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SLOW DEVELOPING NORMAL BOYS AS DISABLED READERS: A SPECULATIVE PILOT STUDY

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This article is being published with the hope it will prompt further research investigation by individuals with the necessary interest, expertise, and financial resource. The reader should exercise care in interpreting the importance of the results which are tentative pending further investigation.

The recognition, in American schools, that boys have greater reading disabilities than girls is not a new phenomenon.(24) Of special concern to many educators is the "normal, healthy, intelligent" boy who, despite ability, advantage, and potential, still becomes a disabled reader and school failure. Rough estimates place 15% of the school population in this category.(19) One functional definition specifies the problem as follows:

Any condition which causes an individual's school achievement to be substantially below his measured potential in spite of an average or above average intelligence, an absence of gross neurological disorders, and severe cultural deficit, and conventional instruction sufficient for the majority of children in the regular classroom.(19:92)

Can we determine the cause of the condition? In this pilot study, focus has been placed on a possible underlying cause of the reading disability problem: the discrepancy between maturation rates of boys and girls. Girls, generally, mature physiologically more rapidly than boys.(9) Educational practice in the United States has established six years as the usual age when boys and girls seriously begin to learn to read. Since girls mature at a faster pace than boys, the immature boy may have a "double disadvantage" competing with children of the same chronological age in the classroom.

REVIEW OF RECENT LITERATURE

Skeletal Age

Over the years, extended efforts have been directed at improving skeletal assessment, more accurate an indicator of physiological ma-

turity than age, height, and weight.(9) Johnston and Manson express the issue as follows:

It may be stated with some truth that the more experience one has in evaluating children's Readiness for School the wider one's concept of normal functional limits at each age becomes. Nonetheless, the inadequacy of chronological age as the basic criterion for the nebulous thing we call School Readiness remains impressive. (20:97)

The Cleveland Atlases are recognized as an excellent standard of reference in determination of bone age.(1) In the hand, fusion in distal phalanx II in the female occurs very near the date of menarche. (4, 13) Bilateral symmetrical development also occurs in the hand.(2)

There is a problem associated with skeletal assessment which involves comparison of an x-ray film of a child with a standard of reference x-ray film. Subjective rating and interpolation must be used. Skeletal age, or bone age, represents the arithmetical average of the ages of all the bones in which ossification has begun. Absence of a center is not acknowledged in computation of bone age since bones not present are rated 0. For this reason, individual bone ages formed the basis of the skeletal assessment in this pilot study. Since expert subjective ratings were desired, Dr. S. Idell Pyle supervised individual bone age assessments.

Expertise in bone age reading is necessary. Schoen, *et al.* (21) found the accuracy of radiologists' reading for bone age in short boys, particularly those without known disease, was not great. In more than 50% of these boys, bone age was usually delayed over two years behind chronological age.

A radiograph may well indicate a record of past illnesses and other "misadventures . . . and what is more important, a measure of the severity of their impact on the developing skeleton—itsself, quite probably a reflection of their impact on the total organism."(9:18-19) One of these indications is lines of arrested growth, or lines of increased density, running transversely across the shaft of the radius. These lines have been observed in children with severe nutritional disturbances and in children exposed to the bombing at Nagasaki and Hiroshima.(9) There is some controversy regarding the physiological mechanism in the deposition of bone in lines of increased density,(17) but little question exists that they represent evidence of disruption in the growth process. Garn *et al.* found, in an investigation of a normative American population, that lines of increased density on

the distal tibia in childhood are associated with episodes of disease, with trauma following minor surgery, and even with routine small-pox immunizations. Yet "in 10% of the cases, a new transverse line was observed on the distal tibia when neither disease nor trauma had been reported for the previous interval."(8:73)

Other aberrations which can be found on radiographs include notches, nicks, cartilaginous strips, and metaphyseal tags. Lee *et al.*, (13) in reviewing the Fels Growth Study radiographs, found no obvious relationship between degree of metacarpal notching and the stature of a child or rate of attaining physiological maturity.

Some relationship has been found between skeletal age and school achievement. In the age range of six and seven years, the slower maturation rate of boys, reflected in average Z scores for weight, height, grip strength, dentition, and carpal age accompanied low achievement in reading and arithmetic in a study by Klausmeuer.(12) Moutis,(18) in a longitudinal study of boys, ages 10 through 12 years, at Phillips Exeter Academy, found boys who were superior in standing height and skeletal age also scored consistently and significantly higher in scholastic achievement tests, academic grades, and grade point average. In contrast, little relationship existed between retarded, normal, and advanced skeletal age groups and scholastic and psychosocial variables in Sekeres(22) investigation of boys at ages nine, 12, 15, and 17.

WISC Test Scores and Reading Disability

Group intelligence tests which demand verbal abilities place the disabled reader at a considerable disadvantage. The Wechsler Intelligence Scale for Children (WISC), an individual intelligence test, consists of two scales: verbal and performance. The subtests in the verbal scale are vocabulary, information, comprehension, arithmetic, similarities, and digit span (forward and backward interpretation of numbers). Performance scale subtests include picture completion, picture arrangement, object assembly, block design (construction of color patterns to duplicate a given pattern), and coding (substitution of symbols for a given digit).

Since the early 1950's, a number of studies of the WISC subtest pattern scores of disabled readers have been published. Despite considerable difference in research design in the various investigations, general patterns have emerged. Besides the diagnostic value of delineating patterns, one purpose of studying patterns has been the attempt to ascertain whether low subtest scores are a symptom of the reading disability or an effect.(15)

Huelsman(10) reviewed 23 previous WISC subtest pattern studies for disabled readers. His findings indicated the disabled reader subtest pattern would include low scores on information, arithmetic, coding, and digit span; and a high score on picture completion. Also a high performance IQ score in relation to the verbal would appear in about 60% of the disabled readers.

Behavior Patterns

To what extent does academic failure affect the behavior of the disabled reader? Fabian,(7) in 1955, proposed that reading disability may be a clue to a personality disorder in an individual child. Barsky(3) investigated aggression scores in disabled readers using the Sears Aggression Scale, the Fels Revised Child Behavior Scale, and the Thematic Apperception Test. She found disabled male readers were higher in anti-social aggression than their matched female counterparts, and significantly higher in projected aggression than superior male readers.

PURPOSES OF THE PRESENT STUDY

The purposes of this pilot study were:

- I. To investigate the possibility that reading disability is associated with immaturity in developmental status in "normal, healthy, intelligent" boys.
- II. To design a research plan for clinical examination and assessment of the children involved. The following guidelines were established for the design:
 - A. The case study approach was followed so all aspects of development could be assessed.
 - B. Each aspect of the investigation was conducted by persons best qualified in that particular aspect:
 1. Physical "normalcy, health, well being" was based on the findings of a medical examination by the family physician.
 2. Intelligence was determined by scores on the WISC, an individual intelligence test, administered by qualified personnel.
 3. Reading and learning disability, and psychological, social, and emotional status were evaluated by clinical psychologists.
 4. Developmental status was determined through individual bone age readings in the hand and wrist. Radiographs were done in a medical clinic. Readings were supervised by Dr. S. Idell Pyle.

METHODS

The four boys, subjects of this pilot study, were referred to the Reading Center and Clinic at Western Michigan University in Kalamazoo, Michigan. One of the functions of the Clinic is to provide developmental and corrective instruction in reading for children and adults.

Clinic services are given to "normal, healthy" children who have a reading disability. The parents, teacher, child, and other representatives of the school system in which the child is enrolled are present at the Clinic the day the child is interviewed and tested. Procedures involve in-depth interviews with all these individuals. Family, developmental, and medical histories are reviewed. Personal-social relationships are carefully assessed. An individual intelligence test, diagnostic reading tests, and school achievement tests are administered to the child. In addition, personality measures and informal inventories are given, and observations recorded. Choice of tests depends on the child's problems and needs. Following this day of interviewing and testing, the staff of the Reading Center and Clinic reviews the case, submits a diagnosis of the problem to the parents and school authorities, and recommends procedures for improvement of the disability.

For the boys in this pilot investigation, additional procedures existed. A letter was sent to the parents explaining the purpose of the study and asking if they would be willing to participate. If the parents agreed, arrangements were made for the return of the boy to the Western Michigan University campus for x-ray filming of the hand and wrist at the Kalamazoo Radiological Laboratory. At least one parent accompanied the child and signed a medical release for the x-ray film so it could be sent to Dr. S. Idell Pyle at Case Western Reserve University Medical School for a bone age assessment reading. At this time, anthropometric measurements were made. The boy was weighed in shorts and T-shirt, without shoes; height and erect sitting height were also measured. Standards specified by Damon(6) were followed in measuring standing height; those of McCloy,(16) for sitting height.

DISCUSSION AND SUMMARY OF CASE STUDY REPORTS

Since most children referred to reading clinics are boys, and since boys mature physiologically more slowly than girls, could the "normal, healthy, intelligent" disabled reader be, in truth, a slow developing child? The results of the present study offer some slight evidence this could be so.

The skeletal assessments of each of the four boys in the present investigation showed that each of these disabled readers was physiologically immature. The boys' chronological ages were seven, 10, and 12 years. Anthropometric measurements did not indicate this developmental lag in two of the four boys. Carpal development was most immature for each boy.

Comparison of the x-ray of Ss 1 (Figure 3), age 7 years, 5 months, with the Standard of Reference Film for chronological age 36 months (Figure 1) and with the Standard of Reference Film for chronological age 84 months (Figure 2) shows striking carpal retardation. Ss 1 was in the "normal" range on the Pryor Height-Weight Tables, yet ossification is not evident in the epiphysis of the ulna, triquetral, scaphoid, trapezium, and trapezoid. The lunate has appeared in advance of the triquetral, otherwise onset of ossification is normal.

Bone age shows increasing maturity in a proximal-distal direction in the hand. The metacarpals range in bone age from 62 to 73 months; the proximal phalanges, from 76 to 84 months; and the middle phalanges, from 80 to 84 months. All distal phalanges are rated at 82 months of bone age. This pattern of retardation in bone development diminishing in a proximal-distal direction in the hand was characteristic of each of the four boys. Space limitations prevent inclusion of the other three x-rays with their appropriate Standard of Reference Films.

Lines of arrested growth similar to those observed in children with severe nutritional deficiencies and in children who have suffered episodes of disease and physical trauma can be observed in the x-ray of Ss 1 in the radius. These same lines appeared for Ss 2. Garn, (8:73) *et al.* reported that "in 10% of the cases studied, transverse lines appeared on the distal tibia when neither disease nor trauma had been reported for the previous interval." In the 37 studies Garn reviewed for the investigation, no findings were reported of a possible association between psychological problems and the appearance of transverse lines.

Other aberrations exist in the x-ray of Ss 1 (Figure 3). A deep notch is evident in metacarpal II; other notches are apparent in metacarpal V and middle phalanx V. Similar notches also appeared in the x-rays of Ss 2 and Ss 3. It should be recalled that Lee *et al.* found no obvious relationship between degree of metacarpal notching and the stature of a child or rate of attaining physiological maturity.

Finally, a cartilaginous strip which was a separate epiphysis can be seen in the x-ray of Ss 1 in metacarpal I. The only radiograph

free of notches, nicks, and epiphyseal damage was that of Ss 4 whose reading disability was of recent origin.

Each of the boys in the present investigation was judged to be physically "normal" on the basis of a medical examination by the family physician. Detailed neurological examinations were not given, but one could assume the family physician would have recommended neurological referral if indicated. Each physician was aware of the psychological manifestations accompanying the reading and school achievement disability of his patient.

Generally, with one exception, the developmental history of these four boys was uneventful. The seven year old boy had experienced rather severe trauma in the early years. His mother had confined him to a crib and had often left home. However, a positive relationship had been established recently with his stepmother. Basically the four boys were living in stable home situations at the time they were tested. All of the boys were Caucasian and from middle class homes. Two of the parents had completed 10th grade; all the rest were high school graduates.

Each of the four boys in this study was given the WISC. Two of the boys were in the normal range of intelligence (90-109); the other two were in the high average range (109-119). In some respects, WISC sub-pattern scores followed the general trend for disabled readers stated by Huelsman.(10) Performance scale scores were higher than verbal for the two boys who had been disabled readers throughout their school careers. Coding and digit span scores were below the mean of all three older boys. The subjects in this study did not follow the conventional disabled reader pattern in arithmetic, information, and picture completion scores. Ss 4, who had recently become a disabled reader, had a verbal scale score higher than the performance scale score. Ss 4's comprehension score was high: two standard deviations above the mean.

Visual-motor-perceptual performance as measured by the Bender Gestalt Test appears to be of greatest importance in reading in the first few years of school in terms of diagnosis, remediation, and prediction.(5, 14) Keough(11) found the Bender Gestalt score proved a good predictor of sixth grade reading ability. Eighty-two percent of the children identified as good or poor performers on the kindergarten Bender Gestalt Test were accurately identified in terms of being above or below grade level in achievement in reading at grade six. Silver(23) reported that reading ability improved with special reading instruction combined with visual-motor perceptual training

at age seven. Yet Connor,(5) in working with the same age group, found poor Bender performance in good readers as often as in poor readers and suggested a cautious approach. In this investigation, Ss 1, age seven, who was unable to read a word at all, had a low Bender Gestalt performance.

Three of the four subjects of the present investigation were conventional disabled readers with a history of learning problems going back to school entrance. Degree of disability was reflected in scores on the Detroit Reading Test: retardation ranged from 1.4 years to 2.9 years in grade placement. For two of the three, all school achievement was affected including spelling and arithmetic. A wide range of reading disabilities were found: lack of coordination, reading reversals, reading blocks, inability to remember what was read and heard, acute difficulty in articulation in reading, poor word attack skills, inability to understand reading as a thinking process, and lack of responsibility for school work.

The disabled reader has lived with failure. He has the impossible task of trying to keep up as he catches up in academic work. It is difficult to separate cause from effect and almost impossible to associate cause and effect. One fact is certain. Each of the boys in the present investigation had behavior deficiencies. Clinical investigation showed the problems for each of them were compounded in ways that were different for each and yet in some ways the same. Immaturity, social withdrawal as a "loner," aggressiveness, dependency, lethargy, disinterest, daydreaming, inattentiveness, verbosity, stuttering were the behaviors observed singularly and in various combinations. One apparently cannot live with failure and inadequacy in school achievement and survive unscathed.

IMPLICATIONS

For many years, reading teachers and researchers have intuitively proposed that the slower physiological developmental pace of boys may adversely affect their chances for success in schools. This investigation is a speculative pilot study, a preliminary report, of that problem. It offers some slight evidence that developmental immaturity may be associated with reading disability. Yet many important questions remain unanswered and must await more extensive investigation by researchers with the necessary financial resource and required expertise.

Would superior readers, male and female, show the same patterns of ossification, aberration, and degree of skeletal immaturity? What

would the data reveal for the disabled female reader? Do all boys who are disabled readers have the same deviations in wrist-hand-bone age? Can disabled readers be classified as a group or must we study children on an individual basis? What is the importance and predictive validity of the Bender Gestalt Test? What degree of variability and asynchronous development can be tolerated in the "normal range" of development—how does one account for a child who has high average intelligence combined with total disability in a psychomotor skill like reading?

Reading disability is a complex phenomenon usually attributed to many various causative factors(19) like developmental lag and immaturity; neurological impairment; nutritional and chemical imbalance; experiential deficit; genetic variation; sensory loss and others. What is the importance and contribution of developmental immaturity to the disabled reader "syndrome"? It is this investigator's hope and belief that further research will be pursued so that positive answers to these questions will be forthcoming.

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X-RAYS

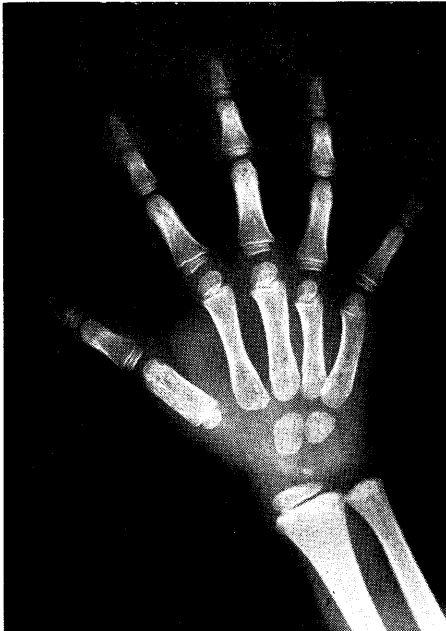
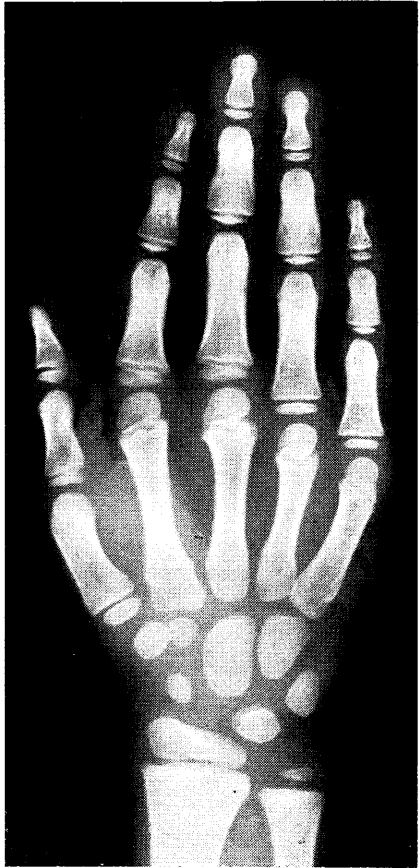
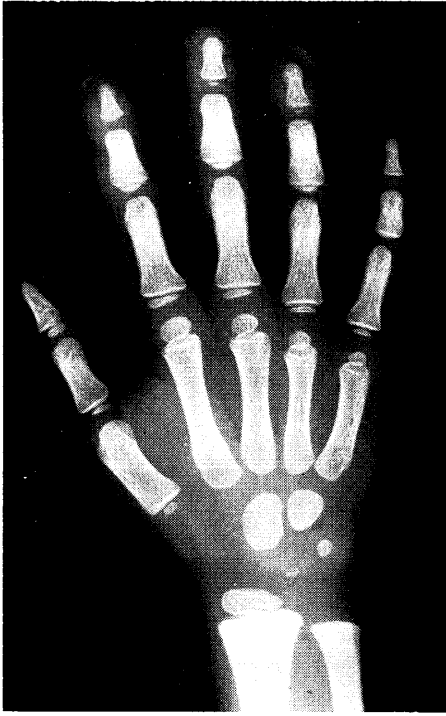


Figure 1: Standard of Reference Film of the Hand and Wrist for 36 Months of Age in the Male

Figure 2: Standard of Reference Film of the Hand and Wrist for 84 Months of Age in the Male

Figure 3: X-ray of the Hand and Wrist of Sub #1 (Ss 1), age 89 Months.

The Standard of Reference Films : from Pyle, S. Idell; Waterhouse, Al M.; and Greulich, William Walter. *Radiographic Reference for the Growing Hand and Wrist* (1970). Plates #7 and #13.

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