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PSYCHOLINGUISTIC ABILITIES IN
CHILDREN WITH EPILEPSY

by

Aldine Sinclair von Isser

A Dissertation Submitted to the Faculty of the
DEPARTMENT OF SPECIAL EDUCATION

In Partial Fulfillment of the Requirements
For the Degree of

DOCTOR OF PHILOSOPHY

In the Graduate College
THE UNIVERSITY OF ARIZONA

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THE UNIVERSITY OF ARIZONA
GRADUATE COLLEGE

I hereby recommend that this dissertation prepared under my
direction by Aldine Sinclair von Isser
entitled Psycholinguistic Abilities in Children
with Epilepsy
be accepted as fulfilling the dissertation requirement of the
degree of Doctor of Philosophy

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Nov. 7, 1974
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*This approval and acceptance is contingent on the candidate's
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ABSTRACT

The purpose of this investigation is to study the linguistic, cognitive, memory, and perceptual functions of a group of petit mal epileptic children and a group of children evidencing mixed epileptic seizures to determine whether any differences exist when these two groups are compared with each other or with a comparable group of non-epileptic children of average intelligence.

Twenty-two children with purely defined petit mal epilepsy (10 males and 12 females) and twenty-eight children diagnosed as having mixed epileptic seizures (18 males and 10 females) were individually administered the Illinois Test of Psycholinguistic Abilities (ITPA). All subjects were in the PLQ range of 80 to 120 and an age range from 3 years, 8 months to 9 years, 11 months and were on medication to control their seizures. A contrast group of 50 children equivalent with respect to age and intelligence was obtained randomly from the standardization population of the ITPA.

The relevant results of this study are:

1. There were no significant differences between the 50 epileptic children and the 50 subjects in the contrast group of average, non-epileptic children on any of the ten subtests of the ITPA.

2. There were no significant differences between the petit mal and the mixed seizure groups on the global scores (mean scaled score, psycholinguistic age, or psycholinguistic quotient) nor on any of the ten subtests of the ITPA.

3. There was no greater proportion of learning disabilities (discrepancies in psycholinguistic development) among the epileptic children than among the children in the contrast group.

It was concluded that no cognitive impairment as a result of epilepsy per se could be demonstrated in the epileptic cases studied. The results suggest that there exists no necessity for special education provisions which could be inferred strictly on the basis of the diagnosis of epilepsy. This is not to say, however, that in individual cases there may not be cognitive dysfunctions which are unrelated to epilepsy but which would require provisions for adaptive instruction were they to occur. Certainly the assumption that a child requires special education because he is epileptic has been shown on the basis of this research to be unwarranted.

Further research may center on (a) a psycholinguistic study of epileptic children in the range of retarded intelligence, and (b) the effect of epilepsy on social, educational, and personality variables.

CHAPTER I

EPILEPSY

Epilepsy has been a major concern to both the physician and the educator for many years. It is a disorder--more accurately a group of disorders--which afflicts four to seven per 1000 individuals. In the United States it is estimated that there are 800,000 to 1,000,000 persons who have epilepsy. While the exact number of children who suffer from this disorder cannot be determined, it would seem that this group is large enough to merit the attention of educators. Although epilepsy appears to be controllable medically, its influence on cognitive functioning related to school performance is not well understood. The educator is, therefore, at a loss in terms of planning special programs for the epileptic child if, in fact, such programs are necessary.

The word epilepsy is Greek for "seizure." Epilepsy and convulsive disorder for all practical purposes may be considered synonymous. Epilepsy has been defined as a group of conditions characterized by recurring convulsions. Harwood-Nash (1974) describes epilepsy as "an intermittent convulsive disorder due to a focal dysrhythmic discharge in the cerebral cortex (n.p.)."

It has been reported by one of the major authorities in epilepsy, Preston Robb (1965), that although the convulsive seizure represents the popular conception of epilepsy it is only a part of the problem. The epilepsies compose a group of disorders in which the common factor is a paroxymal, excessive, neuronal discharge within the brain. It is accompanied by a sudden disturbance of function of the body or mind. The disturbance is subservient to the part of the brain involved and may be manifested by loss of consciousness, excess or loss of muscle tone or movement, disorders of sensation or special senses, or disturbances of the autonomic functions of the body.

Any illness or disorder which is capable of affecting the structure or function of the brain may cause seizures. This is why the conditions are better referred to as the epilepsies. Etiological factors may include congenital anomalies, disorders during intrauterine life, brain injury acquired around the time of birth, infections, trauma, vascular disturbances, metabolic and nutritional disturbances, tumors, degenerative diseases, or other genetic disorders.

Historical Perspective

From the time that records have been made on the illnesses of man, epilepsy has formed a prominent part. The early history of The Falling Sickness, as recorded by Temkin (1945), Lennox (1960), and others, is an interesting story

but contributed little to an understanding of the true nature of the disorder. The theories of its origin were a mixture of magic and religious fantasy. According to Willis (1684) the early approaches to treatment frequently did more harm than good.

In the Hippocratic (1849) collection of medical papers written about 400 B.C., a physician hinted at a significant relationship when he wrote of epilepsy, "Its origin is hereditary like that of other diseases" (Lennox 1960, reporting from Hippocrates, Adams translation 1849, vol. 2, p. 843). This physician recognized that the seat of the trouble was in the brain and expressed the opinion that the precipitating factors of the attack were cold, sun, and winds which changed the consistency of the brain. These phenomena he considered divine and since they influenced all diseases, all diseases were thought divine. At the same time they were also human because of the physiological substratum. Epilepsy, therefore, should not be treated by magic, he suggested, but rather by diet and drugs.

Robb (1965) quoted the words of St. Mark in referring to a young man who since childhood had had a "dumb spirit," which "taketh him, it clasheth him down, and he foameth and grindeth his teeth and pineth away" and which "cast him both into the fires and into the waters to destroy him." These words describe very well the seizures and many of the problems of the victims of epilepsy.

More has been learned about the nature and control of epilepsy in the last 30 years than in the preceding 2000 years. Few advances were made in knowledge about epilepsy from the time Hippocrates localized epilepsy in the brain until the Renaissance. In the 1600's the view arose that chemical reactions in the central nervous system or a "peculiar incident in the brain" were the producers of epilepsy (Sands, 1956).

The first real ray of hope for the patient came in 1857 when Sir Charles Locock reported the successful use of bromides in the treatment of epilepsy. It was not until 1912 when Alfred Hauptmann published "Die Behandlung bei Epilepsie mit Luminal," that seizures were first treated with any degree of success and safety. About the same time advances in drug therapy were occurring, and following the leadership of Hans Berger (1933), the electroencephalogram was being developed and a new era of understanding and hope opened for the person with epilepsy (Robb, 1965).

Current Concepts and Diagnosis

According to Sands (1956) present theories still rest heavily on the work of John Hughlings Jackson (1835-1911) who ascribed epilepsy to an instability of nerve cells which causes a nervous discharge from certain focal areas of the brain. It is due, he said, to a "discharging lesion."

Current concepts of epilepsy stem from Jackson's view that the phenomena of epileptic attacks can all be ascribed in terms of the focal origin of the discharge, the pathway of spread, and the resulting behavioral changes. Jackson's accuracy in grasping the essential nature of epilepsy became apparent in the early 1930's with the advent of electrical recording devices such as the cathode-ray oscillograph which enabled clinicians to make recordings of brain waves (EEG's). The epileptic's brain suddenly releases an abnormally large discharge followed by a refractory period (Harwood-Nash, 1974). The EEG is a recording device which indexes the electrical discharge of brain tissue and is used for diagnosis. Each major type of epilepsy possesses characteristic abnormal EEG tracings (Kram, 1963).

The manifestations of epilepsy take many forms depending on what part of the brain and how much of it is involved by the disordered energy release. If the discharge is confined to one part of the brain, it is focal. However, what starts as a focal discharge may spread and become generalized. The signs and symptoms that develop depend upon the functions subserved by the parts of the brain in which the disorder starts and to which it spreads (Boshes and Gibbs, 1972).

Some authors make a distinction between symptomatic epilepsy and genuine (essential or idiopathic) epilepsy. In the former, the seizures are a symptom of another disease or

a consequences of structural damage to the brain; in the latter, they are supposed to be an expression of a brain disorder that has no structural basis and that is primary, i.e., not secondary to any other disorder, injury, or disease process (Boshes and Gibbs, 1972).

In general, seizures currently are qualified by (1) etiology, (2) location of the discharge in the brain by use of the EEG, or (3) by a major or minor motor attack. A classification which includes both clinical descriptions and characteristic EEG pattern is the most widely used. Using this system all cases of epilepsy can be grouped into categories of grand mal, petit mal, focal, and psychomotor epilepsy (Kram, 1963).

Etiology is currently divided according to the relative primacy of precipitating factors, but it must be stressed that these are not mutually exclusive and in the majority of cases all three factors enter into the causal chain of events (World Health Organization [W.H.O.], 1957). A predisposition to develop epilepsy may be inherited and seizures may be induced by brain damage or emotional and/or physical stress (Chamberlain, 1957).

The majority of seizures begun in infancy (especially those precipitated by fever) are relatively insignificant and do not recur in later years (W.H.O., 1957). A consideration of the child's age is helpful in evaluating the possible causes of a convulsive disorder. During the first year of

life non-febrile convulsions are most apt to reflect cerebral maldevelopment or birth injury. After two years of age such a disorder is more likely to be described as idiopathic or "cause unknown."

Success in treatment has paralleled the rising curve of knowledge about epilepsy. The first medicines to reduce seizures were the bromides, introduced in 1857, and were the medicines of choice until 1912 when phenobarbital was introduced. In 1938 a major improvement in the control of seizures came through the discovery of Dilantin, a drug which effectively controlled seizures with rare side effects. Since then the number of anticonvulsants has grown and includes the diones for the control of petit mal and phenurone for psychomotor episodes (Boshes and Gibbs, 1972).

Classification of the Epilepsies

Just as there are many causes of epilepsy, there are also many different types of seizures. Indeed, one author wisely suggested that there are as many types of seizures as there are regions of the brain, and an attempt to distinguish each of them would be quite hopeless. Although there is some truth in this, Robb (1965) recommended a classification of the various types of seizures for several reasons; (1) to establish a uniform terminology so that those working in the field may use the same terms for specific types of seizures, (2) to provide uniformity in reporting individual cases,

(3) to correlate medication with specific types of seizures, and (4) to determine the relationship between certain types of seizures and known physiological or pathological changes.

Four major types of clinical epilepsy have been identified. They are (1) grand mal, (2) petit mal, (3) temporal lobe or "psychomotor," and (4) focal cortical or Jacksonian (Pond, 1961). The type of epilepsy that develops is largely dependent on the age (the maturational state of the brain) at the time of injury. The immature brain tends to react with a diffuse irritative response even when the injury is a localized one (Boshes and Gibbs, 1972).

Grand Mal

The type of seizure most frequently and easily observed is grand mal epilepsy which is characterized by convulsions that last from 30 seconds to an hour during which time the individual is unconscious. Grand mal is the most visible and prevalent type of diagnosed epilepsy. Four out of five children with diagnosed epilepsy have grand mal seizures (National Epilepsy League, 1958). An aura (olfactory or visual) may precede the seizure, sometimes by only an instant. The person then stiffens with the muscles becoming rigid. This stiffness is the tonic stage which immediately precedes the jerking, convulsive state which is the seizure proper and known as the clonic stage. During this stage the patient may also experience sphincter disturbances and temporary hemipareses.

Petit Mal

Primarily a disorder of childhood, petit mal epilepsy seldom continues into adulthood. Its attacks are unique in that both diagnosis and control can often be readily established (Nelhaus, 1963). Criteria for diagnosis include both (1) recurrent momentary lapses of consciousness which can usually be precipitated by hyperventilation, which accounted for seizures in 93% of the cases studied by Holowach, Thurston, and O'Leary (1962); and (2) diffuse spike wave form EEG (Livingston, Torres, Pauli, and Rider, 1965). Although some studies indicate that as many as 30% of diagnosed epileptic children have petit mal, half of whom will also have grand mal seizures (National Epilepsy League, 1958), others have found it to be a comparatively rare type of epilepsy. Livingston et al., (1965) found that only 2.3% of the 15,102 patients treated at the Johns Hopkins Hospital Epilepsy Clinic had true petit mal. In a study of 88 children with petit mal epilepsy Holowach et al., (1962) found that more than one half of patients with this type of epilepsy experience other types of seizures, particularly grand mal, which usually appears with or after the onset of petit mal. They reported an age of between two and one half and nine years in 80% of the cases with a peak incidence at age six. These findings are in agreement with other similar studies. Of all forms of epilepsy petit mal is the most likely to be precipitated by emotional factors, possibly because of the emotional

sensitivity that is said to be typical of many petit mal patients (Bakwin and Bakwin, 1951).

Temporal Lobe or Psychomotor Seizures

Seizures of this type are less common in children than grand mal or petit mal and are not characterized by any one specific behavior. These attacks often exhibit an alteration of consciousness associated with the performance of semipurposeful stereotyped movements. These movements may be varied and are often accompanied by emotional outbursts. This type of seizure is associated with varying degrees of amnesia (Boshes and Gibbs, 1972). Nelhaus (1963) suspects that this type of epilepsy is often misdiagnosed.

Jacksonian

Jacksonian is a type of focal seizure which usually begins with a jerking movement in the foot, hand, or one side of the face and progressing until it involves one side of the body. If it involves the entire body it ends in a grand mal attack. Focal motor seizures are particularly frequent in young children, but tend to wander or to be multifocal. Consciousness is retained unless the seizure develops into a major generalized convulsion (Nelhaus, 1963). Some cases with clinical seizures that are Jacksonian have normal electroencephalograms even during the clinical seizure. Boshes and Gibbs (1972) found this difficult to explain but suggested that the most reasonable explanation appeared to be that the

discharge may be too small to be detected or lies in buried cortex or in a subcortical area from which there is no spread to the outer convexity of the cerebral hemispheres. In such cases negative findings are not positive evidence of normality, nor do they indicate the absence of a pathological process.

In addition to the well known clinical epilepsies, Gibbs and Gibbs (1951) have described a new type of spike activity which they called 14 and 6 per second positive spikes. The electroencephalogram denoting this abnormality is seen in EEG readings just before a patient drops off to sleep and again upon awakening (Kellaway, Crawley, and Kagawa, 1959). This phenomenon has been further studied by several authors, some of whom have depicted the morphology, age and sex distribution, and symptomatology in patients with neurologic and psychiatric disorders (Demerdash, Eeg-Olofsson, and Petersen, 1968).

Patients with this pattern often have a history of irritability, stomachaches, headaches, and episodic illusions. In addition, they have been found to be management problems to their parents and teachers (Smith, Phillipus, and Guard, 1968).

Fourteen and six per second positive spikes are usually not temporally associated with the patient's clinical seizures, should these exist. As a rule, during the clinical

seizure the electroencephalogram is normal and shows only low voltage activity such as occurs with attention (Boshes and Gibbs, 1972).

This spike disorder is present mainly in childhood and adolescence, with a peak incidence in the early teens. There are no reports on the incidence of the 14 and 6 phenomenon in "strictly normal" children. A few authors, however, have reported on "apparently normal" children. Kellaway et al., (1959) noticed an incidence of 2.3% in 1000 "normal" children of under 16 years without neurologic or other diseases; Gibbs and Gibbs (1963) found an incidence of 20% in their study of 472 "selected normal children" with peak incidence in the age group 12-13 years where the frequency amounted to approximately 25%. Lombroso, Schwartz, Clark, Nuench, and Barry (1966) reported the exceptionally high incidence of 58% 14 and 6 per second positive spikes in healthy boys of 13-15 years. Boshes and Gibbs (1972) found in a study of 3476 electroencephalograms that 15.8% of the children between the ages of five and nine years, and 20.8% between 10 and 14 years evidenced 14 and 6 per second positive spikes. With so large a percentage of the apparently normal population evidencing this abnormal spike activity and with such vague clinical descriptions, it would appear that more research needs to be done to adequately define this phenomenon.

Prevalence

Accurate figures for the number of people who have had a convulsion or epileptic seizure at some time during their lives is unknown. Robb (1965) stated that the incidence of epilepsy is increasing. One reason is that formerly many patients with epilepsy would have died of birth injuries or other abnormalities acquired early in life. The effective use of antibiotics and general medical care now are saving many children with meningitis, brain abscesses, encephalitis, severe head injuries, and brain tumors, thus contributing to the increase of disabling disorders.

Henderson (1953) investigated a representative population of 355,000 school children in Great Britain and found 430 epileptics for an incidence of 1.2 per 1000. There were 250 boys and 180 girls; 316 had grand mal, 65 had petit mal, and 49 had both.

In a longitudinal study Cooper (1965) investigated 5000 children born in Great Britain in 1946. Of the 5000 children studied, any child who had a fit or convulsion during the 18 years of the study was included for discussion. Medical information was gathered initially when the child was two years old. School medical officers examined the child at ages six, seven, and fifteen. The most reliable of the findings, all of which were expressed per thousand, was a rate of 22.7 children having any sort of fit among those surviving to age two. At age six the total prevalence was

8.2 with 5.6 of those being new cases. At age 11 the total rate was 7.1 with 3.7 of the cases being new. At age 15 the total prevalence was 8.2 with 3.5 being new cases.

Richardson, Higgins, and Ames (1965) reviewed 36,555 persons under 21 years of age and found the incidence of epilepsy was highest for the ages 10 to 14 (45 per 1000) with more males than females being affected.

Force (1965) also found that a greater number of males than females evidenced seizures in his descriptive study of children in regular and special classes. The overall rate was 4.52 children with epilepsy per 1000. The 292 children with epilepsy among 68,705 children in regular classes were computed to show a rate of 4.25 per 1000. Of the total number of children with known diagnoses of seizures, boys constituted 56% and girls 44%.

Nelhaus (1963) reported that of the total population one out of 200 has chronic recurrent seizures, 90% of which begin in childhood. The epileptic population in the United States is estimated by Abraham (1956) at 700,000 to one million. Bakwin and Bakwin (1951) have found that approximately seven per 10,000 school age children in the United States are epileptic.

It will be noted from the review of studies on the prevalence of epilepsy in the population that there is a relatively wide variation among researchers in their estimates of prevalence. A generalized statement would indicate

that the prevalence of epilepsy ranges from four to twenty-three per thousand with the majority reporting approximately four to seven cases per thousand (Folsom, 1968).

CHAPTER II

PSYCHOLOGICAL STUDIES OF CHILDREN

WITH EPILEPSY

This chapter will examine studies that have been conducted to investigate the cognitive factors in children with epilepsy. Literature will be reviewed concerning (1) the intelligence of epileptics, (2) the structure of intelligence in epileptics, and (3) educational aspects.

The intelligence of epileptics has been of particular interest to psychologists and educators for many years. The range and severity of intellectual deficits associated with this condition is a recurring question in the clinical and social-vocational evaluation. Many surveys have been conducted to answer the question whether differences exist between epileptics and non-epileptics in their intellectual functioning.

Pond (1961) has identified three main groups of tests that have been used to evaluate epileptics. These include (1) general intelligence tests, (2) tests of special psychological functions, and (3) projective tests. In his discussion he has pointed out the problems which are associated with the use of intelligence and personality assessment instruments.

The first group of tests discussed by Pond is the standardized intelligence tests of the Wechsler or Binet type. He suggested that the measures of deterioration in adults which compare the Verbal and Performance scores of the Wechsler are questionable. He also asserted that their application to children is even more difficult since on the one hand wide discrepancies may be found between Verbal and Performance scores in patients in whom brain damage is not suspected, and on the other hand no such discrepancies may be found in children with unquestionable brain damage. He felt that such discrepant results can be produced by some parents who can educate their children and therefore produce high verbal scores in their backward children.

The second group of tests are those concerned with special psychological functions, of which those related to perceptual anomalies seem to be the most important. The Bender-Gestalt and various formboard tests are examples. Unfortunately, most of these tests have been poorly standardized. As a result, there are rarely clear criteria on which to evaluate the test results since many of these tests are rarely free of external influences, e.g., neurological disturbances, or personality difficulties or maladjustment.

The third group of psychological tests reported by Pond are the so-called projective tests, of which the Rorschach is the one most frequently used. Although Tizard (1962) wrote that many authors have discovered specific

indications of organic malfunctions from the Rorschach test, these manifestations have been equally denied. Therefore, the Rorschach test as a diagnostic tool of organic deficiencies is questionable.

The Intelligence of Epileptics

One of the first investigations to assess the intelligence of epileptic children was carried out by Wallin. After conducting a comparative study of 106 epileptic and normal children using 12 independent psychological tests, he concluded (Wallin, 1917) that epilepsy is compatible with all levels of intelligence from genius to idiocy and cited Byron, Pascal, de Maupassant, Julius Caesar, Alfred the Great, and other notables as exemplifying the way in which accomplishment need not be impaired in people reputed to be epileptics. It should be pointed out that Wallin's study was conducted before the advent of standardized intelligence tests such as the Binet or Wechsler. Since that date there have been many studies using the Binet and Wechsler to assess the intellectual level of epileptic children.

Table 1 presents a summary of studies conducted between 1924 and 1955 on the IQ's of epileptic children. These studies, reported by Keating (1960), were from the United Kingdom and the United States and included epileptic children in institutions and in the public schools. It will be noted from the table that the IQ's ranged from a mean of 65 to a

Table 1. Studies of Intelligence of Epileptic Children*

Investigator(s)	Date	Cases**	Place	Type	Mean IQ
Tylor-Fox	1924	150c	Lingfield, U.K.	Girls	65
Halstead	1947		Chalfont, U.K.	All	66
Hilkevitch	1946		Dixon, U.S.A.	Petit mal	66
Tylor-Fox	1924	150c	Lingfield, U.K.	Boys	71
Fetterman & Barnes	1934	150ca		All	74
Hilkevitch	1946	66	Dixon, U.S.A.	Grand mal	75
Lennox and Collins	1945			Brain lesion	77
Halstead	1947		Lingfield, U.K.	All	80
Dawson and Conn	1929	49c	Glasgow, U.K.	All	80
Baker	1944		Detroit, U.S.A.	All	80
Tenny	1955		Detroit, U.S.A.	All	84
Sullivan & Gahagan	1935	103c	Los Angeles	All	88
Somerfield-Ziskind and Ziskind	1940		Los Angeles	Symptomatic	88
Zimmermann et al.	1951			Symptomatic	89
Zimmermann et al.	1951			Traumatic	89
Zimmermann et al.	1951			Grand mal	91
Zimmermann et al.	1951			Grand mal and idiopathic	92
Somerfield-Ziskind and Ziskind	1940	100ca	Los Angeles	All	93
Zimmermann et al.	1951	100c		All	94
Lennox and Collins	1945			No lesions	96
Henderson	1954	365c	U.K. normal schools	Normal	96
Collins and Lennox	1947			Brain lesions	97
Collins and Lennox	1947	11c		Grand mal and psychomatic	102
Collins and Lennox	1947	25c		Grand mal and petit mal	103
Collins and Lennox	1947	100c		All	104
Collins and Lennox	1947	36c		Grand mal	105
Sullivan & Gahagan	1935		Los Angeles	Non-epileptic	105
Zimmermann et al.	1951			Idiopathic petit mal	106
Lennox and Collins	1945			Non-epileptic	108
Collins and Lennox	1947	8c		Psychomatic	109
Collins and Lennox	1947	18c		Petit mal	113

* Source: Keating, 1960

** (c) children; (ca) children and adults.

mean of 113. In view of the wide range of IQ's found among epileptic children, it is obvious that other variables which may account for the intellectual status of epileptics should be investigated. These may be found in (1) institutionalized and public school epileptics, (2) the effects of brain damage, (3) deterioration, and (4) intellectual functioning related to other variables. These variables will be discussed further.

Institutionalized and Public School Epileptics

In the past the majority of epileptic children were institutionalized as a measure of protection for the normal school age child. Consequently, many of the early studies assessing the intelligence of epileptic children of necessity drew their subjects from an institutionalized population. Since subnormal epileptics may be institutionalized for specific reasons other than epilepsy, it would appear that individuals may be found in an institutionalized epileptic population who show either a retardation in mental development or a deterioration from a standard once achieved. It is possible that the condition of institutionalization lowered the statistical average for intelligence in any study in which epileptics were included (Keating, 1960). This might well explain why the earlier investigations reported a lower IQ for these children than later research revealed. Commencing with the study of Tylor-Fox in 1924 and continuing

through those of Collins and Lennox in 1947 and Henderson in 1953 there has been a reported increase in the measured intelligence of epileptics from a mean of 65 to a mean very close to normal (Keating, 1960).

Hilkevitch (1946) investigated the IQ's of epileptic patients institutionalized in Dixon, Illinois, a state institution for mentally defective individuals which had a substantial proportion of epileptic children and adults. He found that those with petit mal epilepsy had a mean IQ of 66. His subjects with grand mal epilepsy yielded a mean IQ of 75. These results are consistent with those of Tylor-Fox in 1924, Fetterman and Barnes in 1934, and Lennox and Collins in 1945, all of whom used institutionalized populations for their studies.

In contrast to the results of the studies by Hilkevitch, Tenny (1955) studied epileptic children in the public school setting in Detroit, Michigan. He concluded that even seriously handicapped epileptic children are found with average and above average intelligence. His study covered the development and status of the White Special School for Epileptics. The school was established in 1935 to provide educational services for epileptics previously excluded from the regular classroom or failing to adjust satisfactorily in existing school programs. Implications concerning the education of epileptic children were drawn from data on students attending from 1935 to 1947. A wide variety of information

on each pupil was recorded for machine tabulation. The types of information included medical data, social and personal factors, intelligence test scores, and academic placement and progress. Of the 765 subjects 690 were given intelligence tests (unspecified). The range of intelligence was from below 50 to over 130 IQ with the median at 84.

In reviewing all of these studies, Angers and Dennerll (1962) summarized a number of intellectual assessments on institutionalized and non-institutionalized epileptics. While many of these studies reported data based on various psychometric instruments and heterogeneous classifications of epileptic subjects, the investigators concluded that the IQ's of institutionalized epileptics are generally lower than those found in non-institutionalized epileptics. This conclusion is in accord with those of Harrower-Erickson (1941), Reed (1951), Davies-Eysenck (1952), Donovan (1952), and W.H.O. (1957).

The Effects of Brain Damage

Pond (1961) considered the main factors which might affect the intellectual level of epileptic children to be (1) genetic influences, (2) an acquired lesion of the brain prior to the onset of the seizures, (3) the epileptic attacks themselves, (4) social and psychological factors, and (5) the effects of anticonvulsant drugs. He reviewed work done in these areas and concluded that the evidence so far would

suggest that genetic factors are the main determinants of intelligence as in normals, and that these factors are affected progressively and proportionately by the amount of brain damage that has also caused the seizures. Social and psychological factors occupy third place, while the effects of the seizures themselves and the drugs seem relatively much less important.

Other investigators have examined the effect of brain damage on the intelligence of epileptics. Angers and Dennerll (1962), in the review cited earlier, reported that epileptics with demonstrable organic pathology, brain injury, or major seizures tend to have lower IQ's than those with minor seizures or epilepsy of unknown etiology.

The earlier studies by Sands and Price (1947), Collins and Lennox (1947), Collins (1951), Winfield (1951), and Sal Y Rosas (1957) also reported normal IQ values and/or absence of significant differences between control groups and epileptic populations variously characterized as having essential or idiopathic seizures. Significantly lower IQ's in symptomatic epilepsy with inferred brain damage than in epilepsy of unknown etiology are reported in several of these same studies.

Lennox (1954) also considered the fact of brain damage itself to be of greatest importance in determining intellectual level. This point of view is supported by Dawson and Conn (1929), Fetterman and Barnes (1934), Sullivan and

Gahagan (1935), Harrower-Erickson (1941), Winfield (1951), de Haas (1958), Pond (1970), and Boshes and Gibbs (1972).

In a study of 600 office patients with epilepsy, Lennox and Lennox (1960) found that those with metabolic epilepsy actually scored above the norm on IQ tests, whereas those with an organic epilepsy (those who had brain trauma before their first seizure) scored below. This study strongly supports the hypothesis that any lowering of IQ in non-institutionalized epileptics is a result of brain damage rather than epilepsy itself.

Repeated investigations have shown that in random samples of epileptic children the distribution of intelligence levels is very similar to the normal pattern. Although the curve of distribution is skewed slightly to the left with more children of very limited intelligence, this difference practically disappears if children who have suffered gross brain damage are excluded (Sands, 1956 and Keating, 1960).

Deterioration

Studies have been conducted to determine whether there is a deterioration of intellectual abilities in people with epilepsy. They have further sought to identify underlying causes for deterioration that might occur. Such investigations have attempted to relate intellectual deterioration

in epileptics to (a) increase in age, (b) brain damage, (c) frequency of seizures, (d) age of onset of seizures, (e) type of seizure, (f) duration of the disorder, (g) sex differences, (h) pre-morbid intellectual status, and (i) the effects of anticonvulsant drugs.

The most common belief is that epileptics tend to show decrements in their intelligence as they grow older. Studies in this area have been of two types: (1) assessing the IQ's of epileptics of various ages on a cross sectional basis, and (2) assessing the IQ's of epileptics on a longitudinal basis through serial testing.

An example of the first type is in the investigations by Ninde (1927), Hilkevitch (1946), and Collins (1951) who studied epileptics of varying ages. They reported that the older epileptic subjects had higher IQ's than the younger subjects. On the other hand, Barnes and Fetterman (1938) and Reed (1951) found that the younger epileptics in their studies evidenced higher IQ's than did the older ones.

The second approach to the study of deterioration in epileptics which may be more valid is testing and retesting patients over a period of time. In such a study Dawson and Conn (1929) found that there was a mean decrease of 16 IQ points in hospitalized epileptic children. In a later study Collins (1941) described a steady decline in median scores over three test administrations. This trend was also reported by Sullivan and Gahagan (1935) who studied 103

epileptic children, 14 of whom were found to be mentally defective. The median IQ of the children tested by Sullivan and Gahagan was 92, and IQ's ranged from 11 to 141. In these investigations a number of individual patients showed no tendency to deteriorate and several increased their scores appreciably. The significant mean declines were the result of large decrements in the scores of a small percentage of cases.

Equally as many studies, however, have failed to establish any significant general tendency to deterioration through the use of serial testing. Fetterman and Barnes (1934), for example, retested 46 dispensary patients after intervals of one to two years. They found that 19 showed slight gains, 23 showed moderate losses and four were unchanged. Of these patients, 25 were tested three or more times and wide fluctuations of score were observed. An apparently large change from one test to the next was frequently offset at the next retest by an equally large change in the opposite direction. Only two of the 25 patients showed consistently negative changes over a series of three tests. Somerfeld-Ziskind and Ziskind (1940) reported similar results in their study with 100 epileptic out-patients.

More recently Davies-Eysenck (1952) conducted serial testing with 39 children and young adults ranging in age from 5 to 19 years who attended an out patient clinic at National Hospital in London. Her purpose was to determine

whether or not any tendency to deteriorate in cognitive ability would appear on re-testing two years later. A battery of psychological instruments was individually administered under identical conditions and by the same psychologist in both testings. These instruments included (a) Cattell's (1936) Test of Retentivity, (b) Progressive Matrices (untimed version), (c) fluency tests, and (d) Mill Hill Vocabulary Test. She found that on the second testing the average IQ on the progressive matrices was slightly higher than on the first testing; the average on first testing was 97.2 and on the second testing 99.2. In this study, therefore, serial testing did not give evidence of intellectual deterioration in epileptics.

The relationship between intellectual deterioration and brain injury in epileptic patients has been investigated by many workers. As mentioned earlier in this study, symptomatic epilepsy is associated with relatively low intelligence test scores, but this fact does not necessarily imply a deteriorative process. Two well controlled studies do, however, furnish striking evidence of such a process.

Winfield (1951) investigated four groups of fifteen individuals. The groups consisted of cryptogenic epileptics (those with no demonstrable brain damage), normal subjects, symptomatic epileptics (those with demonstrable brain damage) and post-traumatic encephalopaths respectively. They were equated for age, sex, seizure type, duration of illness, and

pre-morbid intellectual status. Winfield found no significant difference between the cryptogenic and normal groups, or between the epileptic and the post-traumatic encephalopaths (non-epileptic brain-injured) groups when tested on a battery of psychological tests. There was, however, a highly significant difference between the cryptogenic and the symptomatic groups with higher scores reported for the cryptogenic epilepsies.

Lennox and Collins (1945) examined the intelligence of normal and epileptic twins and reported lower scores for the brain-injured than for the idiopathic epileptics. They also found a greater discrepancy between the brain-injured epileptics and their normal twins than between the idiopathic epileptics and their normal twins. Kugelmass, Poull, and Rudnick (1938), however, failed to demonstrate such an association. Collins (1941), on the other hand, reported that the highest percentage of deterioration in her research was found within a group with idiopathic epilepsy.

Another area of investigation concerns the relationship between epilepsy and frequency of seizures. The results of these studies are inconsistent. Hilkevitch (1946) reported a significant negative correlation between intelligence test scores and frequency of seizures and a similar trend with respect to change of score on retest. Collin's (1941) research supported this observation but quoted an insignificant correlation. A number of other workers (Dawson

and Conn, 1929; Fetterman and Barnes, 1934; Sullivan and Gahagan, 1935) failed to demonstrate any such relationship.

Hilkevitch (1946) further reported a significant positive correlation between intelligence and duration of the disorder. Other studies, however, presented rather inconclusive evidence in the reverse direction (Collins, Atwell, and Moore, 1938; Barnes and Fetterman, 1938; Johnson, 1947). In summarizing the findings of six further studies Jones (1953) indicated that the evidence was inconclusive since these studies had failed to establish any relationship between intellectual status and duration of epilepsy.

Agreement relating a specific variable to intellectual deterioration is far more marked with respect to the age of onset of seizures. Jones (1953) summarized the data of seven investigations and concluded that there is a deleterious effect from onset of epilepsy at an early age. Various authors related this finding to educational and social deprivations during important developmental periods. Another factor was thought to be increased incidence of brain injury among epilepsies of an early onset, which is consistent with findings reported earlier.

Davies-Eysenck (1952) attempted to correlate different types of epileptic attacks with different degrees of deterioration. The data from this investigation were analyzed to discover whether or not they would show a differential change for the various types. The Progressive Matrices and

Mill Hill Vocabulary tests were administered twice over a period of time to eight individuals with minor attacks, 20 with major attacks, and 11 with major and minor attacks. The results were not statistically significant, although there was a tendency for those with minor motor attacks to score lower on re-testing.

The investigation of the possible negative effects of anticonvulsant drugs on the intellect has been the aim of several investigations. In general, they have failed to demonstrate any detrimental intellectual changes associated with treatment.

It can be seen from the literature cited that progressive deterioration of general intelligence is not characteristic of convulsive patients in general but occurs in individual cases. In a review of studies, Payne (1961) concluded that "Epilepsy as such produces no general deterioration, although if the convulsions are the result of brain damage, considerable general impairment can occur" (p. 209).

Intellectual Functioning Related to Other Variables

Other studies have investigated the intellectual functioning of epileptics as related to other variables such as age of onset, type of seizure, associated behavioral patterns, combined effects of epilepsy and known brain damage, family history, medical history, EEG data, use of drugs,

frequency of seizures, socio-economic level, age, social/psychological data, sex differences, and precipitating circumstances.

Halstead (1957) compared two groups of epileptic children--28 from normal schools and 28 from special residential schools for epileptics--with each other and with an individually matched control group of normal children. All children were administered the Stanford-Binet, Form L; Gates Oral Paragraph Reading; Burt Oral Arithmetic; and parts of the Van der Lugt Psychomotor Series. Other variables studied were cerebral injury, dual seizures, inappropriate behavior, sex differences, school, type and frequency of seizure, age of onset of seizure, precipitating circumstances, family history, abnormal birth, ages of developmental milestones, early neurosis, and EEG data.

In general, the epileptics scored lower than the controls on all four tests, although there were some wide intragroup differences in the epileptics. The greatest deficiencies among epileptics showed up in the Binet and the motor tests. Epileptic children were handicapped (in comparison with the control group) by slowness of thinking and problems with immediate memory and manual dexterity. The epileptic children had a larger scatter of test scores, with grand mal patients achieving the highest scores, and then petit mal (which is contrary to most other findings). Lower scores were found in cases with earlier onset of epilepsy and

also in children with behavior disorders. Most the the variables were positively correlated, though not all correlations were significant. Brain injured children had the highest percentage of what might be called "adverse association." Cases with dual seizures and deviant behavior had the next highest percentage of negative associations. The lowest percentage of adverse associations was found for patients with positive family history, cases with grand mal, and cases with grossly abnormal EEG's.

Keith, Ewart, Green, and Gage (1955) described the mental status of 296 children with epilepsy treated at the Mayo Clinic as a function of type of epilepsy, idiopathic or symptomatic, etiology, number of seizures, and age of onset. In the total group and in each diagnostic classification (petit mal, grand mal, mixed petit and grand mal) there was a much larger percentage of retardation in the group of symptomatic etiology. In the total group a regular decrease of percent of retardation appeared with increasing age of onset. Both the total group and the idiopathic-symptomatic division showed increasing percentages of retardation as a function of increased frequency of seizures. There was no observable relationship between incidence of retardation and the diagnostic classification of petit and grand mal. However, among patients with symptomatic convulsive disorders the incidence of retardation was high regardless of EEG

findings. Further, in contrast to the opinion of Kram (1963) no specific EEG tracing was found typical of any one clinical type of convulsive disorder.

Other studies correlating mental impairment in epileptics with the age of the patient at the onset of the disorder have evidenced similar results. As a general rule, the earlier the onset of epilepsy the greater will be the retardation (Khan, 1960). If there is evidence of gross neuronal loss plus epilepsy then there is likely to be considerable mental deficit (Lindsay, 1972).

In a study of six patients ranging in age from nine to 39 months who were normal until the onset of epilepsy, Dekaban (1960) found that frequent epileptic attacks interfered with mental progress, and that severe slowing of development showed up a few weeks after seizures began and slowed still more as seizures increased in intensity and frequency. Improvement began a few weeks after the seizures were controlled. The degree of improvement seemed to be related to the age of the patient, i.e., the younger the child when controlled, the better was the prospect for mental and motor development.

The study by Blakemore, Ettlinger, and Falconer (1966) tended to show a closer correlation between frequency rather than severity of seizures and verbal test impairment.

Henderson (1953) studied 430 epileptic children and found that slightly more epileptic children had IQ's below 85

as compared to the normal school population. However, nearly 70% of the epileptic children had IQ's of 85 or better. He also concluded that intelligence seemed linked to frequency of seizures. Nearly half the children with IQ's below 85 had one or more seizures a month.

Similarly, Needham, Bray, Wiser, and Beck (1969) found that frequency of seizures was an important factor influencing the intellectual performance of subjects in their research. Their study, one aspect of a research project designed to investigate genetic factors in idiopathic epilepsy, attempted to determine the relationship between (1) familial idiopathic epilepsy and intellectual performance, and (2) intellectual performance and epileptoid electroencephalogram abnormalities in close relatives. The subjects consisted of 73 patients with idiopathic epilepsy of a familial variety. Thirty-eight relatives of these patients had an epileptoid EEG very similar to that of the index patient in the family, but had experienced no seizures. One hundred and eighty-six relatives had a normal EEG and no seizures. All of the patients with seizures in this study lived in their homes. The patients and their families, including parents and siblings, were given an intellectual evaluation, an EEG was taken, and the family was interviewed by a geneticist. They were tested by psychologists with the Wechsler Adult Intelligence Scale (WAIS), the Wechsler Intelligence Scale for Children (WISC), or a Stanford-Binet, Form L-M. The

results of the comparison of scores indicated that the mean IQ's of patients with idiopathic epilepsy differed significantly as a group from those of their unaffected relatives. However, the authors pointed out that several other statistical observations should receive equal consideration: (1) the mean scores of patients with idiopathic epilepsy still were within or near the average range, (2) approximately 30% of affected patients had scores which exceeded the average of their close relatives, and (3) in one of the 61 families in this study, the patient with epilepsy had the highest overall test scores.

From their investigation Needham et al. (1969) also reported that it was unlikely that anticonvulsant drugs significantly reduced intellectual functioning in their patients. This is in accord with the findings of Loveland, Smith, and Forster (1957). In order to settle the question of the influence of drug therapy on the intellectual functioning of epileptic patients Needham et al., suggested that it would be necessary "to carry out a long-term anterospective, controlled study, measuring IQ's before therapy and again after prolonged administration of anticonvulsants. If no significant changes were noted, one could conclude that drug therapy was not responsible for reduced intellect, but if significant reduction in performance were measured, one

would still have to consider the adverse effects of the seizure in patients whose conditions were not well controlled" (p. 1500).

The results from the review of studies relating the intelligence of epileptics to other variables are obscure. It would appear that lower IQ's in epileptics are related to (a) an early onset of the disorder, (b) the degree of brain damage, (c) the frequency of seizures, and (d) the degree of EEG abnormality.

The Structure of Intelligence in Epileptics

The studies of the structure of cognitive abilities in epileptics dealt with (1) memory, (2) association, (3) attention and concentration, and (4) factor associations.

Results of studies assessing the immediate memory functioning in patients with epilepsy are not consistent. Simmins (1933) and Gottschalk (1942) have reported greater impairment of memory span and of the retention of recently learned data among epileptic patients than among other subjects tested. On the other hand, Davies-Eysenck (1952) in a study described earlier reported that results from the administration of a comprehensive battery of memory tests to a group of epileptic children and a control group of normal subjects. No significant differences were found with respect to both immediate and delayed recall, though the mean score of the epileptics was lower for the latter.

Both the Binet and the Wechsler tests have been used to investigate the memory functions of epileptics. From item analyses of Binet test results several workers (Fox, 1924; Collins, Atwell and Moore, 1938; Somerfeld-Ziskind and Ziskind, 1940; Collins, 1941) concluded that memory functions are impaired in various epileptic groups.

Collins and Lennox (1947) reported on the scores from the Wechsler-Bellevue Scale of 400 private patients of superior socio-economic status and intellectual level. They found a marked tendency for the subtests to fall into a pattern of three groups; (1) a relatively high ranking group of the four verbalized tests together with the Block Design test, (2) an intermediate group of the four other performance tests, and (3) a low ranking group consisting of the Digit Span and Arithmetic tests. This pattern remained somewhat constant when the total group was subdivided according to sex, age, type of seizure, etiology, type of EEG abnormality, and intelligence. For all subgroups the Comprehension test scores remained relatively high and Digit Span scores relatively low. In similar studies summarized by Jones (1953) it was concluded that the Digit Symbol test occupied a consistently lower ranking and frequently ranked lowest. Sands and Price (1947) described differential patterns for idiopathic and symptomatic epilepsy. They concluded that Digit Span and Digit Symbol tests, on the average, produce low

scores among both types of patients. In the studies mentioned the deficits reported for epileptics were interpreted as memory impairment.

Several authors have reported on association abilities among epileptic subjects. Simmins (1933) described earlier work which indicated that epileptic patients are particularly weak in associating pairs of words not already connected in meaning. However, when such words are already connected in meaning epileptics do not appear to be inferior. In his work Gottschalk (1942) found little impairment of the learning of new associations. Davies-Eysenck (1952) reported that a group with idiopathic epilepsy took a significantly longer time, on the average, than a specific control group to complete Raven's Progressive Matrices. Capps (1939) found that extended time limits produced the greatest improvement in test scores within his group of idiopathic epileptic patients. Winfield (1951) reported that a group with traumatic epilepsy, but not a group with idiopathic epilepsy, produced significantly lower scores on an association learning test when compared with a normal control group.

Recent authors have tended to interpret lowered scores on digit span and digit symbol tests and in association abilities by lack of attention rather than a deficit in memory. Fox (1924), Gottschalk (1942), and Collins (1951) all quoted evidence of impairment of concentration in convulsive patients.

More recently Dennerll, Broeder and Sokolov (1964) investigated the factorial dimensions of the Wechsler Intelligence Scale for Children (WISC) and the Wechsler Adult Intelligence Scale (WAIS). The groups studied were patients sequentially seen at the Michigan Epilepsy Center for outpatient diagnostic study and were comprised of 100 children (mean age 10.3; 58 males and 42 females) and 100 adults (mean age 28; 42 males and 58 females). After the administration of the WISC to the children and the WAIS to the adults an orthogonal factor extraction using a principal axis solution was performed. An oblique rotation of factors was used because of the known correlation between cognitive dimensions. Basic test results indicated that the children's scores were significantly lower than those of the adults (Verbal Scale, Performance Scale, and Full Scale). Comprehension scores were relatively high and Digit Span and Digit Symbol relatively low for both groups.

The factor analysis identified three major dimensions; Verbal Comprehension, Perceptual Organization, and Distractibility. Comparing the cognitive factor structure of epileptics, normals, and other clinical groups it was found the principal subtests defining the first two factors did not vary greatly among samples. However, the data "indicate that the pattern of relationships among subtests on the 'Distractibility' factor is not completely similar between clinical and normal groups" (Dennerll et al., p. 239). While the three

principal factors are apparently conceptually similar, the pattern of the interrelationships among all subtests for epileptic subjects was different from those of normal groups. Therefore, it was concluded that any study of the cognitive functions of the epileptic by factor scores would warrant the use of normative factor data from the epileptic subjects.

Unfortunately, Dennerll et al., do not provide any data relative to the extent to which the contribution of the subtests to the three factors are, in fact, different for epileptics as contrasted with normals. In light of the similarity which the authors conclude exists between the factor structure of the WISC across various groups this study is not particularly revealing with respect to either a different structure of ability or a different level of ability in epileptics.

In conclusion, the following observations can be made concerning the structure of intelligence in epileptics:

1. Results of studies are relatively consistent in reporting impaired memory functions among epileptic subjects examined with subtests of the Binet and Wechsler. When administered the Digit Span and Digit Symbol tests, epileptics tend to produce low scores. This has been interpreted as a memory impairment.
2. There appears to be some degree of deficit in association abilities among epileptics.

3. Recent authors have attributed memory deficits to a lack of attention and concentration among epileptics.
4. The factorial analysis of the WISC and WAIS with epileptics did not result in definitive cognitive structures. This is to be expected since no reference tests were used.

Educational Aspects

In the past, studies have given considerable attention to the general intellectual functioning of epileptics and, to a lesser degree, to the specific aspects of their cognition. What has been lacking, however, is an understanding of how these might relate to formal learning in the child with epilepsy. Reports of levels of attainment in basic school subjects in epileptics in regular classrooms suggest some degree of academic retardation, but comparatively little is known about this (Ives, 1970). Little research has been conducted relative either to the educational achievement of these children or to the variables that may affect their ability to achieve. Although the issues revolving around the epileptic child in the regular classroom have been much discussed, these discussions have been more related to the management of the child in the classroom rather than upon the specific factors which might influence his academic success

or failure. Generally, information has been gathered through observation and questionnaires.

Fifty epileptic children were selected at random by Price (1956) to investigate appropriate placement in the regular school. Information obtained from the patient, his family, persons responsible for him, and from the attending physician was the basis for his study. Variables involved in the investigation were age distribution, etiology, classification of epilepsy, type of attack, frequency of seizures, and intelligence. In reporting the results Price indicated that the estimated ability of the epileptic child to perform school work is similar to that of the average school student.

Harlin (1965) reported on 200 known epileptics in the Seattle School System. Roughly two thirds of these children had scores in the normal IQ range. One third was below average and six were clearly superior. In some cases poor performance seemed related to side effects from medication, and in others low academic achievement was also found among non-epileptic siblings. Thus, a specific cause-effect relationship between epilepsy and low achievement could not be concluded.

Neither Price nor Harlin presented data concerning the educational level of the children involved in their studies. Tenny (1955), however, summarized the academic placement and progress in school of the children in his study, which was reviewed earlier, as follows:

1. Of 734 pupils for whom data were clear, 67% were retarded one grade or more at admittance to the special school.
2. Over 62% of 195 children entering kindergarten or first grade were retarded in grade placement.
3. Although intellectual retardation was a contributing factor in grade placement, pupils of normal intelligence and above were likewise retarded in grade placement.
4. In addition to initial retardation in grade placement, almost 60% of the pupils failed one-half or more grades during their stay at the special school.
5. Achievement test scores revealed a retardation somewhat greater than that indicated by actual grade placement and progress.
6. A comparison of achievement test ages and mental ages of 540 pupils revealed that 50% of these pupils had academic achievement below the expected average for their mental ages, while only 32% achieved above the expected average for their mental ages.

7. On final achievement tests of 417 pupils, 60% achieved below the expected average for their mental ages and only 22.5% above the expected average for their mental ages.

Tenny concluded that academic achievement and progress of this group of epileptic children was below that expected of children in general. This held true after the influence of variations in intelligence had been eliminated, thus leading to the conclusion that epilepsy per se does interfere with normal academic achievement. It should be noted that the White School in Detroit where Tenny conducted this investigation was established for epileptic children whose adjustment to the regular school was considered unpromising. Tenny indicated that the findings would have been more conclusive if a cross section of all epileptic children could have been studied rather than just those from a special school.

It is clear that knowledge of the relationship between epilepsy and classroom performance is negligible. In view of the lack of any proven specificity of type of cognitive functioning which may characterize the disorder, intelligent program planning is next to impossible. Certainly the present state of our understanding does not permit us to conclude that epileptic children in any way constitute a homogeneous group with respect to cognitive dimensions for whom a specific special education approach might be appropriate.

Ives (1970) has suggested that it would be useful to question the effectiveness of Terman-Merrill and WISC testing of epileptic children and adopt Shapiro's (1951) approach to experimental work based on, for example, the Frostig Developmental Test of Visual Perception, the Illinois Test of Psycholinguistic Abilities, the Hiskey-Nebraska Test of Learning Aptitude, and the Leiter International Performance Scale findings. He concluded that in light of our lack of knowledge of the long term effects of various forms of epilepsy on cognition, there seems every reason to establish longitudinal diagnostic testing-teaching programs with epileptic children presenting a wide range of global IQ's. Further, it would seem necessary to start with descriptive-diagnostic psychological evaluations, although IQ's, standard scores, etc, would be obtained where possible.

In conclusion, a survey of the literature on the educational progress of epileptic children does not yield factual data with respect to the level of educational achievement in epileptics. Most studies that have been done were conducted with children in special schools which makes it appear that epileptic children are retarded in their progress in school. As has been recommended by Taylor (1970), "Future work must move into a situation where the measurements made upon the performance of epileptic children are much more intimately related to the tasks which the children are called upon to perform in the school room" (p. 668).

Summary of Intellectual Functioning

Psychological studies of epileptic children since 1924 have concentrated primarily on the IQ's of these children in different settings and under different conditions. The literature reviewed studies concerning (a) institutionalized and public school epileptics, (b) the effects of brain damage, (c) deterioration, (d) intellectual functioning related to other variables, (e) the structure of intelligence in epileptics, and (f) educational aspects. A summary of these studies is as follows:

1. Studies of the intelligence of epileptic children reported IQ's ranging from a mean of 65 to a mean of 113 and showed wide variation for different samples.
2. In general, children institutionalized for epilepsy evidenced lower IQ's than children remaining in communities.
3. Children with diagnosed organic deficiencies tended to have lower IQ's than children with epilepsy of unknown etiology.
4. Deterioration of IQ as a result of epilepsy is not well established. It appears that children with organic deficiencies, particularly those in institutions, tended to show a decrement in IQ over time.

5. Other variables affecting the IQ of epileptics have been studied. The only recurring findings are those which suggest greater cognitive impairment to be related to a symptomatic etiology, early onset, frequency of seizures, and possibly to degree of EEG abnormality. In the case of each of these factors it is likely that the relationships are due to a greater degree of brain damage having occurred earlier in the maturational process.
6. Of the specific cognitive functions studied, impairment of memory (as revealed through digit span and digit symbol tests), attention, and association deficits were frequently found among epileptics.
7. Academic retardation of epileptics has been noted in institutions and segregated settings where most of these studies have been conducted. No educational achievement studies of epileptics in regular schools have been reported.
8. Comprehensive studies of special psychological functions (other than digit span and digit symbol) have not been made with epileptic children.

Statement of the Problem

From a review of the literature it seems apparent that the major concern of psychologists in the past has been to evaluate epileptic children in terms of interindividual differences determined through the use of intelligence tests. Special education has moved in recent years from an emphasis on classification instruments, from labels, and from categorizing to a thorough analysis of the functioning of the individual by assessment of intraindividual differences. The latter approach lends itself to the organization of an educational program. It is necessary, therefore, that epileptics be studied from a psycholinguistic point of view in order to assess intraindividual differences.

In the earlier review, Halstead (1957) found that epileptics were inferior to controls in IQ, oral reading, oral arithmetic, and in psychomotor ability. The approach of Halstead in studying epileptic children, however, did not discover psychological abilities and disabilities of children with epilepsy.

What appears to be needed in the study of epileptic children is a comprehensive analysis of the linguistic, cognitive, memory, and perceptual functions of different kinds of epileptic children and to determine whether they differ significantly from a comparable group of non-epileptic

children. The Illinois Test of Psycholinguistic Abilities does tap many of these functions and will therefore be the major instrument used in this study.

CHAPTER III

THE ILLINOIS TEST OF PSYCHOLINGUISTIC ABILITIES: DEVELOPMENT AND RELATED RESEARCH

The literature cited in Chapter II reviewed studies with respect to the IQ's of epileptic children of different types and in different settings. It also showed a paucity of comprehensive studies of linguistic, cognitive, memory, and perceptual functions. A need for such an appraisal of different types of epileptics as compared with normals is indicated.

The Illinois Test of Psycholinguistic Abilities was selected as the assessment instrument to be used in this study for a number of reasons: (1) it includes tests of linguistic, cognitive, memory, and perceptual functions, (2) it has been standardized on the same population, (3) it was standardized on age levels required for this study, and (4) it provides an analysis of intraindividual differences. This chapter is devoted to a description of the Illinois Test of Psycholinguistic Abilities (ITPA) with a brief review of the literature relating to different clinical types of children.

The ITPA examines (1) channels of communication, (2) psycholinguistic processes, and (3) levels of organization

and consists of ten major subtests within these general areas.

The intent of each of these subtests can briefly be described as follows:

Auditory Reception: Assesses the child's ability to derive meaning from verbally presented material.

Visual Reception: Assesses the child's ability to gain meaning from visual symbols.

Auditory Association: Assesses the child's ability to relate concepts presented orally.

Visual Association: Assesses the child's ability to relate concepts presented visually.

Verbal Expression: Assesses the child's ability to express his own concepts vocally.

Manual Expression: Assesses the child's ability to express himself manually.

Grammatical Closure: Assesses the child's ability to make use of the redundancies of oral language in acquiring automatic habits for handling syntax and grammatical inflections.

Visual Closure: Assesses the child's ability to identify common objects from an incomplete visual presentation.

Auditory Sequential Memory: Assesses the child's ability to reproduce from memory sequences of digits increasing in length from two to eight digits.

Visual Sequential Memory: Assesses the child's ability to reproduce sequences of nonmeaningful figures from memory (Kirk and Kirk, 1971).

The ITPA was published as an experimental edition in 1961 and after five years of research was revised and restandardized in 1968. It was standardized on 962 children between the ages of two and ten.

The reliability of the ITPA is presented in Table 2 in terms of the internal consistency coefficients and in Table 3 with the stability coefficients over a five month period (Paraskevopoulos and Kirk, 1969).

Coefficients corrected for restricted intelligence range are presented in Table 2. Internal consistency reliability refers to consistency in results obtained throughout a test on a single administration. Thus, internal consistency refers to the homogeneity of items within a test, and, in doing so, may be considered a reflection of the extent to which items within the test measure the same function. The internal consistency coefficient was done with approximately 125 subjects in each age group.

Stability coefficients for the twelve subtests, the composite, and the psycholinguistic quotient are presented in Table 3. Stability reliability is determined in order to evaluate the extent to which test scores are stable over time; that is, how constant are the scores likely to be if the test is repeated after a specified time lapse. For the ITPA

Table 2. Internal Consistency Coefficients for the
Twelve ITPA Subtests and ITPA Composite by
Age Level*

ITPA Subtests	Corrected for Restricted Intelligence Range Age Level			
	6-7/7-1	7-7/8-1	8-7/9-1	9-7/10-1
<u>A. Main Subtest</u>				
Auditory Reception	.95	.95	.93	.90
Visual Reception	.93	.82	.86	.87
Auditory Association	.91	.89	.92	.89
Visual Association	.80	.89	.90	.91
Verbal Expression	.83	.86	.88	.86
Manual Expression	.89	.82	.84	.87
Grammatic Closure	.88	.89	.82	.80
Visual Closure	.69	.82	.83	.76
Auditory Sequential	.85	.92	.92	.95
Visual Sequential	.60	.80	.75	.83
<u>B. Composite</u>	.93	.94	.95	.96
<u>C. Supplementary</u>				
Auditory Closure	.80	.76	.45	.69
Sound Blending	.89	.95	.89	.90

* Source: Paraskevopoulos and Kirk, 1969

Table 3. Five-Month Stability Coefficients for the ITPA Scores for 4-Year-, 6-Year-, and 8 Year Old Children*

ITPA Subtests	Corrected for Restricted Intelligence		
	4-Year-Olds	6-Year-Olds	8-Year-Olds
<u>A. Main Subtests</u>			
Auditory Reception	.79	.63	.63
Visual Reception	.69	.56	.66
Auditory Association	.90	.86	.83
Visual Association	.75	.45	.67
Verbal Expression	.74	.63	.74
Manual Expression	.67	.70	.55
Grammatical Closure	.72	.78	.87
Visual Closure	.72	.70	.82
Auditory Sequential	.75	.86	.89
Visual Sequential	.71	.38	.28
<u>B. Composite</u>	.93	.87	.87
<u>C. Supplementary</u>			
Auditory Closure	.73	.71	.71
Sound Blending	.69	.42	.54
<u>D. Psycholinguistic Quotient</u>	.91	.87	.86

* Source: Paraskevopoulos and Kirk, 1969

stability study, a five to six month test-retest interval was selected by the authors on the assumption that a remedial program is usually of at least four to six months' duration.

The ITPA provides norms for psycholinguistic ages and standard scores for the total and for each subtest. In addition, it can be analyzed in terms of (1) channels of communication, (2) psycholinguistic processes, and (3) levels of organization.

Much research has followed from the development of the ITPA. In addition to psychometric studies of the reliability, validity, and factor structure of the ITPA subtests, there have been numerous studies on the special abilities and disabilities of different groups of children. The studies that will be summarized here relate to representative investigations relating to (a) speech disorders, (b) mental retardation, (c) mongoloid children, (d) cerebral-palsied children, and (e) children with visual and auditory handicaps.

Speech Disorders

Foster (1963), Hallom (1964), and Ferrier (1966) conducted independent studies on the relationship of subtests of the ITPA to articulation disorders among young school children. All three studies showed that this relationship

was at the automatic rather than at the representational level. Ferrier's graph, Figure 1, is reproduced here to show this relationship.

Children with articulatory speech defects show a deficiency in the integrational, or automatic, level with an additional deficiency in vocal encoding. From these studies it appears that the automatic level is more closely related to speech defect than is the representational or symbolic level.

Mental Retardation

A number of studies appear to indicate that mentally retarded children, too, have lower scores on tests at the automatic level than at the representational level. The deficits at the automatic level for both mongoloid and non-mongoloid children are demonstrated in Figure 2 from a study by McCarthy (1965) with young day-school children and in Figure 3 from a study by Wiseman (1965) with residential educable mentally retarded children. These findings are consistent with other findings that the mentally retarded are deficient in short-term memory.

In summarizing some of the studies on mental retardation, Bateman and Wetherell (1965) stated that there appears to be a typical profile for groups of retarded children whose IQ's are near or below 75. They reported the outstanding

Figure 1. Profile of Children with Articulation Disorders (N=40). Source: Ferrier, 1966

Figure 2. Profiles of Mongoloid and Nonmongoloid Children
Source: McCarthy, 1965

Figure 3. Pre- and Post-test Profiles of an Experimental Group of Educable Mentally Retarded Children
Source: Wiseman, 1965

feature to be a deficit in the entire automatic level as compared to the relative strength at the representational level.

Mongoloid Children

Two studies have been made of mongoloid children, one by Bilovsky and Share (1965) and one by McCarthy (1965). McCarthy compared thirty mongoloid with thirty nonmongoloid children in day-school classes for trainable mentally retarded children. She found that (a) the mongoloid children were clearly superior in motor encoding in relation to their other abilities and (b) the mongoloids were superior to the nonmongoloids in motor encoding. Figure 2 presents the psycholinguistic profiles of the mongoloid and non-mongoloid groups of the same CA and MA. Similar findings are obtained by Bilovsky and Share (1965). While they did not compare the mongoloid children with normals, they found that the mongoloid children were superior in motor encoding in comparison with their other abilities.

Cerebral Palsy

McCarthy (1957) compared athetoid and spastic cerebral-palsied children on the Sievers Language Facility Test. His major findings included a superiority of spastic children over athetoid children on tasks at the automatic level. The athetoids were inferior to their other abilities on the automatic tests. Meyers (1963) conducted a similar

study with the ITPA but used a normal group for a control. The results of her experiment are presented in Figure 4. It will be noted from Figure 4 that the normal group profile is a straight line similar to that of the standardization group. Both the athetoid and spastics were below the normal group on all subtests. The spastics show lower abilities than the athetoids on tests at the representational level but show a superiority to the athetoids at the automatic level.

Dillon (1966) compared cerebral-palsied and non-involved children on the ITPA using twenty-five pairs of children matched for intelligence, age, and sex. As in Meyer's study, the cerebral-palsied children were significantly inferior to the noncerebral-palsied children on all subtests of the ITPA.

Children with Sensory Handicaps

Bateman (1963) studied the psycholinguistic and reading functions of 131 children enrolled in twenty classes for the partially seeing in Illinois. She found that children classified as legally blind tested below the standardization population on the visual subjects. In classes for the partially seeing those children who had visual acuity greater than 20/200 showed no significant inferiority on the tests utilizing the visual-motor channel as compared with their auditory-vocal abilities. Bateman concluded that with mild and moderate visual handicaps, the ITPA measures central

Figure 4. Profiles of Spastic and Athetoid Children
Source: Meyers, 1963

rather than peripheral processes, and that mild visual defects do not affect scores on ITPA subtests using the visual modality.

Olson (1960), Hamlin (1962), and Reichstein (1963), studied the effects of hearing loss on children's responses using the ITPA. Olson compared children diagnosed clinically as receptive-aphasic, expressive-aphasic, and deaf. His results showed that the ITPA discriminates these three groups of handicapped children with communication disorders. Profiles of the deaf and the receptive-aphasic children were each consistent within their own groups. Those children diagnosed as expressive-aphasic, however, did not present a stable profile. They appeared to be not a homogeneous group but, rather, to have a wide assortment of disabilities and abilities as measured by the ITPA. The deaf were superior to the receptive-aphasic group on the Visual-Motor Association Test and on some of the auditory tests.

Hamlin tested twenty-nine students attending the Kansas School for the Deaf. She found a negative correlation between the ITPA total score and the degree of hearing loss; i.e., the greater the hearing loss, the lower the score on the ITPA. Although the children in this study were twelve years old (above the age for the norms of the ITPA) and their scores on the visual tests were at the top of the norms, their auditory-channel test scores ranged from language ages of two to four years.

Reichstein administered the ITPA to twenty-four hard-of-hearing children and twenty-four receptive-aphasic children four and a half to six and a half years of age and of approximately the same IQ. In this study the hard-of-hearing group was significantly superior to the receptive-aphasic group on all auditory and visual tests except Visual Sequential Memory and Motor Encoding. These findings on hard-of-hearing and receptive-aphasics parallel those of Olson's on deaf and receptive-aphasics.

Summary

The Illinois Test of Psycholinguistic Abilities is an individually administered test which measures a number of independent psycholinguistic dimensions. It is sufficiently reliable and appropriate for use with young children. Through its use differences have been found to exist among many clinical groups of children when compared with normals.

CHAPTER IV

PURPOSE AND PROCEDURES

The purpose of this investigation is to study the linguistic, cognitive, memory, and perceptual functions of a group of petit mal epileptic children and a group of children evidencing mixed epileptic seizures to determine whether any differences exist when these two groups are compared with each other or with a comparable group of non-epileptic children of average intelligence.

While the global intelligence tests and some psychological functions of epileptics have been of focal interest to researchers, there have been few studies related to the nature of the psychological functions of epileptics and no studies that have utilized the Illinois Test of Psycholinguistic Abilities (ITPA). Little data related to educational and psycholinguistic characteristics exist relative to the epileptic population in general or within specific types of epilepsy.

Hypotheses

Hypothesis 1

There will be no significant differences between the epileptic groups and the normal contrast group on the raw scores of the subtests of the ITPA.

Hypothesis 2

There will be no significant differences between the petit mal epileptics and the mixed epileptic group on the mean scaled score, psycholinguistic age, or psycholinguistic quotient as measured by the ITPA.

Hypothesis 3

There will be no significant differences between the petit mal epileptics and the mixed epileptic group on the scaled scores of the subtests of the ITPA.

Hypothesis 4

As a corollary of Hypothesis 3 there will be no significant differences between the petit mal epileptics and the mixed epileptic group on the scores for the channels, levels, and processes of the ITPA.

Hypothesis 5

The prevalence of developmental discrepancies in epileptic subjects will be similar to the normal contrast group.

Design of the Study

As indicated earlier there exist many kinds of epilepsy. Through consultations with neurologists it was decided that this research would confine itself to a study of two groups of children with generalized seizures-one with

minor motor seizures of purely defined petit mal epilepsy, and another with major motor seizures which will be referred to hereafter as the mixed seizure group. Instead of testing a small group of normal children for a control group, it was felt that a more representative contrast group could be obtained from a random selection of subjects from the pool of scores on the 962 normal children as set forth in Paraskevopoulos and Kirk (1969, pp. 228-243) which constitute the standardization population for the ITPA. The study, then, would consist of three groups; (1) a group of children with purely defined petit mal epilepsy, (2) a group of children with mixed epileptic seizures, and (3) a group of non-epileptic children equivalent with respect to age, sex, and intelligence.

Selection of Subjects

Criteria for Subjects

The criteria for the selection of the (1) petit mal group, (2) mixed seizure group, and (3) contrast group will be discussed first, followed by the problems encountered in the acquisition of subjects.

Two groups of experimental subjects were to be selected. The first group was to be composed of children diagnosed as having purely defined petit mal epilepsy. Their EEG records must manifest paroxysmal bisynchronous spike and wave

at 3 cycles per second. In addition, all children in this group must have had clinically observed petit mal seizures known as absence.

The second experimental group was to be made up of children with major motor seizures and is to be referred to as the mixed group. These children must have manifested an EEG abnormality of the spike, polyspike, and paroxysmal activity type but not necessarily bisynchronous. In all cases the child must have had observed or clinically recorded grand mal or myclonic seizures.

In addition to the specified EEG and clinical criteria, all epileptic subjects had to meet the following requirements:

1. All subjects had to be of the ages three through nine.
2. Mentally defective or extremely superior children were to be excluded.
3. In addition to the EEG record of abnormality and the observed clinical seizure, all subjects must have had a confirmed diagnosis by a neurologist.
4. All children were to be on medication to control their seizures.

A contrast group equivalent with respect to age, sex, and intelligence was to be randomly selected from the scores

of the children who constituted the ITPA standardization population.

Acquisition of Subjects

The task of finding purely defined petit mal epileptic children and the subjects for the mixed seizure group proved to be very difficult due to the scarcity of cases that would meet the criteria established for this study. To acquire the necessary subjects the investigator first approached neurologists in her home community of Tucson, Arizona. Because Tucson did not have an epileptic center, and since neurologists found it time consuming and difficult to trace among their epileptic patients the children that conformed to the criteria for this research, it was impractical to locate the subjects locally.

The investigator then contacted the heads of major neurological and medical centers in Los Angeles and San Francisco, California to determine whether a sufficient number of epileptic children appropriate for the study could be located readily and tested. In every case willingness to cooperate was extended; however, it appeared that retrieval of these patients would have required full time clerical assistance for several weeks without assurance that the requisite number of subjects could ultimately be obtained. Although the institutions contacted were confident that ample children could be found to fit the criteria for the mixed

seizure group, they expressed serious doubt that sufficient subjects with purely defined petit mal would be available. Four other major hospitals throughout the United States were contacted but it was found that their facilities could not accomodate the requirements of the study.

The investigator was then fortunate to discover at the Barrow Neurological Institute in Phoenix, Arizona under the direction of Dr. Josphe C. White a single source that could provide not only the entire mixed seizure group, but also a sufficient number of purely defined petit mal patients as well, all of whom satisfied the criteria established for the study. Through the outstanding cooperation and efforts of Dr. White and his staff it was possible to locate all but four subjects who were found through other sources.

Examination of Subjects

Each child in the experimental groups was individually administered the Illinois Test of Psycholinguistic Abilities by the investigator who was trained in its administration by the authors of the instrument. The investigator is a qualified school psychologist with extensive experience in ITPA administration and scoring. As a service to physicians whose patients were utilized as subjects, a report with a thorough analysis of the child's psycholinguistic development was provided. This service was extended to all

the children tested even though some were of necessity eliminated from the study when they failed to meet the established criteria.

Statistical Analysis

The statistical method to test hypotheses one, two, three, and four was a series of one-way analyses of variance with $\alpha = .05$. To test hypothesis five a table of cumulative percentage of average deviation was constructed for the experimental group and was compared with the 50 contrast children used in this study and with the ITPA standardization sample.

CHAPTER V

RESULTS

This chapter will report the results of the study in terms of (1) the characteristics of the subjects, (2) the comparison of the epileptics with the normal contrast group on each of the ten subtests of the ITPA, (3) the comparison of the petit mal epileptics and the mixed epileptic group on the mean scaled score, psycholinguistic age, and psycholinguistic quotient of the ITPA, (4) the comparison of the petit mal epileptics and the mixed epileptic group on the scaled scores of the subtests of the ITPA, (5) a comparison of the petit mal epileptics and the mixed epileptic group on the scores for the channels, levels, and processes of the ITPA, and (6) a comparison of the epileptic group with the contrast group and standardization sample in terms of developmental discrepancies.

Characteristics of the Children

Table 4 presents the data for the petit mal group, the mixed seizure group, and the contrast group with respect to age, sex distribution, and intelligence. It should be noted that while the intelligence of the epileptic groups is expressed in terms of a psycholinguistic quotient (PLQ) the intelligence of the contrast group is reported as an IQ.

However, the PLQ is comparable in nature to a ratio IQ; Huizinga (1973) found a correlation of .90 between the Stanford-Binet IQ and the ITPA PLQ in his study with six-year-old children. It can be seen from the table that the petit mal group, the mixed group, and the contrast group all have PLQ's or IQ's within the average range. To meet the intellectual criteria established for this research, it was necessary to exclude from the study seven children who had been tested and had been found to be mentally retarded. Six of these children had been diagnosed as having mixed seizures, while only one was from the petit mal group. In addition, one patient manifesting mixed seizures produced a PLQ of 140. This child also did not meet the requirements for inclusion in the study.

Epileptics Compared with the
Normal Contrast Group

Table 5 presents the data on the results of the analysis of variance between the 50 epileptic children and the 50 contrast subjects on all ten subtests of the ITPA. It will be noted from Table 5 that analysis of variance yielded no differences between the combined epileptic groups and the contrast group on the raw scores for any of the ten subtests of the ITPA and that the hypothesis of no significant differences is maintained. In contrast to the other studies of clinical types of handicapped children reviewed in Chapter III, there is no indication in the present results that

Table 5. Anova Yielded no Differences Between the Combined Epileptic Groups and the Contrast Group on the Raw Scores for Each of the Ten Subtests of the ITPA

Subtest	Groups				F ratio	P
	Epileptics n=50		Contrast n=50			
	$\bar{X}$	SD	$\bar{X}$	SD		
Auditory Reception	28	9	30	9	1.825	.18 ns
Visual Reception	22	7	22	8	.222	.64 ns
Auditory Association	23	8	26	8	3.002	.09 ns
Visual Association	21	7	23	8	2.188	.14 ns
Verbal Expression	26	8	26	11	.007	.93 ns
Manual Expression	24	6	24	7	.206	.65 ns
Grammatic Closure	20	8	22	7	1.023	.31 ns
Visual Closure	24	9	25	9	.645	.42 ns
Auditory Sequential Memory	24	9	25	10	.330	.57 ns
Visual Sequential Memory	18	6	18	6	.003	.96 ns

epileptic children differ in any way on any of the ten subtests of the ITPA.

Petit Mal Epileptics Compared with the
Mixed Epileptic Group on the Mean Scaled Scores,
Psycholinguistic Age, and Psycholinguistic Quotient

In Table 6 global scores are presented for the petit mal epileptics and the mixed epileptic group including the mean scaled score, psycholinguistic age, and psycholinguistic quotient. It is obvious from the results of the analysis of variance that there are no significant differences on any of these scores confirming the null hypothesis of no differences between the petit mal and mixed epileptic children.

Petit Mal Epileptics Compared with the
Mixed Epileptic Group on the
Ten Subtests of the ITPA

Table 7 presents the mean scaled scores of the 22 petit mal epileptic children and the 28 children from the mixed seizure group for each of the ten subtests of the ITPA. It will be noted from these scaled scores that the means revolve around the standardization population mean of 36 for both groups indicating relatively normal development in all psycholinguistic functions within these groups of epileptic children. The F ratios resulting from the analysis of variance for the petit mal and mixed groups were nonsignificant for every test thereby sustaining hypothesis 3 that there is no difference between these two groups on the psychological functions measured by the ITPA.

Table 6. Anova Yielded no Differences Between the Petit Mal and the Mixed Epileptic Group in the Mean Scaled Score, Psycholinguistic Age, or Psycholinguistic Quotient on the ITPA

	Groups				F ratio	P	
	Petit Mal n=22		Mixed n=28				
	$\bar{X}$	SD	$\bar{X}$	SD			
Mean Scaled Score	35	3	35	3	.007	.93	ns
Psycholinguistic Age	87	16	82	24	.795	.38	ns
Psycholinguistic Quotient	97	9	97	9	.017	.90	ns

Table 7. Anova Yielded no Differences Between the Petit Mal and the Mixed Epileptic Group on the Scaled Scores for the Ten Subtests of the ITPA

Subtest	Groups				F ratio	P
	Petit Mal n=22		Mixed n=28			
	$\bar{X}$	SD	$\bar{X}$	SD		
Auditory Reception	34	4	34	5	.002	.96 ns
Visual Reception	36	5	38	4	2.017	.16 ns
Auditory Association	33	7	32	7	.017	.90 ns
Visual Association	34	7	32	5	.943	.34 ns
Verbal Expression	36	5	36	6	.083	.77 ns
Manual Expression	37	5	36	5	1.215	.28 ns
Grammatic Closure	34	8	35	7	.453	.50 ns
Visual Closure	35	6	37	5	1.801	.19 ns
Auditory Sequential Memory	36	7	34	6	.815	.37 ns
Visual Sequential Memory	36	6	36	7	.002	.97 ns

Petit Mal Epileptics Compared with the
Mixed Epileptic Group on the Scores
for the Channels, Levels, and
Processes of the ITPA

This hypothesis was included as a corollary of the third hypothesis. Since an analysis of variance yielded no differences between the petit mal and the mixed seizure groups on the ten subtests of the ITPA, it was highly unlikely that differences would be found on the scores for the channels, levels, and processes. Since, however, the ITPA is often reported in these terms an analysis of variance was computed. The resultant F ratios are presented in Table 8 and are clearly nonsignificant thereby sustaining the hypothesis that there are no differences between the two experimental groups on the scores for the channels, levels, and processes of the ITPA.

Developmental Discrepancies

Table 9 presents the cumulative distribution for the 50 children in the epileptic groups, for the 50 subjects selected as a contrast group for the study, and the cumulative percentage for the 962 subjects of the ITPA standardization group (Paraskevopoulos and Kirk, 1969, p. 141). The average deviation is a measure of the extent of the discrepancies between abilities and disabilities in psycholinguistic functions. In a paper by Kirk and Elkins (1974) the authors indicated that an average deviation of 6.0 and above is

Table 8. Anova Yielded no Differences Between the Petit Mal and the Mixed Epileptic Group in the Channels, Levels, and Processes of the ITPA

	Groups				F	ration	P
	Petit $\bar{X}$	Mal n=22 SD	Mixed $\bar{X}$	n=28 SD			
Channels							
Auditory-Vocal	34	5	34	4	.001	.98	ns
Visual-Motor	36	3	36	3	.072	.79	ns
Levels							
Representational	35	4	35	3	.060	.81	ns
Automatic	35	4	36	4	.180	.68	ns
Processes							
Reception	35	4	36	4	.736	.40	ns
Association	33	6	32	5	.412	.52	ns
Expression	37	5	36	5	.188	.67	ns

Table 9. This Table of Cumulative Percentage of Average Deviation for the Epileptic Groups, Contrast Children, and ITPA Standardization Sample Indicates that All the Groups are Quite Similar

Average Deviation	Epileptic	Contrast	Standardization Sample
6.9 or more		100	98
6.8			98
6.7			97
6.6			97
6.5	100		96
6.4	98		96
6.3			95
6.2	94	96	95
6.1		94	94
6.0		92	93

considered to be indicative of a significant developmental discrepancy and that an average deviation of 6.6 and above, which includes 2 to 3% of the average population, is considered to be a definite developmental discrepancy (learning disability). From Table 9 it can be seen that the epileptic group as a whole does not show a larger proportion of children with developmental discrepancies as measured by the average deviation than does the contrast group and the standardization sample. It will be noted that at the average deviation of 6.2 and above there are 6% of the epileptics, 4% of the contrasts, and 5% of the total standardization population. At 6.6 there were no deviations among the epileptics, one among the contrasts, and 3% of the standardization population.

Summary of Results

The results obtained indicated:

1. There were no significant differences between the petit mal epileptics, the mixed seizure group, and the contrast group in age, sex, and intelligence.
2. When compared on the ten subtests of the ITPA there were no significant differences between the 50 epileptic children and the 50 subjects in normal contrast group on any of the ten subtests.

3. No significant differences were found between the 22 petit mal epileptic children and the 28 children in the mixed seizure group when they were compared for mean scaled score, psycholinguistic age, and psycholinguistic quotient.
4. In comparing the petit mal subjects with the mixed epileptic children on the ten subtests of the ITPA no significant differences were found.
5. Although it was obvious there would be no significant differences found among channels, levels, and processes these data were included as the ITPA is often reported in these terms. No differences were found between the two epileptic groups.
6. The frequencies of the average deviations were similar for the combined epileptic groups, the contrast group, and the standardization population thus indicating that epileptic children do not have a larger proportion of developmental discrepancies.

CHAPTER VI

SUMMARY AND CONCLUSIONS

The purpose of this investigation was to study the linguistic, cognitive, memory, and perceptual functions of a group of petit mal epileptic children and a group of children with mixed epileptic seizures to determine whether any differences exist when these two groups are compared with each other or with a comparable group of non-epileptic children of average intelligence.

Previous Research

A review of the literature concerning previous studies of epilepsy show:

1. Studies of the intelligence of epileptic children reported IQ's ranging from a mean of 65 to a mean of 113, and showed wide variation for different samples.
2. In general, children institutionalized for epilepsy evidenced lower IQ's than children remaining in communities.
3. Children with diagnosed organic deficiencies tended to have lower IQ's and tended to show a greater degree of deterioration

than children with epilepsy of unknown etiology.

4. Greater cognitive impairment appears to be related to a symptomatic etiology, early onset, frequency of seizures, and possibly to degree of EEG abnormality.
5. Impairment of memory and deficits in attention and association are reported in studies which assessed specific cognitive abilities.
6. No educational achievement studies of epileptics enrolled in regular grades have been reported.
7. Comprehensive studies of special psychological functions have not been made with epileptic children.

Procedure

1. Two groups of experimental subjects were selected. The first group was composed of children diagnosed as having purely defined petit mal epilepsy. Their EEG records manifested paroxysmal bisynchronous spike and wave activity at 3 cycles per second. In addition, all children in this group had clinically observed petit mal seizures known as absence.

The second experimental group was made up of children with major motor seizures and is referred to as the

mixed group. These children had manifested an EEG abnormality of the spike, polyspike, and paroxysmal activity type but not necessarily bisynchronous. In all cases the child had observed or clinically recorded grand mal or myclonic seizures.

In addition to the specified EEG and clinical criteria, all epileptic subjects met the following criteria; (a) all subjects had to be of ages three through nine; (b) mentally defective or extremely superior children were excluded; (c) in addition to the EEG record of abnormality and the observed clinical seizure, all subjects must have had a confirmed diagnosis by a neurologist; and (d) all children were to be on medication to control their seizures.

2. A contrast group was selected at random from a pool of scores on 962 normal children as set forth in Paraskevopoulos and Kirk (1969, pp. 228-243) which constituted the standardization population for the Illinois Test of Psycholinguistic Abilities (ITPA). In addition to being matched for sex, the subjects in the contrast group were selected to be approximately the same ages and intelligence as the experimental subjects.

3. The ITPA was individually administered to each child in the two experimental groups.

4. Using the scores from the ITPA the two epileptic groups were compared with each other. In the same way the combined epileptic groups were compared with the normal contrast group.

Results

The experimental groups were made up of 22 children with purely defined petit mal epilepsy and 28 children with mixed seizures. With the exception of four subjects obtained from other sources all experimental children were provided from the case load of the Barrow Neurological Institute, Phoenix, Arizona.

The relevant results of this study are:

1. There were no significant differences between the 50 epileptic children and the 50 subjects in the contrast group of average, non-epileptic children on any of the ten subtests of the ITPA.
2. There were no significant differences between the petit mal and the mixed seizure groups on the global scores (mean scaled score, psycholinguistic age, or psycholinguistic quotient) nor on any of the ten subtests of the ITPA.
3. There was no greater proportion of learning disabilities (discrepancies in psycholinguistic development) among the epileptic children than among the children in the contrast group.

Previous research had suggested the possibility that differences might exist with respect to global intelligence

between epileptic and non-epileptic children. This appeared to be especially true with epileptic children having brain damage. While this study did include children with brain damage, it restricted the range of intelligence in subjects used. For this reason it is not possible to draw conclusions concerning possible differences in general intellectual ability.

Earlier studies directed toward assessing more specific cognitive functions reported that epileptic children evidenced difficulty with memory tasks. No such deficit was found within the age and intelligence range sampled in the present investigation on the memory tests administered.

In examining dispersion of ability, researchers have asserted that children with epilepsy produce a greater scatter of scores. However, within the intellectual range of subjects examined in the present study there is no evidence to indicate greater dispersion among children with epilepsy.

Discussion and Implications

Despite previous research with the ITPA which had revealed differences between clinical groups of children and normals, and despite at least suggestive evidence of cognitive differences provided by studies of epileptics using more global measures of intelligence, this research has clearly failed to demonstrate any differences whatsoever

either between the two epileptic groups or between the combined epileptic groups and a normal contrast group in linguistic, cognitive, memory, or perceptual functions.

The question should be raised as to whether the groups of epileptic children used in this investigation are representative of all epileptic children who are under medication to control their seizures. Clearly it is not representative of the population of epileptic children who may be found in hospitals or institutions for the mentally retarded or for epileptics. By excluding mentally retarded epileptics it is felt that the subjects used in this study are representative of epileptic children in a community who are living at home, who are taking anticonvulsant drugs, and who are attending public schools.

On the basis of results obtained from this investigation it may be concluded that those subjects tested did not suffer any impairment in psychological abilities as a result of their epileptic involvement. Two explanations seem reasonable. The first is that while uncontrolled epilepsy might eventually result in psychological dysfunction, the effect of proper medication, such as was being provided for all the subjects in this research, serves to forestall any deterioration in cognitive, memory, or perceptual functions that might conceivably occur as a result of prolonged uncontrolled seizures.

The second possible explanation is that epilepsy per se does not operate to produce psychological dysfunction. The suggestion from previous research, much of which lacked in definition of the groups and/or in control of influencing variables, that cognitive dysfunctions may exist was simply not borne out with the use of experimentals and controls equivalent with respect to age and general intelligence.

The results of this study suggest that, at least for children whose seizures are under control, there exists no necessity for special educational provisions strictly on the basis of a diagnosis of epilepsy. It is possible, however, that in individual cases there may be psychological or educational dysfunctions which are unrelated to epilepsy but which would require special educational provisions. The present data would tend to negate the assumption that a child requires adaptive instruction merely on the basis of his being epileptic.

Suggestions for Future Research

While this study has been limited to children within the normal range of intelligence it is possible that epileptic children in the retarded range might show a particular pattern in their linguistic, cognitive, memory, or perceptual functions such as has been the case in studies of other retarded children. One suggested piece of research would be the study of the psycholinguistic functions of mentally retarded

epileptic children whose brain damage has been confirmed to determine whether this group has discrepancies in abilities.

Little research has been conducted which yields factual data with respect to the educational progress of the epileptic child in the regular school and with his level of academic achievement. In view of the fact that this research failed to identify any cognitive differences between epileptics in the normal range of intelligence and a contrast group of non-epileptic children, it would be of interest to ascertain whether or not epileptic children in the public school setting function in accordance with expectations based on their cognitive ability.

Although this study would contraindicate special teaching techniques for children with epilepsy, it did not include an evaluation of possible behavior maladjustments which may require special attention. In view of the prevalence of epilepsy and the frequency with which personality disorders are attributed to it, it is somewhat surprising to find that there are almost no adequate studies that attempt to assess the incidence of behavior disorders in children with this condition and to determine their influence on the social and educational adaptation of the epileptic child. Such a study might be very revealing.

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