Intelligence (IQ) Testing

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Objectives

After completing this article, readers should be able to:

1. **Define intelligence quotient (IQ) and what constitutes the "normal" range of IQ scores.**
2. **Describe the predictive validity of intelligence test scores.**
3. **Discuss the factors that may influence performance on intelligence tests.**
4. **Recognize the relationship between variability observed in factor scores and the probability of the child having a learning or cognitive disability.**
5. **Describe how achievement tests are used in conjunction with IQ tests to determine eligibility for a learning disability.**

Introduction

Intelligence tests assess a person's mental abilities and compare them with the abilities of other people through the use of numerical scores. Although the term intelligence is used as if there is agreement on what it means, in reality there is much debate as to how this term should be and has been defined. For example, debate has surrounded whether intelligence should be considered an inherent cognitive capacity, an achieved level of performance, or a qualitative construct that cannot be measured. Psychologists have debated whether intelligence is learned or inherited, culturally specific or universal, and one ability or several abilities. While these debates are ongoing, evidence is increasing that traditional intelligence tests measure specific forms of cognitive ability that are predictive of school functioning, but do not measure the many forms of intelligence that are beyond these more specific skills, such as music, art, and interpersonal and intrapersonal abilities. (1) Despite these debates, most experts view intelligence as a person's problem-solving abilities, such as adapting to the environment and having vocabulary skills, higher-order thinking (eg, decision making, reasoning skills, verbal and nonverbal problem-solving skills), memory, and mental speed. More specifically, for the purpose of this article, intelligence is discussed as it relates to a child's score on the intelligence (IQ or "intelligence quotient") tests that are used most commonly to measure a person's intelligence for educational planning or neuropsychological assessment.

Intelligence Tests

Efforts to measure intelligence have long been a part of psychology, and despite controversy over the meaning and scope of intelligence, an IQ score can provide meaningful data about a child's cognitive abilities if put within a conceptual framework that does not overstate its meaning or implications for the child. Intelligence tests are the most studied and, consequently, the most reliable, valid, and useful tests available for measuring specific cognitive abilities. Within a particular IQ test, children tend to perform the same on items designed to assess the same ability, which suggests internal consistency. The tests are reliable because children generally receive the same score when they retake the same test years later, although the reliability of the test usually increases with the age of the child. Test validity is based on numerous studies that have found high correlations between children's IQ scores and their performance in school, achievement tests, and tests of specific intellectual functioning (eg, measures of language, visual motor processing).

An IQ score reflects a child's performance on an intelligence test relative to that of children of the same age. In short, a child's IQ score tells the extent to which his or her

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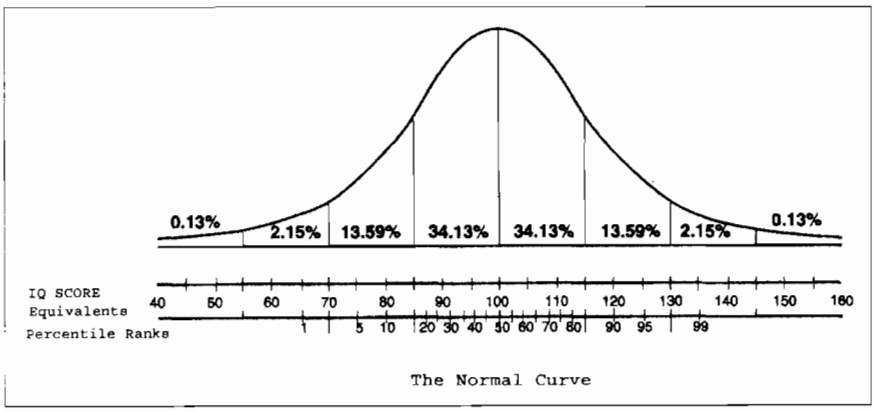

Figure. Classification ratings for IQ ranges as they are distributed along the normal curve.

performance on the test departs from average. The IQ score represents a construct of "intelligence" that includes a combination of verbal and nonverbal processing skills, such as vocabulary, information about the world, reasoning, short-term memory, and speed of information processing; these skills, together, are represented by the IQ score. Nearly all comprehensive psychological evaluations include some measure of intelligence. For example, for a child who is being tested to confirm a diagnosis of attention-deficit/hyperactivity disorder (ADHD), an intelligence test can confirm that the child's academic difficulties do not indicate a specific cognitive weakness or mild mental retardation.

Most intelligence tests assess a range of verbal, visual-spatial, and problem-solving skills. Because they target multiple cognitive skills, IQ tests are composed of subtests that measure specific areas of functioning. Scores on these subtests are combined to yield measures of verbal and nonverbal problem-solving abilities, as well as a full-scale IQ score. IQ scores are assumed to be normally distributed in the population, with most scores falling in the middle of the distribution and fewer scores falling at the upper and lower extremes (Figure). The average IQ score on most IQ tests is 100, with a standard deviation of 15. Most IQ scores (about 68%) fall within 1 standard deviation on either side of the mean (eg, between 85 and 115), and almost all scores (99% of population) fall within 3 standard deviations above or below the mean.

School-age children most frequently are tested with the Wechsler Intelligence Scale for Children–Fourth Edition (WISC-IV). The Wechsler Adult Intelligence Scale, Third Edition (WAIS-III) is the test used most frequently for adolescents ages 16 and older. The Wechsler Preschool and Primary Scale of Intelligence – Third Edition (WPPSI-III) is used most frequently to test children ages 2½ to 6 years of age. Each of these tests is composed of subtests that measure a variety of domains. The WISC-IV contains 15 subtests that are divided into 10 core subtests and 5 supplemental (ie, optional) subtests, which form four composites scales (referred to as "factor scores"): Verbal Comprehension (verbal knowledge and the ability to use verbal skills in new situations), Perceptual Organization (the ability to think about and organize visual material without the use of words), Working Memory (the ability to hold information in memory to manipulate it or perform calculations with it), and Processing Speed (the speed at which one can process simple visual information without making errors). The Table lists the WISC-IV subtests and factor scores. Although there are tests of infant "intelligence," such as the Bayley Scales of Infant Development, most tests for children younger than age 3 years measure abilities, such as sensorimotor development and early language skills, which are not highly correlated with later IQ.

Predictive Validity of IQ

Intelligence tests are reasonably accurate at predicting which children will be successful in school and which will

WISC-IV Factors and Subtests

Verbal Comprehension Factor

Perceptual Reasoning Factor

Working Memory Factor

Processing Speed Factor

have difficulty, with correlations between intelligence tests and measures of educational achievement averaging about 0.50. Thus, IQ tests are one of the best single indices of how well a child will do in school. However, IQ test scores are not the sole predictive factor of how a person will perform in school and are not the definitive indication of how a person eventually will function in society because other variables, such as intellectual domains not measured by a specific test, parenting, quality of schooling, motivation, and exposure to culture and books, also are important determinants of success in life. Research has shown that IQ constancy increases with age, although correlations tend to be slightly higher for elementary students than for high school or college students. Generally, the correlations with educational achievement and IQ are highest for verbal subjects, such as reading. In contrast, the predictive power of IQ test scores before the first birthday are not very strong for children who fall in the average to superior range, (2) but the tests are fairly predictive (ranging in studies from 0.50 to 0.97) for children assessed at lower IQ levels (ie, below IQs of 50). (3)

Overall, the general rule of thumb is that the older the child, the more stable the IQ. By age 4 years, the correlation with IQ 12 years later is relatively high (r=0.77). (2) Although many older children show little fluctuation in their IQ scores, research has indicated that a subset of younger children show wide fluctuation in IQ scores. Finally, even older children may show some fluctuations in scores in response to major stressors such as a loss of a parent, divorce, or change in schools. With these possible exceptions, by around age 10 years, IQ scores generally are relatively stable.

Factors That Influence Performance on IQ Tests

IQ is influenced by genetic factors (eg, the child's genetic makeup), familial factors (eg, parents' IQs and education and quality of the home environment), educational factors (eg, quality of educational opportunities and teaching), and other factors, such as the community in which the child lives. Environmental influences on the development of intelligence include access to stimulating or enriching experiences, caregivers who help the child learn problem-solving skills, access to books and sources of knowledge, good nutrition, a high level of social support, parental involvement in the child's learning and education, an enriched language environment, good school attendance, good schools, and stable neighborhoods. (4)

Cultural and ethnic differences in performance on intelligence tests also have been documented. For example, studies have indicated that the average scores on standardized intelligence tests of children from African-American and Latino families often are below those of children from Caucasian families. However, the available data do not support a genetic interpretation; (5) rather, the differences likely reflect a cultural or language bias.

In addition to innate and background factors, an almost limitless list of intervening variables can affect a child's performance on an IQ test. A qualified test administrator attempts to minimize such variables as much as possible, but influencing factors can include the location of the evaluation (eg, noisy office), previous testing experiences that may result in practice effects, the examiner-examinee interaction, a negative stance on the part of the child, peer-group pressure to fail, or poor motivation. Other causes of poor performance can include limited hearing or visual acuity, a lack of proficiency with the English language, situational stressors, poor attentional skills, or acute emotional difficulties such as depression or anxiety.

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Discrepancies in IQ Test Score Patterns

In general, children's factor scores on the WISC-IV should be fairly similar; the more variability observed in factor scores, the higher the probability that the child has a learning or cognitive disability. Previous versions of the WISC provided verbal and performance IQ scores in addition to a full-scale IQ. Differences greater than 15 points between a child's verbal comprehension and perceptual reasoning scores are worthy of an explanation and may be cause for concern because many learning disabilities result in large verbal-performance splits on IQ tests. For example, many children who have dyslexia have lower verbal abilities compared with nonverbal abilities because dyslexia is a verbally based learning disability.

Children who have nonverbal learning disabilities, by definition, have lower perceptual reasoning scores compared with verbal comprehension abilities and frequently have significantly weak processing speed scores, as well. However, even a 15-point difference does not necessarily indicate the presence of a learning disability. This is because differences in styles of thinking and learning are common and often are reflected in a child's pattern of IQ scores, such as in the case of a child who has superior intellect and has a verbal comprehension index of 140 and a perceptual reasoning index of 120. That said, if an extremely large (>25-point) verbal comprehension-perceptual reasoning split is present, and if one of these scores is below the average range, psychologists frequently refer the child to a neurologist or to a developmental pediatrician to rule out the possibility of neurologic impairment. Even if the difference between a child's factor scores on an IQ test is large, the discrepancy should not be used alone to make a diagnosis of a learning disability or to predict brain functioning without substantial support from other test data and observations. Finally, when the differences between a child's WISC-IV factor scores are significant, the full-scale IQ may not be a valid measure of the child's level of overall intellectual functioning because the IQ may represent a forced "average" of very disparate skills.

Comparisons of IQs with tests of academic achievement frequently are used in diagnosing specific learning disabilities.

Using Intelligence Tests to Evaluate Learning Disabilities

To evaluate specific learning disabilities, such as a reading disorder, disorder of written expression, or math disability, IQ tests typically are used in conjunction with achievement tests. Achievement tests are designed to measure what a child has actually learned, including mathematical problem-solving, reading, spelling, writing, or an understanding of science concepts. Most achievement tests focus on a particular subject and measure a child's learning with questions of varying difficulty. The child's score then either is compared with that of a child of the same age or grade or measured against an objective standard. When used to diagnose a specific learning disability, a child's academic achievement in one or more areas is compared with his or her intellectual abilities. If a child's ability in one or more areas of achievement, as measured on standardized tests, is significantly lower than expectations based on age, education, and intelligence, the probability is high that a learning disability exists. However, these difficulties also must impede the child's ability in academic achievement or activities of daily living. Also, if the child has a sensory deficit, such as in visual perception, memory, or attention, the difficulties in math or writing need to be worse than what would be expected with the sensory deficit alone. For example, if a child who has ADHD has problems with math, the math difficulties must be worse than what would be expected from a child who has attentional difficulties. Thus, although IQ and achievement tests are used frequently to diagnose a learning disability, a simple discrepancy is not sufficient to make the diagnosis because other issues need to be eliminated.

In addition, the lack of a discrepancy is not necessarily an indication that a learning disability does *not* exist. This is particularly true for the young child who may exhibit early signs of a learning disability, but who does not yet lag behind to the extent that a discrepancy exists. In these cases, the pattern of scores on relevant tests (eg, reading fluency, phonics skills, reading comprehension, prereading skills) becomes primary in the diagnosis of a learning disability. Because current federal law recognizes the shortcomings of a discrepancy approach in determining a learning disability, school districts are not bound by the discrepancy criteria before children are found to be eligible for special education services. However, current law also states that the lack of achievement must not be due to mental retardation; a visual, hearing, or motor impairment; emotional disturbance; or environmental disadvantage. Thus, intelligence tests typically are given to rule out the possibility that a cognitive deficit underlies the child's difficulties with academic skills.

Summary

Intelligence is a multifaceted construct that, for the purposes of this review, is operationalized as the standard IQ tests (eg, Wechsler Scales) used by schools and psychologists to measure cognitive functioning in a formal environment. Intelligence scores predict the ease with