THE INFLUENCE OF PURULENT MENINGITIS ON MENTAL DEVELOPMENT OF CHILDREN AS DETERMINED BY PSYCHOLOGICAL TESTS AND SCHOOL ADJUSTMENT

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by

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ABSTRACT OF THESIS

BACKGROUND

This thesis is one part of a follow-up study of forty-three school children who had been treated for purulent meningitis at the Children's Hospital of Winnipeg, during the period of 1952-1956, inclusive. The research project was a combined effort of the Departments of Pediatrics, Otolaryngology, Psychiatry, Electroencephalography, Psychology, and Education. The part of the project reported in this thesis is the psychological and educational assessment of the meningitis children.

PURPOSE

The purpose of the study was to learn more about the effects of purulent meningitis on the mental development and academic achievement of children and to find out what problems might be anticipated. Therefore, the investigation was made with reference to: (1) possible intellectual impairment of post-meningitis children as demonstrated by psychological tests, and (2) classroom behavior and learning as rated by teachers.

VARIABLES

Five variables were considered in the assessment of

mental abilities. It was believed that children treated for meningitis would show impairment in:

(a) intellectual development

(b) figure-ground reactions in the visual perceptual field

(c) visuomotor integration

(d) sensory motor development

(e) development of non-verbal abilities.

Three variables were considered in the assessment of classroom behavior and learning. It was believed that children treated for meningitis would present:

(a) a typical brain-injured behavior pattern

(b) special oral reading problems

(c) special writing problems.

The null hypothesis was used to test these variables.

The non-meningitis children were chosen in such a way as to approximate the chronological age, sex, grade, and general level of ability of the meningitis children.

FINDINGS

Children with a history of meningitis were found to experience more difficulty than non-meningitis children in (1) the reproduction of visually perceived stimuli, indicating a degree of impairment in visuomotor integration, and (2) the drawing of human figures, suggesting a faulty body concept or perception.

The non-verbal abilities of post-meningitis children were found to be lower in comparison to their general level of ability as assessed by the Binet test. About one-third of the subjects obtained WISC Performance scores which were ten or more IQ points below the Binet scores, whereas only three children obtained significantly higher Binet scores. However, the disparity between these two levels of functioning was found to be not significant for the group as a whole.

Differences between the meningitis children and the Binet standard population with respect to mean IQ's were not significant. Although the incidence of retardation for the meningitis group was higher than is normally expected, the distribution of scores did not depart significantly from normality. All of the subnormal children had physical defects such as impaired speech and hearing. One showed a deficiency in the neuromotor system.

No differences were demonstrated between the meningitis and non-meningitis children in the visual perceptual field. The meningitis children reacted mainly to foreground detail, suggesting normal visual perception.

Finally, the post-meningitis children were observed to be rated by teachers as having slightly more difficulties in areas of reading and writing than other children in the classroom, but these differences were not significant. In terms of behavior, children treated for meningitis displayed less behavior characteristics common to brain-injured children than others in the classroom. This reversal from expectations was not significant.

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CHAPTER I

INTRODUCTION

This thesis is one part of a follow-up study of children who had been admitted to the Children's Hospital of Winnipeg from 1952 to 1956 inclusive, for treatment of purulent meningitis. The research project was a combined study of the Departments of Pediatrics, Otolaryngology, Psychiatry, Electroencephalography, Psychology, and Education, and was carried out under the auspices of the Research Committee of the Children's Hospital of Winnipeg.

The following examinations were made of each patient:

1. A routine neurological and physical examination; Dr. P. Hutchison, Pediatric resident, Children's Hospital of Winnipeg.

2. Audiometric examination; Speech and Hearing Therapist, Children's Hospital of Winnipeg.

3. Electroencephalographic study; Dr. M. G. Saunders, Electroencephalographer, Children's Hospital of Winnipeg.

4. Psychiatric review; Dr. M. Kovacs, Psychiatric resident, Children's Hospital of Winnipeg.

5. Psychological assessment; W. Nazeravich Psychology Department, Child Guidance Clinic, Winnipeg, under the supervision of Dr. M. Wright, Department of Psychology, Winnipeg General Hospital and Dr. W. H. Lucow, Faculty of Education, University of Manitoba.

The part of the project reported in this thesis is the last item in the foregoing list, the psychological assessment.

The Problem

The problem considered in this thesis is the relationship between meningitis of bacterial origin and possible brain damage as revealed by psychological tests. This was studied with special reference to potential learning and behavior problems as they might influence a child's school performance.

Purpose of the study. For educational purposes it is of value to know whether children with a history of meningitis show evidence of organic impairment which might influence their learning and behavior in the classroom. In many of the urban centres in Manitoba there are special classes for grossly handicapped children who show a conspicuous loss in mental ability and behaviorial control. However, it is now being recognized that learning and behavior may also be affected by minimal brain injury where there is only a slight lowering of the intellectual level. Mental disturbances of this nature may affect school performance because such children are frequently inattentive, distractible, disinterested, and lacking in persistency and effort. Because of a lack of understanding of such mental disturbances, these children are often considered as being lazy, daydreamers, stubborn, aggressive, or uncooperative.

If it can be demonstrated that there is a relationship between brain damage, as assessed by psychological tests, and meningitis, then teachers and others responsible for the education of such children can be better prepared in dealing with potential learning and behavioral problems.

Hypotheses

The general assumption guiding the design of this study was that meningitis is associated with brain damage. This problem was investigated under two general headings: (1) intellectual impairment as indicated by psychological tests, and (2) classroom behavior and learning problems as determined by teachers' ratings.

In research requiring statistical analysis, hypotheses are stated in the "null" form; that is, no difference is hypothesized. The analysis leads to an acceptance or rejection of the null hypothesis.

The specific null hypotheses in this study were as follows:

1. There are no differences between:
   (a) meningitis-treated children and children from the Binet standard population[1] with respect to mean IQ scores;
   (b) the meningitis and Werner and Strauss' normal children[2] in terms of figure-ground reactions in the visual perceptual field;
   (c) the meningitis and non-meningitis children in terms of their ability to reproduce visually perceived stimuli;
   (d) the Binet mental ages and the Goodenough mental ages of the post-meningitis children;
   (e) the verbal and non-verbal abilities of post-meningitis children as revealed on Binet and WISC Performance scales.
2. There are no differences between the meningitis and non-meningitis children in terms of their
   (a) behavior pattern in the classroom,
   (b) reading abilities,
   (c) writing abilities.

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[1] L. M. Terman and M. A. Merrill, Measuring Intelligence (Boston: Houghton Mifflin Company, 1937), p. 35.

[2] H. Werner and A. A. Strauss, "Causal Factors in Low Performance," Am. J. Ment. Deficiency, 45: 213, 1940.

Definitions of Terms Used

Purulent meningitis.[3,4,5] The nature of purulent meningitis and its effects on the nervous system are as follows:

> The brain and the spinal cord are encased in the skull and the vertebral column and are separated from it by the cerebrospinal fluid and three membranes. These membranes are known, from outside in, as (1) dura mater, (2) arachnoid mater, and (3) pia mater. The cerebrospinal fluid produced by the choroid plexus in the ventricles of the brain passes through various channels and flows into the subarachnoid space (between pia mater and arachnoid mater) forming a protective fluid cushion for the delicate central nervous system.
>
> The term "meningitis" signifies inflammation of the covering membrane(s) of the brain and spinal cord. Although any of the membranes may become inflamed, usually the term refers to inflammation of the piarachnoid membranes. This inflammation may be caused by mechanical irritations, toxins, vascular anomalies and accidents, or infections. These infections may be of viral or bacterial etiology.
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> The term "purulent meningitis" refers to the type of meningitis resulting from bacteria which

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[3] W. E. Nelson, A Textbook of Pediatrics, (Seventh Edition) (Philadelphia: W. B. Saunders Co., 1959), pp. 3, 9.

[4] W. Boyd, A Textbook of Pathology (Fifth Edition) (Philadelphia: Lea and Febiger, 1947), p. 889.

[5] T. B. Johnson, D. V. Davies and F. Davies, Gray's Anatomy (New York: Longman's Green and Co., 1957), pp. 1079-1088.

causes supperation or formation of pus. The common organisms causing purulent meningitis are, in order of frequency:

1. Haemophilus influenzae.
2. Neisseria meningitidis.
3. Pneumococcus pneumonia.
4. A group of rarer causative bacteria, including the staphylococcus, streptococcus, and the enteric organism.
5. In a relatively large group of bacterial meningitides, no organism can be found on smear or culture of C. S. F., although the clinical illness and laboratory data point to a supperative organism.

Children with this disease present a clinical picture of an infection plus signs or symptoms of cerebral irritation, which lead to the performance of a lumbar puncture, so establishing the diagnosis.

Children may die or be seriously damaged developmentally by this disease, because of the extensive brain tissue damage by the infection. The cerebrospinal fluid pressure may be raised in the rather rigid bony skull and the vertebral cage, thus interfering with vital respiratory and cardiovascular functions. The thick exudate may block channels at the base of and over the surface of the brain, interfering with circulation and absorption of C.S.F., so leading to hydrocephalus and finally brain tissue atrophy. Other long term sequelae may also occur.

Specific therapy for this condition was first introduced around 1938 and has advanced markedly with the introduction of antibiotics since that time. Before 1938 there was a 90 per cent mortality rate from meningitis. Now the mortality rate is only about 10 per cent.[6]

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[6] The writer acknowledges his indebtedness to Dr. P. A. Hutchison, Pediatric Resident, Children's Hospital of Winnipeg, for this description of purulent meningitis in children.

Brain-injured child. The following is a definition of the "brain-injured child" as it will appear throughout this report:

> A brain-injured child is a child who before, during or after birth has received an injury to, or suffered an infection of the brain. As a result of such organic impairment, defects of the neuromotor system may be present or absent; however, such a child may show disturbances in perception, thinking, and emotional behavior, either separately or in combinations.... These disturbances prevent or impede a normal learning process.[7]

School adjustment. The term "school adjustment" was interpreted in this study as meaning the adjustment that a child makes to general classroom procedures. This term included (1) a child's behavior in the classroom and on the playground, and (2) a child's school performance.

Being abnormally responsive to extraneous stimuli, organic children find it difficult to conform to classroom procedures where inhibition and restraint are very often necessary. They are usually distractible, hyperactive, variable in interests, and lacking in persistence and sustained effort. It was hypothesized that these and other such characteristics would be common to post-meningitis children.

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[7]A. A. Strauss and L. E. Lehtinen, Psychopathology and Education of the Brain-injured Child (New York: Grune and Stratton, 1950), p. 4.

The school performance was limited to reading and writing. There were two reasons for this: (1) these two areas of learning are particularly sensitive to organic impairment, and (2) a large percentage of children used in this study were in the primary grades where reading and writing are basic subjects of formal learning.

Figure-ground disturbances. The term "foreground-background or figure-ground disturbances" used in this investigation in relation to visual perception was interpreted as follows:

> ... To differentiate foreground activity from background activity, to select proper aspects of the situation for foreground treatment, and to respond to foreground as foreground and to background as background....[8]

There is constant conflict between figure and ground in normal perception, where it is necessary to select the pattern which will be treated as the figure and which will not be confused with background stimuli. This involves a fine degree of form perception, which is a learned ability. It is in this area of learning that a brain-injured child has difficulty. He cannot hold

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[8]A. A. Strauss and N. C. Kephart, Psychopathology and Education of the Brain-injured Child. (New York: Grune and Stratton, 1955), p. 50.

the form or foreground figure if the background is also patterned, and his difficulty increases when the contrast between figure and ground is decreased.

Visuomotor coordination.[9] In this study, visuomotor (visual motor) coordination was interpreted as meaning the ability to reproduce visually perceived stimuli such as geometric figures. Failure in such tests results from difficulty in spatial relationship and inability to make use of visual perception to guide a rather complex set of motor coordinations. The figures are perceived as wholes and not as meaningless lines. The ability to make eye-hand coordinations is measured by execution of angles, perseveration of proportions, and the straightness of lines. The functions involved are affected by brain injury.

Body concept. The term "body concept" as used in this report means the image or picture that a child has of his own body, as a result of certain sensations which impinge upon him. Strauss and Kephart explain this term as follows:

> As a result of certain sensations which we receive, we form a picture of our own body in our

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[9] Ibid, p. 151

> minds which represents the way in which the body appears to us. We have tactile, temperature and pain impressions from the surface of the body. There are sensations which come from the muscles indicating their state of contraction or relaxation. There are visual impressions of parts of the body. There are sensations arising from the viscera. All these become welded into unity which represents the body to us. ... This schema differs from that of objects outside the body. It has a sense of differentness, of belonging to us alone....[10]

The body concept is not static but continues to develop with experience. It may be altered by organicity or by emotional disorders.

Disparity in mental development.[11] In this study the term "disparity in mental development" was interpreted as meaning the difference in levels of performance on verbal and non-verbal tests. This difference has been frequently observed to accompany brain injury. There are psychological tests which differentiate verbal abilities from non-verbal abilities. The language type of test places much weight on language abilities, whereas the performance type puts relatively little stress on language and much stress on ability to manipulate concrete objects. The most typical test pattern of brain-injured children

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[10] Ibid, pp. 67-68.

[11] Ibid, p. 183.

involves low performance achievement and high language achievement.

Exogenous child.[12] The brain-injured mentally defective child was referred to in this study as the "exogenous child." His mental deficiency was caused by injury to or infection of the brain received before, during, or after birth.

Endogenous child. The non-brain-injured mentally defective child was referred to in this study as the "endogenous child." The mental deficiency of these children was a "continuation of the inferior endowments of their progenitors."[13] This deficiency was also referred to as the hereditary or familial type.

Outline of the Presentation

A review of related work regarding the effects of infectious diseases on the nervous system is presented in Chapter II. The procedure followed in the selection of meningitis and non-meningitis groups, and the description and rationale underlying the use of various psychological tests and rating scales in the assessment of brain

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[12] Strauss and Lehtinen, *op. cit*. p. 118.

[13] *Ibid*, p. 14.

damage are discussed in Chapter III. Chapter IV contains the statistical treatment of test data and ratings. Chapter V deals with the discussion and interpretation of findings.

CHAPTER II

REVIEW OF THE LITERATURE

Relatively few published psychological studies were found to deal specifically with meningitis in relation to brain damage and learning. There is, however, ample literature indicating that various infectious agents may cause considerable damage to the brain tissue, thus creating disturbances in perception, thinking, and behavioral control. These disturbances prevent or impede a normal learning process. This chapter contains a brief summary of studies related to brain damage.

Literature on Meningitis and Other Infectious Diseases as Related to Brain Damage

Intellectual impairment. It is commonly accepted in the literature on brain damage that infectious diseases may affect the mental development of children, particularly of those whose nervous system is still immature. In some cases the injury due to these diseases may be widespread, causing a conspicuous loss of intellectual ability. In other instances intellectual development may be relatively normal with isolated disturbances in visuomotor integration.

Benda and Farrell[1] reported that the incidence of mental deficiency due to this disease was as large as the number of congenital malformations, not including mongolism. The number for meningitis alone was found to be rather low, but they felt that this low figure was partially due to the difficulty of separating meningitis from encephalitis.

Referring specifically to meningitis, Bakwin and Bakwin[2] maintained that this disease may have a serious effect on mental development. Mild degrees of mental defect may become evident several years after the attack of meningitis. Complete loss of mental power may sometimes result from this disease.

The effects of infectious diseases upon the nervous system are not always widespread and only certain mental functions may be impaired. Klebanoff, Singer and Wilensky[3] have stated that in early brain pathology the basic functions likely to be impaired were motor functions, perceptual

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[1] P. H. Hoch and J. Zubin, Psychopathology of Childhood (New York: Grune and Stratton, 1955), pp. 67-69.

[2] H. Bakwin and M. R. Bakwin, Behavior Disorders in Children (Philadelphia: W. B. Saunders Co., 1954), p. 266.

[3] C. F. Reed, I. E. Alexander and S. S. Tomkins, Psychopathology, a Source Book (Cambridge, Massachusetts: Harvard University Press, 1958), pp. 556-560.

functions, thought processes, and personality. Dysfunctioning in one or more of these areas, they maintained, would tend to lower the functioning level of the individual. Goldenberg[4] came to similar conclusions. He stated that a number of researchers have reported finding IQ's well within or beyond the average level of ability among the brain-injured children. However, he maintained that others have pointed out that these children often showed selective impairment in intellectual functioning, and this accounted for the lowering of the original potential.

The severity of impairment is also dependent upon the age of the child at the time of acute illness. Some authorities[5] believe that if a child is very young and the nervous system still immature, the damage is usually widespread and the ensuing mental deficiency most severe. In later years, when the nervous system is more fully developed, disturbances caused by infectious diseases may be limited to behavior disorders with only slight impairment in the intelligence.

In some brain-injured children a marked tendency for the intelligence to deteriorate has been observed. In

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[4] A. A. Strauss and N. C. Kephart, _Psychopathology and Education of the Brain-injured Child_ (New York: Grune and Stratton, 1955), pp. 145-146.

[5] Hoch and Zubin, _op. cit._, p. 72.

a study of thirty-nine institutionalized exogenous children whose impairment resulted from various etiologic agents, Strauss and Lehtinen[6] found a significant change in the intelligence quotient over a period of six years. They felt, however, that this deterioration in intelligence may have been partly due to lack of suitable academic training. In a study of one hundred and eight postencephalitic patients ranging from infants to adults, Brown, Jenkins and Cisler[7] found a decrease in the average intelligence quotient, from one examination to the other, of 1.4 points per year. This deterioration, they believed, was probably related to the severity of the disease and to the amount of destruction of the brain and nervous system.

Impairment in the intellectual functioning may also be due to physical defects. Bakwin and Bakwin[8] reported that, in a survey of 3,734 children in nineteen institutions

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[6]A. A. Strauss and L. E. Lehtinen, Psychopathology and Education of the Brain-injured Child (New York: Grune and Stratton, 1950), p. 119.

[7]A. W. Brown, R. L. Jenkins and L. E. Cisler, "Influence of Lethargic Encephalitis on Intelligence of Children as Determined by Objective Tests," Am. J. of Diseases of Child., 59: 238-254, 1940.

[8]Bakwin and Bakwin, op. cit., pp. 148-162.

and schools for the deaf in the Chicago and Philadelphia areas, meningitis was found to be the most frequent cause of defective hearing. Total deafness was reported in 152 of the 209 children who had had meningitis. As this survey was carried out in 1927, it was believed that the reported number of cases of total deafness was probably too high, and that more recent methods of examination would have revealed considerable residual hearing in many instances.

Studies regarding the effects of infectious diseases upon the mental development of children indicate: (1) a possible lowering of intelligence, (2) a greater incidence of retardation, (3) a gradual deterioration of intelligence, and (4) a more severe form of retardation, particularly in infants whose nervous systems are undeveloped at the time of acute illness. Physical defects, such as impaired hearing caused by infectious diseases, may also affect intellectual development.

Figure-ground disturbances in visual perception. Clinical observations of children with a history of organic impairment indicated that disturbances in the visual perceptual field were related to brain injury. Werner and

Strauss[9] devised a test of purely visual perception to demonstrate figure-ground disturbances in brain-injured children. Experimenting in Detroit, they used three groups of children: (1) normal, ranging in age from 7 to 10 years, (2) endogenous, ranging in mental age from 7 to 11 years, and (3) exogenous, ranging in mental age from 7 to 11 years. They found that the brain-damaged group differed outstandingly from the other two groups, particularly from the normal children, in the number of foreground reactions. The brain-injured children gave a large number of background responses, suggesting failure to discriminate between figure and ground.

A similar experiment in visual perception was carried out by Werner and Strauss[10] but this time the Marble Board Test was used. Children were asked to copy, or to reproduce by drawing, patterns of marbles. The result of this experiment showed that background reactions occurred in 84 per cent of the brain-injured group and in 15 per cent of the non-brain-injured group. They assumed from this experiment that perceptual disturbances of brain-

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[9] H. Werner and A. A. Strauss, "Pathology of Figure-Background Relation in the Child," _J_. _Abnorm_. _Soc_. _Psychol_., _36_: 236, 1941.

[10] H. Werner and A. A. Strauss, "Causal Factors in Low Performance," _Am_. _J_. _Ment_. _Deficiency_, _45_: 213, 1940.

injured children were in certain situations caused by "forced responsiveness" to the background.

Other studies in this area showed similar results. Bensberg[11] compared familial mental defectives and brain-injured defectives, also using the Marble Board Test. The brain-injured subjects proved significantly inferior in accuracy and tended to show incoherency more often in their procedures. This difficulty, he concluded, was due to pathological figure-ground perception. Dolphin and Cruickshank[12] studied perception of imbedded figures and mosaic reproductions by matched normal and cerebral-palsied children of low average intelligence. They attributed the significant inferiority in perceptual performance of children with cerebral palsy to "forced responsiveness" to background stimuli.

The results of the experiments in the visual perceptual field indicate that children with brain injury

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[11] G. J. Bensberg, "A Test for Differentiating Endogenous and Exogenous Mental Defectives," Am. J. Ment. Deficiency, 54: 502-506, 1950.

[12] J. E. Dolphin and W. N. Cruickshank, "The Figure-Background Relationship in Children with Cerebral Palsy," J. Clin. Psychol., 7: 228-231, 1951.

tend to respond more frequently to background stimuli. Disturbances in this area are believed to affect learning and behavior, particularly in school situations.

Impairment of visuomotor functions. Lack of ability to reproduce visually perceived stimuli such as geometric designs is believed to be a characteristic of children who are brain-damaged. When tests of visuomotor coordination were first employed in experimental work, they were administered as memory tests. Designs were presented singly for a few seconds and then withdrawn, and the subject was asked to draw the figure from memory. On the basis of clinical experience, Bender[13] and Bakwin[14] emphasized that poor memory, as shown by low performance on such tests, was an important syndrome of organicity.

The two tests which have been found to be quite promising in differentiating between brain-injured and non-brain-injured children are the Ellis Visual Designs Test and Bender's Visual-Motor Gestalt Test. The former,

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[13] L. Bender, "Psychological Problems of Children with Organic Brain Disease," Am. J. Orthopsychiat., 19: 404-415, 1949.

[14] H. Bakwin, "Cerebral Damage and Behavior Disorders in Children," J. Pediat., 34: 371-383, 1949.

used in this study, has been made more objective by Wood and Shulman[15], who devised a scoring system which has been followed by others using the test.

Cassel[16] deviated from the usual administration of the Ellis Visual Designs Test by having subjects reproduce patterns by copying, rather than from memory. He pointed out that, when used as a memory test, it was assumed that the child was able to reproduce the design from copy, and that the failure was due to memory. He studied endogenous and exogenous children matched for C. A. and M. A. The mean chronological ages of these groups were 17.6 and 17.7 and the mean mental ages were 8.3 and 8.0 respectively. The mean group scores were found to differ at beyond the one per cent level of confidence. The exogenous children displayed marked difficulty in the copying of geometric designs.

Cassel's findings confirmed the results of a previous experiment carried out by Hoakley and Frazeur[17] who

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[15]L. Wood and R. Shulman, "The Ellis Visual Designs Test," _J. Educ. Psychol._, _31_: 591-602, 1940.

[16]R. H. Cassel, "Relation of Design Reproduction to the Etiology of Mental Deficiency," _J. Consult. Psychol._, _13_: 421-428, 1949.

[17]Z. P. Hoakley and H. A. Frazeur, "Significance of Psychological Test Results of Exogenous and Endogenous Children," _Am. J. Ment. Deficiency_, _50_: 263-271, 1945.

administered the revised Stanford-Binet, Form L scale, to 18 pairs of matched mental defectives. The deficiency of one member of each pair was due to exogenous factors and the other defective was of the familial or genetic type. The only test items which differentiated the two groups were the reproductions of the diamond, the Greek key, and the truncated pyramid. From these results they concluded that the only reliable differences occurred in the perceptual or visuomotor field.

The Bender Visual-Motor Gestalt Test was also found to be reliable in differentiating between brain-injured and non-brain-injured children. Bensberg[18] administered this test to a group of 161 brain-injured mentally defective children and also to the same number of mental defectives having a familial or hereditary etiology. The familial group was more accurate in its reproductions. Reversals, parts repeated, and the use of lines instead of dots occurred more frequently in reproductions done by brain-injured children. Hanvick and Andersen[19], using

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[18] G. J. Bensberg (Lincoln, Ill. State School and Colony), "Performance of Brain-injured and Mental Defectives on the Bender Gestalt Test," J. Consult. Psychol., 16: 61-64, 1952.

[19] L. J. Hanvick and L. A. Andersen (Minneapolis, Minn., V. A. Hosp.), "The Effects of Focal Brain Lesions on Recall and on the Reproduction of Rotation in the Bender Gestalt Test," J. Consult. Psychol., 14: 197-198, 1950.

this same test, found that the brain-injured group exceeded the non-brain-injured group significantly in the reproduction of rotated figures. They reported no difference in the number of figures recalled, or in ability to reproduce figures.

One may conclude from the studies described that certain graphic tests, particularly the Ellis Visual Designs Test, are highly sensitive to manifestations of brain injury. This test measures a series of functions: (1) the visual function, (2) integration or the ability to interpret the visual stimuli, and (3) motor function involving the reproduction of visual stimuli. Dysfunctioning in any one of these particular areas tends to affect a child's performance on this test.

Impairment of body concept. The development of body perception, or body concept, is generally believed to run parallel to the sensory motor development. Body concept is therefore not static, but changes with the development of the individual. Disturbances in either personality or sensory motor development are believed to be reflected in a child's perception of the body.

The Goodenough Draw-a-Man Test has been widely used in conjunction with other psychological measurements for diagnosis and evaluation of children with respect to intelligence, personality disturbances, and brain damage. Bender[20] found this test very useful in detecting evidence of organic impairment. Her contention was that a Goodenough M. A. two years or more below the Binet M. A. was highly suggestive of organic injury to the brain. Her observations were based solely on clinical experience and no attempt was made to show how frequently this sign failed to occur in organic cases or did occur in non-organic individuals.

Basing their observations on literature in this area, Bakwin and Bakwin[21] maintained that drawings had a diagnostic value with regard to organic brain disease. Disorganization and distortion of the figure was suggestive of brain injury. In some cases this could be so severe as to yield a score far below the child's mental age. They felt that this ability could also be relatively unimpaired.

Strauss and Kephart believed that children's figure

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[20] L. Bender and A. Silvers, "Body Image Problems of the Brain-Damaged Child," J. Soc. Issues, 4: 84-89, 1948.

[21] Bakwin and Bakwin, op. cit., pp. 228, 440.

drawings indicated a relationship between body concept and general development. They write:

> ... Drawing is a somewhat complicated procedure involving both a perceptual factor and a motor factor. Therefore, we cannot be sure whether the difficulty in the finished product is a deficiency of perception or a deficiency of the motor skill necessary to produce the perception. However, in view of the fact that the child is completely satisfied with his drawing, we can probably assume that, in part at least, his perception of the human figure is faulty. If this be true, the way in which children draw human figures may reflect their knowledge and sensory experience of the body-schema. They thereby express to some degree the extent to which their own body schema is developed.[22]

Although the diagnostic value of this test, with respect to brain injury, has been highly rated by some authorities, there are those who question the degree of validity of this test in discriminating brain-injured from emotionally disturbed children. On the basis of clinical observations, Benton and Collins[23] have reported that this test detected brain injury in about 50 per cent of the cases seen by them. Other investigators[24] have reported that distortions, disorganization, and low

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[22] Strauss and Kephart, op. cit., pp. 70-71.

[23] A. L. Benton and N. T. Collins, "Visual Retention Test Performance in Children," Arch. Neurol. and Psychiat., 62: 610-617, 1949.

[24] F. L. Goodenough and D. B. Harris, "Studies in the Psychology of Children's Drawings," II, Psychol. Bull., 47: 369-433, 1950

Goodenough scores were also noted in emotionally disturbed children.

From the review of literature on the validity of the Goodenough Draw-A-Man Test as a discriminator of brain injury in children, it seems that one cannot be too sure whether low scores, distortions or disorganization in children's drawings of human figures are due to brain injury or emotional disturbances. However, it appears that, if used in conjunction with other psychological measurements, this test is a useful tool for detecting organic brain damage in children.

Disparity in mental development. Children with organic brain damage are believed to show a disparity in mental development. The disparity most frequently observed in these children is between the verbal and non-verbal functioning levels. Because of perceptual disturbances, these children usually experience difficulty in tests involving the manipulation of concrete objects. In attempting to demonstrate this uneveness of mental development in brain-injured children, Beck and Lam,[25] using the Wechsler Intelligence Scale for Children, studied 104

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[25] H. S. Beck and R. L. Lam, "Use of the WISC in Predicting Organicity," J. Clin. Psychol., 11: 154-158, 1955.

organic and non-organic children, ranging in age from 6 to 16 years and with IQ's below 80. These children were divided into three groups: (1) those diagnosed as brain damaged on the basis of neurological examination, (2) those diagnosed as brain damaged on the basis of psychological examination, and (3) those not suspected of organicity. The results of this study showed that the Verbal, Performance, and Full Scale IQ's for the groups varied significantly. Only in the non-organics was the Performance IQ above the Verbal IQ.

In a study of twenty-two brain-damaged patients, Morrow and Mark[26] found that there was a typical Wechsler-Bellevue pattern for gross pathology, consisting of significantly low scores in Digit Symbol, Block Design, and Digit Span (particularly in repeating digits backwards.) The Performance and Full Scale IQ's were significantly lower for the brain-damaged population.

Klebanoff, Singer, and Wilensky[27] reviewed studies

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[26] R. S. Morrow (V. A. Hosp., Bronx, N. Y.) and J. C. Mark, "The Correlation of Intelligence and Neurological Findings on 22 Patients Autopsied for Brain Damage," _J. Consult. Psychol._, _19_: 283-289, 1955.

[27] Reed, Alexander, and Tomkins, _op. cit._, p. 569.

on the validity of the WISC test as a discriminator of of brain injury in children. They noted that certain functions appeared again and again in the list as being particularly susceptible to impairment by brain injury. These were Digit Symbol, representing psychomotor learning, Digit Span, a test of recent memory, and Block Design, a test of analytic and synthetic capacity.

Lehtinen[28] presented case histories of thirteen brain-injured children who tested within the normal range on standardized tests. One of the common characteristics noted by her was the discrepancy between verbal and perceptual abilities of these children. It was not uncommon for them to have a Performance score of 20 or more points below the Verbal score.

There are rather strong indications in the literature presented that the mental development of brain-injured children is uneven. The disparity most frequently observed is between verbal and non-verbal functioning levels. This discrepancy, which can be detected by means of psychological tests, shows a lower functioning level in non-verbal abilities.

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[28]Strauss and Kephart, op. cit., pp. 223-252.

The Behavior Characteristics of Brain-Injured Children

The general behavior pattern is one of the primary symptoms of brain injury in children whose adjustment is influenced by organic factors.[29] It is believed that in many cases it is possible to establish a diagnosis of organicity on the basis of a careful evaluation of the behavior pattern. These children present a distinctive pattern of behavior which has been described in comparable terms by Bradley,[30] Bender,[31] Bakwin,[32] Strauss and Lehtinen,[33] and others. They found these children, as compared to others of similar age and development, to be erratic, hyperactive, distractible, impulsive and emotionally overreactive, and perseverative. Their power of concentration or ability to sustain a prolonged effort was limited.

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[29] Hoch and Zubin, _op. cit._, p. 96.

[30] _Ibid_, pp. 88-96.

[31] L. Bender, "Psychological Problems of Children with Organic Brain Disease," _Am. J. Orthopsychiat._, _19_: 404, 1949.

[32] Bakwin and Bakwin, _op. cit._, pp. 433-443.

[33] Strauss and Lehtinen, _op. cit._, pp. 75-79, 127-146.

Bradley[34] stated that the attitudes or behavior shown by brain-injured children were not always the direct result of organic impairment. He agreed with Bender[35] that the child's own basic personality and the way he was accepted by his family and others had a great deal more to do with his general adjustment than did the presence of organic factors alone. An impatient teacher or parent, she felt, often stimulated negativism in these children and this usually resulted in other forms of maladjustment. Extreme anxiety on the part of the parents was something such children often picked up and incorporated into their own outlook on life.

Strauss and Lehtinen observed the behavior of brain-injured children in classroom situations. They found them to be inattentive, extremely mobile in activity, unduly attracted by doings of others, inconsistent, and lacking in persistence. They describe their behavior as follows:

> ... Such a child not only attends to the noises outside, but is unable to inhibit the impulse to run to the window to find it. Classmates sitting nearby or passing his desk are a constant source

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[34] Hoch and Zubin, op. cit., p. 88.

[35] Bender, loc. cit.

> of excitation to which he responds by reaching out to hit, or punch, or push. Class games designed to motivate and interest the normal or familial mentally retarded child are over-stimulating for the brain-injured child, with the result that a child who is hyperactive and disinhibited is driven to boisterous talking, shouts, uncontrolled laughter, running about the room, etc. ... Scolding or deprivations, reasoning, subtle approach by precept or example are equally ineffectual, since the organic irritability and the situational irritating agents remain.[36]

There are also brain-injured children who may be extremely inhibited and yet be as reactive to extraneous stimuli as is the distractible child. Strauss and Lehtinen[37] state that in a classroom such a child may sit quietly at his desk apparently absorbed in his work, but at the end of the period has not completed the work. He is usually described as being lazy or a daydreamer. However, a brain-injured child of this type, they maintain, is constantly at the mercy of stimuli provided by such factors as pictures, numbers, markings, or flaws on the paper. These extraneous stimuli interfere with his thought processes, thus causing him to lose sight of his intended goal.

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[36] Strauss and Lehtinen, op. cit., p. 130.

[37] Ibid, p. 129.

Perseveration is a characteristic frequently observed in brain-injured children in learning situations. This is often termed as negativism or stubbornness. Strauss and Kephart[38] attribute this disorder to the inability of a brain-injured child to change from one structure to another quickly and efficiently because of the restricted range of responses open to him in any stimulus situation. Thus, when faced with a situation for which he has no structuring, a brain-injured child will usually respond on the basis of a structure which he has previously developed.

Strauss and Kephart[39] studied a group of institutionalized high grade defective children. They were interested in knowing whether, on the basis of personality and behavior alone, the exogenous children could be reliably differentiated from the endogenous group. In this experiment the two groups were matched according to chronological age and intelligence. The rating scale was

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[38]Strauss and Kephart, op. cit., pp. 139-142.

[39]A. A. Strauss and N. C. Kephart, "Behavior Differences in Mentally Retarded Children Measured by a New Behavior Rating Scale," Am. J. Psychiat., 96, 1117-1123, March, 1940.

made up of terms descriptive of abnormal behavior in expressive movements and in areas of mood, social relationship, and anxiety. Both groups were rated by teachers and cottage parents who were well acquainted with the children but who had no knowledge of the diagnosis. A statistical analysis of these ratings indicated that such a differentiation could be made. The brain-injured group was described in the same terms as had been selected as being characteristic of brain-injured behavior, on the basis of clinical observations.

The same rating scale was used in this study for the purpose of determining whether children with a history of meningitis could be reliably differentiated from other children of similar age and development on the basis of their behavior and personality. These matched pairs were rated by their classroom teachers.

Ingram[40] investigated the behavior of 25 brain-injured children. Some of the behavior disorders most frequently noted were distractibility, poor attention span, diminished capacity for spontaneous affectionate behavior, aggressive outbursts, irresistable urge to touch and chew

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[40] T. T. S. Ingram, "A Characteristic Form of Over-Active Behavior in Brain-Damaged Children," J. Ment. Sci., 102: 550-558, 1956.

every object, and failure to respond to reprimand.

Trolle[41] studied 327 patients with a history of meningococcal meningitis, a disease of bacterial origin. Some of the characteristics common to this group were: failing concentration, restlessness, memory disturbances, excitability and emotional instability, timidity, fatigability, and nervousness. In the majority of patients studied, he maintained, this was a permanent syndrome, and was not rarer after chemotherapy. This syndrome was also seen in post-concussional states, birth traumas, and after toxic and epidemic encephalitis.

Literature indicates that behavior disorders are most conspicuous in brain-injured children. These disorders are not always the direct result of organic impairment, but may be the child's reaction to his own handicap or to the way that he feels others regard him. Regardless of the etiological factors, these children present a distinctive behavior pattern which in many cases distinguishes them from other children.

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[41] E. Trolle, "Late Prognosis in Meningococcal Meningitis," Acta Psychiat., Kbh., Suppl., 66: 310, 1951.

The Learning Problems of Brain-injured Children

<u>Reading</u>. "Failure or partial failure to master the reading process is an experience shared by a large number of brain-injured children."[42] Other researchers have observed this close relationship between brain injury and reading disability.[43,44] Reading, they state, is a subject which is extremely abstract in nature, and in order for normal learning to take place there must be a smooth functioning of the brain and the nervous system. A breakdown in any of the brain's components prevents this harmonious functioning, with the result that the child experiences a reading difficulty.

Referring specifically to brain-injured children, Strauss and Lehtinen maintain that a child's reading disability, or difficulty in learning to read, seldom exists as an isolated problem but is usually a further manifestation of the general disturbance of perception

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[42] Strauss and Lehtinen, <u>op</u>. <u>cit</u>., p. 168.

[43] F. H. Burke, "The Effect on Learning of Brain Pathology," <u>Excep</u>. <u>Child</u>., <u>24</u>: 169-172, 1957.

[44] M. H. Fouracre, "Learning Characteristics of Brain-injured Children," <u>Excep</u>. <u>Child</u>., <u>24</u>: 210-212, 1958.

and behavior. In observing a group of brain-injured children who were experiencing reading difficulties, they noted similarities in the type and nature of reading problems. They write:

> ... Reading disability is characterized by absence of an adequate approach to new words and faulty recognition of familiar words, confusions of similar words and letters, omission of words, phrases and sentences with a generally careless attitude toward the content of the material read....[45]

Similarities were also noted in the types of behavior disorders and motor difficulties of these children. These were described as follows:

> ... All these children show evidence of general disturbances in the classroom situation: distractibility, hyperactivity, and disinhibition as expressed in difficulty in conforming to the usual standards of group and classroom management. Most of the children show these same disturbances in such manual activities as cutting and coloring as well as in academic subjects of arithmetic and writing. Comments by psychologists administering intelligence tests note the presence of these disturbances in the test situation.[46]

They concluded that the similarity of difficulties in the areas of reading and classroom behavior was further indication that reading disability was but one aspect of the

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[45] Strauss and Lehtinen, op. cit., pp. 169-170.

[46] Ibid, pp. 170-171.

general disturbance in a brain-injured child.

Burke[47] and Fouracre[48] studied the effects of brain pathology on learning and came to similar conclusions. They noted that children with a reading problem also showed disturbances in behavior, motor coordination, and perceptual functions. Though the intelligence of some of these children was above the defective range, they had academic difficulties. Their behavior was not a problem but they were distractible, restless, and impulsive. They were uncoordinated in small motor tasks.

Studies indicate that reading problems can be anticipated in brain-injured children. Because of perceptual and behavioral disorders these children are unable to learn to read in a normal manner. Special educational methods are necessary to help them in their reading program.

<u>Writing</u>. Brain-injured children with comparatively little or no motor handicap often experience a writing difficulty. Some authorities attribute this difficulty

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[47]Burke, <u>loc</u>. <u>cit</u>.

[48]Fouracre, <u>loc</u>. <u>cit</u>.

to a deficiency in visual perception and in visual motor integration.[49,50] As these functions are found to be impaired most frequently in brain-injured children it is, therefore, not unusual for them to experience difficulties in the complex, coordinated acts of writing.

Dealing specifically with the problem of writing deficiencies in brain-injured children, Strauss and Lehtinen[51] noted a relationship between types of writing difficulties and specific areas of impairment. Their observations were as follows:

(1) Children with a deficiency in visuomotor integration have difficulty forming letters. This is particularly noticeable in the early stages of printing or writing. They cannot make the joining of diagonal lines, thus producing letters which are distorted.

(2) Children with disturbances in the perception of spatial relationships experience repeated failures in attempting to organize writing space; that is, they are unable to indicate with certainty the line on which the letters should rest and the size of the various letters.

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[49] Burke, loc. cit.

[50] Strauss and Lehtinen, op. cit., pp. 184-190.

[51] Ibid, pp. 186-189.

(3) Children with disturbances in visual perception often prolong the stage of copying letters as they are unwilling to attempt to write from memory.

(4) Children who are distractible and hyperactive are slow in learning to write, as they lack the restraint and inhibition required in writing.

Most writing difficulties experienced by brain-injured children indicate a deficiency in perception and visuomotor integration rather than lack of muscular co-ordination. Strauss and Lehtinen[52] maintain that, in dealing with this problem, it is necessary to precede writing instructions with a program aimed at strengthening deficient visuomotor perception.

Summary

A review of the literature on brain damage has revealed the nature of meningitis and its general consequences, the organic disorders it generates, and its effects on learning and behavior.

Meningitis is an infectious disease which causes an inflammation of the covering membranes of the brain and spinal cord. As a result of this disease, children

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[52] Ibid, p. 184.

may die or be seriously impaired mentally because of the extensive damage to the brain tissue. The severity of damage depends somewhat upon the age of the child at the time of acute illness. If the child is young, the damage to the nervous system may be widespread. On the other hand, if the child's nervous system is well developed at the time of illness, the damage may be minimal and, in some cases, only temporary.

The damage caused by infectious diseases may be manifested in various organic disorders. Postinfectious defects may be convulsions, epileptic seizures, cerebral palsy, speech and hearing defects, and other forms of neurological disorders.[53] Other disturbances, which can be demonstrated by specific psychological tests, may be in perception, thinking, and emotional behavior. These disturbances, depending on the extent and location of injury, may appear separately or in combinations.

Learning and behavior may be affected by minimal brain damage without an apparent lowering of the intelligence level. Research carried out on brain-injured adults suggests that the undamaged portions of the brain hold resources which may substitute or compensate for

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[53] Hoch and Zubin, op. cit., pp. 69 and 72.

disabilities resulting from injury.[54] These resources must, therefore, be used in the education of brain-damaged children in order to remedy specific handicaps, especially as in most cases the only treatment for brain injury is medication.

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[54] Strauss and Lehtinen, op. cit., p. 129.

CHAPTER III

METHOD OF PROCEDURE

Subjects selected for this study were children who had been treated for purulent meningitis and were now attending schools in Greater Winnipeg. A battery of psychological tests and teachers' assessments of behavior and abilities in reading and writing were used to investigate the relationship between this disease and possible brain damage. In areas of investigation where conclusions were based on comparisons, a non-meningitis group was used. The ensuing discussion deals with these and other related problems in the following order:

1. Selection of meningitis and non-meningitis subjects.
2. Testing program and collection of school data.
3. Selection and description of psychological tests.
4. Description of behavior, reading and writing scales.
5. Treatment of results.

Selection of Meningitis and Non-Meningitis Subjects

Meningitis group. The selection of subjects for the meningitis group was based on medical records. The procedure and criteria determining this selection were as follows: Examination was made of records of all meningitis patients admitted to the Children's Hospital of Winnipeg, from 1952 to 1956 inclusive.* No admissions prior to 1952 were considered, since treatment of meningitis with broad-spectrum antibiotics dates from approximately 1951. No admissions in 1957 or subsequently were considered, so that the minimum follow-up period would be 2.5 years.

From a survey of the hospital records all those who definitely represented acute purulent meningitis of bacterial origin were identified.** Cases of other types of meningitis (including tuberculous) were excluded. For inclusion, a definite diagnosis based on cerebrospinal fluid examination was required, with one or both of the following findings:

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*Medical records were examined by staff members of the Departments of Pediatrics and Psychiatry, Children's Hospital of Winnipeg.

**The criteria for selection of children were determined by the Research Committee of the Children's Hospital of Winnipeg.

1. Identification of the causative organism on C.S. F. smear or culture.

2. Marked C.S.F. polymorphonuclear pleocytosis.

One hundred and twenty-three cases met these criteria. Because of anticipated difficulty in arranging follow-up studies, 43 patients, whose residence at the time of admission was outside Greater Winnipeg, were rejected. Since valid psychological test results are difficult to obtain on children under 5 years of age, 16 who had not reached this age at the time of the follow-up study (June 1, 1959) were also rejected. This number was further reduced to the 43 cases that comprise this group by the exclusion of 8 who died in hospital, 10 who could not be traced, 2 who had died subsequent to hospitalization, and 1 who failed to take the required follow-up tests. The classifications of this group as to etiology, characteristics, age, and grade distributions are shown in Tables X, XI, XII, and XIII. (See Appendix B.)

<u>Non-meningitis group</u>. In selecting children for the non-meningitis group, factors considered were: (1) sex, (2) age, (3) intelligence or general ability, and (4) grade. In order to determine differences between the meningitis and non-meningitis groups in areas of

behavior, reading and writing, it was also necessary that each matched pair be from the same classroom and exposed to the same teaching and environmental influences. The following criteria were observed in matching these pairs:

1. Only the school principal was informed as to the purpose of the study.
2. Cumulative information on school record cards was used in the matching of pairs.
3. The teacher and principal were not involved in the selection of children for this group.
4. The teachers had no knowledge of the medical history of children in the meningitis group.

Some difficulty was encountered in matching these children on the basis of standardized intelligence scores, as a number of children used in the non-meningitis group had to be selected from either kindergarten or grades one and two, where such scores were not available. Therefore, other means of matching for intelligence were used. Children in these early grades had been rated by their teachers with regard to their general abilities, and on this basis were divided into categories A, B, and C. Thus, where an IQ score was not available, the non-meningitis child was selected from the same category as the meningitis child. This was not a problem in the higher grade levels, as these children had standardized intelligence test scores which were used in the matching of pairs. (A comparison of the meningitis and non-meningitis groups in terms of sex, age, grade, and intelligence or general ability is shown in Table XI, Appendix B.)

Testing Program and Collection of School Data

The testing program for the meningitis group was carried out at The Children's Hospital of Winnipeg, during July and August of 1959. Appointments were made by the Out-Patients' Department, and children were seen individually for a series of psychological tests in the mornings only. The average testing time was about one and one-half hours.

The psychological test used on the non-meningitis group was the Ellis Visual Designs Test. This was administered individually in schools.

The data collected from schools were teachers' assessments of behavior, reading, and writing of the matched pairs. The rating scales were distributed to schools after the children had been attending school for a period of four months. This period was believed to give the teachers an opportunity to become better acquainted with pupils in regard to classroom work, behavior, and adjustment. The only instructions given teachers were those printed on the face sheets of the scales. (The instructions and rating scales in behavior, reading, and writing are shown in Appendix A.) These scales were to be returned by mail and self-addressed envelopes were provided for this purpose.

Selection and Description of the Psychological Tests

The psychological tests used in this study were those devised and used by Werner and Strauss,[1] and Strauss and Kephart,[2] as well as those suggested by Goldenberg,[3]

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[1]H. Werner and A. A. Strauss, "Pathology of Figure-Background Relations in the Child," J. Abnorm. Soc. Psychol., 36: 236, 1941.

[2]A. A. Strauss and N. C. Kephart, "Behavior Differences in Mentally Retarded Children Measured by a New Behavior Rating Scale," Am. J. Psychiat., 96: 1117-1123, March, 1940.

[3]A. A. Strauss and N. C. Kephart, Psychopathology and Education of the Brain-Injured Child (New York: Grune and Stratton, 1955), pp. 144-164.

and Klebanoff et al,[4] after making extensive reviews of studies related to brain damage. The characteristics of brain pathology and psychological tests used in the assessment of these functions are shown in Table I. A description of tests, methods of administration and scoring, and the rationale underlying the use of these particular tests are discussed in this section.

Stanford-Binet Scale.[5] The 1937 revision of the Binet, Form L scale, was used for the purpose of measuring intelligence and determining the incidence of retardation of the meningitis group. Standard procedures of administration and scoring of the test were followed. The assumption underlying the use of this test was that, due to a higher incidence of retardation, the mean IQ of children with a history of meningitis would be lower than that for the Binet standard population.

Picture Test.[6] A Picture test similar to the one

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[4] C. F. Reed, I. E. Alexander, and S. S. Tomkins, Psychopathology, a Source Book (Cambridge, Massachusetts: Harvard University Press, 1958), pp. 556-569.

[5] L. M. Terman and M. A. Merrill, Measuring Intelligence (Boston: Houghton Mifflin Company, 1937), pp. 75-132.

[6] Werner and Strauss, loc. cit.

TABLE I

CHARACTERISTICS OF BRAIN PATHOLOGY AND PSYCHOLOGICAL TESTS USED IN THE MEASUREMENT OF SPECIFIC CHARACTERISTICS

Characteristics	Psychological Tests
1. Intellectual Impairment	Stanford-Binet (Rev.37)L
2. Impaired Visual Perception	Picture Test
3. Impaired Visuomotor Integration	Ellis Visual Designs Test
4. Impaired Sensory Motor Development	Goodenough Draw-A-Man Test
	Stanford-Binet (Rev.37)L
5. Disparity in Mental Development	Stanford-Binet (Rev.37)L
	Wechsler Intelligence Scale for Children*

*The Performance Scale of the WISC was used.

constructed and used by Werner and Strauss to demonstrate "figure-ground" disturbances in brain-injured children was used. The pictures were tachistoscopically exposed for one-fifth of a second and the child was asked, "What do you see?" To make sure that the child could perceive the short exposure, each card was presented twice. At the end of the test all cards were again exposed but without the time limit, to make certain that errors which had been made were not due to defective vision. In scoring this test four different reactions to the cards were recorded. These were: (1) object, (2) vague or unprecise object, (3) background, and (4) formal characteristics of both figure and ground. Each response was given a credit of one point, the total score being 9.

This test was used to see if a structured background interfered with foreground or object reactions. Brain-injured children are believed to be so attracted by background structure and bound in their attraction to such an extent that objects or figures are distorted or unnoticed. A predominance of background reaction by children in the meningitis group would be considered as an indication of organicity.

The Picture Test has not been a widely used test and therefore is not well standardized. However, Werner and Strauss found this test to be reliable in differentiating between brain-injured and non-brain-injured children. In comparing organic and non-organic children in terms of their visual perception, they found the percentage of background responses for the normal group of children to be 9 per cent of all responses as compared to 14 per cent for the non-brain-injured deficient children and 75 per cent for the brain-injured group.

Ellis Visual Designs Test. In order to determine whether children in the meningitis and non-meningitis groups could be discriminated on the basis of their visuomotor functions, the Ellis Visual Designs Test as administered by Cassel[7] was used. Each of the seven geometric figures, on separate 4" x 6" cards, was presented one at a time and the subject was told, "Here are some figures (or designs) for you to copy; just copy them the way you see them." Turning of cards was discouraged, but was allowed if the subject persisted in doing this. All other

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[7] R. H. Cassel, "Relation of Design Reproduction to the Etiology of Mental Deficiency, J. Consult. Psychol., 13: 421-428, 1949.

instructions were non-committal. These designs were copied with no time limit. The scoring criteria were essentially those of Wood and Shulman.[8] Three judges* scored the test and the median score was used. Credit of one point was given for each design correctly drawn; a half point credit was allowed for each design containing only one error or two errors which were symmetrically consistent. Reversing, inverting, or turning of designs on a ninety degree angle was considered as one error. Errors obviously due to poor motor control were disregarded. The total score for this test was 7.

The supposition underlying the use of this test was that children with organic impairment would have difficulty reproducing visually perceived stimuli. Significantly lower scores for the meningitis group as compared to those for the non-meningitis group would be considered an indication of organic impairment.

In terms of group means, Cassel[9] found a

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[8]L. Wood and R. Shulman, "The Ellis Visual Designs Test," J. Educ. Psychol., 31: 591-602, 1940.

[9]Cassel, loc. cit.

*The judges were two psychologists from the Child Guidance Clinic of Greater Winnipeg, and one from The Children's Hospital of Winnipeg.

significant difference at better than one per cent level of confidence between the organic and non-organic mentally deficient children. The exogenous children displayed marked difficulty in the copying of figures. These findings confirmed clinical observations that brain-injured children were deficient in visuomotor integration.

Goodenough Draw-A-Man Test.[10] The Goodenough drawing test of intelligence and the Binet scale were used to demonstrate impaired body concept, or a deficiency in sensory motor development in post-meningitis children. Standard procedures of administration and scoring of tests were followed.

It is believed that the development of body concept runs to a great extent parallel with sensory motor development. The supposition underlying the use of these tests was that a deficiency in sensory motor development would be revealed in a faulty body concept as shown in children's drawings of human figures. A substantially lower score on the Goodenough test would be considered an indication of possible brain injury.

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[10] F. L. Goodenough, Measurement of Intelligence by Drawings (New York: World Book Company, 1926), pp. 85-110.

The Goodenough drawing test of intelligence has been used in conjunction with other psychological measurements for the purpose of detecting brain injury in children. Bender,[11] on the basis of clinical experience, stated that a Goodenough M.A. two or more years below the Binet M.A. was suggestive of organic injury to the brain.

Wechsler Intelligence Scale for Children.[12] The WISC Performance and the Binet Form L scales were used to determine the disparity between verbal and non-verbal functioning levels in children treated for meningitis. Standard procedures of administration and scoring of tests were followed.

It was assumed that, due to perceptual disturbances, children with organic impairment would have difficulty manipulating concrete objects and would, therefore, obtain significantly lower scores on tests where such functions were stressed. This discrepancy between verbal and performance scores has been reported in a number of psychological studies to be an indication of brain damage in children.

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[11] L. Bender and A. Silvers, "Body Image Problems of the Brain-Damaged Child," J. Soc. Issues, 4: 84-89, 1948.

[12] D. Wechsler, Wechsler Intelligence Scale for Children, Manual (New York: The Psychological Corp., 1949).

Description of Behavior, Reading, and Writing Rating Scales

The behavior and abilities in reading and writing of children in the meningitis and non-meningitis groups were rated by classroom teachers on scales provided. The purpose of these ratings was to see if post-meningitis children presented problems in these areas to such an extent that they could be differentiated from other children in the classroom.

Diagnostic Behavior Rating Scale of Personality.[13] This rating scale was used to assess the classroom behavior of each matched pair. The teachers were asked to describe the behavior of these children by underlining characteristics most descriptive of them. The printed instructions constituted the only advice given to them. In scoring, one point was given for each underlined characteristic which was descriptive of brain-injured behavior. The total score on this scale was 52.

Strauss and Kephart[14] used this scale and found that it reliably differentiated the brain-injured group from the

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[13]A. A. Strauss and N. C. Kephart, "Behavior Differences in Mentally Retarded Children Measured by a New Behavior Rating Scale," Am. J. Psychiat., 96: 1117-1123, March, 1940.

[14]Ibid, pp. 1117-1123.

non-brain-injured group. The brain-injured children were described in the same terms which had been selected as characteristic of brain-injured behavior on the basis of clinical observation.

Rating scale in oral reading. A rating scale (shown in Appendix A) was used to compare the reading abilities of children in the meningitis and non-meningitis groups. The classroom teachers rated these children on the basis of their daily work and other cumulative information. Kindergarten children as well as those not attending school were not included in this area of investigation. The categories used in rating were: A, Excellent; B, Above Average; C, Average; D, Below Average; and E, Not Acceptable. The teachers indicated each child's reading ability by circling a letter. In scoring this test, the focus was on the direction of the differences between each member of the pair, noting whether the sign of the difference was plus or minus. All tied cases where no differences were observed were dropped.

Failure or partial failure to master reading is believed to be an experience shared by a large number of brain-damaged children. It was, therefore, hypothesized that children treated for meningitis would experience such difficulties.

Rating scale in writing or printing. A rating scale similar to the one for reading was used to compare the writing abilities of children in the meningitis and non-meningitis groups. (This scale is shown in Appendix A.) The classroom teachers rated these children in writing (or in printing, if writing had not been taught) on the basis of their daily work. In scoring, the same procedures as outlined in reading were followed.

Brain-injured children are believed to experience difficulties in writing because of a deficiency in visuo-motor integration. It was assumed that children with a history of meningitis would also experience such difficulties, and on this basis could be reliably differentiated from other children in the classroom.

Treatment of Results

Since this study is concerned with comparisons, the analysis was based on the significance of differences in ratings and the levels of achievement on psychological tests. The ensuing discussion deals with the procedures followed.

The differences between means on the Stanford-Binet

Scale for the meningitis and standardization[15] groups was found to be small. Therefore, further statistical treatment was considered unnecessary. The chi square was used to determine the significance of retardation; that is, whether the distribution of IQ scores for the meningitis group departed significantly from that of the normal curve. The procedure followed was that outlined by Downie and Heath.[16] Using k - 1 degrees of freedom, the significance of χ^2 was estimated from Table IV.[17]

The percentages of the three types of reactions (figure, background, and formal characteristics of both figure and ground) to the Picture Test were computed for the meningitis group and compared with those of the normal and exogenous groups used in a similar experiment by Werner and Strauss (Hypothesis 1.b). The following formulae were used to determine the significance of differences between percentages for these groups:

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[15]Terman and Merrill, _op_. _cit_., p. 35

[16]N. M. Downie and R. W. Heath, _Basic Statistical Methods_ (New York: Harper and Brothers, Publishers, 1959), p. 153.

[17]_Ibid_, p. 266.

[18]_Ibid_, p. 138.

$$SD_p = \sqrt{pq\left(\frac{1}{N_1} + \frac{1}{N_2}\right)}$$

$$t = \frac{p_1 - p_2}{SD_p}$$

The results were interpreted using infinite degrees of freedom.

Intra-group comparisons of reactions to the Picture Test were also made for the purpose of determining whether the number of foreground reactions of children in the meningitis group increased with age. These comparisons required no further statistical treatment.

Where the study employed two related samples and yielded difference scores which could be ranked in order of absolute magnitude, the Wilcoxon matched-pairs signed-ranks test was used (Hypotheses 1.c and 2.a). The method outlined in Siegel[19] was followed in determining the "z" value. As the sample used in this study was larger than 25 subjects, "z" was determined by the following formula:[20]

$$z = \frac{T - \frac{N(N+1)}{4}}{\sqrt{\frac{N(N+1)(2N+1)}{24}}}$$

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[19] S. Siegel, Nonparametric Statistics for the Behavioral Sciences (New York: McGraw-Hill Book Company Inc., 1956), pp. 75-83.

[20] Ibid, p. 81.

Table A[21] was used to estimate the significance of "z".

A t-test of related measures was used where data were correlated (Hypotheses 1.d and 1.e). In testing the significance of differences between means, the method used was as follows:[22]

$$\Sigma d^2 = \Sigma D^2 - \frac{(\Sigma D)^2}{N}$$

Standard deviation of differences.

$$S_d = \frac{\Sigma d^2}{N - 1}$$

Standard error of the mean difference.

$$S_{\bar{d}} = \frac{S_d}{\sqrt{N}}$$

$$z = \frac{\text{mean difference}}{\text{standard error of mean difference}}$$

The results were interpreted using (N - 1) degrees of freedom.

In order to determine the significance of differences in ratings of reading and writing abilities of children in

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[21] *Ibid*, p. 247.

[22] Downie and Heath, *op. cit.*, pp. 129-131.

the meningitis and non-meningitis groups, the sign test[23] was used (Hypotheses 2.b and 2.c). This test was chosen for these two variables because the groups used in this study were related, and the differences could be appropriately represented by plus and minus signs. Since the number of fewer signs was less than 25, Table D[24] was used to estimate the significance of "x".

A probability of .01 was regarded as an acceptable level of significance in this study.

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[23]Siegel, op. cit., pp. 68-75.

[24]Ibid, p. 250.

CHAPTER IV

RESULTS OF STUDY

The presentation of results follows the general plan suggested by the statement of hypotheses in Chapter I.

Intelligence. The mean intelligence score for the meningitis group, not including two untestable children, was 102.2 as compared to 102.9 for the Binet standard population[1] in the same age range. The median intelligence score for the total sample of 43 children was 103. (The Stanford-Binet scores and mean for the meningitis group are shown in Table XV, Appendix C.) The mean difference of .7 between these two groups was considered small and not significant.

A comparison of the meningitis group and the standard population in terms of IQ score distribution is shown in Table II. This comparison indicated a high incidence of retardation for the meningitis group, it being 9.3 per cent as compared to 2.2 per cent for the

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[1] L. M. Terman and M. A. Merrill, Measuring Intelligence (Boston: Houghton Mifflin Company, 1937), p. 35

TABLE II

COMPARISON OF THE MENINGITIS GROUP AND THE BINET STANFARD POPULATION IN TERMS OF IQ DISTRIBUTION

Groups	130 and above	120-129	110-119	90-109	80-89	70-79	69 and below
Meningitis (0)	1	6	6	22	4	0	4
Standard Population (E)	.946	2.881	6.923	21.5	6.923	2.881	.946
<u>Combined</u>							
Meningitis			13	22	8		
Standard Population			10.75	21.5	10.75		

$$\chi^2 = \frac{(13 - 10.75)^2}{10.75} + \frac{(22 - 21.5)^2}{21.5} + \frac{(8 - 10.75)^2}{10.75}$$

$$= \frac{5.0625}{10.75} + \frac{.25}{21.5} + \frac{7.5625}{10.75}$$

$$= .471 + .116 + .703$$

$$\chi^2 = 1.290$$

$$df = k - 1$$

$$= 3 - 1$$

$$df = 2 \qquad p > .50$$

standard population.[2] Of the four retarded children, one was severely retarded with gross defects in the neuromotor system, two had defective hearing, and one had impaired speech. Two of these children were untestable, while two were developing mentally at about half the normal rate. A statistical analysis of the data (presented in Table II) indicated, however, that the distribution of IQ scores did not depart significantly from that of the normal curve ($x^2 = 1.290$, $p > .50$).

<u>Conclusion</u>. The null hypothesis 1.a stating that there were no differences between children treated for meningitis and the Binet standard population, with respect to mean IQ scores is accepted. It may be concluded that, as a group, post-meningitis children do not show a significant decline in their intellectual level.

<u>Visual Perception</u>. A comparison of the meningitis group with normal and exogenous groups in terms of percentage reactions to the Picture Test is shown in Table III. In this table, 17 subjects ranging in age from 7 to 10 years were evaluated. One untestable 8-year-old boy was not included in this group. An analysis of this data

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[2] D. Wechsler, <u>Wechsler Intelligence Scale for Children, Manual</u> (New York: The Psychological Corporation), 1949.

TABLE III

COMPARISON OF MENINGITIS, NORMAL AND EXOGENOUS GROUPS IN TERMS OF PERCENTAGE REACTIONS TO THE PICTURE TEST

Reactions	Meningitis N = 17	Normal* N = 30	Exogenous* N = 25	p_1	p_2	p	SD_p	t ratio	df	Significance
Object, Precise and Unprecise	68.6	62.7	--	.686	.627	.648	.149	.396	∞	p .10
Background	7.2	9.3	--	.072	.093	.085	.085	.247	∞	p .10
Characteristics of both Figure and Ground	24.2	28.0	--	.242	.280	.266	.134	.284	∞	p .10
Object, Precise and Unprecise	68.6	--	11.7	.686	.117	.347	.150	3.793	∞	p .001
Background	7.2	--	75.5	.072	.755	.479	.157	4.350	∞	p .001
Characteristics of both Figure and Ground	24.2	--	12.8	.242	.128	.118	.118	.966	∞	p .10

Age Range: Meningitis, 7-10; Normal, 7-10; Exogenous (M.A.), 7-11.

*These were the two groups used in the study by Werner and Strauss.

indicated insignificant differences between the meningitis and normal groups in terms of the three types of reaction to the Picture Test. On the other hand, these differences were significant between the meningitis and the exogenous groups. The relative proportion of object and background reactions of the meningitis and normal groups was the reverse of the responses given by the exogenous group. This high percentage of object or foreground reactions, as compared to a low percentage of background reactions, indicated normal visual perception in children treated for meningitis.

One further observation was made. Intra-group comparisons of reactions to this test showed that the number of foreground reactions increased with age. These same differences had been noted in normal children by Werner and Strauss.[3] (The intra-group comparisons of reactions to the Picture Test for the meningitis group are shown in Table XVI, Appendix C.)

Conclusion. The null hypothesis 1.b stating that there were no differences between the meningitis and

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[3] H. Werner and A. A. Strauss, "Pathology of Figure-Background Relation in the Child," J. Abnorm. Soc. Psychol., 36: 236, 1941.

normal groups in terms of figure-ground reactions in the visual perceptual field is accepted. These findings suggest normal visual perception in children treated for meningitis.

Visuomotor integration. The Ellis Visual Designs Test was used for the purpose of determining whether children in the meningitis and non-meningitis groups could be reliably differentiated on the basis of their visuomotor functions. The results of this test and differences in scores for these two groups are shown in Table IV. This table did not include one retarded and two untestable children whose motor skills were either undeveloped or impaired. In comparing the scores of each member of the pair, it was observed that those of children in the meningitis group, as indicated by minus signs, were consistently lower. An analysis of the data in Table IV indicated these differences to be significant ($z = -3.659$, $p < .001$.)

In terms of score distributions for the two groups, those of the non-meningitis group were noted to follow the normal pattern of distribution, whereas those for the meningitis group were concentrated at the lower end of the scale. (The score distributions are shown in

TABLE IV

ELLIS VISUAL DESIGNS TEST SCORES OF THE MENINGITIS AND NON-MENINGITIS GROUPS

Pair	Meningitis Group	Non-Meningitis Group	d	Rank of d	Rank with Less Frequent Sign
1	.5	.5	0		
2	.5	1.5	-1.0	-10.5	
3	1.5	2.5	-1.0	-10.5	
4	0	1.0	-1.0	-10.5	
5	1.0	1.5	- .5	- 4.0	
6	.5	2.5	-2.0	-21.5	
7	.5	1.5	-1.0	-10.5	
8	3.5	2.0	1.5	16.5	16.5
9	.5	1.5	-1.0	-10.5	
10	.5	4.0	-3.5	-32.0	
11	3.0	2.5	.5	4.0	4.0
12	1.0	4.0	-3.0	-30.0	
13	1.0	1.5	- .5	- 4.0	
14	4.0	2.5	1.5	16.5	16.5
15	1.0	3.5	-2.5	-26.0	
16	1.5	5.5	-4.0	-33.5	
17	1.0	5.0	-4.0	-33.5	
18	.5	.5	0		
19	2.5	5.5	-3.0	-30.0	
20	1.5	4.0	-2.5	-26.0	
21	3.5	6.5	-3.0	-30.0	
22	4.5	4.0	.5	4.0	4.0
23	3.0	4.5	-1.5	-16.5	
24	3.0	1.5	1.5	16.5	16.5
25	5.5	5.5	0		
26	3.5	5.5	-2.0	-21.5	
27	4.5	4.5	0		
28	3.5	4.0	- .5	- 4.0	
29	2.0	4.5	-2.5	-26.0	
30	5.0	2.5	2.5	26.0	26.0
31	4.0	4.0	0		
32	4.0	6.0	-2.0	-21.5	
33	5.0	5.0	0		
34	5.5	6.0	- .5	- 4.0	
35	4.5	7.0	-2.5	-26.0	
36	5.0	7.0	-2.0	-21.5	
37	4.5	5.0	- .5	- 4.0	
38	4.5	5.5	-1.0	-10.5	
39	4.5	6.0	-1.5	-16.5	
40	5.5	7.0	-1.5	-16.5	
					T = 83.5

$z = -3.659 \qquad p < .001$

in Table XVII, Appendix C.)

Conclusions. The findings on the Ellis Visual Designs Test led to the rejection of the null hypothesis 1.c stating that there were no differences between the meningitis and non-meningitis children in terms of their ability to reproduce visually perceived stimuli. The visuomotor functions of post-meningitis children appear somewhat less well developed than those of "normal" children.

Body concept. The sensory motor development or body concept of children treated for meningitis was determined by comparing their mental ages as estimated on the Binet and Goodenough scales. A comparison of mental ages of these children, ranging in age from 5 to 11 years, is shown in Table V. One retarded and two untestable children in this age group who failed to achieve scores on one or both tests were not included in the table.

The mental ages on the Goodenough scale were found to be low in comparison to Binet ratings, the mean difference being 11.91 months. This mean difference was found to be statistically significant ($z = 4.64$, $p < .01$.) Further observations of test data showed that 8 out of the

TABLE V

COMPARISON OF MENTAL AGE SCORES OF THE MENINGITIS GROUP ON THE BINET AND GOODENOUGH SCALES

Case	Binet M.A	Goodenough M.A.	D (Months)	D^2
1	4- 5	4- 6	1	1
2	6- 2	5- 6	- 8	64
3	6-10	5- 6	-16	256
4	5- 2	4- 3	-11	121
5	6- 2	6- 6	4	16
6	7- 2	4- 9	-29	841
7	6- 4	4- 3	-25	625
8	5-10	7- 3	17	289
9	6- 4	6- 3	- 1	1
10	6- 0	6- 9	9	81
11	7- 8	6- 6	-14	196
12	5-10	6- 0	2	4
13	7-10	6- 9	-13	169
14	7-10	6- 9	-13	169
15	7- 6	5- 9	-21	441
16	6-10	5- 9	-13	169
17	7- 2	7- 3	1	1
18	4- 1	5- 6	17	289
19	8- 4	6- 9	-19	361
20	7- 0	6- 3	- 9	81
21	7- 8	7- 3	- 5	25
22	7- 6	7- 6	0	0
23	7- 6	5- 9	-21	441
24	6- 6	6- 0	- 6	36
25	10- 6	7- 0	-42	1764
26	8- 2	7- 0	-14	196
27	8- 8	7- 3	-17	289
28	10- 0	7- 0	-36	1296
29	9- 4	6- 6	-34	1156
30	8-10	9- 9	11	121
31	10- 2	7- 9	-29	841
32	10- 0	9- 6	- 6	36
33	12- 6	10- 0	-30	900
34	13- 8	10- 6	-38	1444
35	10- 6	9- 9	- 9	81
Sum	272	237.25	-417	12801
Mean	7.77	6.78	11.91	

$\Sigma d^2 = 7832.743$ $S_d = 15.178$ $S_{\bar{d}} = 2.566$ $z = 4.64$

$df = 34$ $p < .01$

35 children showed wide mental age discrepancies of more than two years.

In terms of IQ ratings on the two scales, it was noted that the Goodenough scores tended to appear more frequently at the lower end of the scale, whereas those of the Binet scale followed more closely the normal curve pattern. (The frequency distribution of these scores is shown in Table XVIII, Appendix C.)

In order to determine whether such discrepancies occurred in other children of similar age and mental ability, a normal group matched for age and intelligence was used. This was a group of children who had been referred to the Child Guidance Clinic of Greater Winnipeg for various reasons associated with learning. (The characteristics of this group are shown in Table XIV, Appendix B.) A statistical analysis of test data for this group showed differences in mental ages on the Binet and Goodenough scales to be insignificant ($z = 1.438$, $p > .10$.) The mean mental age difference for this group was 3.36 months, as compared to 11.91 months for the meningitis group. (A comparison of mental ages on the Binet and Goodenough scales for this group is shown in Table XIX, Appendix C.)

Conclusion. Although the mean mental age discrepancy for the meningitis group was not as great as had been suggested in the literature on brain damage, test findings indicated that these children experienced more difficulty in the drawing of human figures than other children of similar age and mental ability. Therefore, the null hypothesis 1.d stating that there are no differences between the Binet and Goodenough mental ages of children treated for meningitis is rejected. The rejection of this hypothesis supports the assumption that the sensory motor development of children treated for meningitis is somewhat impaired.

Disparity in mental development. The disparity between verbal and non-verbal functioning levels of children in the meningitis group was determined by comparing the intelligence scores on the Binet and WISC Performance scales. A comparison of these scores is shown in Table VI. This table did not include the scores of two untestable children and two others whose non-verbal functioning levels could not be assessed on the WISC Performance Scale. The mean intelligence score on the WISC scale was found to be lower, the mean difference being 4.44. This mean difference was not significant at the .01 level of confidence,

TABLE VI

COMPARISON OF BINET AND WISC PERFORMANCE IQ SCORES OF THE MENINGITIS GROUP

Case	Binet	WISC (Performance)	D	D^2
1	112	106	- 6	36
2	124	127	3	9
3	93	67	-26	676
4	104	86	-18	324
5	121	118	- 3	9
6	106	74	-32	1024
7	97	85	-12	144
8	103	97	- 6	36
9	96	92	- 4	16
10	123	89	-34	1156
11	93	90	- 3	9
12	125	110	-15	225
13	116	110	- 6	36
14	108	115	7	49
15	94	94	0	0
16	99	101	2	4
17	56	74	18	324
18	114	117	3	9
19	94	104	10	100
20	103	103	0	0
21	101	106	5	25
22	99	113	14	196
23	86	103	17	289
24	137	118	-19	361
25	104	110	6	36
26	111	117	6	36
27	125	114	-11	121
28	112	106	- 6	36
29	97	100	3	9
30	103	93	-10	100
31	92	85	- 7	49
32	114	93	-21	441
33	121	108	-13	169
34	91	76	-15	225
35	103	100	- 3	9
36	90	97	7	49
37	87	85	- 2	4
38	86	90	4	16
39	104	98	- 6	36
Σ	4044	3871	-173	6393
Mean	103.69	99.26	- 4.44	

$\Sigma d^2 = 5625.59$ Sd $= 12.167$ S $= 1.948$ $z = 2.279$

df $= 38$ $p > .025$

($z = 2.279$, $p > .025$). Of the twenty-three children having low performance scores, 12 showed discrepancies of over 10 points. On the other hand, only three subjects had significantly higher verbal scores.

Conclusion. The null hypothesis 1.e stating that there were no differences between verbal and non-verbal ability of children treated for meningitis is accepted. In terms of their non-verbal abilities, the post-meningitis children show no evidence of organic impairment.

Behavior. The teachers' ratings of behavior on the Diagnostic Behavior Rating Scale of Personality were used to determine whether children in the meningitis and non-meningitis groups could be reliably differentiated on the basis of behavior characteristics displayed in the classroom. A comparison of these two groups in terms of their behavior is shown in Table VII. This table did not include the ratings of one retarded and two untestable children not attending school, nor those of four others whose rating scales had not been returned. An analysis of this data showed that the meningitis group could not be reliably differentiated from the non-meningitis group in terms of behavior characteristics displayed in the classroom,

TABLE VII

DIFFERENCES IN BEHAVIOR CHARACTERISTICS OF CHILDREN IN THE MENINGITIS AND NON-MENINGITIS GROUPS AS INDICATED ON THE DIAGNOSTIC BEHAVIOR RATING SCALE OF PERSONALITY

Pair	Meningitis Group	Non-Meningitis Group	d	Rank of d	Rank with Less Frequent Sign
1	13	5	8	16.0	
2	7	7	0		
3	1	0	1	2.0	
4	19	21	- 2	- 4.0	- 4.0
5	12	4	8	16.0	
6	6	9	- 3	- 7.0	- 7.0
7	21	29	- 8	-16.0	-16.0
8	24	11	13	21.0	
9	18	0	18	24.0	
10	25	13	12	19.5	
11	3	6	- 3	- 7.0	- 7.0
12	11	14	- 3	- 7.0	- 7.0
13	5	5	0		
14	6	23	-17	-23.0	-23.0
15	11	38	-27	-26.5	-26.5
16	31	27	4	10.5	
17	8	11	- 3	- 7.0	- 7.0
18	6	3	3	7.0	
19	2	2	0		
20	5	14	- 9	-18.0	-18.0
21	4	0	4	10.5	
22	7	7	0		
23	4	34	-30	-29.0	-29.0
24	6	1	5	12.5	
25	16	4	12	19.5	
26	4	33	-29	-28.0	-28.0
27	2	1	1	2.0	
28	14	33	-19	-25.0	-25.0
29	1	8	- 7	-14.0	-14.0
30	31	4	27	26.5	
31	2	1	1	2.0	
32	0	0	0		
33	20	4	16	22.0	
34	0	5	- 5	-12.5	-12.5
35	32	32	0		
				T =	224.0

z = .141 p = .443

($z = .141$, $p = .4443$.) In fact, as a group the non-meningitis subjects showed more behavior characteristics common to brain-injured children. However, this reversal in expectations was not significant.

Conclusion. The null hypothesis 2.a stating no differences are shown in the behavior of meningitis and non-meningitis children is accepted. The behavior pattern of post-meningitis children gives no indication of organicity, in terms of behavior displayed in the classroom.

Reading. Teachers' estimates were used to determine differences in reading abilities of children in the meningitis and non-meningitis groups. A comparison of these ratings is shown in Table VIII. This table did not include two untestable, one retarded, and three kindergarten children, nor the ratings of five others whose rating forms had not been returned. A tabulation of these ratings showed a rather close relationship between the two groups in terms of their reading abilities. Of the thirty-two pairs, fourteen meningitis subjects, as compared to eleven non-meningitis subjects, were observed to have greater reading disabilities. Seven pairs showed no differences. Statistical treatment of this data indicated

TABLE VIII

COMPARISON OF READING ABILITIES OF CHILDREN IN THE MENINGITIS AND NON-MENINGITIS GROUPS

Pair	Ratings in Reading		Direction of Difference	Sign
	Meningitis	Non-Meningitis		
1	B	C	$X_m > X_n$	+
2	C	C	$X_m = X_n$	0
3	B	C	$X_m > X_n$	+
4	D	D	$X_m = X_n$	0
5	D	D	$X_m = X_n$	0
6	E	B	$X_m < X_n$	-
7	B	C	$X_m > X_n$	+
8	C	B	$X_m < X_n$	-
9	C	A	$X_m < X_n$	-
10	B	B	$X_m = X_n$	0
11	B	C	$X_m > X_n$	+
12	C	B	$X_m < X_n$	-
13	D	C	$X_m < X_n$	-
14	C	D	$X_m > X_n$	+
15	B	C	$X_m > X_n$	+
16	B	B	$X_m = X_n$	0
17	C	D	$X_m > X_n$	+
18	C	B	$X_m < X_n$	-
19	A	A	$X_m = X_n$	0
20	C	B	$X_m < X_n$	-
21	A	B	$X_m > X_n$	+
22	C	B	$X_m < X_n$	-
23	B	C	$X_m > X_n$	+
24	B	A	$X_m < X_n$	-
25	C	C	$X_m = X_n$	0
26	C	B	$X_m < X_n$	-
27	C	B	$X_m < X_n$	-
28	B	C	$X_m > X_n$	+
29	C	B	$X_m < X_n$	-
30	C	B	$X_m < X_n$	-
31	C	B	$X_m < X_n$	-
32	A	D	$X_m > X_n$	+

$N = 25$ $x = 11$ $p = .345$

X_m -- Meningitis Child X_n -- Non-Meningitis Child the differences between these two groups to be not significant ($p = .345$).

Conclusion. Although the post-meningitis children were observed to have slightly more reading problems, differences with respect to this ability were found to be not significant. Therefore, the null hypothesis 2.b stating that there were no differences between the meningitis and non-meningitis children in this area is accepted.

Writing. A comparison of the meningitis and non-meningitis groups in terms of writing abilities is shown in Table IX. One retarded, two untestable, three kindergarten, and five other children whose rating forms had not been returned were not included in this table. Of the thirty-two pairs compared in this area of investigation, fourteen post-meningitis children as compared to ten non-meningitis subjects were rated as having greater difficulties in writing, while eight pairs showed no differences. An analysis of test data showed the differences in writing abilities of these two groups to be insignificant ($p = .271$).

Conclusion. Post-meningitis children tended to experience more difficulties in the area of writing or printing. However, differences between the two groups were

TABLE IX

COMPARISON OF WRITING ABILITIES OF CHILDREN IN THE MENINGITIS AND NON-MENINGITIS GROUPS

Pair	Ratings in Writing: Meningitis	Ratings in Writing: Non-Meningitis	Direction of Difference	Sign
1	B	B	$X_m = X_n$	0
2	C	B	$X_m < X_n$	-
3	C	B	$X_m < X_n$	-
4	C	E	$X_m > X_n$	+
5	C	B	$X_m < X_n$	-
6	E	C	$X_m < X_n$	-
7	B	C	$X_m > X_n$	+
8	B	B	$X_m = X_n$	0
9	B	A	$X_m < X_n$	-
10	A	A	$X_m = X_n$	0
11	D	C	$X_m < X_n$	-
12	C	A	$X_m < X_n$	-
13	D	B	$X_m < X_n$	-
14	B	B	$X_m = X_n$	0
15	C	D	$X_m > X_n$	+
16	B	A	$X_m < X_n$	-
17	C	D	$X_m > X_n$	+
18	B	C	$X_m > X_n$	+
19	A	A	$X_m = X_n$	0
20	C	D	$X_m > X_n$	+
21	B	B	$X_m = X_n$	0
22	C	B	$X_m < X_n$	-
23	B	C	$X_m > X_n$	+
24	B	D	$X_m > X_n$	+
25	B	C	$X_m > X_n$	+
26	C	B	$X_m < X_n$	-
27	C	C	$X_m = X_n$	0
28	A	C	$X_m > X_n$	+
29	C	B	$X_m < X_n$	-
30	A	A	$X_m = X_n$	0
31	D	C	$X_m < X_n$	-
32	E	D	$X_m < X_n$	-

$N = 24$ $x = 10$ $p = .271$

X_m - Meningitis Child X_n - Non-Meningitis Child not significant. The null hypothesis 2.c stating that there were no differences between the meningitis and non-meningitis children in terms of writing abilities is accepted. These findings give no indication of organic impairment in children treated for meningitis.

Summary of Results

1. The null hypothesis 1.a stating that there were no differences between children treated for meningitis and the Binet standard population with respect to mean IQ scores was accepted. The mean IQ score for the meningitis group was 102.2 as compared to 102.9 for the standard population. Although the incidence of retardation was relatively high (9.3 per cent), the distribution of Binet scores did not depart significantly from that of the normal curve. These findings gave no evidence of organic impairment in post-meningitis children.

2. The null hypothesis 1.b stating that there were no differences between the meningitis and normal groups in terms of figure-ground reactions in the visual perceptual field was accepted. The high percentage (68.6) of foreground reactions as compared to a low percentage (7.2) of background reactions indicated normal visual perception

in post-meningitis children.

3. The null hypothesis 1.c stating that there were no differences between the meningitis and non-meningitis children in terms of their ability to reproduce visually perceived stimuli was rejected. These findings indicated a degree of impairment in the visuomotor functions of post-meningitis children.

4. The null hypothesis 1.d stating that there were no differences in the mental ages of post-meningitis children as determined by the Binet and Goodenough scales was rejected. Although the discrepancy in the mean mental age (11.91 months) was not as great as suggested in literature, these children experienced more difficulty than other children of similar age and ability in the drawing of human figures. These findings suggested impairment in sensory motor development of post-meningitis children.

5. The null hypothesis stating that there were no differences between the verbal and non-verbal abilities of meningitis children as revealed on the Binet and WISC Performance scales was accepted. In terms of these functions post-meningitis children show no evidence of organic impairment.

6. The null hypothesis 2.a stating that there were no differences between meningitis and non-meningitis children in terms of their behavior pattern in the classroom was accepted. There was a reversal from expectations, but this was not significant. These findings gave no support to the assumption that children treated for meningitis displayed a typical brain-injured behavior pattern.

7. The null hypothesis 2.b stating that there were no differences between the meningitis and non-meningitis children in terms of their reading abilities was accepted. These findings did not support the assumption that, due to organic factors, the meningitis children would tend to experience marked reading difficulties.

8. The null hypothesis 2.c stating that there were no differences between the meningitis and non-meningitis children in terms of their writing abilities was accepted. These findings gave no evidence of brain injury in post-meningitis children.

CHAPTER V

DISCUSSION AND INTERPRETATION OF RESULTS

The general hypothesis guiding this study was that meningitis is associated with brain damage. In terms of psychological test performance, children with a history of meningitis showed impairment in visuomotor functions and sensory motor development or body concept. As a group, these children also showed a greater incidence of retardation and a lower functioning level in the non-verbal area. No differences were demonstrated between post-meningitis and "normal" children in terms of mean IQ's and figure-ground reactions in the visual perception field. Teachers' ratings of classroom behavior and abilities in reading and writing failed to differentiate reliably those children treated for meningitis from other children in the classroom. The ensuing discussion deals with the interpretation of these findings.

Visuomotor integration. It was believed that, due to organic disorders, children with a history of meningitis would show a deficiency in visuomotor integration. The data for the meningitis and non-meningitis groups support this assumption. In comparing the performance of these two groups on the Ellis Visual Designs Test, it was found that children treated for meningitis experienced greater difficulties in the reproduction of these designs. By using an objective scoring method it was possible to make this differentiation.

The distribution of test scores (Table XVII, Appendix C) also revealed differences between these two groups. It was found that at an arbitrary cut-off point (2.0 on a scale ranging from 0 to 7,) 42.5 per cent of the meningitis and 25.0 per cent of the normal subjects fell below this point. On the other hand, 7.5 per cent of the meningitis and 30.0 per cent of the normal subjects placed above the arbitrary cut-off point, 5.

These observations are consistent with findings of other investigators in the area of brain damage. Cassel,[1] as well as Hoakley and Frazeur[2] found that brain-injured children tended to experience marked difficulties in the

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[1]R. H. Cassel, "Relation of Design Reproduction to the Etiology of Mental Deficiency," J. Consult. Psychol., 13: 421-428, 1949.

[2]Z. P. Hoakley and H. A. Frazeur, "Significance of Psychological Test Results of Exogenous and Endogenous Children," Am. J. Ment. Deficiency, 50: 263-271, 1945.

reproduction of visually perceived stimuli. Goldenberg[3] maintained that of the current psychological tests the Ellis Visual Designs Test showed the greatest promise in differentiating between brain-injured and non-brain-injured children. This deficiency in visuomotor functions of children whose IQ's fall below 85 is also believed to be caused by other defects in mental organization. Since the children used in this study were predominantly of average and bright average intelligence, these findings take on a greater significance.

Body concept. An assumption was made that, due to a deficiency in sensory motor development, the body concept of children treated for meningitis was impaired. Investigations in this area support this assumption.

The impairment in sensory motor development was determined by comparing the mental ages of these children as estimated on the Binet and Goodenough scales, a significantly lower Goodenough rating being an indication of organicity. This comparison showed the mean Binet M.A. to be 7.77 years, as compared to 6.78 years on the Goodenough scale, the mean difference being approximately 11.91

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[3]A. A. Strauss and N. C. Kephart, Psychopathology and Education of the Brain-Injured Child (New York: Grune and Stratton, 1955), pp. 162-164.

months. This difference was found to be significant at the .01 level of confidence. Further observations of test data (Table V) showed that nine out of the 35 children used in this area of investigation had mental age discrepancies of one to two years, while eight had discrepancies of more than two years. On the other hand, only nine children obtained higher Goodenough scores.

Another group of children* was investigated to see if such mental age discrepancies occurred. The 33 children, matched for age and intelligence (Table XIV, Appendix B), showed a mean mental age discrepancy of 3.36 months (Table XIX, Appendix C), the mean of the Binet M.A. being higher. This was significant at about the .10 level of confidence. Of the 33 children used in this group, it was noted that six showed mental age discrepancies of one to two years, while only three showed discrepancies greater than two years. Seventeen of these children obtained higher Goodenough scores.

The findings in this area of investigation were consistent with expectations. The literature on brain

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*A group of non-meningitis children were selected from record files of the Child Guidance Clinic of Greater Winnipeg.

damage[4,5] indicates that impaired body concept or sensory motor development was related to organic factors. Body concept, they maintained, was closely associated with personality and was usually altered as personality underwent changes. Children's drawings of human figures usually revealed to some extent the changes that occurred.

In terms of mental age differences on these two tests, Bender[6] maintained that a discrepancy of two or more years, that is, a Goodenough M. A. two years or more below the Binet M.A., was suggestive of brain injury. Bakwin and Bakwin,[7] on the other hand, stated that the body concept in some instances could be relatively unimpaired, and that little or no differences could be demonstrated on such tests.

The mean mental age difference for this group was not as great as that indicated in the literature. However, in view of the fact that this difference was found to be

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[4] Strauss and Kephart, op. cit., pp. 67-69.

[5] H. Bakwin and M. R. Bakwin, Behavior Disorders in Children (Philadelphia: W. B. Saunders Co., 1954), pp. 228, 440.

[6] L. Bender and A. Silvers, "Body Image Problems of the Brain-Injured Child," J. Soc. Issues, 4: 84-89, 1948.

[7] Bakwin and Bakwin, loc. cit.

significant at the .01 level of confidence, and that other children of similar age and mental ability showed smaller mental age discrepancies on these two tests, it may be concluded that the body perception of these children is somewhat faulty.

Disparity in mental development. The introductory chapters of this study have stated that post-meningitis children could be expected to show a disparity in mental development, particularly in areas involving verbal and non-verbal skills. The findings supported this assumption in part.

The Binet and WISC Performance scales were used to demonstrate the levels of achievement in verbal and non-verbal areas. The IQ scores of 39 subjects treated for meningitis were compared and the Binet mean was found to be 4.44 points higher than the WISC Performance mean. This difference was found to be significant at slightly higher than .025 level of confidence.

A further observation of test data (presented in Table VI) was made. Almost one-third of the cases were found to show discrepancies of 10 or more IQ points, four of these being greater than 20 points. In addition, two five-year olds were dropped because the raw scores on the

WISC Performance scale were too low to register on the scale. On the other hand, only four children obtained Performance scores which were 10 or more points higher than the Binet scores.

One factor should perhaps be considered in the interpretation of the mean difference. The Binet scale, representing verbal abilities, at the five and six year levels contains a number of test items which are not entirely based on verbal skills. Therefore, the scale at these particular age levels cannot be considered a test of pure verbal abilities. Since about a third of the subjects used in this study were from this age group, the computed mean difference may not be too reliable.

These findings, though inconclusive, are consistent with a number of investigations which indicate that, due to selective impairment, brain-injured children show a disparity in mental development. Using the WISC scale, Beck[8] and Morrow[9] found the Performance scores to be significantly

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[8] H. S. Beck and R. L. Lam, "Use of the WISC in Predicting Organicity," J. Clin. Psychol., 11: 154-158, 1955.

[9] R. S. Morrow (V. A. Hosp., Bronx, N. Y.) and J. C. Mark, "The Correlation of Intelligence and Neurological Findings on 22 Patients Autopsied for Brain Damage," J. Consult. Psychol., 19: 283-289, 1955.

lower for the brain-damaged population. Case studies by Lehtinen[10] indicated that a common characteristic of brain-injured children was the discrepancy between verbal and perceptual abilities. Similar conclusions were reached from observation of test records of children who were diagnosed as brain damaged.*

On the basis of data and information presented, one cannot be certain as to what extent this disparity has occurred in the mental development of these children. However, the direction of difference which has been demonstrated indicates that, as a group, these children tend to have better verbal than non-verbal abilities. This may be indicative of minimal organic disorders.

Intelligence. Due to organic factors, the mean IQ of the meningitis group was believed to be considerably lower than that of the Binet standard population in the same age range. This hypothesis was not supported by the data presented, although differences were in the predicted direction.

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[10] Strauss and Kephart, op. cit., pp. 223-252.

*Test records of children diagnosed as brain damaged at The Children's Hospital of Winnipeg.

The Binet scale was used to estimate the mean IQ of this group. Excluding two untestable children, the mean was found to be 102.2 (Table XV, Appendix C), as compared to 102.9 for the Binet standard population. The median for the total sample of 43 children was 103. Therefore, even with the inclusion of the two untestable children, the mean for the group was not believed to have changed significantly.

Although the mean for this group was found to be relatively high, these findings are consistent with other findings in this area. Strauss and Lehtinen[11] pointed out that the intellectual level of the child is not always affected by brain injury. They believed that some children may suffer minimal brain damage without an apparent lowering of the intelligence.

The incidence of retardation for this group was relatively high, being 9.3 per cent as compared to 2.2 per cent for the standard population. An analysis of this data (Table II) showed that the distribution of scores for this group did not depart significantly from that of the normal curve. A further examination of test results

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[11] A. A. Strauss and L. E. Lehtinen, Psychopathology and Education of the Brain-Injured Child (New York: Grune and Stratton, 1950), p. 128.

indicated that these subnormal children were developing mentally at about half, or less than half, of the normal rate. Physical defects such as impaired speech and hearing were noted in all of these defective children. In addition to these defects, one child showed gross impairment in the neuromotor system. Still further observations showed that two of these children contracted the disease at the age of six months, one at the age of one year, and one at the age of one year, eleven months.

The effects of meningitis on the mental development of these children are consistent with observation of other investigators. Benda and Farrell,[12] as well as other authorities, have stated that meningitis may have serious effects upon the mental development of children, in some cases causing a generalized destruction of the nerve substance. The severity of impairment, they maintained, depended to a large extent upon the age of the child at the time of acute illness, a very young child whose nervous system was undeveloped being most susceptible to more serious and widespread damage of the brain tissue.

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[12] Hoch and Zubin, op. cit., p. 72.

It may be concluded that meningitis can, in some instances, seriously affect the mental development of children, particularly if the disease is contracted during the early developmental period of the nervous system. As none of the older children in the group showed widespread damage to the nervous system, this disease seems to have less serious effects on a nervous system which is well developed.

Figure-ground reactions. Several studies[13,14] have reported that brain-injured children very often show disturbances in the visual perceptual field. On this basis, an assumption was made that, due to organic factors, post-meningitis subjects would react more frequently to background or irrelevant detail than would "normal" children.

A Picture Test was used to test this hypothesis and the results were compared with "known reactions" of normal and exogenous groups. This comparison indicated that such disturbances were not present in post-meningitis children.

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[13] H. Werner and A. A. Strauss, "Pathology of Figure-Background Relations in the Child," _J. Abnorm. Soc. Psychol._, _36_: 136, 1941.

[14] H. Werner and A. A. Strauss, "Causal Factors in Low Performance," _Am. J. Ment. Deficiency_, _45_: 213, 1940.

Their reactions were similar to those of the normal group, and the reverse of the responses given by the exogenous group. In fact, these children gave more object and fewer background responses than did those in the normal group.

There are two possible reasons for this "better than average" performance. Firstly, as the Picture Test used in this study is not a well standardized test, such differences were probable. Secondly, as reported by Werner and Strauss,[15] intra-group comparisons in this study (Table XVI, Appendix C) indicated that the number of foreground reactions increased and background responses decreased with age and maturity. Therefore, the results may have been influenced by the inclusion of bright average and superior children in this group.

From the data presented it may be concluded that, in terms of figure-ground reactions, no differences were demonstrated between children in the meningitis and "normal" groups. On this basis there is no evidence of organic impairment in post-meningitis children.

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[15] H. Werner and A. A. Strauss, "Pathology of Figure-Background Relations in the Child," J. Abnorm. Soc. Psychol., 36: 136, 1941.

Behavior. General behavior disorders are believed to be the most conspicuous manifestations of abnormalities in brain-injured children.[16] These disorders are particularly noticeable in controlled situations such as the classroom where academic demands placed upon the child are most insistent. Because of organic disorders, children with a history of meningitis were assumed to show a typical brain-injured behavior pattern and on such basis could be reliably differentiated from other children in the classroom. A statistical analysis of their behavior characteristics, as rated by classroom teachers, failed to differentiate the meningitis from the non-meningitis group. This was a reversal from expectations, but this was not significant.

This data indicates that in terms of classroom behavior there are no differences between children who had been treated for meningitis and "normal" children of similar age and ability. It may be concluded, therefore, that on the basis of behavior and personality displayed in the classroom these children show no evidence of organic disorders.

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[16] Hoch and Zubin, *op. cit.*, pp. 86, 96.

Reading. Observations have been made regarding a positive relationship between brain injury and reading disability in children.[17,18] This disability is believed to be but one aspect of the general disturbance caused by such injury. Disturbances in perception, thinking, and emotional behavior prevent or impede a normal process of learning to read.

A statistical analysis of the teachers' ratings of these abilities did not reliably differentiate children who had been treated for meningitis from other children in the classroom. Of the 32 pairs rated by teachers (Table VIII), four from the meningitis group, as compared to five from the non-meningitis children, were reported to be having definite reading problems. On the other hand, 13 of the meningitis and 17 non-meningitis children were rated as being better than average readers.

The findings in the area of reading are not

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[17] F. H. Burke, "The Effect on Learning of Brain Pathology," Excep. Child., 24: 210-212, 1957.

[18] Strauss and Lehtinen, op. cit., pp. 168-183.

consistent with expectations. It may be concluded, therefore, that in terms of reading abilities, post-meningitis children show no evidence of organic impairment.

Writing. In learning to write, brain-injured children, with or without motor defects, may be handicapped by disturbances in perceptual-motor integration.[19] Due to organic disorders, children with a history of meningits were believed to have difficulty in the area of learning and in this respect could be differentiated from "normal" children. Although the discrepancies in writing, as revealed by teachers' ratings, were in the predicted direction, the differences were small and unreliable.

It is probable that minor disturbances in visual-motor integration may have occurred in these children but, since the scoring method used for the detection of such impairment in writing was not objective, differences of a minor nature may not have been detected. However, in terms of writing abilities, it seems reasonable to assume that children treated for meningitis are not seriously handicapped in perceptual-motor integration.

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[19] Strauss and Lehtinen, op. cit., pp. 184-190.

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APPENDIX A

RATING SCALES

DIAGNOSTIC BEHAVIOR RATING SCALE OF PERSONALITY[1]

Instructions: On the following page you will find a list of paired words. These pairs are considered to be opposite in meaning. Each word describes a type of behavior in children. By marking certain of these words you can give a description of the behavior of this child. This group of marked words will then describe his behavior in the same way that you would describe it were you asked directly. Make no attempt to evaluate the behavior--merely describe what the child actually does.

Possibly none of the specific words listed will completely fit the behavior of this child. There are three possibilities of marking: (1) If one word in a pair adequately describes the behavior of this child, mark only that member of the pair; (2) if both members of a pair adequately describe the behavior of this child, underline both members of that pair; (3) if neither member of a pair describes adequately the behavior of this child, do not underline either member of that pair. This scale is so constructed that the second and third type of marking will occur very rarely. Describe the most outstanding behavior.

The scale is divided into two parts. The first part describes expressive movements. These are motor behavior in general and bodily and facial movements in emotional states. The second part describes the general personality make-up of the child.

Please consider each pair carefully.

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[1] A. A. Strauss and N. C. Kephart, "Behavior Differences in Mentally Retarded Children Measured by a New Behavior Rating Scale," _Am_. _J_. _Psychiat_., _96_: 1117-1123, March, 1940.

SCALE[2]

Name ____________________ Grade ________ Age ______

City ________________ School ____________ Date ______

PART I. EXPRESSIVE MOVEMENTS

1. graceful - clumsy
2. smooth - jerky
3. normal - peculiar
4. energetic - inactive
5. purposive - aimless
6. impulsive - cautious
7. certain - hesitant
8. mature - childish
9. restless - placid
10. shifting - steady (eyes)
11. chattering - silent (talking)
12. clear - confused (speech)
13. hearty - flat (laughter)
14. explosive - soft (laughter)
15. noisy - quiet (laughter)

PART II. PERSONALITY

16. fluctuating - constant
17. excessive - moderate
18. daydreaming - present
19. patient - impatient
20. temper outbursts - self-controlled
21. fearing - intrepid
22. furious - restrained
23. flighty - steady
24. confused - clear
25. erratic - stable
26. temperamental - stolid
27. excitable - not excitable
28. lonesome - sociable
29. cooperative - uncooperative
30. misfit - belonging
31. acceptable - bystanding
32. popular - unpopular
33. leader - follower
34. annoying - undisturbing
35. attractive - repellent
36. critical - acceptable
37. clear-headed - muddled
38. hit-or-miss - planning
39. accurate - inexact
40. neat - slovenly
41. distractible - concentrating
42. careful - careless
43. dependable - undependable
44. energetic - lazy
45. reliable - unreliable
46. restless - settled
47. awkward - skilful
48. reckless - cautious
49. fidgety - balanced
50. decisive - drifting
51. aimful - aimless
52. dreamy - alive

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[2] *Ibid.*

RATING SCALE IN ORAL READING

Name ________________________ Grade ______ Age _______

City ________________ School __________ Date _________

Instructions: Please indicate, by circling a letter on the scale shown below, the child's oral reading ability. In making this assessment consider only the mechanical skills of reading.

Please consider each child's reading ability carefully.

A Excellent

B Above Average

C Average

D Below Average

E Not Acceptable

RATING SCALE IN WRITING OR PRINTING

Name ________________________ Grade ______ Age ______

City __________________ School __________ Date _______

Instructions: Please indicate the child's writing or printing skills by circling a letter shown on the scale below. Assess the child's printing in cases where writing has not been taught.

Please consider each child's ability carefully.

A Excellent

B Above Average

C Average

D Below Average

E Not Acceptable

APPENDIX B

ADDITIONAL DESCRIPTIVE DATA

TABLE X

CLASSIFICATION OF MENINGITIS SUBJECTS AS TO ETIOLOGY

Etiology	No. of Cases
Meningococcal	15
Influenzal	12
Pneumococcal	3
"Unknown Purulent"	13
Total	43

TABLE XI

CHARACTERISTICS OF MENINGITIS AND NON-MENINGITIS SUBJECTS

Pair	Meningitis					Non-Meningitis				
	Sex	Gr.	C.A.	IQ	Class Rating	Sex	Gr.	C.A.	IQ	Class Rating
1	F	K	5- 0	88	C	F	K	5- 2	--	C
2	M	K	5- 6	112	B	M	K	5- 6	--	B
3	F	I	5- 6	124	A	F	I	5- 3	--	A
4	M	K	5- 7	93	C	M	K	5- 5	--	C
5	F	I	5-11	104	C	F	I	5- 9	--	C
6	M	I	5-11	121	A	M	I	6- 0	--	A
7	M	I	6- 0	106	B	M	I	6- 2	--	B
8	F	I	6- 0	97	C	F	I	6- 1	--	C
9	F	I	6- 2	103	C	F	I	6- 2	--	C
10	M	I	6- 3	96	C	M	I	6- 1	--	C
11	M	I	6- 3	123	A	M	I	6- 4	--	A
12	F	I	6- 3	93	C	F	I	6- 3	--	C
13	M	I	6- 3	125	A	M	I	6- 5	--	A
14	F	II	6- 9	116	A	F	II	6-11	120	A
15	M	II	6-11	108	B	M	II	6-10	--	B
16	M	II	7- 3	94	C	M	II	7- 1	--	C
17	M	II	7- 3	99	C	M	II	7- 5	--	C
18	M	Ungr	7- 4	56	-	M	Ungr	7- 6	56	-
19	M	II	7- 4	114	B	M	II	7- 4	--	B
20	F	II	7- 5	94	C	F	II	7- 2	--	C
21	M	II	7- 5	103	C	M	II	7- 3	105	C
22	F	II	7- 5	101	B	F	II	7- 3	99	B
23	M	II	7- 7	99	C	M	II	7- 7	--	C
24	F	IR	7- 7	86	B	F	IR	7-10	93	B
25	M	III	7- 8	137	A	M	III	7- 8	129	A
26	F	III	7-10	104	C	F	III	7- 7	--	C
27	M	III	7-10	111	B	M	III	7- 9	108	B
28	M	III	8- 0	125	A	M	III	8- 3	118	A
29	M	III	8- 4	112	B	M	III	8- 4	110	B
30	F	IV	9- 1	97	C	F	IV	9- 0	104	C
31	M	V	9-11	103	C	M	V	9- 7	106	C
32	M	Ungr	10-11	92	-	M	Ungr	10- 8	88	-
33	F	VI	11- 0	114	B	F	VI	10-11	118	B
34	M	VI	11- 4	121	A	M	VI	11- 2	125	A
35	F	V	11- 7	91	C	F	V	11- 5	96	C
36	M	VIII	13- 0	103	C	M	VIII	13- 3	98	C
37	M	IX	15- 2	90	C	M	IX	14-11	86	C
38	F	VII	16- 2	87	C	F	VII	15- 5	84	C
39	F	VIII	17- 0	86	C	F	VIII	16-10	90	C
40	M	XI	17- 3	104	C	M	XI	17- 2	107	C
Sum			338.917	4132				336.667		
Mean			8.473	103.3				8.417		

Two untestable and one retarded child not attending school were not included in this table.

TABLE XII

AGE DISTRIBUTION OF CHILDREN IN THE MENINGITIS GROUP

Age	Girls	Boys	Total
5	3	5	8
6	4	5	9
7	4	8	12
8	0	3	3
9	1	1	2
10	0	1	1
11	2	1	3
12	0	0	0
13	0	1	1
14	0	0	0
15	0	1	1
16	1	0	1
17	1	1	2
Total	16	27	43

TABLE XIII

GRADE DISTRIBUTION OF CHILDREN IN THE MENINGITIS GROUP

Grade	Girls	Boys	Total Number in Grade
K	1	2	3
I	6	5	11
II	3	6	9
III	1	4	5
IV	1	0	1
V	1	1	2
VI	1	1	2
VII	1	0	1
VIII	1	1	2
IX	0	1	1
X	0	0	0
XI	0	1	1
Ungraded	0	2	2
Not Attending	0	3	3
Total	16	27	43

TABLE XIV

CHARACTERISTICS OF SUBJECTS BY GROUPS

Pair	Meningitis Group			Normal Group*		
	C. A.	M. A.	IQ	C. A.	M. A.	IQ
1	5- 6	6- 2	112	5- 5	6- 2	114
2	5- 7	5- 2	93	5- 4	5- 2	97
3	5-11	6- 2	104	5-10	5-10	100
4	5-11	7- 2	121	5-11	7- 4	124
5	6- 0	5-10	97	6- 1	5- 9	95
6	6- 0	6- 4	106	5- 9	6- 4	110
7	6- 2	6- 4	103	6- 3	6- 4	101
8	6- 3	5-10	93	6- 1	5- 9	95
9	6- 3	6- 0	96	6- 8	6- 3	94
10	6- 3	7- 8	123	6- 0	7- 4	122
11	6- 3	7-10	125	6- 6	7- 8	118
12	6- 9	7-10	116	6- 3	7- 0	112
13	6-11	7- 6	108	6-11	7- 2	104
14	7- 3	6-10	94	7- 0	6- 8	95
15	7- 3	7- 2	99	7- 1	7- 2	101
16	7- 4	4- 1	56	7- 8	4- 7	60
17	7- 4	8- 4	114	7- 8	8- 8	113
18	7- 5	7- 0	94	7- 7	6-10	90
19	7- 5	7- 8	103	7- 7	8- 2	108
20	7- 5	7- 6	101	7- 6	7- 4	98
21	7- 7	6- 2	86	7- 2	6- 0	84
22	7- 7	7- 6	96	7- 6	7- 2	96
23	7- 8	10- 6	137	7-11	11- 0	139
24	7-10	8- 2	104	7- 9	7- 8	99
25	7-10	8- 8	111	7-11	9- 2	116
26	8- 0	10- 0	125	7-11	10- 4	131
27	8- 4	9- 4	112	8- 6	10- 2	116
28	9- 1	8-10	97	9- 1	9- 2	101
29	9-11	10- 2	103	10- 1	10- 6	104
30	10-11	10- 0	92	11- 0	10- 0	91
31	11- 0	12- 6	114	10-11	12- 3	112
32	11- 4	13- 8	121	10- 9	12- 4	115
33	11- 7	10- 6	91	11-11	11- 8	98
Sum	249.83	260.41	3447	249.50	260.92	3453
Mean	7.57	7.89	104.45	7.56	7.91	104.64
S.D.			14.72			14.55

*This group was selected from record files of the Child Guidance Clinic of Greater Winnipeg.

APPENDIX C

SUMMARY OF RESEARCH AND ADDITIONAL STATISTICAL DATA

TABLE XV

SUMMARY OF RESEARCH DATA

Case No.	Children's Hospital File No.	Date of Birth	Age	Sex	Grade	Binet M.A.	Binet I.Q.	Goodenough M.A.	Goodenough I.Q.	WISC (Perf.) I.Q.	Ellis Designs Men.	Ellis Designs Non-men.	Visual Perception* A	B	C	D	Behavior Rating Men.	Behavior Rating Non-men.	Reading Men.	Reading Non-men.	Writing Men.	Writing Non-men.
1	A9968	6/ 7/54	5- 0	F	K	4- 5	88	4- 6	90	--	.5	.5	4	2	-	3	13	5	-	-	-	-
2	A16630	10/ 7/54	5- 2	M	-	3- 0	58	-	-	--	-	-	-	-	-	-	-	-	-	-	-	-
3	A6788	15/ 3/54	5- 4	M	-	-	-	-	-	--	-	-	-	-	-	-	-	-	-	-	-	-
4	A5060	1/ 2/54	5- 6	M	K	6- 2	112	5- 6	100	106	.5	1.5	5	-	1	3	7	7	-	-	-	-
5	A6697	25/12/53	5- 6	F	I	6-10	124	5- 6	100	127	1.5	2.5	4	2	-	3	1	0	B	C	B	B
6	-	31/12/53	5- 7	M	K	5- 2	93	4- 3	76	67	0	1.0	6	-	2	1	19	21	-	-	-	-
7	A7809	25/ 8/53	5-11	F	I	6- 2	104	6- 6	110	86	1.0	1.5	5	2	-	2	12	4	C	C	C	B
8	A7017	16/ 8/53	5-11	M	I	7- 2	121	4- 9	80	118	.5	2.5	6	-	1	2	6	9	B	C	C	B
9	A29189	10/ 7/53	6- 0	M	I	6- 4	106	4- 3	71	74	.5	1.5	2	2	3	2	21	29	D	D	C	E
10	A7555	18/ 8/53	6- 0	F	I	5-10	97	7- 3	121	85	3.5	2.0	4	2	1	2	24	11	D	D	C	B
11	A5468	1/ 7/53	6- 2	F	I	6- 4	103	6- 3	101	97	.5	1.5	5	2	2	-	18	0	E	B	E	C
12	A11809	27/ 4/53	6- 3	M	I	6- 0	96	6- 9	108	92	.5	4.0	3	-	1	5	25	13	B	C	B	C
13	A2597	29/ 3/53	6- 3	M	I	7- 8	123	6- 6	104	89	3.0	2.5	5	2	-	2	3	6	C	B	B	B
14	531986	25/ 4/53	6- 3	F	I	5-10	93	6- 0	96	90	1.0	4.0	6	1	2	-	11	14	C	A	B	A
15	532352	28/ 4/53	6- 3	M	I	7-10	125	6- 9	108	110	1.0	1.5	4	1	1	3	5	5	B	B	A	A
16	A4786	1/10/52	6- 9	F	II	7-10	116	6- 9	100	110	4.0	2.5	4	1	4	-	-	-	-	-	-	-
17	53-1483	28/ 8/52	6-11	M	II	7- 6	108	5- 9	83	115	1.0	3.5	5	-	-	4	6	23	B	C	D	C
18	53970	24/ 4/52	7- 3	M	II	6-10	94	5- 9	73	94	1.5	5.5	7	-	1	1	11	38	C	B	C	A
19	A8800	1/ 6/52	7- 3	M	II	7- 2	99	7- 3	100	101	1.0	5.0	7	1	-	1	31	27	D	C	D	B
20	A16220	7/ 4/52	7- 4	M	Ungraded	4- 1	56	5- 6	75	74	.5	.5	5	-	1	3	8	11	C	D	B	B
21	52-2470	11/ 4/52	7- 4	M	II	8- 4	114	6- 9	92	117	2.5	5.5	6	-	-	3	6	3	B	C	C	D
22	523086	24/ 1/52	7- 5	F	II	7- 0	94	6- 3	84	104	1.5	4.0	6	1	1	1	2	2	B	B	B	A
23	523268	4/ 3/52	7- 5	M	II	7- 8	103	7- 3	98	103	3.5	6.5	6	-	-	3	5	14	C	D	C	D
24	53106	16/ 4/52	7- 5	F	II	7- 6	101	7- 6	101	106	4.5	4.0	4	1	-	4	4	0	C	B	B	C
25	A2924	28/12/51	7- 7	M	II	7- 6	99	5- 9	76	113	3.0	4.5	7	-	1	1	7	7	A	A	A	A
26	A4435	14/ 1/52	7- 7	F	IR	6- 6	86	6- 0	79	103	3.0	1.5	7	1	1	-	4	34	C	B	C	D
27	53870	15/11/51	7- 8	M	III	10- 6	137	7- 0	91	118	5.5	5.5	4	-	1	4	6	1	A	B	B	B
28	A5845	10/ 9/51	7-10	F	III	8- 2	104	7- 0	89	110	3.5	5.5	6	1	-	2	16	4	C	B	C	B
29	A17141	28/ 9/51	7-10	M	III	8- 8	111	7- 3	93	117	4.5	4.5	5	-	1	3	4	33	B	C	B	C
30	A31258	31/ 7/51	8- 0	M	III	10- 0	125	7- 0	88	114	3.5	4.0	5	-	1	3	2	1	B	A	B	D
31	A1405	16/ 5/51	8- 2	M	--	--	--	--	--	--	-	-	-	-	-	-	-	-	-	-	-	-
32	532057	7/ 3/51	8- 4	M	III	9- 4	112	6- 6	78	106	2.0	4.5	4	1	1	3	14	33	C	C	B	C
33	A3903	7/ 8/50	9- 1	F	IV	8-10	97	9- 9	107	100	5.0	2.5	7	-	1	1	1	8	C	B	C	B
34	A8489	5/ 8/49	9-11	M	V	10- 2	103	7- 9	78	93	4.0	4.0	4	-	1	4	-	-	-	-	-	-
35	A9445	5/10/48	10-11	M	Ungr.	10- 0	92	9- 6	87	85	4.0	6.0	8	1	-	-	31	4	C	B	C	C
36	A12648	27/ 7/48	11- 0	F	VI	12- 6	114	10- 0	91	93	5.0	5.0	8	1	-	-	2	1	B	C	A	C
37	A1337	3/ 4/ 48	11- 4	M	VI	13- 8	121	10- 6	93	108	5.5	6.0	8	-	-	1	0	0	C	B	C	B
38	52557	13/12/47	11- 7	F	V	10- 6	91	9- 9	84	76	4.5	7.0	7	-	-	2	20	4	C	B	A	A
39	A8108	29/ 7/46	13- 0	M	VIII	13- 4	103	12- 6	96	100	5.0	7.0	9	-	-	-	0	5	C	B	D	C
40	52918	25/ 4/44	15- 2	M	IX	13- 0	90	9- 0	62	97	4.5	5.0	8	1	-	-	32	32	A	D	E	D
41	A3046	26/ 5/43	16- 2	F	VII	13- 0	87	11- 0	73	85	4.5	5.5	9	-	-	-	-	-	-	-	-	-
42	522883	21/ 7/42	17- 0	F	VIII	12-10	86	10- 9	72	90	4.5	6.0	9	-	-	-	-	-	-	-	-	-
43	A4574	13/ 5/42	17- 3	M	XI	15- 8	104	10- 9	72	98	5.5	7.0	8	-	1	-	-	-	-	-	-	-
Sum			357.58			342.83	4190	291.25	3580	3871	111.0	154.5	232	26	30	72	377	409				
Mean			8.32			8.36	102.20	7.28	89.50	99.26												
S.D.							16.03		13.15	13.84												

*(A - Object, B - Unprecise Object, C - Background, D - Formal Characteristics of Both Figure and Ground)

TABLE XVI

INTRA-GROUP COMPARISONS OF MENINGITIS SUBJECTS WITH RESPECT TO PERCENTAGE REACTIONS TO THE PICTURE TEST

Age Range	Number of Children	Object, Precise and Unprecise	Background	Formal Characteristics of both Figure and Ground
5 - 6*	15	63.0	13.3	23.7
7 - 10**	17	68.6	7.2	24.2
11-- 17	8	94.4	1.4	4.2
Σ		226.0	21.9	52.1
Mean		75.3	7.3	17.4

* One untestable and one retarded child were not included.

** One untestable child was not included.

TABLE XVII

COMPARISON OF THE MENINGITIS AND NON-MENINGITIS GROUPS IN TERMS OF SCORE DISTRIBUTIONS ON THE ELLIS VISUAL DESIGNS TEST

Score	Number Included	
	Meningitis*	Non-Meningitis
0 - 1	13	3
1.5 - 2	4	7
2.5 - 3	4	5
3.5 - 4	7	7
4.5 - 5	9	6
5.5 - 6	3	8
6.5 - 7	0	4
Total	40	40

* Two untestable and one retarded child not attending school were not included in this group.

TABLE XVIII

FREQUENCY DISTRIBUTION OF BINET AND GOODENOUGH IQ SCORES OF THE MENINGITIS GROUP*

IQ Range	Stanford-Binet (N = 40)	Goodenough (N = 40)
130 and above	1	0
120 - 129	6	1
110 - 119	6	1
90 - 109	22	19
80 - 89	4	7
70 - 79	0	11
69 and below	1	1

* One retarded child, two untestable children, and those over 11 years of age were not included in this distribution.

TABLE XIX

COMPARISON OF MENTAL AGE SCORES OF A NORMAL GROUP*
AS ACHIEVED ON THE BINET AND GOODENOUGH SCALES

Case	Binet M.A.	Goodenough M.A.	d (months)	d^2
1	6- 2	6- 3	1	1
2	5- 2	6- 0	10	100
3	5-10	6- 9	11	121
4	7- 4	8- 0	8	64
5	5- 9	4- 9	-12	144
6	6- 4	7- 3	11	121
7	6- 4	6- 0	- 4	16
8	5- 9	6- 6	9	81
9	6- 3	7- 9	18	324
10	7- 4	7- 3	- 1	1
11	7- 8	6- 6	-14	196
12	7- 0	6- 0	-12	144
13	7- 2	6- 0	-14	196
14	6- 8	7- 6	-10	100
15	7- 2	7- 3	1	1
16	4- 7	5- 6	11	121
17	8- 8	8- 6	- 2	4
18	6-10	7- 0	2	4
19	8- 2	8- 9	7	49
20	7- 4	7- 0	- 4	16
21	6- 0	6- 3	3	9
22	7- 2	6- 3	-11	121
23	11- 0	9- 9	-15	225
24	7- 8	6- 9	-11	121
25	9- 2	6- 9	-29	841
26	10- 4	7- 9	-31	961
27	10- 2	10- 6	4	16
28	9- 2	9- 6	4	16
29	10- 6	10- 9	3	9
30	10- 0	10- 5	5	25
31	12- 3	9- 0	-39	1521
32	12- 4	10- 9	-19	361
33	11- 8	10- 9	-11	121
Sum	260-11	251- 8	-111	6151
Mean	7.91	7.63	3.36	

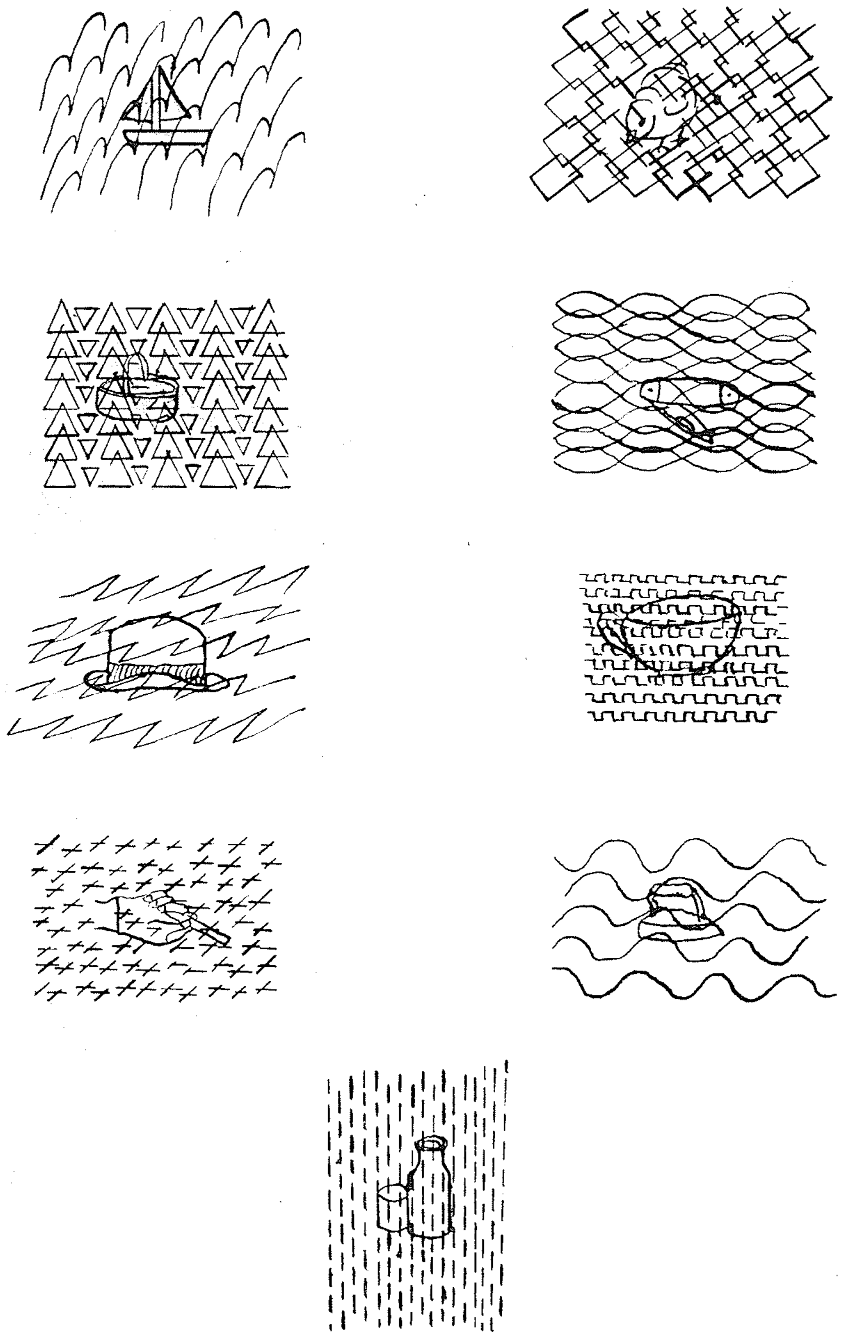
$\Sigma d^2 = 5778.636$ $S_d = 13.438$ $S_{\bar{d}} = 2.339$ $z = 1.438$
df = 32 $p > .10$

*This group was made up of children selected from files of the Child Guidance Clinic of Greater Winnipeg. (See Table XIV, Appendix B.)

APPENDIX D

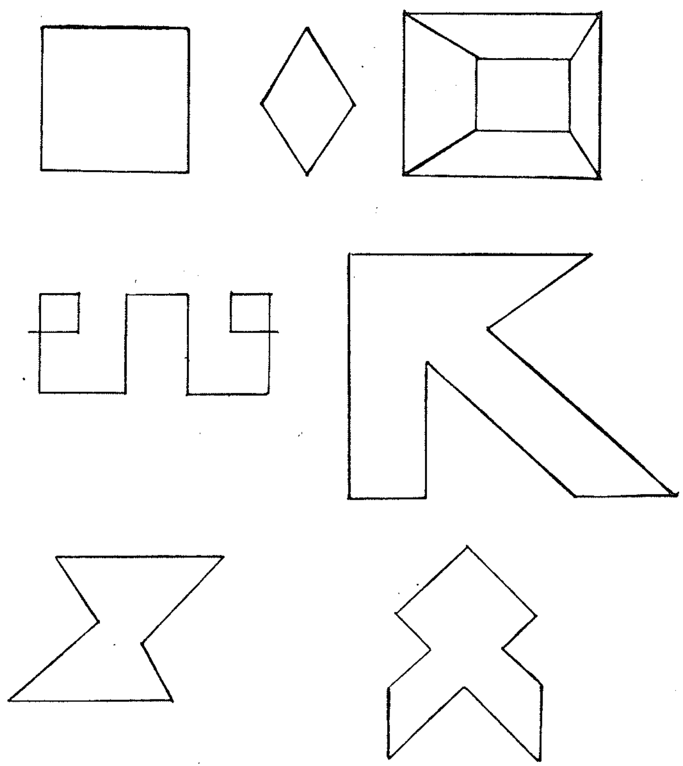
PSYCHOLOGICAL TESTS

PICTURE TEST



Cards of the Picture Test, a test of pure visual perception.

ELLIS VISUAL DESIGNS TEST



The Ellis Visual Designs Test of visuomotor coordination.

REVISED STANFORD-BINET INTELLIGENCE SCALE

Record Form

Form L

Name.............................Examiner.................................. C.A. . . .

Sex...........Birthdate.......................Date of test.............................M.A.. .. ...

School..Grade....................................I.Q.........

Year II (6 tests × 1, or 4 *tests × 1½)

... 1. *Form board (1+) a... b...
... 2. Ident. by name (4+) No. ....
... 3. *Parts of body (3+) a... b... c... d...
... 4. Block tower
... 5. *Pict. voc. (2+) No. ....
... 6. *Word comb.
Alt. Simple commands (2+)

Year II–6 (6 tests × 1, or 4 *tests × 1½)

... 1. *Ident. by use (3+) No. ....
... 2. Parts of body (4+)
... 3. *Naming obj. (4+) a... b... c... d... e...
... 4. *Pict. voc. (9+) No. ....
... 5. *Two dig. (1+) 47... 63... 58...
... 6. Form board: rotated (1+) a... b...
Alt. Ident. by name (5+)

Year III (6 tests × 1, or 4 *tests × 1½)

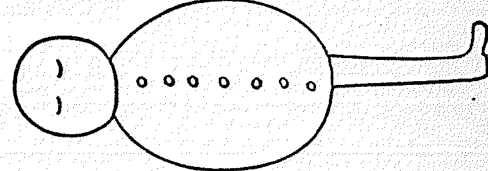
... 1. Stringing beads (4+) (2 min.) No. ....
... 2. *Pict. voc. (12+) No. ....
... 3. *Block bridge
... 4. *Pict. mem. (1+) a... b...
... 5. Circle (1+) a... b... c...
... 6. *Three dig. (1+) 641... 352... 837...
Alt. Form board: rotated (2+)

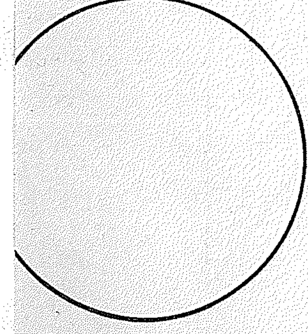
Year III–6 (6 tests × 1, or 4 *tests × 1½)

... 1. *Simple commands (3+) a... b... c...
... 2. *Pict. voc. (15+) No. ....
... 3. Compar. sticks (3 of 3, or 5 of 6)
... 4. Pict. I (2+) a... b... c...
... 5. *Ident. by use (5+)
... 6. *Compre. I (1+) a... b...
Alt. Cross

Test Summary

	Yrs.	Mos.
II	....	....
II–6	....	....
III	....	....
III–6	....	....
IV	....	....
IV–6	....	....
V	....	....
VI	....	....
VII	....	....
VIII	....	....
IX	....	....
X	....	....
XI	....	....
XII	....	....
XIII	....	....
XIV	....	....
A.A.	....	....
S.A. I	....	....
S.A. II	....	....
S.A. III	....	....
Total	....	....





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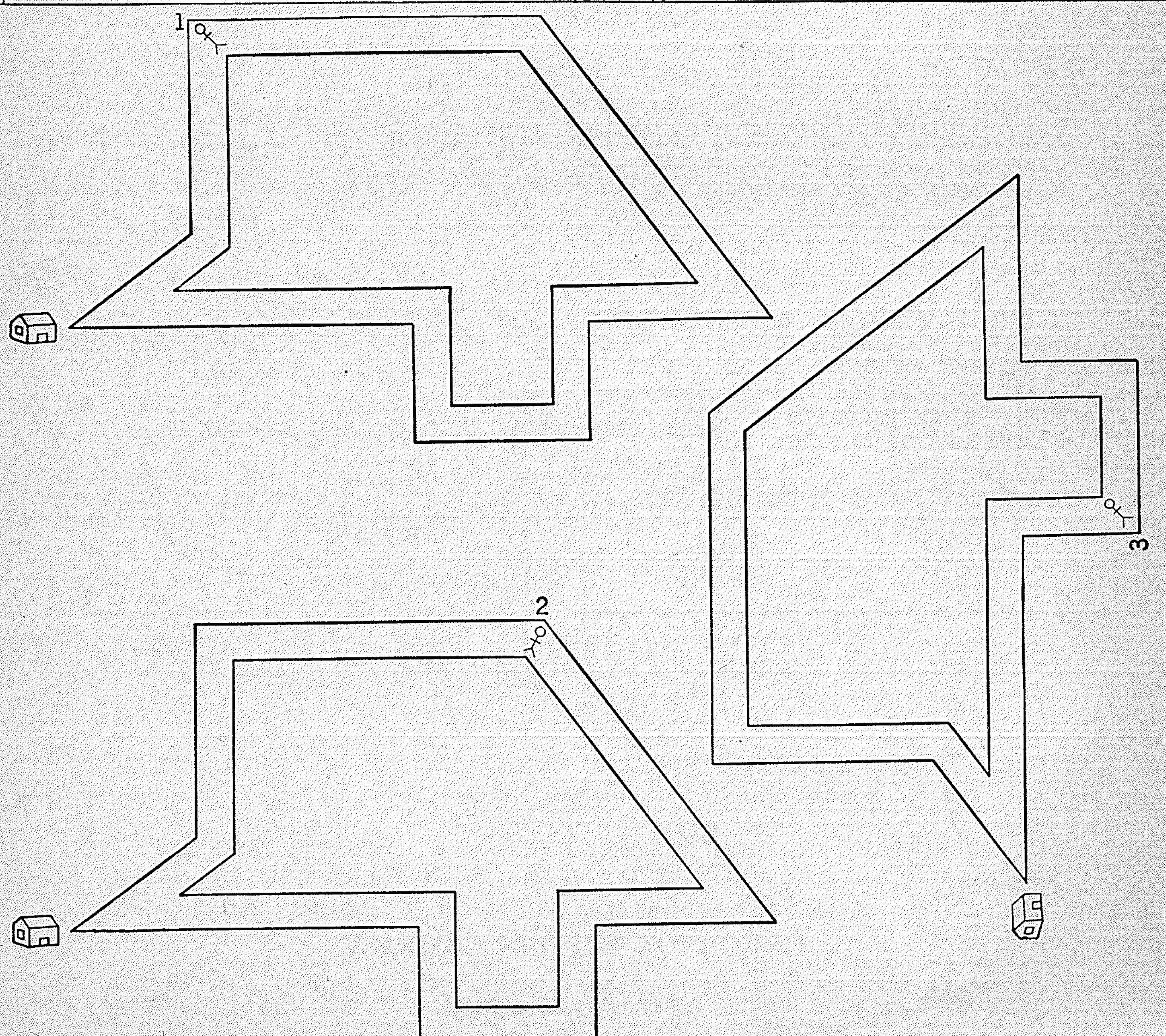
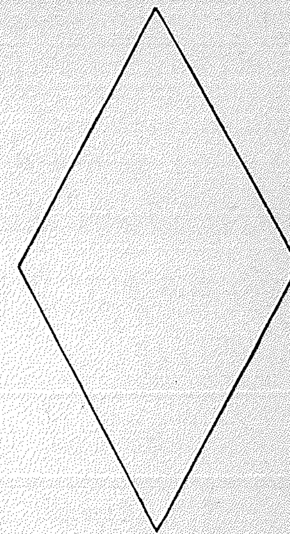
	Year IV (6 tests × 1, or 4 *tests × 1½)		Year V (6 tests × 1, or 4 *tests × 1½)
......	1. *Pict. voc. (16+) No.	......	1. *Pict. compl.: man (2 points)
......	2. *Obj. from mem. (2+) a... **b... c...**	......	2. Folding triangle
......	3. Pict. compl.: man (1 point)	......	3. *Definitions (2+) a... b... c...
......	4. *Pict. ident. (3+) No.	......	4. Square (1+) a... b... c..
......	5. *Forms (8+) No.	......	5. *Sent. mem. II (1+) a... b...
......	6. Compre. II (2+) a... b...	......	6. *Counting obj. (2+) a... b.. c...
	Alt. Sent. mem. I (1+) a... b...		Alt. Knot

	Year IV–6 (6 tests × 1, or 4 *tests × 1½)		Year VI (6 tests × 2, or 4 *tests × 3)
......	1. Aesth. comp. (3+) a... b... c...	......	1. *Voc. (5+) No. ....
......	2. *Four dig. (1+) 4729... 3852... **7261...**	......	2. *Bead chain I (2 min.)
......	3. *Pict. compar. (3+) No.	......	3. Mut. pict. (4+) a... **b... c... d... e...**
......	4. Materials (2+) a... b... c...	......	4. *Number (3+) a... b... c... d...
......	5. *Three com. (3+) a... b... c...	......	5. *Pict. compar. (5+)
......	6. *Opp. anal. I (2+) a... b... c... **d... e...**	......	6. Maze (2+) a... b... **c...**
	Alt. Pict. ident. (4+)		





	Year VII (6 tests × 2, or 4 *tests × 3)		**Year X** (6 tests × 2, or 4 *tests × 3)
.	1. Pict. absurd. I (3+) a... b... c... d...	......	1. *Voc. (11+) No. ....
.	2. *Two simil. (2+) a... b... c... d...	......	2. Pict. absurd. II: Frontier Days
.	3. *Diamond (2+) a... b... c...	......	3. *Read. Mem. (10)... T. (35″)... E. (2)...
.	4. Compre. III (2+) a... b... c...	......	4. *Reasons I (2+) a... b...
.	5. *Opp. anal. I (5+) a... b... c... d... e...	......	5. *Word naming (28 in 1′)
.	6. *Five dig. (1+) 31859... 48372... 96183...	......	6. Six dig. (1+) 473859... 529746... 728394...
	Year VIII (6 tests × 2, or 4 *tests × 3)		**Year XI** (6 tests × 2, or 4 *tests × 3)
.	1. *Voc. (8+) No.	......	1. *Designs (1½+).
.	2. Wet Fall (5+) a... b... c... d... e... f...	......	2. *Verb. absurd. III (2+) a... b... c...
.	3. *Verb. absurd. I (3+) a... b... c... d...	......	3. *Abstr. wds. I (3+) a... b... c... d... e...
.	4. *Sim. & dif. (3+) a... b... c... d...	......	4. Sent. mem. IV (1+) a... b...
.	5. *Compre. IV (2+) a... b... c...	......	5. Problem situation
.	6. Sent. mem. III (1+) a... b...	......	6. *Three simil. (3+) a... b... c... d... e...
	Year IX (6 tests × 2, or 4 *tests × 3)		**Year XII** (6 tests × 2, or 4 *tests × 3)
.	1. Paper cutting I (1+) a... b...	......	1. *Voc. (14+) No. ....
.	2. Verb. absurd. II (3+) a... b... c... d... e...	......	2. *Verb. absurd. II (4+)
.	3. *Designs (1+ or 2 with ½ credit) a... b...	......	3. Pict. II
.	4. *Rhymes (3+) a... b... c... d...	......	4. Five dig. rev. (1+) 81379... 69582... 52941...
.	5. *Change (2+) 10–4... 15–12... 25–4...	......	5. *Abstr. wds. II (2+) a... b... c... d...
.	6. *Four dig. rev. (1+) 8526... 4937... 3629...	......	6. *Minkus compl. (2+) (5 min.) No. ....

COME TO LONDON

DPNF UP MPOEPO

HURRY

COME TO LONDON

BDNPLNDF SUNP KMNPMOCENPMO

HURRY

	Year XIII (6 tests × 2, or 4 *tests × 3)
......	1. Plan of search
......	2. Word mem. (1+) a... b...
......	3. *Paper cutting I (2+)
......	4. *Prob. fact (2+) a... b... c...
......	5. *Dissect. sent. (2+) (1 min. ea.) a... b... c...
......	6. *Bead chain II (2 min.)
	Year XIV (6 tests × 2, or 4 *tests × 3)
......	1. *Voc. (16+) No. ....
......	2. *Induct. a... b... c... d... e... f... R...
......	3. Pict. absurd. III: The Shadow
...	4. *Ingenuity (1+) (3 min. ea.) a... b... c...
......	5. Direction I (3+) a... b... c... d... e...
....	6. *Abstr. wds. II (3+)
	Aver. Adult (8 tests × 2, or 4 *tests × 4)
......	1. *Voc. (20+) No. ....
......	2. *Codes (1½+) (3 min. ea.) a... b...
....	3. *Diff. bet. abstr. wds. (2+) a... b... c...
....	4. Arith. reas. (2+) (1 min. ea.) a... b... c...
......	5. Proverbs I (2+) a... b... c...
......	6. *Ingenuity (2+) (3 min. ea.)
......	7. Sent. mem. V (1+) a... b...
......	8. Recon. opp. (3+) a... b... c... d... e... f...
	Super. Adult I (6 tests × 4, or 4 *tests × 6)
......	1. *Voc. (23+) No. ....
......	2. Boxes (3+) a... b... c... d...
......	3. *Minkus compl. (3+) (5 min.)
......	4. *Six dig. rev. (1+) 471952... 583694... 752618...
......	5. *Sent. bldg. (2+) a... b... c...
......	6. Essen. simil. (2+) a... b... c...
	Super. Adult II (6 tests × 5, or 4 *tests × 7½)
......	1. *Voc. (26+) No. ....
......	2. *Reasons II (2+) a... b...
....	3. *Dig. (1+) 72594836... 47153962... 41935826...
....	4. *Proverbs II (2+) a... b...
......	5. Recon. opp. (5+)
......	6. Passage: Value of Life
	Super. Adult III (6 tests × 6, or 4 *tests × 9)
......	1. *Voc. (30+) No. ....
......	2. *Direction II (2+) a... b...
......	3. *Opp. anal. II (2+) a... b... c...
......	4. Paper cutting II
......	5. *Reasoning (5 min.)
......	6. Dig. (1+) 596138274... 925841736... 472916853...

VOCABULARY

1. orange............
2. envelope.........
3. straw.............
4. puddle............
5. tap...............
6. gown.............
7. eyelash...........
8. roar..............
9. scorch............
10. muzzle............
11. haste.............
12. lecture...........
13. Mars.............
14. skill..............
15. juggler...........
16. brunette..........
17. peculiarity........
18. priceless.........
19. regard...........
20. disproportionate...
21. shrewd..........
22. tolerate..........
23. stave............
24. lotus............
25. bewail...........
26. repose...........
27. mosaic...........
28. flaunt...........
29. philanthropy......
30. ochre............
31. frustrate.........
32. incrustation.......
33. milksop..........
34. harpy............
35. ambergris.........
36. piscatorial........
37. depredation.......
38. perfunctory.......
39. limpet...........
40. achromatic.......
41. casuistry.........
42. homunculus.......
43. sudorific.........
44. retroactive.......
45. parterre..........

Score...........

MINKUS COMPLETION

a) One cannot always be a hero, ... one can always be a man.

b) The streams are dry .... there has been little rain.

c) .... either of us could speak, we were at the bottom of the stairs.

d) He is .... well grounded in geography .... his brother.

WISC RECORD FORM

NAME________________AGE______SEX______

ADDRESS________________

PARENT'S NAME________________

SCHOOL________________GRADE______

REFERRED BY________________

	Year	Month	Day
Date Tested			
Date of Birth			
Age			

	Scaled Score	IQ
Verbal Scale	*	
Performance Scale	*	
Full Scale		

*Prorated if necessary

	Raw Score	Scaled Score
VERBAL TESTS		
Information		
Comprehension		
Arithmetic		
Similarities		
Vocabulary		
(Digit Span)		
Sum of Verbal Tests		
PERFORMANCE TESTS		
Picture Completion		
Picture Arrangement		
Block Design		
Object Assembly		
Coding		
(Mazes)		
Sum of Performance Tests		

NOTES

____
Examiner

The Psychological Corporation
304 East 45th Street
New York 17, N. Y.

Printed in U. S. A. 0010

57-200 AS

1. INFORMATION	Score 1 or 0		Score 1 or 0		Score 1 or 0
1. Ears		11. Season—Year		21. Pounds—Ton	
2. Finger		12. Color—Rubies		22. Capital—Greece	
3. Legs		13. Sun—Set		23. Turpentine	
4. Animal—Milk		14. Stomach		24. New York—Chicago	
5. Water—Boil		15. Oil—Float		25. Labor Day	
6. Store—Sugar		16. Romeo—Juliet		26. South Pole	
7. Pennies		17. Fourth—July		27. Barometer	
8. Days—Week		18. C.O.D.		28. Hieroglyphic	
9. Discoverer—America		19. American—Man		29. Genghis Khan	
10. Things—Dozen		20. Chile		30. Lien	

2. COMPREHENSION	Score 2, 1 or 0
1. Cut—Finger	
2. Lose—Balls (Dolls)	
3. Loaf—Bread	
4. Fight	
5. Train—Track	
6. House—Brick	
7. Criminals	
8. Women—Children	
9. Bills—Check	
10. Charity—Beggar	
11. Government—Examinations	
12. Cotton—Fiber	
13. Senators	
14. Promise—Kept	

3. ARITHMETIC

Problem	Response	Time	Score 1 or 0
1. 45"			
2. 45"			
3. 45"			
4. 30"			
5. 30"			
6. 30"			
7. 30"			
8. 30"			
9. 30"			
10. 30"			
11. 30"			
12. 60"			
13. 30"			
14. 60"			
15. 120"			
16. 120"			

4. SIMILARITIES

4. SIMILARITIES	Score 1 or 0
1. Lemons—Sugar	
2. Walk—Throw	
3. Boys—Girls	
4. Knife—Glass	
	Score 2, 1 or 0
5. Plum—Peach	
6. Cat—Mouse	
7. Beer—Wine	
8. Piano—Violin	
9. Paper—Coal	
10. Pound—Yard	
11. Scissors—Copper Pan	
12. Mountain—Lake	
13. Salt—Water	
14. Liberty—Justice	
15. First—Last	
16. 49—121	

SUPPLEMENTARY TESTS

DIGIT SPAN

Digits Forward	Score (Circle)	Digits Backward	Score (Circle)
3-8-6	3	2-5	2
6-1-2	3	6-3	2
3-4-1-7	4	5-7-4	3
6-1-5-8	4	2-5-9	3
8-4-2-3-9	5	7-2-9-6	4
5-2-1-8-6	5	8-4-9-3	4
3-8-9-1-7-4	6	4-1-3-5-7	5
7-9-6-4-8-3	6	9-7-8-5-2	5
5-1-7-4-2-3-8	7	1-6-5-2-9-8	6
9-8-5-2-1-6-3	7	3-6-7-1-9-4	6
1-6-4-5-9-7-6-3	8	8-5-9-2-3-4-2	7
2-9-7-6-3-1-5-4	8	4-5-7-9-2-8-1	7
5-3-8-7-1-2-4-6-9	9	6-9-1-6-3-2-5-8	8
4-2-6-9-1-7-8-3-5	9	3-1-7-9-5-4-8-2	8

F____ + B____ = ____
Highest numbers circled

MAZES

Maze	Max. Errors	Errors	Score
A. 30"	2		0 1 2
B. 30"	2		0 1 2
C. 30"	2		0 1 2
1. 30"	3		0 1 2 3
2. 45"	3		0 1 2 3
3. 60"	5		0 1 2 3
4. 120"	6		0 1 2 3
5. 120"	8		0 1 2 3

Notes:

5. VOCABULARY

	Score 2 or 0	5. VOCABULARY
1. Bicycle		
2. Knife		
3. Hat		
4. Letter		
5. Umbrella		
	Score 2, 1 or 0	
6. Cushion		
7. Nail		
8. Donkey		
9. Fur		
10. Diamond		
11. Join		
12. Spade		
13. Sword		
14. Nuisance		
15. Brave		
16. Nonsense		
17. Hero		
18. Gamble		
19. Nitroglycerine		
20. Microscope		
21. Shilling		
22. Fable		
23. Belfry		
24. Espionage		
25. Stanza		
26. Seclude		
27. Spangle		
28. Hara-Kiri		
29. Recede		
30. Affliction		
31. Ballast		
32. Catacomb		
33. Imminent		
34. Mantis		
35. Vesper		
36. Aseptic		
37. Chattel		
38. Dilatory		
39. Flout		
40. Traduce		

6. PICTURE COMPLETION

	Score 1 or 0
1. Comb	
2. Table	
3. Fox	
4. Girl	
5. Cat	
6. Door	
7. Hand	
8. Card	
9. Scissors	
10. Coat	
11. Fish	
12. Screw	
13. Fly	
14. Rooster	
15. Profile	
16. Thermometer	
17. Hat	
18. Umbrella	
19. Cow	
20. House	

7. PICTURE ARRANGEMENT

Arrangement	Time	Order	Score
A. Dog 75''	1 2		0 · 1 ABC · 2 ABC
B. Mother 75''			0 · 1 OYT · 2 TOY
C. Train 60''			0 · 1 IR ON · 2 IRON
D. Scale 45''			0 · 2 ABC
(Fight)			
1. Fire 45''			0 · 4 · 5 (11-15) · 6 (6-10) · 7 (1-5) · FIRE
2. Burglar 45''			0 · 4 · 5 (11-15) · 6 (6-10) · 7 (1-5) · THUG
3. Farmer 45''			0 · 4 · 5 (11-15) · 6 (6-10) · 7 (1-5) · QRST OR SQRT
4. Picnic 45''			0 · 4 · 5 (11-15) · 6 (6-10) · 7 (1-5) · EFGH OR EFHG
5. Sleeper 60''			0 · 4 · 5 (16-20) · 6 (11-15) · 7 (1-10) · PERCY
6. Gardener 75''			0 · 4 · 5 (21-30) · 6 (16-20) · 7 (1-15) · FISHER OR FSIHER
7. Rain 75''			0 · 2 MSTEAR ASTEMR · 4 · 5 (21-30) · 6 (16-20) · 7 (1-15) · MASTER

8. BLOCK DESIGN

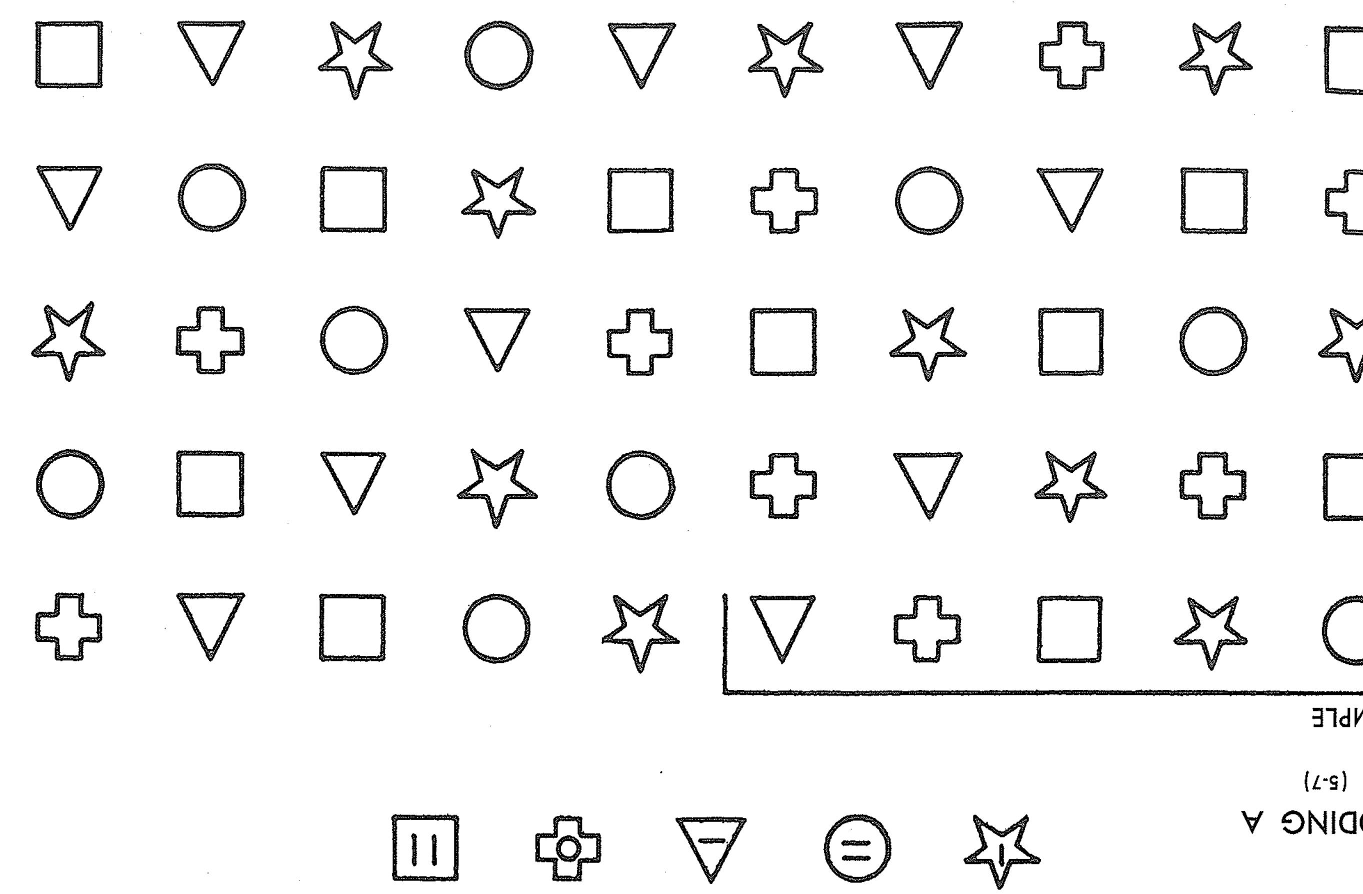
Design	Time	Pass-Fail	Score
A. 45''	1 2		2 0 1
B. 45''	1 2		2 0 1
C. 45''	1 2		2 0 1
1. 75''			0 · 4 (21-75) · 5 (16-20) · 6 (11-15) · 7 (1-10)
2. 75''			0 · 4 (21-75) · 5 (16-20) · 6 (11-15) · 7 (1-10)
3. 75''			0 · 4 (26-75) · 5 (21-25) · 6 (16-20) · 7 (1-15)
4. 75''			0 · 4 (21-75) · 5 (16-20) · 6 (11-15) · 7 (1-10)
5. 150''			0 · 4 (66-150) · 5 (46-65) · 6 (36-45) · 7 (1-35)
6. 150''			0 · 4 (81-150) · 5 (66-80) · 6 (56-65) · 7 (1-55)
7. 150''			0 · 4 (91-150) · 5 (66-90) · 6 (56-65) · 7 (1-55)

9. OBJECT ASSEMBLY

Object	Time	Score
Manikin 120''		0 · 1 · 2 · 3 · 4 (21-120) · 5 (16-20) · 6 (11-15) · 7 (1-10)
Horse 180''		0 · 1 · 2 · 3 · 4 · 5 · 6 (31-180) · 7 (21-30) · 8 (16-20) · 9 (1-15)
Face 180''		0 · 1 · 2 · 3 · 4 · 5 · 6 (71-180) · 7 (46-70) · 8 (36-45) · 9 (1-35)
Auto 180''		0 · 1 · 2 · 3 · 4 · 5 · 6 (46-180) · 7 (31-45) · 8 (26-30) · 9 (1-25)

Notes:

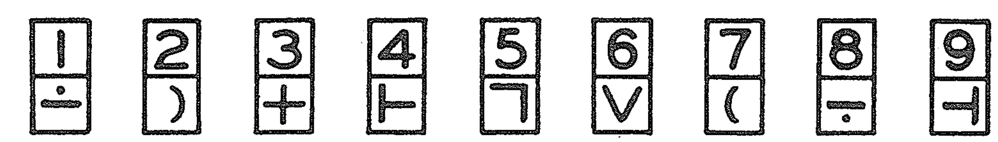
TIME (120'') ______ NO. RIGHT ______ SCORE ______



SAMPLE

CODING A (5-7)

CODING B (8-15)



SAMPLE																								
2	1	4	6	3	5	2	1	3	4	2	1	3	1	2	3	1	4	2	6	3	1	2	5	1
3	1	5	4	2	7	4	6	9	2	5	8	4	7	6	1	8	7	5	4	8	6	9	4	3
1	8	2	9	7	6	2	5	4	7	3	6	8	5	9	4	1	6	8	9	3	7	5	1	4
9	1	5	8	7	6	9	7	8	2	4	8	3	5	6	7	1	9	4	3	6	2	7	9	3

TIME (120'') ______ SCORE (NO. RIGHT) ______