The ability to obtain maximum comprehension, using either silent or oral methods.

3. Writing.--The ability to express oneself in his best writing modality, printing, typing, manuscript, etc.

4. Calculation.--The ability to calculate in one's best modality, orally, mentally, writing, etc.

5. Auditory verbal comprehension.--The ability to comprehend spoken language.

TABLE 1

CORRELATION COEFFICIENTS BETWEEN THE INDEPENDENT LANGUAGE AND MOTIVATION RATINGS OF TWO SPEECH EXPERTS*

	Speech	Reading	Writing	Calculation	Auditory Verbal Comprehension	Motivation
Pre-Training Language Ratings	1.00	1.00	1.00	.986	.997	.987
Post-Training Language Ratings	.966	1.00	.981	1.00	1.00	.984
Ratings of Language Progress	.800	.832	.866	.944	.896	.974

*Each coefficient is based on ratings for all 22 subjects.

The experts were asked to rate each subject in each of the above language skills on the basis of the following seven point scale of ability:

- Class 1. Complete loss
- Class 2. Very severe impairment
- Class 3. Severe impairment
- Class 4. Moderate impairment
- Class 5. Slight impairment
- Class 6. Very slight impairment
- Class 7. No apparent impairment

Each subject was rated on each of the language processes at the beginning of the training session and again at the end of the training session. Progress was to have been judged on the shift in the language ratings. Since the shift between pre- and post-training language ratings reduced the progress scale to a narrow, three-point scale which did not adequately indicate the relative progress made by individual subjects, the judges were asked to again rate each subject, at the end of the training session, on the basis of the following seven point scale of progress:

- Class 1. Remained on the same level of ability
- Class 2. Almost no improvement
- Class 3. Slight improvement
- Class 4. Fair improvement
- Class 5. Good improvement
- Class 6. Excellent improvement
- Class 7. Superior improvement

The progress ratings were then correlated with the pre-training Seashore scores.

Control of factors which influence recovery.--An effort was made to account for factors other than those measured by the Seashore Tests which might be responsible for progress during the training session. That other

factors such as general health, previous therapy, morale, etc. could not be controlled, was recognized as one of the limitations of the study. However, the subject group was considered to be homogenous with reference to the following:

1. All subjects used in the study showed primarily expressive symptoms. Of the twenty-two subjects, nineteen displayed receptive difficulties in addition to expressive problems. As most of the group were diagnosed as having the same type of aphasia, the problem of varying rates of recovery due to different types of aphasia was not disturbing. For all the subjects organic damage was severe enough to warrant retraining in all language functions. However, it could not be stated that the subjects were at the same level of ability for the different language functions.

2. The influence of personality factors, morale, anxiety, cooperation of the patient, etc., was taken into account by incorporating ratings of motivation in the study. The correlation between motivation ratings and language ratings was estimated. Also, in order to compare the effect of personality factors on progress in training with the effect of the factors measured by the Seashore Test, correlation coefficients were computed between motivation ratings and progress in training.

3. The influence of varying degrees of intellectual ability was taken into account by the administration of an intelligence test to all subjects. The intelligence

estimates were treated similarly to the motivation ratings.

4. Lapse of time between the injury and the time therapy was offered could not be controlled well. However, all subjects had incurred the injury at least six months prior to training thus partially controlling the factor of spontaneous recovery affecting progress.

Maximal spontaneous recovery is held to occur within six months after the injury. (9 and 48)

5. The ages of the patients varied considerably, but all were adults, and none exhibited symptoms attributable to old age.

6. All subjects seemed to be in fair health, and all seemed to have adequate energy for the amount of daily training.

Motivation ratings.--In order to evaluate motivation, personality factors, etc., and the influence thereof on improvement in language re-training, the judges were asked to rate each subject on a seven-point scale, according to their estimation of the individual subject's motivation during the training session, with a rating of "1" representing complete lack of motivation, and a rating of "7" representing maximal evidence of motivation. For the purposes of this study, motivation was defined as "evidence of personality factors which affected the individual's desire to get better." Motivation ratings were made for each individual at the beginning of the training session and again at the end of the training session. Also, at the end

of the training session, each subject was rated on the seven point scale of progress or change shown in motivation.

Intelligence.--In order to evaluate the factor of intelligence and its influence on the rate of improvement in speech therapy, each subject was given an intelligence test, and the resulting scores were correlated with the language ratings and with ratings of progress in training.

The intelligence test selected was the Non-Language Multi-Mental Test (44) by Terman, McCall, and Lorge. Of the several tests considered for use with the experimental group, the above test was selected for the following reasons:

1. The test was short and simple to administer.
2. It could be administered to groups.
3. It had been standardized on adults.
4. The nature of each test item was the same.

Thus, there was but one set of instructions. This eliminated the necessity of having to shift concept from one set of test instructions to another. This was desirable, as it is known that aphasics have difficulty in shifting concepts.

Hypotheses.--This investigation is concerned primarily with the relationship between Seashore scores of aphasic patients and the progress made by the same individuals during an intensive, twelve-week training session. As a secondary objective this study tests whether aphasics, as a group, show a significant change between test, re-test scores for the Seashore battery.

To investigate this, the Seashore Measures were given twice to each subject, pre- and post-training. Seashore has indicated that the measures of musical talent tap components of innate function, i.e. basic capacities which do not change with age, maturing or training (37, pp. 3, 302-303). Data among normal subjects bear this out. It was considered worthwhile to note whether or not aphasics follow the pattern of normal subjects in this respect.

The various possible relationships between Seashore scores, ratings of language ability, and progress in language re-training, and between pre- and post-training Seashore scores are involved in the form of the following null hypotheses:

There is no significant relationship between:

1. Any one of the pre-training Seashore scores and any one of the pre-training language ratings.
2. Any one of the pre-training Seashore scores and any one of the ratings of progress in language re-training.
3. Any one of the pre-training language ratings and any one of the ratings of progress in language re-training.
4. Motivation ratings and any one of the progress ratings.
5. Intelligence and any one of the progress ratings.
6. There is no significant difference between pre-training Seashore scores and the corresponding post-training Seashore score.

7. No significant difference can be determined between language ratings and Seashore scores in the extent to which these two factors correlate with progress in training.

Statistical analysis.--Two measures, for example, Seashore pitch score and spontaneous speech rating, were obtained for each of the subjects. The question was then asked, "What is the degree of relationship between these two variables, or, in other words, does the individual who ranks high (or low) on one variable tend to rank high (or low) on the other also. The statistical measurement used to indicate the degree of relationship between the variables was the correlation coefficient, designated "r". (31, pp. 90-91)

To test the relationship between the pre-training and post-training Seashore scores, the Student-Fisher t, a test of significant difference between the means of two variables, was used. The Student-Fisher t was also used to test the probable significance of the mean of each group of correlation coefficients.

CHAPTER IV

RESULTS

Various possible relationships between Seashore scores, ratings of ability in language skills, motivation ratings, and estimates of general intelligence were stated (Chapter III, p. 41) in the form of seven hypotheses. The discussion of results will be concerned with the support or rejection of these hypotheses.

Hypothesis no. 1.--The first hypothesis, which states that there is no significant relationship between any one of the pre-training Seashore scores and any one of the pre-training language ratings, generates thirty sub-hypotheses, seven of which tend to be rejected by the data and twenty-three of which seem to be supported. It appears from the data (Table 2, p. 44) that there is a significant, positive correlation (10% level) between the following pairs of pre-training Seashore scores and pre-training language ratings:

1. Pitch and spontaneous speech.
2. Loudness and spontaneous speech.
3. Rhythm and spontaneous speech.
4. Time and spontaneous speech.
5. Tonal memory and spontaneous speech.
6. Time and writing.
7. Time and auditory verbal comprehension.

Hypothesis no. 2.--The second hypothesis, which states that there is no significant relationship between any one of

TABLE 2

CORRELATION COEFFICIENTS BETWEEN PRE-TRAINING SEASHORE SCORES, I.Q., PRE-TRAINING MOTIVATION RATINGS, AND PRE-TRAINING LANGUAGE RATINGS

Pre-Training Language Ratings	Pre-Training Seashore Scores						I.Q. N=22	Pre-Training Motivation Ratings N=22
	Pitch N=22	Loudness N=20	Rhythm N=22	Time N=22	Timbre N=22	Tonal Memory N=21		
Spontaneous Speech	.384 10%	.572 .01%	.376 10%	.653 1%	.257	.448 5%	.462 5%	.229
Reading	.180	.065	.088	.312	-.204	-.257	.014	.101
Writing	.056	.190	.065	.406 10%	-.085	-.119	-.038	.095
Calculation	-.011	-.044	.176	.311	-.272	-.087	-.127	.022
Auditory Verbal Comprehension	-.101	-.063	-.055	.432 5%	-.050	-.063	.273	.301

The level of confidence for significant correlation coefficients is shown in the lower corner of each cell.

the pre-training Seashore scores and any one of the ratings of progress in language re-training, also generates thirty sub-hypotheses. Of the thirty, the data (Table 3, p. 46) seem to uphold the hypotheses in sixteen instances and reject the remaining fourteen. It appears from the data that there is a significant correlation (10% level) between the following pairs of pre-training Seashore scores and ratings of progress in language functions:

1. Loudness and spontaneous speech.
2. Time and spontaneous speech.
3. Rhythm and reading.
4. Time and reading.
5. Timbre and reading.
6. Loudness and writing.
7. Time and writing.
8. Pitch and calculation.
9. Loudness and calculation.
10. Rhythm and calculation.
11. Time and calculation.
12. Tonal memory and calculation.
13. Rhythm and auditory verbal comprehension.
14. Timbre and auditory verbal comprehension.

Hypothesis no. 3.--The third hypothesis, which states that there is no significant relationship between any one of the pre-training language ratings and any one of the ratings of progress in language re-training, leads to twenty-five sub-hypotheses, fourteen of which seem to be upheld by the data (Table 4, p. 47), and eleven of which seem to be rejected. It appears that significant correlations (10% level) exist between:

1. The pre-training rating in spontaneous speech and progress in the same function.
2. The pre-training rating in spontaneous speech and progress in reading.
3. The pre-training rating in spontaneous speech and progress in writing.

TABLE 3

CORRELATION COEFFICIENTS BETWEEN PRE-TRAINING SEASHORE SCORES, I.Q., PRE-TRAINING MOTIVATION RATINGS, AND LANGUAGE RATINGS OF PROGRESS

Language of Ratings of Progress	Pre-Training Seashore Scores						I.Q. N=22	Pre-Training Motivation Ratings N=22
	Pitch N=22	Loudness N=20	Rhythm N=22	Time N=22	Timbre N=22	Tonal Memory N=21		
Spontaneous Speech	.240	.559 5%	.351	.618 1%	.302	.277	.290	.343
Reading	.284	.365	.381 10%	.589 1%	.577 1%	.283	.276	.301
Writing	.260	.439 10%	.290	.643 1%	.151	.306	.273	.246
Calculation	.462 5%	.650 1%	.442 5%	.747 1%	.069	.418 10%	.284	.035
Auditory Verbal Comprehension	.073	.117	-.365 10%	-.056	.685 1%	.128	.266	.551 1%

The level of confidence for significant correlation coefficients is shown in the lower corner of each cell.

TABLE 4
CORRELATION COEFFICIENTS BETWEEN PRE-TRAINING LANGUAGE RATINGS
AND RATINGS OF PROGRESS IN LANGUAGE SKILLS

Ratings of Progress in Language Skills	Pre-Training Language Ratings			
	Spontaneous Speech	Reading	Writing	Calculation
Spontaneous Speech	.476 5%	.168	.202	.119
Reading	.381 10%	.213	.144	.199
Writing	.493 5%	.264	.301	-.627 1%
Calculation	.562 1%	.206	.306	.238
Auditory Verbal Comprehension	.010	-.431 5%	-.420 10%	-.527 5%
				.329 10%
				.420 10%
				.412 10%
				.337
				-.150

The level of confidence for significant correlation coefficients is shown in the lower corner of each cell. For all correlations, N=22.

4. The pre-training rating in spontaneous speech and progress in calculation.
5. The pre-training rating in reading and progress in auditory verbal comprehension.
6. The pre-training rating in writing and progress in auditory verbal comprehension.
7. The pre-training rating in calculation and progress in writing.
8. The pre-training rating in calculation and progress in auditory verbal comprehension.
9. The pre-training rating in auditory verbal comprehension and progress in spontaneous speech.
10. The pre-training rating in auditory verbal comprehension and progress in reading.
11. The pre-training rating in auditory verbal comprehension and progress in writing.

Hypothesis no. 4.--The fourth hypothesis, which states that there is no significant relationship between ratings of motivation and any one of the ratings of progress in language re-training, leads to five sub-hypotheses, four of which seem to be upheld by the data (Table 3, p. 46), and one of which tends to be rejected. It appears that the null hypothesis does not hold for the relationship between motivation ratings and progress in auditory verbal comprehension. The positive correlation between these two variables is significant at the 1% level of confidence.

Hypothesis no. 5.--The fifth hypothesis, which states that there is no significant relationship between estimates of general intelligence and any one of the ratings of progress in language re-training, generates five sub-hypotheses, all of which seem to be upheld by the data of this study. See Table 3, p. 46.

Hypothesis no. 6.--The sixth hypothesis, which states that there is no significant difference between any one of

the pre-training Seashore scores and the corresponding post-training Seashore score, generates six sub-hypotheses, all of which tend to be upheld by the data (Table 5, p. 50) of this study.

Hypothesis no. 7.--This hypothesis, which states that in the extent to which language ratings and Seashore scores correlate with progress in training, no significant differences can be determined between the two, is neither clearly supported nor rejected by the data of this study. It appears that both language ratings and Seashore scores are positively correlated with progress in training. In this respect the hypothesis seems to be upheld. However, a higher percentage of positive correlations was observed among the Seashore and Progress ratings than among the correlations between language ratings and progress. In this respect the hypothesis tends to be rejected.

TABLE 5

TABLE OF t FOR SIGNIFICANCE OF DIFFERENCE BETWEEN THE MEANS OF PRE-TRAINING AND POST-TRAINING SEASHORE SCORES

Post-Training Seashore Scores	Pre-Training Seashore Scores					Tonal Memory N=21
	Pitch N=22	Loudness N=20	Rhythm N=22	Time N=22	Timbre N=22	
Pitch	.332 $P > .7$					
Loudness		.311 $P > .7$				
Rhythm			.322 $P > .7$			
Time				.326 $P > .7$		
Timbre					.309 $P > .7$	
Tonal Memory						.308 $P > .7$

CHAPTER V

DISCUSSION AND RECOMMENDATIONS

On the basis of the twenty-two cases in this study, evidence supports the statement that there is a positive correlation between the Seashore scores and progress made in language skills by aphasic patients during an intensive twelve-week training session. Further, it is indicated that Seashore scores tend to correlate more highly with success in training than estimates of intelligence, motivation ratings, or ratings of ability in various language functions. It can be said, from the evidence of this study, that odds favor the Seashore tests as prognostic tools to a greater degree than tests of intelligence, ratings of motivation, or estimates of ability. The limitations imposed by the small sample prevent one's being able to predict the size, within limits, of the correlation between Seashore scores and success in training, but if the same relationships held for a similar study with more subjects, one could predict the extent of correlation, and a significant correlation would be shown at higher levels of confidence. In other words, in relationships where the significance may have been lowered by the few cases, there was some evidence to indicate that the relationships might become significant with more cases and the same degree of relationship.

In instances where a significant correlation was obtained at the 10% level of confidence, it was not possible to say, within general limits, what the true correlation was, but only that if the study were repeated one would expect to get a correlation greater than zero ninety times out of one hundred.

Although the evidence of this study points toward a positive correlation between Seashore scores and progress in language rehabilitation, it is difficult to indicate the true correlation with only twenty-two cases. If the relationships of this study held for fifty cases, all correlation coefficients above .273 would be significant at or above the 5% level of confidence. In view of the trend toward positive relationships, it is felt that by including correlations at the 10% level of confidence in the discussion, the trends of the study will be more accurately presented.

Level of achievement of aphasics on Seashore Tests.--

In comparing the scores of the subject group with scores of normal subjects, it was seen that the aphasic subjects, as a group, achieved lower scores in all six tests than could be expected from a random sampling of normal subjects. From the scores in Appendix B, the achievement of each subject can be compared with norms published in the booklet of instructions for the Seashort Tests. (40, pp. 10-15)

Discussion of Respective Relationships Suggested
by Each Hypothesis

A. Correlation between pre-training Seashore scores and pre-training ratings of language ability.--Inspecting the

correlation coefficients (Table 2, p. 44) as a total group, and not considering the fact that the correlations are based on only twenty-two cases, it might be concluded that there is little if any relationship between the two variables. Of the thirty correlations, only seven are proved significant at the 10% level of confidence. Also, thirteen of the correlations, almost half of the total number, are negative. To some observers this might indicate that the relationships expressed between the two variables are not greater than could be expected between two unrelated populations. To test this probability, a Student-Fisher t was computed in order to estimate the probability that the mean of the correlation coefficients between Seashore scores and language ratings would be greater than zero. The mean of the correlations was .119. The value of t was 3.212, which gave a probability rating of less than 1%. From this it can be said that the variables are positively correlated at the 1% level of confidence.

In further support of the statement that a positive correlation is indicated between the Seashore scores and ratings of language ability, the following can be pointed out: Of the negative correlations, none was significant at the 10% level of confidence. Fifty-six percent of the correlations were in a positive direction, and of these, seven were significant at the 10% level of confidence.

Turning from the over-all relationships to the correlation coefficients which are significant, two interesting conclusions emerge: the first being that, of the language

ratings, spontaneous speech correlates significantly, at the 10% level, with five of the six Seashore tests, secondly, that, of the Seashore tests, the test for time discrimination correlates more highly with language ratings than any of the other Seashore tests.

The relationship of spontaneous speech to Seashore tests seems especially significant in view of the fact that it is the only one of the language abilities which bears an over-all relationship to the Seashore battery. Of the total seven significant correlation coefficients, five include spontaneous speech. The language ratings of writing and auditory verbal comprehension each show only one significant correlation, and, as both of these are with the test of time, one's attention becomes focused on the language rating of spontaneous speech and the Seashore Test for time discrimination, since all of the significant correlations include one or the other of these variables.

The positive correlation between spontaneous speech and Seashore scores suggests that good ability in spontaneous speech is more indicative than any other language skill considered in this study, of ability to score well on the Seashore battery. If this is true, and, if the Seashore tests are good prognostic tools, one would expect ratings of spontaneous speech to correlate positively with progress in training. This seems to hold true since ratings in spontaneous speech (Table 4, p. 47) correlate more highly with progress in training than any other rating of language ability.

One can generalize from this that good functional speech is indicative of good ability in perceptive elements which the Seashore battery measures, and also that good functional speech seems to be a more accurate indicator of success in training than any of the other language ratings.

From the relationship expressed between the Seashore Test of time and the language ratings of ability, indications are that the time test is the only one of the Seashore tests that discriminates aphasic patients' abilities in language skills. Those who rate high in language ability seem to do well on the time test, while those who are poor in language skills seem to do poorly on the test for time discrimination.

B. Relationship between pre-training Seashore scores and language ratings of progress.--Analyzing the relation between Seashore scores and progress in training it is seen from Table 3, page 46, that, in terms of the number of significant correlation coefficients and the size thereof in a positive direction, odds favor the Seashore Tests as prognostic tools. That there is an over-all positive correlation between the two variables is shown by the result of a Student-Fisher t test of the difference between the mean correlation and zero. A t of 7.710 was obtained, indicating at the 1% level of confidence, that the variables are positively related. Of the thirty correlation coefficients, thirteen are demonstrated to be significant at the 10% level of confidence. This evidence is not sufficient to recommend the use of the Seashore battery in the diagnosis of aphasic patients. In fact, the evidence

based on only twenty-two cases limits enthusiasm for the Seashore battery as a prognostic tool. But the evidence points in the direction of a significant positive relationship and warrants the recommendation that further research be conducted with a greater number of subjects.

Of the six individual Seashore tests our attention is directed to the test of time discrimination. This test shows a correlation, at the 1% level of confidence, with four of the five ratings of language progress. The low correlation with progress in auditory verbal comprehension can be attributed to the fact that the scale of progress shown in auditory verbal comprehension favored those subjects who rated low in ability in this function. The time test correlates with ability in auditory verbal comprehension, but not with progress in the same function.

On the basis of this study the time test offers prospects of having value in research, and clinically, in diagnosis and prognosis. As it is believed that this is the first experimental study of the Seashore Tests in connection with aphasia, one could not base estimates of prognosis on the time test alone. However, a favorable score on the test of time would indicate the possibility of good progress in therapy.

C. Relationship between pre-training language ratings and ratings of progress in language re-training.--

From analyses of the correlation coefficients in Table 4, p. 47, the relationship between initial abilities in language skills and improvement shown in the same

language skills during a three months training period is obtained. Using the Student-Fisher t and testing for a definite, over-all relationship between the variables, a positive correlation is found at the 5% level of confidence.

The abilities in spontaneous speech and auditory verbal comprehension correlate more highly with progress ratings than any other language rating of ability. It appears from this that the abilities to comprehend speech and to speak fluently are important assets for good progress in training. This is consistent with earlier evidence that the subjects who had high ratings in speech obtained high scores on the Seashore tests. Also, as Schuell (38) has indicated, the ability to comprehend spoken words seems paramount to recovery of language.

From the negative correlations between progress in auditory verbal comprehension and the ratings of ability one might assume that the ability to improve in the comprehension of speech is dependent on low ratings of ability in the other language skills. While this is true to some extent, i.e. those who were more severely impaired initially showed correspondingly more progress in auditory verbal comprehension, it is felt that the significance of the negative correlations in question can be explained by the fact that those subjects who had high ratings of pre-training ability showed very little impairment of ability to comprehend speech. Consequently those who had good ability in auditory verbal

comprehension showed less progress than those who were more severely handicapped in this area. Those who had difficulty improved, but those who did not have difficulty could not show evidence of progress. Therefore, the best interpretation of the negative correlations between progress in auditory verbal comprehension and language ability seems to be that those who rated high in ability showed less progress in auditory verbal comprehension even though they remained on a higher level of ability throughout the training period.

One is led to wonder about the relatively high negative correlation between ability in calculation and progress in writing.

This is possibly due to the fact that writing is dependent on the ability to verbalize, or that these two skills (writing and speech) require the same basic capacities, whereas the ability to calculate is a form of symbolization not necessarily dependent on verbalization.

Another possible explanation for the negative correlation between ability in calculation and progress in writing is that the rating of ability for calculation was judged on the basis of the aphasic's best modality and may, therefore, not be the same basic function in each individual. The fact that different functional abilities may have accounted for the ability ratings in calculation, may have also accounted for the negative correlation between the variables in question.

This suggests an investigation of the relation between

the ability to grasp mathematical concepts and the ability to express these concepts by the expressive functions, writing and speech.

D. Relationship between motivation and progress in training.--Analyses of the correlation coefficients between ratings of motivation and ratings of progress (Table 3, p. 46) indicate a small but unimpressive positive relationship. The Student-Fisher t test permits one to say, at the 1% level of confidence, that the probability of the two variables being unrelated is only one out of a hundred. While the relationship is in a positive direction, the size of the correlations is significant in only one out of five cases. The correlation between motivation and progress in auditory verbal comprehension is significant at the 1% level of confidence. To explain this, one can only speculate from experience with aphasics that this correlation is probably a reflection of the great effort made by persons with receptive difficulties to know what is going on about them. The desire of receptive aphasics to improve in their ability to understand, as reflected by their serious efforts, seems more intense than that of expressive aphasics to improve in spontaneous speech. Apart from this specific relationship, one must say that the evidence of this study does not support the concept that motivation as rated by the clinician is an important prognostic factor. From Table 2, p. 44, we see that there is no significant relationship between motivation ratings and ratings of ability in language skills.

E. Relationship between intelligence and progress in training.--As was seen in the chapter on results, the evidence of this study does not suggest a significant relationship between estimates of intelligence and any one of the language progress ratings. The test of the Student-Fisher t indicates, at the 1% level of confidence, a positive correlation between the two variables, but the size of the correlation is small enough to be clinically insignificant. (Table 3, p. 46) From Table 2, p. 44, it is seen that the relationship between intelligence and language ability is even more unimpressive than the relationship between intelligence and progress.

One significant correlation is indicated between intelligence and ability in spontaneous speech. From this it is suspected that those with good functional speech are generally less handicapped in other functions including the ability to perform well on the intelligence test used in this study. This aspect of the study supports Goldstein (19) in his opinion that intelligence of brain-injured persons is difficult to measure and that deviations in aphasic performance cannot be explained alone as an intellectual defect. The evidence is also in agreement with Wepman's statements (48, p. 72) that the predictive value of postmorbidity intelligence ratings is very limited. For intelligence scores of aphasic subjects, see Appendix C.

F. Relationship between pre-training seashore scores and post-training seashore scores.--To investigate whether there is a significant difference between pre- and post-training

Seashore scores of aphasic patients a t-test of significant difference between the means of the two sets of scores for each Seashore test was computed. These data are shown in Table 5, p. 50. On the basis of the evidence one must conclude that the results are consistent with the null hypothesis that there is no significant difference between any one of the pre-training Seashore scores and the corresponding post-training Seashore score. This study fails to reveal differences between pre- and post-training Seashore scores. This is consistent with evidence for normal subjects, that successive scores on re-test do not change appreciably.

G. Comparison of language ratings of ability and Seashore scores as prognostic indices.--It has been shown that both language ratings and Seashore scores correlate positively with progress in training. A Student-Fisher t test for a significant difference between two correlations did not reveal a significant difference between the size of any two significant correlation coefficients. Thus, there is not sufficient evidence to conclude that the two sets of correlations are not drawn from equally correlated populations.

Analyzing the data in another way, it is seen that 43% of the correlations between Seashore scores and progress are in a positive direction and at the 10% level of confidence, while only 28% of the correlations between ratings of ability and progress are in a positive direction at the same level of confidence. One must conclude that statistically neither set of correlations can be proven more significant

than the other, but that the odds favor Seashore scores, as the better prognostic index, over ratings of ability. Analyzing the evidence in view of utilizing information of clinical significance, one's attention is drawn to components of ability ratings and components of Seashore results. This seems more significant, from a practical view, than a discussion of whether ratings of ability as a group correlate more highly with progress than the group of Seashore scores. This leads to the conclusion that the Seashore test of time and the language rating of spontaneous speech, in conjunction with each other offer excellent potential as a prognostic index.

Recommendations.--As an outcome of this investigation a study of the question concerning what is involved in the perception of time, or more specifically in the discrimination of tones which differ slightly in duration can be recommended. An account of why aphasics perform as they do on the time test would be considered a significant contribution. While the literature offers but little information in this area, the following can be pointed out. Of time perception Seashore (39, p. 3) indicates that it is one of the basic sensory capacities, by which he means that it is largely inborn and functions from very early childhood. Seashore continues by saying that the perception of time, along with the other basic sensory capacities of pitch, loudness, and timbre, does not vary with intelligence, training, or increasing age, but that it can deteriorate with various changes and experiences in one's life.

Further, the sense of time depends upon the structure of the ear just as acuity of vision depends upon the structure of the eye. Training or maturing will not increase the acuity of the eye, and likewise, no amount of training or maturing will increase the sensitivity of the ear to the perception of time. Seashore adds, however, that training and maturing in both cases can greatly increase the functional scope of these capacities.

But as to what is involved in the perception of variations of time, Seashore gives no more than the meager information above.

Also, in this vein, Goldstein (19, p. 88) emphasizes the problem and lack of knowledge that surround perceptual difficulties. That authorities such as Goldstein recognize the problem, explain it inadequately, and recommend further research, indicates only too well the difficulty which the problem presents for investigation.

At this stage it seems feasible to recommend studies which collect data to further define the problem.

From this study it is recommended that further investigation be conducted among aphasics using the Seashore Measures of Musical Talents. Continued research is specifically recommended with the Seashore Test of time discrimination. A sequel to this study is suggested in which the same subjects are rated according to their progress over a longer period of time, the progress to be compared with their response to the Seashore Test of time. If the same speech experts could be

used, and if the time test could be administered frequently, such measures would serve to refine reliability of results.

A study of the relation between mathematical ability and the ability to express mathematical concepts in speech and in writing was also recommended in the study. (page 58)

CHAPTER VI

SUMMARY AND CONCLUSIONS

This study investigated the prognostic value of the Seashore Measures of Musical Talents when used with aphasic patients. The Seashore measures were administered to an experimental group of twenty-two adult aphasics enrolled in a twelve week intensive speech training program. The tests were given at the beginning of the training session and again at the end of the session. Criterion data in the form of

usage ratings by speech experts were collected to show how the experimental group of aphasics succeeded during training. In order to evaluate the factors of intelligence and motivation on the rate of improvement in speech therapy, the degree of motivation and the level of intelligence were estimated for each subject. Results of the study were drawn from statistical analyses of the relation between test scores, motivation ratings, estimates of intelligence, and progress in training.

Conclusions.--Data of this study support the following conclusions:

1. Aphasics as a group achieve scores on all six Seashore Tests which are considerably lower than could be expected from a random sampling of the normal population.

2. There is a small, unimpressive, positive relation

between the Seashore scores of aphasic patients and estimates of ability in spontaneous speech, reading, writing, calculation, and auditory verbal comprehension.

3. There is evidence of a positive relation between the Seashore scores of aphasic patients and ratings of progress shown in language skills.

4. There is a small, unimpressive, positive relation between motivation and progress in language skills, and between intelligence and progress in language skills.

5. Scores on the Seashore battery obtained by persons with aphasia are not improved by re-test or language training.

6. Ability in spontaneous speech appears to be an important prognostic factor in recovery from language impairment.

7. The Seashore test for time discrimination is the only one of the six Seashore tests that discriminates among aphasic patients according to abilities in language functions.

8. The Seashore Test for time discrimination offers a prospect of being valuable both in diagnosis of aphasia and estimations of prognosis with aphasic patients.

9. The Seashore Test of time and the language rating of spontaneous speech each have prognostic value. These factors, in conjunction, offer good potential as a prognostic index.

APPENDIX

APPENDIX A. VITAL STATISTICS FOR EACH SUBJECT

Subject	Age	Diagnosis of Type of Aphasia	Time Between Injury and Beginning of Therapy	Cause of Injury	Pre-Morbid Occupation
R.B.	51	Exp.-rec.	8 mos.	CVA*	Businessman
W.B.	51	Exp.	8 mos.	"	"
N.B.	41	Exp.-rec.	2 yrs.	"	Printer
J.B.	55	Exp.	10 yrs.	"	Tool & Dye Maker
C.B.	60	Exp.-rec.	2 mos.	"	Professor
G.G.	46	Exp.-rec.	1 yr.	"	Welder
C.G.	24	Exp.-rec.	8 mos.	"	Factory Worker
R.H.	52	Exp.-rec.	2 yrs.	"	Hospital Supt.
T.J.	38	Exp.-rec.	8 mos.	Anoxia	Vocational Counselor
R.M.	30	Exp.-rec.	3 mos.	Combat Injury	Student
V.M.	60	Exp.	2 yrs.	CVA	Butcher
C.M.	50	Exp.-rec.	1½ yrs.	"	Farmer
S.M.	52	Exp.-rec.	2 yrs.	"	Civil Engineer
V.R.	16	Exp.-rec.	3 wks.	Gun Shot Wound	Student
C.R.	40	Exp.-rec.	4 mos.	Auto	Mechanic
A.S.	45	Exp.-rec.	2 yrs.	CVA	Physician
G.T.	24	Exp.-rec.	2 yrs.	Auto Accident	Student
S.T.	47	Exp.-rec.	1 yr.	CVA	Lawyer
C.W.	46	Exp.-rec.	4 mos.	"	Transportation Dispatcher
S.W.	46	Exp.-rec.	6 mos.	"	Minister
R.W.	22	Exp.-rec.	6 mos.	Combat Injury	Student
H.W.	62	Exp.-rec.	2 yrs.	CVA	Lumberman

*Cerebral Vascular Accident.

APPENDIX B. PRE-TRAINING AND POST-TRAINING SEASHORE SCORES

Subject	Pre-Training Seashore Scores						Post-Training Seashore Scores					
	Pitch	Loudness	Rhythm	Time	Timbre	Tonal Memory	Pitch	Loudness	Rhythm	Time	Timbre	Tonal Memory
1.	39	46	28	42	36	21	39	35	26	35	33	24
2.	42	49	26	46	31	25	35	47	24	43	38	10
3.	39	39	19	36	34	24	48	44	24	29	33	25
4.	32	31	16	27	32	9	26	33	12	27	28	11
5.	31	37	17	33	41	13	31	41	22	31	41	14
6.	26	32	18	33	32	15	42	45	21	40	33	16
7.	26	37	18	36	30	11	36	37	17	37	40	10
8.	37	45	21	36	38	20	38	43	23	36	32	23
9.	28		18	26	35	11	37	40	21	40	38	16
10.	33	35	27	35	36	20	38	34	26	42	35	23
11.	21	27	18	28	26	7	29	43	18	40	29	13
12.	24	40	23	36	28	11	34	42	21	37	30	6
13.	45	40	19	28	34	10	32	30	23	26	31	11
14.	34	39	20	27	38	24	32	34	26	35	34	21
15.	32	39	20	27	38	24	32	34	26	35	34	21
16.	33		25	23	29		31		23	30	30	
17.	42	39	23	39	32	30	41	37	23	32	34	27
18.	27	40	21	31	42	18	37	32	22	41	31	17
19.	29	25	22	28	36	17	29	32	26	35	29	15
20.	43	45	23	37	33	23	41	41	22	42	38	27
21.	44	46	24	47	41	27	48	47	23	40	39	28
22.	27	23	19	23	32	12	32	34	22	34	31	14

APPENDIX C. APHASIC INTELLIGENCE SCORES ON THE NON-LANGUAGE
MULTI-MENTAL TEST

Subject	Form B	Form A	Average of A & B
R.B.	75	86	80 ¹
W.B.	93	111	103
N.B.	86	111	100
J.B.	70	80	75
C.B.	82	105	95
G.G.	64	77	69
C.G.	68	96	80
R.H.	73	67	69
T.J.	67	77	71
R.M.	89	96	93
V.M.	58		65 ²
C.M.	64	80	70
S.M.	96	93	95
V.R.	86	93	89
C.R.	70	96	81
A.S.	75	77	76
G.T.	86	105	96
S.T.	108	105	107
C.W.	93	120	107
S.W.	67	80	73
R.W.	93	120	107
H.W.	75	103	87

¹The average of Forms A and B was used in the computation of the correlation coefficients.

²This subject did not take Form A, which was administered four weeks after Form B. His average I.Q. was based on his I.Q. for Form B, plus the adjusted rating of the difference between the means of the two forms of the test.

BIBLIOGRAPHY

1. Aita, J. A. "Modern Considerations of the Man with Brain Injury," Journal of Neurosurgery, 1947, 4, 240-254.
2. Anderson, J. "Aphasia from the Viewpoint of a Speech Pathologist," Journal of Speech Disorders, IX, Sept., 1944, 209-226.
3. Anderson, J. "Is is not the Verb for Aphasia," Journal of Speech Disorders, 7, Dec., 1942, 289-292.
4. Bastian, H. D. "The Brain as an Organ of the Mind," London, Kegan Paul, Trench, Trubner & Co., 1880, p. 68, cited by Wepman, J., Recovery from Aphasia, New York, Ronald Press Co., 1951, p. 9.
5. Broca, Paul. "Nouvelle Observations d'aphemie produit par une lesion de la troisieme circonvolution frontale," Bulletin Societe Anatomique de Paris, 36, 2me serie, Nov., 1861, 393, cited by Wepman, J., Recovery from Aphasia, New York, Ronald Press Co., 1951, p. 9.
6. Broca, Paul. "Remarques Sur le Siege de la faculte du langage articule suivie d'une observation d'aphemie," Bulletin Societe Anatomique de Paris, 36 2me serie, August, 1861, 331, cited by Wepman, J., Recovery from Aphasia, New York, Ronald Press Co., 1951, p. 9.
7. Brown, I. "Abstract and Concrete Behavior of Dysphasic Patients and Normal Subjects on the Goldstein-Scheerer Tests," Unpublished Ph. D. dissertation, Department of Speech, University of Michigan, 1953.
8. Brown, J. and Schuell, H. "A Preliminary Report on a Diagnostic Test for Aphasia," Journal of Speech and Hearing Disorders, 1950, XV, 21-28.
9. Butfield, E. and Zangwill, O. L. "Re-education in Aphasia, A Review of Seventy Cases," Journal of Neurology, Neurosurgery, and Psychiatry, IX, (New Series), No. 2, April, 1946.

10. Charcot, J. M. and Pitres, A. Centres moteurs corticaux chez l'homme, Paris, Reuff et Cie, 1883, p. 27, cited by Wepman, J., Recovery from Aphasia, New York, Ronald Press Co., 1951, p. 9.
11. Charcot, J. M. and Pitres, A. Etude Critique et Clinique de la localization matrices, Paris, F. Alcan, 1883, p. 218, cited by Wepman, J., Recovery from Aphasia, New York, Ronald Press Co., 1951, p. 9.
12. Cobb, S. "Personality as Affected by Lesions of the Brain," In: Personality and the Behavior Disorders, J. M. Hunt, Ed., New York: The Ronald Press Co., 1944, 1, 550-581.
13. Cronbach, L. J. "Essentials of Psychological Testing," New York, Harper and Brothers, 1949.
14. Denny-Brown, D. "Disability Arising from Closed Head Injury," Journal of the American Medical Association, 1945, 127, 429-436.
15. Eisenson, J. "Aphasics: Observations and Tentative Conclusions," Journal of Speech Disorders, 1947, XII, 290.
16. Eisenson, J. Examining for Aphasia and Related Disturbances, The Psychological Corporation, 522 Fifth Avenue, New York, 1946.
17. Frazier, C. H. and Ingham, S. D. "A Review of the Effects of Gunshot Wounds of the Head," Archives of Neurology and Psychiatry, 1920, III, 17-40.
18. Goldstein, K. After Effects of Brain Injuries in War, New York: Grune and Stratton, Inc., 1942.
19. Goldstein, K. Language and Language Disturbances, New York: Grune and Stratton, Inc., 1948.
20. Goldstein, K. and Scheerer, M. "Abstract and Concrete Behavior," Psychological Monographs, 1941, LIII, 329.
21. Granich, L. Aphasia: A Guide to Retraining, New York: Grune and Stratton, Inc., 1947.
22. Greenblatt, M., Levin, S. and Atwell, C. "Comparative Value of Electroencephalogram and Abstraction Tests in Diagnosis of Brain Damage," Journal of Nervous and Mental Diseases, 1945, CII, 383-391.

23. Halstead, W. C. Brain and Intelligence: A Quantitative Study of the Frontal Lobes, Chicago: University of Chicago Press, 1947.
24. Head, H. Aphasia and Kindred Disorders of Speech, New York: The MacMillan Co., 1936.
25. Hebb, D. O. "Man's Frontal Lobes," Archives of Neurology and Psychology, 1945, LIV, 10-24.
26. Henschen, S. E., cited in Weisenburg and McBride, Aphasia, New York, Commonwealth Fund, Inc., 1935.
27. Huber, M. "Re-Education of Aphasics," Journal of Speech Disorders, Dec., 1942, 7, 289-292.
28. Kennedy, Foster, Wolf and Alexander, "The Relationship of Intellect to Speech Defect in Aphasic Persons," Journal of Nervous and Mental Disorders, 1936, 84: 125-145, 293-311.
29. Knight, M. Rating Scale for Estimating the Functional Level of Adults with Aphasia, Unpublished rating scale, University of Michigan Speech Clinic, 1951.
30. Larsen, R. C. "Studies on Seashore's Measures of Musical Talent," University of Iowa Series, Aims and Progress of Research, 1930, 2.
31. McNemar, Q. Psychological Statistics, John Wiley and Sons, Inc., New York, 1949.
32. Meyers, R. "Aphasia: A Problem in Differential Diagnosis and Re-education," Quarterly Journal of Speech, 1937, XXIII, 357-377.
33. Mills, C. K. "Treatment of Aphasia by Training," Journal of the American Medical Association, XLIII, 1904, 1940.
34. Nielsen, J. M. Agnosia, Apraxia, Aphasia, New York, Paul B. Hoeber, Inc., Medical Book Dept. of Harper Bros., 1946.
35. Nielsen, J. M., Schultz, D. A., Corbin, M. L. and Crittsinger, A. "The Treatment of Traumatic Aphasics of World War II at Birmingham General V. A. Hospital," The Military Surgeon, Vol. 102, No. 5, May, 1948, 351-364.
36. Robbins, S. D. "Examination and Re-education of Aphasics," Journal of Speech Disorders, IV, 1938, 15-24.

37. Russell, W. R. "The After Effects of Head Injury," Edinburgh Medical Journal, 1934, 41, 129-141.
38. Schuell, H. "Aphasic Difficulties Understanding Spoken Language," Neurology, Vol. 3, No. 3, March, 1953, 176-184.
39. Seashore, C. E. Psychology of Music, McGraw-Hill Book Co., Inc., New York and London, 1938.
40. Seashore, C., Lewis, D. and Saetveit, G. Manual of Instructions and Interpretations for the Seashore Measures of Musical Talents, Educational Department, RCA Manufacturing Co., Inc., Camden, New Jersey, 1939.
41. Simon, C. T. "Comments on Testing Aphasia in the Speech Clinic," Journal of Speech Disorders, 1946, 11, 139-141.
42. Symonds, C. P. "Closed Head Injuries," Journal of the Royal Army Medical Corps, 1941, 76, 320-329.
43. Symonds, C. P. "Prognosis in Closed Head Injuries," British Medical Bulletin, 3, 1945, 14-18.
44. Terman, E., McCall, W. and Lorge, I. Directions for Non-Language Multi-Mental Test, Forms A and B, Bureau of Publications, Teachers College, Columbia University, New York.
45. Tooth, G. "On the Use of Mental Tests for the Measurement of Disability after Head Injury," Journal of Neurology, Neurosurgery, and Psychiatry, X, (New Series), No. 1, 1-11, Feb., 1947.
46. Wechsler, D. "Psychological Diagnosis," in Wechsler, I. S., A Textbook of Clinical Neurology, (7th Ed.), Philadelphia, W. B. Saunders Co., 1952.
47. Weisenburg, T. H. and McBride, K. E. Aphasia, New York: Commonwealth Fund, Inc., 1935.
48. Wepman, J. M. Recovery from Aphasia, New York: Ronald Press Co., 1951.
49. Wernicke, C., cited in Weisenburg and McBride, Aphasia, New York, The Commonwealth Fund, Division of Publications, 1935, p. 10.
50. Yacorzynski, G. K. "Modern Approach in the Study of Aphasia," Journal of Speech Disorders, VIII, 1943, 349-353.