AN INVESTIGATION OF THE RELATIONSHIP BETWEEN MEASURED INTELLIGENCE AND PERFORMANCE ON THE STAGGERED SPONDAIC WORD TEST

By

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CHAPTER I

INTRODUCTION

Within the past ten years numbers of speech and hearing specialists have been concerned with various aspects of hearing testing with mentally retarded populations; however, no information has been published on the utilization of specialized audiological procedures for assessing the "central auditory" (as opposed to peripheral auditory) functioning on this type of population. More specifically, no systematic data has been accumulated on the application of the Staggered Spondaic Word (SSW) test with the mentally retarded.

The purpose of this study was to compare the relationship between mean scores on the (SSW) test and levels of measured intelligence (MI). More specifically, an attempt was made to determine how three groups of institutionalized mentally retarded adults (borderline, mild and moderate retardation) compared with each other on SSW test performance. It was felt that this information would be of value in helping to establish norms for retarded adults on the SSW test.

This chapter is concerned with a brief description of the concept of mental retardation, how the retarded are medically classified according to the standards of the American Association on Mental Deficiency (AAMD), a selected review of audiological

procedures for assessing "central auditory" disorders, and the scope and limitations of the study.

The Concept of Mental Retardation

The concept of mental retardation is extremely difficult to define. Is a forty-five year old male whose individual intelligence test scores show that he is functioning on the same level as a three year old actually comparable to an intellectually normal three year old child? Certainly the three year old child does not need to shave, nor has he the muscular coordination or strength to bail hay. Their mental ages would be the same, but their interests usually differ as well as their physical abilities. Yet, the forty-five year old retarded male is unlike an intellectually normal adult of the same age. The normal adult can generally drive a car and read road signs; the retarded individual's judgment and ability to read would not permit such a task as driving safely.

Many people in various professions have been concerned with the question of what mental retardation actually is or is not. Within the past ten years a large quantity of research has been initiated in this area; however, relatively little is known about the retarded individual; especially the mentally retarded adult. With further research in medicine and allied areas, causes and perhaps "cures" may be found for numbers of retarded individuals.

The American Association on Mental Deficiency's Classification System in Mental Retardation

It is felt that the following explanation about the AAMD classification system in mental retardation (Refer to Appendices A and B) be reviewed to facilitate the reader's understanding of this paper. This system is currently being used at Winfield State Hospital and Training Center, where this study took place, as well as in similar institutions throughout the United States.

Under the direction of AAMD, Heber completed the monumentous task of organizing an etiological classification code system in mental retardation. He organized the possible primary medical causes into eight major categories with numerous sub-categories. The major categories are as follows: (Heber 1961, pp. 10-12)

> I. Mental Retardation Associated with Diseases and Conditions Due to Infection...Rubella...; II. Mental Retardation Associated with Diseases and Conditions Due to Intoxication...encephalopathy due to toxemia of pregnancy...; III. Mental Retardation Associated with Diseases and Conditions Due to Trauma...anoxia at birth...; IV. Mental Retardation Associated with Diseases and Conditions Due to Disorders of Metabolism, Growth or Nutrition...phenylketonuria [PKU]...; V. Mental Retardation Associated with Diseases and Conditions Due to New Growths...intracranial neoplasm...; VI. Mental Retardation Associated with Diseases and Conditions Due to (unknown) Prenatal Influence...hydrocephaly or mongolism...; VII. Mental Retardation Associated with Diseases and Conditions Due to Unknown or Uncertain Cause with the Structural Reaction Manifest; VIII. Mental Retardation Due to Uncertain (or Presumed Psychogenic) Cause with the Functional Reaction Alone Manifest... cultural familial mental retardation...

As a further explanation about the last category, Heber (1962, pp. 240-241) stated:

> The eighth category, however, is reserved for the classification of those cases where after exhaus-

> tive evaluation, there is no indication of organic disease or pathology which could reasonably account for the mental retardation; and for the classification of those cases where the mental retardation presumably is associated with psychological rather than biological variables...

Furthermore, individuals who are classified in the eighth category and whose retardation is ascribed to cultural-familial causes are coded by Heber as 81's. Those in this category whose retardation is considered to be of uncertain causes with the functional reactions alone manifest are classified as 89's (Heber 1961, p. 12) (For additional information on the "Expanded Medical Classification" refer to Appendix A.)

Because a primary medical diagnosis may not fully describe the retarded individual, Heber (1961, pp. 13-17) developed a supplementary classification code system:

> 10 Genetic Component..., 20 Secondary Cranial Anomaly..., 30 Impairment of Special Senses..., 40 Convulsive Disorder..., 50 Psychiatric Impairment..., and 60 Motor Dysfunction.

If the examination of a patient revealed no impairments in any of the preceding, his supplementary classification code would be 10-20-30-40-50-60. The appropriate 0(s) would be exchanged for a number(s) or the symbol "x" for a specific impairment(s). For example, the supplementary code of a patient displaying only grand mal seizures would be 10-20-30-44-50-60. (For further information on the Supplementary Classification System see Appendix B.)

To describe the intellectual functioning of the mentally retarded individual in more definite terms than idiot, imbecile and moron and yet group them according to general intellectual

abilities, Heber (1961, p. 58) constructed five levels of measured intelligence (MI) based upon standard deviations from the norms. These are -1 or borderline retardation, -2 or mild retardation, -3 or moderate retardation, -4 or severe retardation and -5 or profound retardation.

The corresponding IQ ranges and standard deviations are listed in Appendix C.

A Selected Review of Audiological Procedures for Assessing Central Auditory Integrity

According to Katz (1962, p. 327):

> The literature consistently reveals that conventional pure-tone and speech audiometry do not identify 'cortical hearing' impairments. Audiologically, hearing disorders of this type may be uncovered by demanding the evaluation of unusually difficult material by the patient. In so doing, a heavier burden is placed upon the higher auditory mechanism. Weakness in integrative behavior is manifested in the inability to utilize the stimuli appropriately.

An analysis of the literature suggests that there are four major audiological procedures for identifying "central auditory" lesions utilizing speech stimuli. Katz (1968a, p. 133) succinctly identified these as follows:

> ...Distorted speech materials delivered in a monaural mode were the first central speech tests to be employed. The distortion may be accomplished by acoustic filtering, low fidelity, and other means. A second technique is time distortion. Speech which is speeded up or slowed down falls into this category. The third major category is that of supplementary messages, or integration. These methods usually require the listener to combine binaural sources of information in order to obtain an accurate response. A fourth approach to uncovering central auditory disorders is the competing message technique or separation. These methods are usually binaural. Independent signals are presented in an overlapped fashion.

> One or both of the messages may be required of the listener. These four groups of tests may have many modifications and combinations thus offering an infinite variety of techniques. Presumably, many cortical and subcortical centers might be identified by appropriate assortment of auditory tests.

The SSW test utilizes the competing message technique and has been found to be effective in detecting "central auditory" disorders. (Katz, 1962, Katz et al, 1963, Katz, 1968a, Katz, 1968b).

From a pilot investigation of the SSW test on twenty normal hearing subjects, six unilateral head trauma subjects with normal hearing, five conductive hearing loss subjects, and ten sensory-neural hearing loss subjects, Katz et al (1963, p. 916) found:

> The individuals with unilateral head trauma exhibited considerable difficulty on the SSW test especially in the ear contralateral to the injury. These findings agree with the results found by other investigators using different tests of higher auditory function and thus tend to support the theoretical considerations upon which the present test is based. Control subjects had essentially no difficulty on the proposed test. Children as young as eight years of age responded without apparent difficulty. Patients with conductive hearing losses behaved as did the normals of the SSW test. This suggests that hearing loss per se is not sufficient to interfere with the analysis of CNS function. Individuals with sensorineural hearing losses along with word discrimination losses of moderate to severe degree demonstrated reduced ability on the SSW test. Thus, it appears that the SSW test, in its present form, is resistent only to mild or perhaps moderate peripheral distortions.

Since the pilot study, Katz has tested over six hundred individuals who ranged in age from five to eighty years. These individuals have included both normals as well as those with a wide variety of problems (Katz, 1968a). Katz has also reported

in various articles that test scores on the SSW can be corrected for speech sound discrimination losses by subtracting the raw SSW score from the speech discrimination score for each ear. He designates this score as C-SSW. Furthermore, Katz (1968a, p. 139) has established tentative norms for the C-SSW test scores. The upper limits for the total C-SSW are as follows (Katz 1968a, p. 139): normal = 5% error, mildly abnormal = 15% error, moderately abnormal = 35% error and severely abnormal = 100% error. He (Katz 1968b, p. 21) also found that subjects with no measureable neurological impairments between the ages of 11 and 60 years of age displayed no more than five per cent error on the total C-SSW test score and that children as young as five years of age could respond to the SSW test. Furthermore, a patient whose test results showed a C-SSW total score of 15% (error) or more was very likely to have "central auditory" dysfunction if the factors of lack of cooperation and motivation could be ruled out (Katz 1968a, p. 140).

Turner used the SSW test (ED-2 test form) with school children and adults. She found: (Turner pp. 35-36):

(1) Normal performance on the SSW test is considered 5% or fewer errors on the non-competing and 13% or fewer errors on the competing conditions. These percentages are based on corrected error scores.
(2) Normative data for this study does not apply to groups of children twelve years and younger.
(3) There is no significant difference in performance of boys or girls.
(4) There is no significant effect of socio-economic condition on the SSW test.

Myrick used the SSW test on a group of children aged 7 through 11. She (p. 23) found that 10 years seemed to be a

transitional level between the performance of children and adults, and by the age of 11 children reach the adult level. In addition, she found that there was no significant difference between male and female subjects even as young as 7 years. In view of Katz's 5% criterion of normal, however, all of Myrick's groups with the exception of the 7 year olds (whose C-ssw score was 11 [p. 26]) functioned within this range.

Katz et al (1966) reported on the application of this test on cerebral palsied individuals. They found that normal responses (less than 5% error) were seen in these subjects at the age of 16 years or five years after normal subjects met this criterion.

From a review of the literature, two studies (which are reported below) were found in which dichotic listening techniques were employed; however, these authors were not attempting to assess the "central auditory" process.

Neufeldt (1966, p. 1), using Broadbent's dichotic listening technique to investigate short-term memory, found that mentally retarded adolescents of "organic" origins and of "cultural-familial" origins performed essentially the same as normal controls equated on mental age, but inferior to those equated on chronological age. In addition, Neufeldt (1966, p. 1) stated:

> ...both normal groups demonstrated a marked degree of flexibility in their adaptation of different strategies of recall to various rates of informational input, and ability in using more ambiguous strategies. Such flexibility was not found in the retardates. Differences between the two normal control groups, on the other hand, were indicative of the degree to which both memoric capacity and ability to make use of useful strategies develops in normal individuals over time.

In dichotic listening situations, Jones and Spreen (1967a, p. 101) found that concrete words were significantly better recalled than abstract words by a group of educable mentally deficient children whose age range was between 6 and 12 years and whose IQ ranged from 69 to 95. Furthermore, they found (Jones and Spreen 1967a, p. 102) that the performance level between sexes was almost identical.

At the present time, no systematic investigation has been made with the SSW test on mentally retarded individuals. Furthermore, a review of the literature on the use of other audiological procedures for assessing the "central auditory" function reveals no research on their application with mentally retarded children or adults.

Scope and Limitations of the Study

This study was designed to accumulate data on the relationship between the SSW test scores and levels of measured intelligence. It should be pointed out, however, that this investigation was based upon a select sample of institutionalized retarded adult individuals, specifically those who were residents of Winfield State Hospital and Training Center, and to infer that all retarded adults either in or out of institutions would function in the same way or manner on this test would only be speculation.

Other limitations were inherent in this study. One was the accuracy and completeness of the data reported in the clinical files by physicians and social workers, as well as individuals

in other professions.

It was also possible that the levels of medication may have interfered with the assessment of measured intelligence, reflex activity or even with the SSW test performance of the subjects used in this investigation.

To more accurately assess the effects of measured intelligence on the SSW test scores, each individual selected should have had a complete neurological examination, including an electroencephalogram (EEG) prior to the administration of the SSW test. Staff time and cost prohibited such an examination for each individual.

The investigator attempted to partially overcome the limitations previously mentioned by carefully screening information on approximately 890 adult mentally retarded patients residing at Winfield State Hospital and Training Center and choosing only those individuals who appeared to display the least neurological risk (in terms of reflex activity, skull x-ray, EEG and developmental history).

CHAPTER II

METHODS AND PROCEDURES

This chapter includes a description of the conditions under which the investigation was conducted and the procedures which were employed. The subjects and test instruments, as well as the hypothesis tested in this study will be discussed. In addition, the treatment of the data will be described.

Selection of Subjects

For the purposes of this study as well as for possible future research, the investigator obtained and recorded the following information on the adult mentally retarded patients (approximately 890) residing at Winfield State Hospital and Training Center (between January and June, 1968): Date of birth, primary and supplementary medical classification code and MI level (See pages 3-4 for information regarding the AAMD Classification Code System).

From this list only those patients whose primary classification code placed them in the VIIIth category, whose supplementary classification revealed no known neurological deficits, and whose age ranged between 20 and 45 years were considered. One hundred twenty patients met this criteria.

The clinical files on these patients were reviewed by the

author, and the following available information on each individual was recorded on large index cards: prenatal, paranatal and postnatal histories; medical information, including interpretations of skull x-rays and EEG's, reflex activity as well as medication and dosage; intelligence tests and results; educational background and estimated grade placement; personality description; plus other pertinent information.

The clinical files on only two of the one hundred twenty patients revealed sufficient and negative case history and medical information to rule out possible negative effects on the SSW test scores. Because of the inadequate population size (N = 2) of the ideal group, forty-four patients who appeared to display the least possible neurological risk (in terms of reflex activity, skull x-ray, EEG and developmental history) were chosen for an audiological evaluation.

Due to the possible negative effects on the SSW test results of peripheral hearing disorders, patients were also excluded from this investigation if they did not display reasonable normal hearing sensitivity in both ears; i.e., speech reception thresholds (SRT) poorer than 20 dB (re: 22dB SPL) (Davis, p. 193) and speech discrimination scores of less than 88% (Carhart, 1964). Six of the forty-four patients failed to meet this criteria.

In addition, nine individuals (eight MI level -4 and one MI level -3) were excluded from the investigation because of unintelligible speech or lack of adequate responses to the audiometric testing situations.

Two MI level -4 patients (out of ten) were able to appropriately respond to all phases of testing, including the SSW test; however, they were excluded from this study because of their small sample size (N = 2) and their atypical performance of their group.

The remaining twenty-seven patients met the various criteria previously established and were selected as subjects. They included four MI level -1 patients (whose IQ's ranged from 80 to 72), fourteen MI level -2 patients (whose IQ's ranged from 65 to 55), and nine MI level -3 patients (whose IQ's ranged from 49 to 41).

Although subjects were included if their SRT's for either ear were as great as 20dB (re: 22dB SPL), only three subjects were found to have an SRT for either ear greater than 12dB. It might be noted that the approximate combined mean SRT for both ears was 3.5dB for the MI level -1 subjects, 4.5dB for the MI level -2 subjects, and 2.5dB for the MI level -3 subjects.

The speech discrimination scores for the total group ranged from 100% to 88%. The approximate combined mean score for both ears was 96% for the level -1 subjects, 96% for the level -2 subjects and 93% for the level -3 subjects.

Subjects were not restricted because of sex (eight were females and nineteen were males). Neither were they excluded because of personality characteristics, length of institutionalization, family background, left handedness or medication level.

Ideally, the subjects selected for this investigation should have been free from all known neurological anomalies,

have had a negative developmental background and have been on no medication. Fourteen of the subjects were receiving tranquilizers at the time of testing. Ten subjects were considered to have normal EEG's, but no record of this test was found on the remaining seventeen subjects. In six cases, reflex activity was reported to be either slightly hyperactive, slightly hypoactive or conflicting information was recorded in the clinical files. (Note: Hyperactive or hypoactive reflexes may be related to the side effects of medication, to well established behavioral patterns or to neurological disorders.) Nine subjects also had questionable developmental histories.

In conclusion, the subjects in this investigation were considered to display the least neurological involvement of the total adult patient population residing at Winfield State Hospital and Training Center, to possess normal peripheral hearing, to be young adults (20 to 45 years), as opposed to an adolescent or old aged population and to have intelligible speech. If any of these factors had been varied it is possible that they would have produced adverse effects on the SSW test performance.

Description of the Staggered Spondaic Word Test

Prior to this study, the investigator administered the SSW test to a number of patients who represented the four MI levels. These patients were ambulatory adults (20-45 years of age) who possessed "normal" peripheral hearing, and had intelligible speech. They did not necessarily meet all the criteria established for the subjects in this investigation. The purpose of

this pilot investigation was to determine whether or not retarded adults could take the SSW test and what problems might be encountered in its administration.

From the pilot investigation, it was observed that retarded adults could respond appropriately to the SSW test if the vocabulary for the instructions was kept on as simple a level as possible, if sufficient time was allowed for conditioning to instructions and if ample praise was given.

The SSW test has many desirable features according to Katz et al (1963, pp.909-910). He identified these as follows:

> The stimulus material and the structural makeup of this procedure might well provide a reliable and versatile means of investigating higher auditory behavior. Methods for assessing cortical hearing which are oblivious to peripheral hearing loss or to other unrelated individual differences have important attributes for clinical diagnosis. Procedures with high reliability are of considerable value for both clinical and research purposes. In addition, techniques which provide a number of independent scores are potentially capable of offering finer distinctions among various sites of lesions.

Furthermore, Katz and Young (1968, p. 1) presented the following rational for the application of the SSW test with the mentally retarded:

> At the present time there is no central auditory test which has well defined norms for clinical use. In addition, most of these techniques are too difficult for use with retarded patients, particularly those with -2 and -3 measured intelligence levels. Katz, (1968) has presented tentative norms for the SSW test for a large population of normal, brain damaged and hearing impaired patients, all with reasonably normal intelligence. Thus far, the test has been used clinically in many hearing centers. It is the consensus that the test stands up well as an indicator of central dysfunction despite the presence of impaired intellectual functioning. One of the important needs in establishing a useful clinical tool is to determine the normative limits. This has been particularly simple with the SSW test because of the

> lack of overlap between the normal subjects and those with central auditory lesions. In addition, the test seems to have considerable retest reliability...

The SSW test as described by Katz et al (1963, p. 910) is as follows:

> ...the SSW test is composed of 40 items. Each item is made up of two spondaic words such as upstairs and downtown. One spondee is presented to each ear in a partially overlapping fashion. That is, the second monosyllable of the initial spondaic word and the first monosyllable of the second spondaic word are transmitted simultaneously to opposite ears. The ear receiving the initial word is alternated. The presentation of an item may be diagrammed as follows:

	Time Sequence		
	1	2	3
Right ear	up	stairs	
Left ear		down	town

In addition Katz (1968b, p. 21) stated:

> The patient is expected to repeat both spondees, starting with the time sequence #1. While this procedure might appear rather difficult and complex, the normal listener experiences very few, if any errors. Our present norms indicate no more than 5% error for control subjects 11 through 60 years of age Katz, 1968 . A correction is made for reduced proficiency on standard speech discrimination tasks, such as the W-22 word lists. Patients with discrimination problems and hearing loss can also be evaluated using this correction. Thus far, after correction for word discrimination, only patients with central auditory disorders have shown more than 15% error on the total test.

Four practice items preceding the forty test items are presented to each individual tested. These are non-competing spondees. The first spondee is presented to the right (or left) ear and the second spondee to the opposite ear. The ear receiving the initial spondee is alternated on the practice as well as the test items. The practice items may be repeated (Katz, instructions, p. 1) until the examiner feels confident the patient understands the directions.

Instrumentation and Materials

All tests were administered in a sound treated auditory testing room (IAC Model 402) within the Speech and Hearing Clinic at Winfield State Hospital and Training Center.

A Grason-Stadler (Model 162) Speech Audiometer and an Electronic Voice (Model 650) microphone and TDH 39 earphones were used for the SRT tests and the Speech Discrimination Tests.

The Collaborative Study of Cerebral Palsy, Mental Retardation, and other Neurological and Sensory Disorders of Infancy and Childhood Speech (CCDPS) Language and Hearing Examination (funded through the National Institutes of Health, U.S. Public Health Service) spondaic word list, was used to obtain the SRT for each ear separately. This test is designed specifically for children who are approximately three years old (chronologically).

The phonetically balanced (PB) words for the speech discrimination tests were taken from the CID W-22 word lists (Hirsh p. 305).

The SSW tape, recorded and produced at Menorah Medical Center in Kansas City, Missouri, by Jack Katz, was played on an Ampex (Model 1000) tape recorder coupled to, fed through and controlled by the Grason-Stadler Speech Audiometer. The test results were recorded on the E-C SSW test form (See Appendix E).

Administration of Tests

The SRT and Speech Discrimination tests were presented by monitored live voice. See Figure 1 (p. 18) for a photographic representation of the administration of these tests.

Figure 1. Administration of the SRT and Speech Discrimination Tests on the Grason-Stradler Speech Audiometer

The peak response for all stimulus words was within ± 2.5dB on the VU meter on the Grason-Stadler Speech Audiometer.

The SRT was defined as the lowest intensity the subject could respond to fifty per cent of the stimulus words presented to each ear (Newby, 1964, p. 112). Spondee words for the SRT test were presented in a descending-ascending technique described by Newby (1964, pp. 118-120). The carrier phrase, "say the word" and the PB words for the speech discrimination test were presented at a sensation level of +50dB above the subject's SRT for each ear. (Note: The sensation level of +50dB was used because the SSW was administered at this level.)

The SSW test was presented at a sensation level of +50dB for each ear (Katz, instructions, p. 1). (Note: According to Balas and Simmons 1965, p. 288 +50dB is the maximum performance level for this test.)

For the entire testing period, each subject was seated in the IAC model 402 sound treated testing room facing the two-way mirror.

Before the earphones were placed on the subject, he was given the following instructions for the SRT test. "I am going to say some words to you. They will become softer and softer. You might have to guess at some of the words because they will be hard to hear." (It must be noted that the instructions for this test as well as for the other tests were kept on a simple vocabulary level to insure the subject's understanding of the instructions.) When it was felt that the subject was anxious or confused, a few practice words were given in a face to face sit-

uation before the earphones were placed on the subject. The examiner then shut the door, returned to the control room and reinstructed the subject.

Ideally, the examiner should have had a clear view of his subject's face through the two-way mirror, but from past experience the author felt it often critical that the subject retain some form of visual contact with the examiner; therefore, the light in the control section generally remained on for all tests. To avoid speech reading during testing, the examiner's mouth was shielded from the subject.

Preceding the administration of the speech discrimination test, the subject was usually verbally praised for his performance on the SRT test (for example, the examiner said, "You did a good job".). Then he was instructed: "Now I am going to say some words which you will be able to hear better. Listen carefully and say the word after me." If the subject repeated the carrier phrase, he was reinstructed and told, "You do not need to repeat 'say the word'. That is just to help you listen to the word I want you to say."

At the discretion of the examiner and following the speech discrimination test, the earphones were removed and the subject was allowed to stretch or get up for a drink of water if he appeared fatigued or restless.

The earphones were then carefully replaced on the subject by the examiner. Then the examiner returned to the control section where the subject was given the following information regarding the taped SSW test instructions and the test itself:

"Now a man is going to say some words to you. Listen carefully and say all of the words back to me. Now he will tell you what to do, so listen. I will point to you when I want you to say the words."

The recorded instructions were as follows:

> You are going to hear a group of words which will be presented to one or both of your ears. Wait until the group of words is completed and then repeat all of the words that you heard. If you are not quite sure of a word, guess. The first four groups will be for practice. Remember, wait until you have heard all of the words before answering.

If the subject repeated or answered the carrier phrase ("Are you ready?") on any of the practice items, he was told, "You are doing a good job, but you don't need to say 'are you ready' (or answer 'yes' to the question). The man is just saying that so you will be ready to listen to the words. I will point to you when I want you to say the words." Sometimes the author would also cover her own mouth when the subject was hearing the carrier phrase. This seemed to help him follow the directions.

If the subject began repeating the practice words before they were completed, he was instructed as follows: "You will hear better if you listen to all of the words. I'll point to you when I want you to say the words." If the subject's difficulty persisted, he was told: "I am going to say the words the man just said. Don't talk until I point to you."

On a few occasions, conditioning on the practice words required ten to fifteen minutes. Verbal and gestural praise were given for accomplishments in following instructions. The failure to condition to instructions after 15 minutes of practice resul-

ted in the exclusion of the patient from this study.

If it was felt that the subject was becoming frustrated because of his errors during the SSW test, he was told: "I know how you feel about taking this test. I took it. It was hard for me too. I missed a few words - everyone does. You are doing a good job." (Note: A score of 100% is not uncommon for individuals with no known "central auditory" disorders Katz, 1968a, p. 138 however; these comments, along with periodic verbal and gestural praise, seemed to encourage the subject to continue the task.)

Treatment of the Data

This study was concerned with the relationship between mean scores on the SSW test and levels of measured intelligence. This study sought to investigate the following question: How do three groups of institutionalized mentally retarded adults (MI level -1, MI level -2, and MI level -3) compare with each other on the C-SSW test? (Note: For the purposes of this study, the SSW test score for each subject was corrected for speech discrimination. See page 7 for the computation of the C-SSW.)

To compare the relationship between the means for three groups of institutionalized mentally retarded adults (MI level -1, MI level -2, and MI level -3) the following null and alternate hypotheses were developed and tested at the .05 level of significance.

1. Null Hypothesis: No statistically significant difference exists between means on the C-SSW test for MI level

-1 subjects and MI level -2 subjects. (H_o: $\mu_1 = \mu_2$)
Alternate Hypothesis: A statistically significant difference exists between means on the C-SSW test for MI level -1 subjects and MI level -2 subjects. (H_1: $\mu_1 \neq \mu_2$)

2. Null Hypothesis: No statistically significant difference exists between means on the C-SSW test for MI level -2 subjects and MI level -3 subjects. (H_o: $\mu_1 = \mu_2$)
Alternate Hypothesis: A statistically significant difference exists between means on the C-SSW test for MI level -2 subjects and MI level -3 subjects. (H_1: $\mu_1 \neq \mu_2$)

Two statistical procedures were employed to test the significance of these hypotheses. The F test (as described by McNemar pp. 247-249) was used to determine if there was a significant difference among the pooled mean scores. The obtained value of F was compared with the tabulated F at the .05 level of significance for twenty six degrees of freedom. Kramer's Extension of the Multiple Range Test (Kramer, pp. 307-310) was employed to determine if a significant difference existed at the .05 level between level -1 and level -2 subjects and between level -2 and level -3 subjects.

CHAPTER III

SELECTED REVIEW OF RELATED RESEARCH

A great deal of controversy appears to exist in the literature regarding the relationship between cortical impairment and mental retardation. The answer to this question is of special importance to this investigation because the SSW test is reported to measure "cortical hearing" (Katz, 1968a).

Based upon the medical and case history information obtained from the clinical files on the one hundred twenty adult patients whose AAMD medical classification revealed no known neurological involvement (Refer to pages 13-14), the author felt (in spite of negative AAMD medical classification) it was possible that the majority of these individuals demonstrated some degree of cortical impairment.

Two major approaches have been used to identify cortical impairment in the mentally retarded. These are (1) medical examinations, including EEG's (electroencephalograms measure electrical impulses within the brain), reflex activity and skull x-rays, and (2) individual intelligence test performance on such tests as the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC) and others.

Gibbs et al (1960, p. 246) concluded from their study of EEG patterns on 1118 subjects with IQ's of 80 and below (none of

whom had epilepsy, cerebral palsy or specific etiologies) that: "The high percentage of spike discharges even in the familial group, points to the dominant role of organic factors in the etiology of mental retardation."

Vogel and Broverman (1964, p. 135) critically reviewed the literature on the relationship between EEG and test intelligence. They stated:

> The findings of Netchine et al (1959) and Netchine (1962) suggest that highly significant relationships might well be obtained throughout the range of feeblemindedness by employing electrodes from areas other than the occipital, and by using overall indices which combine measures of frequency, amplitude, and patterning.

Furthermore, Vogel and Broverman reported (1964, p. 135):

> The weight of the evidence, then supports the proposition that a significant relationship exists between intelligence and various aspects of EEG functioning (especially occipital alpha frequency) among feebleminded persons, particularly at the lower ranges of feeblemindedness.

Mathews and Manning compared the relationship between Wechsler-Bellevue scores and three groups of mildly retarded individuals. These subjects were matched on age, sex and academic achievement level and grouped into the three following categories: (1) abnormal EEG, (2) borderline EEG, and (3) normal EEG. "The results indicated that a positive relationship exists between the degree of EEG abnormality and level of psychological test performance in institutionalized retardates." (Mathews and Manning 1964, p. 490) Furthermore, they stated (Mathews and Manning 1964, p. 489) that "Lower intelligence scores were associated with an increased incidence of EEG abnormalities." In addition, Mathews and Manning (1964, p. 490) reported: "...

'exogeneous' classification of retarded are reported to demonstrate verbal test scores superior to those obtained by 'endogeneous'."

Fisher (1960, p. 259) found in his investigation of the WAIS on 508 retarded adults that there was no significant difference between verbal and performance scores for cultural-familial or undifferentiated retardates. He reported, however, that verbal scores were higher than performance scores for a group whose etiologies were due to "central nervous system infections".

Baumeister (1964, p. 192), however, stated:

> It does appear in general, that cultural-familial and undifferentiated retardates score higher on the Performance than on the Verbal Scale. Brain damage subjects appear to perform more evenly across the two scales.

In a comparison of the Verbal and Performance Scores on the WAIS on the subjects in this study, who could also be classified as cultural-familial and undifferentiated, it was noted that the mean Performance score for the total population was eight points higher than the mean Verbal score.

Birch et al compared the WISC intelligence test "patterns" with two groups of educable mentally retarded children. One group showed signs of central nervous system damage while the other did not (1967, p. 247). They concluded that intelligence test patterns on the WISC could not be systematically associated with the presence or absence of brain damage (1967, p. 257). But they stated (1967, p. 256):

> It may be that subnormal mental functioning is a far more sensitive indicator of damaged brain than either the clinical neurological examination or the identification of antecedent conditions of risk. If this

> is so then the whole range of educable mentally subnormal children, including those classified as 'garden variety' or 'familial' have brain defects.

Ellingson (1956, p. 30) concluded from his review of the literature:

> The so-called higher mental processes still appear to be beyond reach. Present neurophysiological techniques do not seem to be adequate to deal with them. Little practical assistance can be offered (by the electrophysiologist) to the psychologist investigating the processes of learning or thinking...

It is difficult to draw conclusions regarding the relationship between cortical impairment and mental retardation because of the methods and procedures employed in the studies reported. At this time there does appear to be a trend towards considering the majority of mentally retarded cortically impaired on the basis of EEG studies. On the basis of individual intelligence tests, however, the question of cortical impairment and mental retardation appears to be unresolved.

CHAPTER IV

RESULTS

This study was developed to compare the relationship between mean scores on the C-SSW test for three groups of institutionalized mentally retarded adults. The subjects were grouped according to MI levels. Group one consisted of four MI level -1 (borderline retardation) subjects, group two consisted of fourteen MI level -2 (mild retardation) subjects, and group three consisted of nine MI level -3 (moderate retardation) subjects. (For corresponding IQ ranges and standard deviations see Appendix C.)

This study sought to investigate the following question: How do three groups of institutionalized mentally retarded adults (MI level -1, MI level -2, and MI level -3) compare with each other on the C-SSW test? (Refer to Appendix F for the individual C-SSW test scores.)

To compare the relationship between the mean C-SSW test scores for these three groups, the following null hypotheses and alternate hypotheses were tested at the .05 level of significance:

1. Null Hypothesis: No statistically significant difference exists between means on the C-SSW test for MI level -1 subjects and MI level -2 subjects.

   (H_o: $\mu_1 = \mu_2$)

Alternate Hypothesis: A statistically significant difference exists between means on the C-SSW test for MI level -1 subjects and MI level -2 subjects. (H_1: $\mu_1 \neq \mu_2$)

2. Null Hypothesis: No statistically significant difference exists between means on the C-SSW test for MI level -2 subjects and MI level -3 subjects. (H_o: $\mu_1 = \mu_2$)

Alternate Hypothesis: A statistically significant difference exists between means on the C-SSW test for MI level -2 subjects and MI level -3 subjects. (H_1: $\mu_1 \neq \mu_2$)

To test these hypotheses an application of the F test and Kramer's Extension of the Multiple Range test were used.

The F test was used to determine if there was a significant difference in means among the various groups. The application of this test to the study indicated that a significant difference existed between one or more of the mean scores for the three groups on the C-SSW test. The F test did not, however, indicate the source of this difference. From an examination of Table I, it may be noted that a significant difference existed.

TABLE I

SUMMARY OF THE ANALYSIS OF VARIANCE BETWEEN GROUPS

Source of Variance	df	ss	ms(ss/df)	$F(ms_1/ms_2)$
Total	26	7176.630		

TABLE I (Continued)

Source of Variance	df	ss	ms(ss/df)	$F(ms_1/ms_2)$
Between Groups	2	2262.582	1131.291	5.50*
Within Groups (error)	24	4934.048	205.585	

*$p \leq .05$ (df = degrees of freedom, ss = sums of squares, and ms = variance of the mean. The significance of F was determined from a table of F values.)

To determine the source(s) of variance (significant difference) between one or more of the group means, Kramer's Extension of the Multiple Range test was employed. This test is used when groups are of unequal number (Kramer, 1956, p. 307). Kramer's formula is: $\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)\ ms} \cdot z$ (N = the number of subjects within a particular group and z is obtained from a table of Significant Studentized Ranges at the .05 level of significance.) For two scores $(\bar{X}_2 - \bar{X}_1)$ to be significantly different, their difference should exceed the value for $\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)\ ms} \cdot z$

Table II identifies the number of subjects within each group, the means $(\bar{X})$, the difference between means $(\bar{X}_2 - \bar{X}_1)$, and the value obtained from Kramer's formula.

TABLE II

SUMMARY OF THE ANALYSIS OF VARIANCE BETWEEN VARIOUS GROUPS

Subjects	N	$\bar{X}$	$\bar{X}_2 - \bar{X}_1$	$\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)\ ms} \cdot z$
MI level - 1	4	4.54		
			12.04	16.64

TABLE II (Continued)

Subjects	N	$\bar{X}$	$\bar{X}_2 - \bar{X}_1$	$\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)}\ ms \cdot z$
MI level - 2	14	16.58	15.39*	13.14
MI level - 3	9	31.87		

*$p \leq .05$

From the information presented in Table II, the first null hypothesis may be accepted. This hypothesis stated that no significant difference existed between means of the C-SSW test for MI level -1 subjects and MI level -2 subjects. The second null hypothesis was rejected on the basis that a significant difference existed between means on the C-SSW test for MI level -2 subjects and MI level -3 subjects. Accepted at the .05 level of significance was the alternate hypothesis which stated there was a significant difference between means for MI level -2 subjects and MI level -3 subjects.

Since a significant difference existed between MI level -2 subjects and MI level -3 subjects, it may be inferred that a significant difference also existed between MI level -1 subjects and MI level -3 subjects.

CHAPTER V

SUMMARY AND CONCLUSIONS

This chapter will be devoted to a restatement of the problem, recapitulation of the results, discussion and interpretation of the results and recommendations for future research.

Restatement of the Problem

The purpose of this study was to investigate the relationship between MI and mean scores on the C-SSW test for three groups of mentally retarded adults. The groups consisted of four MI level -1 (borderline mentally retarded) subjects, fourteen MI level -2 (mildly mentally retarded) subjects, and nine MI level -3 (moderately mentally retarded) subjects. (See Appendix C Standard Deviations and IQ Ranges). These twenty-seven subjects whose age range (at the time of testing) was between 20 and 45 years were in-patients at Winfield State Hospital and Training Center, Winfield, Kansas. These individuals were considered (1) to display the least neurological involvement of the total adult patient population at this institution, (2) to possess reasonably normal peripheral hearing, and (3) to have intelligible speech.

Three tests were administered to each subject: An SRT test for each ear, a speech discrimination test for each ear and the

SSW test.

Recapitulation of the Results

Two hypotheses were tested in this investigation. Both were concerned with the analysis of variance of the means for the three groups of mentally retarded adults. To test the hypotheses, an application of the F test and Kramer's Extension of the Multiple Range test (Kramer, pp. 307-310, 1956) were utilized. The computed value of F was compared with the tabulated value of F to determine if a significant difference existed among the pooled means. Since a significant difference at the .05 level existed, Kramer's test was employed to find the source of variance. When the formula $\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)\ ms} \cdot z$ is compared with the difference between two means $(\bar{X}_2 - \bar{X}_1)$ a significant difference is said to exist if $(\bar{X}_2 - \bar{X}_1)$ is greater than $\sqrt{\frac{1}{2}(1/N_2 + 1/N_1)}\ \overline{ms} \cdot z$.

From an analysis of the data, it was found that a significant difference existed at the .05 level of confidence between MI level -2 subjects and MI level -3 subjects. No significant difference at the .05 level was found between means for MI level -1 subjects and MI level -2 subjects. It may be inferred that a significant difference at the .05 level also existed between means for the MI level -1 subjects and the MI level -3 subjects.

Discussion and Interpretation of Results

The finding that there was a significant difference between the means on the C-SSW test for MI level -1 and -2 subjects and

MI level -3 subjects suggests that a relationship exists between measured intelligence and C-SSW test performance. Since level -3 subjects functioned significantly poorer on the SSW test, this difference should be considered when evaluating the "central auditory" integrity of the level -3 patients on the basis of their performance on the SSW test.

Although no significant difference was found to exist between the MI level -1 group and the MI level -2 group, it appears questionable that the same norms could be applied to these two groups if a larger sample of level -1 subjects had been drawn.

At this point, one wonders whether the present norms established by Katz (1968a) on the SSW test can be applied to the mentally retarded. This question cannot be answered on the basis of the findings of this study. But it is interesting to note that only four subjects (two level -1 and two level -2) functioned like normal listeners on the SSW test, i.e., had five per cent or less errors on their total corrected score. (For further comparison of each subject's SSW test performance with the norms see Appendix F for the individual scores and page for the norms.) If the norms can be applied, then it may be suggested that most mentally retarded individuals display "central auditory" impairments.

Although the computation of mental age was not possible on the basis of MI levels or the individual intelligence test scores of these patients, it is interesting to note that only the mean score for the level -1 subjects (4.54) did not exceed any of the means for Myrick's groups of children (see page 7 for a discussion

of this study). The comparison of this study and Myrick's further suggests the possibility of "central auditory" dysfunction.

Of further interest is the observation that those subjects who were receiving tranquilizers during the time of testing performed significantly poorer (at the .05 level) than those who were not receiving this type of drug. Since it was not the intention of this author to report a drug study, this question cannot be resolved on the basis of the information from this investigation. It may be noted, however, that those subjects on medication appeared to be as cooperative as those who were not receiving tranquilizers.

Another observation that can be noted from Appendix F is the variability within each group. Even with all factors considered (developmental history, medication, reflex activity, EEG, Skull x-ray and level of measured intelligence), this variability cannot be accounted for from this particular investigation. Further studies on the utilization of "cortical hearing" tests seem in order to determine the functioning of the "central auditory" area of the mentally retarded.

Implications for Future Research

Many implications for future research in this area are in order:

1. A drug study to determine the effects of tranquilizers on SSW test performance.
2. A correlation study on EEG tracings, measured intelligence and SSW test scores.

3. A comparison of the SSW test performance of mentally retarded adults and intellectually normal individuals matched on MA (mental age).
4. An analysis of the SSW test results on mongoloid, hydrocephalics, microcephalics, and seizure patients.
5. A reliability study on the SSW test with mentally retarded individuals.
6. A comparative analysis of the WAIS Verbal scores and SSW results.

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APPENDIX A

Outline of the Medical Classification

Expanded Medical Classification[1]

Code

I

Mental Retardation Associated with Diseases and Conditions Due to Infection

11 Encephalopathy, congenital, associated with prenatal infection

(3rd digit)

- 11.x Not further specified
- 11.1 Cytomegalic inclusion body disease, congenital
- 11.2 Rubella, congenital
- 11.3 Syphilis, congenital
- 11.4 Toxoplasmosis, congenital
- 11.9 Other, congenital (specify)

12 Encephalopathy due to postnatal cerebral infection

(3rd digit)

- 12.x Not further specified
- 12.1 Virus (specify)
- 12.2 Bacteria (specify)
- 12.9 Other micro-organism (specify)

II

Mental Retardation Associated with Diseases and Conditions Due to Intoxication

21 Encephalopathy, congenital, associated with toxemia of pregnancy

22 Encephalopathy, congenital, associated with other maternal intoxications (specify)

23 Bilirubin encephalopathy (kernicterus)

24 Post-immunization encephalopathy (specify)

29 Encephalopathy, other, due to intoxication (specify poison)

III

Mental Retardation Associated with Diseases and Conditions Due to Trauma or Physical Agent

31 Encephalopathy due to prenatal injury (specify)

32 Encephalopathy due to mechanical injury at birth

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[1]Rick Heber, "A Manual on Terminology and Classification in Mental Retardation," 2nd ed., Monograph Supplement to American Journal of Mental Deficiency, (1961), pp. 10-12.

33 Encephalopathy due to anoxemia at birth
34 Encephalopathy due to postnatal injury

(3rd digit)

34.x Not further specified
34.1 Contusion (laceration) (specify region)
34.2 Hemorrhage (hematoma) of brain (specify whether intracerebral, epidural, or subdural
34.3 Porencephaly (specify region)
34.4 Vascular occlusion
34.5 Postnatal anoxemia

IV

Mental Retardation Associated with Diseases and Conditions Due to Disorder of Metabolism, Growth, or Nutrition

40 Cerebral lipoidosis, infantile (Tay-Sach's disease)
41 Encephalopathy associated with other disorders of lipoid metabolism

(3rd digit)

41.x Not further specified
41.1 Cerebral lipoidosis, late infantile (Bielschowsky's disease)
41.2 Cerebral lipoidosis, juvenile (Spielmeyer-Vogt disease)
41.3 Cerebral lipoidosis, late juvenile (Kuf's disease)
41.4 Lipid histiocytosis of kerasin type (Gaucher's disease)
41.5 Lipid histiocytosis of phosphatide type (Niemann-Pick's disease)
41.9 Other (specify)

42 Phenylketonuria
43 Encephalopathy associated with other disorders of protein metabolism

(3rd digit)

43.x Not further specified
43.1 Hepatolenticular degeneration (Wilson's Disease)
43.2 Porphyria
43.9 Other (specify)

44 Galactosemia
45 Encephalopathy associated with other disorders of carbohydrate metabolism

(3rd digit)

45.x Not further specified
45.1 Glycogenosis (Von Gierke's disease)

45.2 Hypoglycemosis
45.9 Other (specify)

46 Arachnodactyly
47 Hypothyroidism
48 Gargoylism (Lipochondrodystrophy)
49 Encephalopathy, other, due to metabolic, growth, or nutritional disorder (specify)

V

Mental Retardation Associated with Diseases and Conditions Due to New Growths

51 Neurofibromatosis (Von Recklinghausen's disease)
52 Trigeminal cerebral angiomatosis (Sturge-Weber-Dimitri's disease)
53 Tuberous sclerosis
59 Intracranial neoplasm, other (specify)

VI

Mental Retardation Associated with Diseases and Conditions Due to (Unknown) Prenatal Influence

61 Cerebral defect, congenital

(3rd digit)

61.x Not further specified
61.1 Anencephaly (including Hemianencephaly)
61.2 Malformations of gyri (specify region)
61.3 Porencephaly, congenital (specify region)
61.4 Multiple congenital anomalies of brain
61.9 Other (specify)

62 Cerebral defect, congenital associated with primary cranial anomaly

(3rd digit)

62.x Not further specified
62.1 Craniostenosis (specify sutures)
62.2 Hydrocephalus, congenital
62.3 Hypertelorism (Greig's disease)
62.4 Macrocephaly
62.5 Microcephaly, primary
62.9 Other (specify)

63 Laurence-Moon-Biedl syndrome
64 Mongolism
69 Other, due to unknown prenatal influence (specify)

VII

Mental Retardation Associated with Diseases and Conditions Due to Unknown or Uncertain Cause with the Structural Reactions Manifest

71 Encephalopathy associated with diffuse sclerosis of brain

(3rd digit)

- 71.x Not further specified
- 71.1 Acute infantile diffuse sclerosis (Krabbe's disease)
- 71.2 Diffuse chronic infantile sclerosis (Merzbacher-Pelizaeus disease)
- 71.3 Infantile metachromatic leukodstrophy (Greenfield's disease)
- 71.4 Juvenile metachromatic leukodystrophy (Scholz's disease)
- 71.5 Progressive subcortical encephalopathy (Schilder's disease)
- 71.9 Other (specify)

72 Encephalopathy associated with cerebellar degeneration

- 72.x Not further specified
- 72.1 Spinal sclerosis (Friedreich's ataxia)
- 72.9 Other (specify)

78 Encephalopathy associated with prematurity

79 Encephalopathy, other, due to unknown or uncertain cause with the structural reactions manifest (specify)

VIII

Mental Retardation Due to Uncertain (or Presumed Psychologic) Cause with the Functional Reaction Alone Manifest

81 Cultural-familial mental retardation

82 Psychogenic mental retardation associated with environmental deprivation (specify nature of deprivation)

83 Psychogenic mental retardation associated with emotional disturbance (specify)

84 Mental retardation associated with psychotic (or major personality) disorder (specify as e.g., autism)

89 Mental retardation, other, due to uncertain cause with the functional reaction alone manifest

APPENDIX B

Expanded Supplementary Term Listing

Code

Genetic Component

1x Undetermined genetic mechanism present
10 No apparent genetic mechanism present
11 Multiple gene type transmission
12 Sex-linked recessive gene type transmission
13 Single dominant gene type transmission
14 Single recessive gene type transmission

Secondary Cranial Anomaly

2x With secondary cranial anomaly but not further specified
20 No secondary cranial anomaly present
21 Hydrocephalus, secondary
22 Microcephaly, secondary
29 Other (specify)

Impairment of Special Senses

3x With impairment of special senses but not further specified
30 No sensory impairment present
31 Blind
33 Hearing handicapped
34 Visually handicapped
36 Blind and hearing handicapped
38 Hearing and visually handicapped
39 Other (specify)

Convulsive Disorder

4x With convulsive disorder but not further specified
40 No convulsive disorder present
41 Akinetic seizures
42 Autonomic seizures
43 Focal seizures
44 Major motor seizures
46 Myoclonic seizures
47 Petit mal seizures
48 Psychomotor seizures
49 Mixed, unclassifiable, or other (specify)

Psychiatric Impairment

5x With other psychiatric impairment but not further specified
50 No other psychiatric impairment present
51 Behavioral reaction
52 Neurotic reaction
53 Psychotic reaction

Motor Dysfunction

	Type	(1st additional digit Location)	(2nd additional digit Severity)
6x	With motor dysfunction but not further specified		
60	No motor dysfunction		
61	Ataxia	1 Diplegia	1 Mild
62	Hypotonia	2 Hemiplegia	2 Moderate
63	Choreoathetosis	3 Monoplegia	3 Severe
65	Dystonia	4 Paraplegia	
66	Rigidity	5 Quadriplegia	
67	Tremors	6 Triplegia	
68	Spasticity		
69	Mixed		

APPENDIX C

CONVERSION OF IQ SCORES ACCORDING TO STANDARD DEVIATION VALUES[1]

Level of Deviation in Measured Intelligence	Range of Level In Standard Deviation Units	Revised Stanfordbinet Tests of Intelligence Forms L and M	W-B, WISC, & WAIS[2]
-I	-1.01 to -2.00	83-68	84-70
-II	-2.01 to -3.00	67-52	69-55
-III	-3.01 to -4.00	51-36	54-40
-IV	-4.01 to -5.00	35-20	
-V	-5.00	20	

[1]Rick Heber, "A Manual on Terminology and Classification in Mental Retardation," 2nd ed., Monograph Supplement to American Journal of Mental Deficiency, (1961), p. 59.

[2]W-B: Weschler-Bellevue Intelligence Scale, Forms I and II; WISC: Weschler Intelligence Scale for Children; WAIS: Weschler Adult Intelligence Scale.

APPENDIX D

SSW TEST

Name_____ Date_____ S#_____

Age_____ Sex_____ Group_____ List E-C 1st Ear_____

ERROR TYPE		POSITION		TOTAL ERROR	ENTER ROW#
0	-	1234	-	( )	- - - -
1	-	x234	-		1
2	-	1x34	-		3
3	-	12x4	-		2 3
4	-	123x	-		2
5	-	xx34	-		1 7
6	-	1xx4	-		4 5
7	-	12xx	-		2 7
8	-	x23x	-		5 6
9	-	x2x4	-		5 6
10	-	1x3x	-		5 6
11	-	xxx4	-		1 6
12	-	xx3x	-		5 6
13	-	x2xx	-		5 6
14	-	1xxx	-		2 6
15	-	xxxx	-		5 6

ROW #	FACTOR	ENTER "TOTAL ERROR" HERE	GRAND TOTAL	WEIGHT
1	Memory	- _____ = ____	/3 = ____ × ____	= _____
2	Fixation	- _____ = ____	/4 = ____ × ____	= _____
3	Overlo. 1	- _____ = ____	/2 = ____ × ____	= _____
4	Overlo. 2	- _____ = ____	/1 = ____ × ____	= _____
5	Confusion	- _____ = ____	/7 = ____ × ____	= _____
6	Multiple	- _____ = ____	/8 = ____ × ____	= _____
7	5 + 7	- _____ = ____	/2 = ____ × ____	= _____

CORRECTION SCORES

(R-WDS) - (R-NC) ____ - ____ = _____

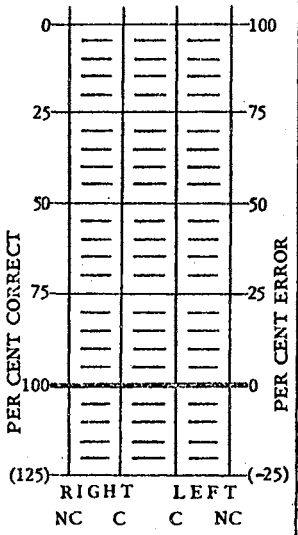
(R-WDS) - (R-C) ____ - ____ = _____

(R-WDS) - (TOT R) ____ - ____ = _____

(L-WDS) - (L-C) ____ - ____ = _____

(L-WDS) - (L-NC) ____ - ____ = _____

(L-WDS) - (TOT L) ____ - ____ = _____



X = RAW PER CENT

O = CORRECTED (WDS-SSW)

ENTER THE TOTAL NUMBER OF ERRORS HERE

A. R-NC: ____ × ( ) = 100 - _____ = _____ % correct

B. R-C: ____ × ( ) = 100 - _____ = _____ % correct

C. L-C: ____ × ( ) = 100 - _____ = _____ % correct

D. L-NC: ____ × ( ) = 100 - _____ = _____ % correct

E. TOT R: (A+B number errors) ____ × ( ) = 100 - ____ = ____ % correct

F. TOT L: (C+D number errors) ____ × ( ) = 100 - ____ = ____ % correct

G. TOT SSW: (A,B,C,D number errors) ____ × ( ) = 100 - ____ = ____ % correct

COMMENTS: _____

TO GET % ERROR MULTIPLY BY:

#ITEMS	MONOSYL	TOT EAR	TOT SSW
20	5	2.5	1.25
25	4	2	1
40	2.5	1.25	.63
50	2	1	.5
52	1.9	.96	.48
60	1.7	.83	.42

PURE TONE AND SPEECH SUMMARY

	1-kc	S.A.	SRT	WDS	BC@1	SSW LEVEL
RE						
LE						
M						

J-K-65b

SSW TEST

LIST E-C

Name_____

Right Ear First_____ Left Ear First_____
(A=R-NC, B=R-C etc.) (A=L-NC, B=L-C etc.)

S#_____ Group_____
Age_____ Sex_____

PRACTICE ITEMS: a. airplane - wetpaint 1._____ 2._____
b. cowboy - whitebread 1._____ 2._____
c. northwest - stairway 1._____ 2._____
d. oatmeal - flashlight 1._____ 2._____

	L-NC (A) R-NC	L-C (B) R-C	R-C (C) L-C	R-NC (D) L-NC		R-NC (E) L-NC	R-C (F) L-C	L-C (G) R-C	L-NC (H) R-NC		NO. WRONG	ERROR TYPE
1.	up	stairs	down	town								
					2.	out	side	in	law			
3.	day	light	lunch	time								
					4.	wash	tub	black	board			
5.	corn	bread	oat	meal								
					6.	bed	spread	mush	room			
7.	flood	gate	flash	light								
					8.	sea	shore	out	side			
9.	meat	sauce	base	ball								
					10.	black	board	air	mail			
TOTAL												

	L-NC (A) R-NC	L-C (B) R-C	R-C (C) L-C	R-NC (D) L-NC		R-NC (E) L-NC	R-C (F) L-C	L-C (G) R-C	L-NC (H) R-NC	NO. WRONG	ERROR TYPE
11.	house	fly	wood	work							
					12.	green	bean	home	land		
13.	sun	day	shoe	shine							
					14.	white	walls	dog	house		
15.	back	door	play	ground							
					16.	school	boy	church	bell		
17.	snow	white	foot	ball							
					18.	band	saw	first	aid		
19.	blue	jay	black	bird							
					20.	ice	land	sweet	cream		
TOTAL											

	L-NC (A) R-NC	L-C (B) R-C	R-C (C) L-C	R-NC (D) L-NC		R-NC (E) L-NC	R-C (F) L-C	L-C (G) R-C	L-NC (H) R-NC	NO. WRONG	ERROR TYPE
21.	hair	net	tooth	brush							
					22.	fruit	juice	cup	cake		
23.	ash	tray	tin	can							
					24.	nite	light	yard	stick		
25.	key	chain	suit	case							
					26.	play	ground	bat	boy		
27.	corn	starch	soap	flakes							
					28.	birth	day	first	place		
29.	day	break	lamp	light							
					30.	door	knob	cow	bell		
TOTAL											

	L-NC (A) R-NC	L-C (B) R-C	R-C (C) L-C	R-NC (D) L-NC		R-NC (E) L-NC	R-C (F) L-C	L-C (G) R-C	L-NC (H) R-NC	NO. WRONG	ERROR TYPE
31.	bird	cage	crow's	nest							
					32.	week	end	work	day		
33.	book	shelf	drug	store							
						wood	work	beach	craft		
35.	hand	ball	milk	shake							
					36.	fish	net	sky	line		
37.	for	give	milk	man							
					38.	sheep	skin	bull	dog		
39.	race	horse	street	car							
					40.	green	house	string	bean		
TOTAL (p.4)											
p.3											
p.2											
p.1											
GRAND TOTAL											
	R-NC L-NC	R-C L-C	L-C R-C	L-NC R-NC		L-NC R-NC	L-C R-C	R-C L-C	R-NC L-NC		

COMBINED:			
R-NC	R-C	L-C	L-NC

TESTER _____

APPENDIX E

INDIVIDUAL SUBJECT'S CORRECTED SSW TEST SCORES

SUBJECT	CORRECTED SSW SCORE
MI Level -1 (Borderline)	
1	.625
2	1.000
3	7.500
4	9.000
MI Level -2 (Mild)	
5	2.750
6	5.000
7	5.750
8	8.000
9	8.125
10	8.625
11	11.000
12	11.250
13	17.250
14	26.000
15	31.000
16	34.875
17	37.375
18	45.000
MI Level -3 (Moderate)	
19	10.625
20	12.500
21	17.350
22	25.250
23	35.750
24	37.125
25	43.250
26	44.125
27	60.500

VITA

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Candidate for the Degree of

Master of Arts

Thesis: AN INVESTIGATION OF THE EFFECTS OF MEASURED INTELLIGENCE ON THE SUCCESSFUL ADMINISTRATION OF THE STAGGERED SPONDAIC WORD TEST

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