MEASUREMENT OF INTELLIGENCE AND USES OF INTELLIGENCE TESTS

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by

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What is intelligence?

- A loaded question . . .
- Ability to understand, reason and perceive ; quickness in learning; mental alertness; ability to grasp relationships etc
- Buddhi, pratibha, prajna, medha, dhi,chaturya are terms used in Indian context
- The capacity to profit from experience and to go beyond the given

- Intelligence is what intelligence test measures(Alfred Binet,1904)
- The ability to judge well, to understand well and to reason well (Binet & Simon,1905)
- ***The aggregate capacity of the individual to act purposefully, to think rationally and to deal effectively with the environment(David Wechsler,1939)***
- The ability or skill to solve problems or fashion products which are valued within one or more cultural settings(Howard Gardner,1986)

- Intelligence comprises the mental abilities necessary for adaptation to, as well as shaping and selection of, any environmental context (Robert Sternberg,1997)

Some Classical Theories of Intelligence

Thorndike (1911) proposed that there are four types of intelligence viz,

- comprehension,
- arithmetic,
- vocabulary and
- ability to follow direction

Spearman's two-factor theory

- Intellectual ability consists of two factors " g" factor and "s" factor
- General factor is universal in nature, found in all humans. It is the innate ability acquired at birth through heredity
- Specific factor determines individual differences which is unique to individuals
- e. g clerical, mathematical, musical intelligence

- His theory was published in the American Journal of Psychology in 1927
- Based on the observation that persons who excel on one type of intellectual task(e.g. math)tends also to perform well on others(e. g. defining words)
- He noted that when individuals are given ability tests tapping a variety of contents(e.g. numerical problems and visuo-spatial designs) the resulting test scores consistently yielded positive intercorrelation.

Thurstone's theory of Primary mental Abilities(1938)

Intelligence consists of seven major factors which are relatively independent of the others

- Verbal comprehension
- Numerical
- Spatial visualisation
- Perceptual speed
- Memory
- Reasoning
- Word/verbal fluency

Raymond Cattel's Fluid and Crystallysed intelligence

- Proposed that there are two g factors
- "gf" for fluid intelligence and "gc" for crystallised intelligence
- Fluid intelligence includes the ability to think creatively, to reason abstractly, to make inferences from data and to understand relationships
- Measured by analogy ,working memory, concept formation and classification problems
- Strongly influenced by heredity
- Reflects the biological integrity of the CNS

- Crystallized intelligence includes what a person learns and retains from experience and is strongly influenced by environment
- Reflects the influence of formal education and acculturation
- Tests of vocabulary and general information and academic achievement can be used to measure “g c”
- Fluid intelligence peaks in young adolescence and young adulthood and declines at an early age than crystallised intelligence
- “gc”can be increased throughout the lifespan via formal education , personal reading and socialisation

Intelligence testing in retrospect

- British scientist ***Sir Francis Galton*** establishes first anthropometric lab in 1884 to measure intelligence (head circumference, reaction time strength and movement, visual discrimination, breathing capacity)
- Father of mental testing
- James McKeen Cattell coined the term ***mental test***
- ***Both reduced intelligence to sensory , perceptual and motor processes***

- First systematic attempt by Alfred Binet and his student T Simon in 1904
- First test of intelligence consisting of 30 items came out in 1905 to identify children with special needs(Binet-Simon test)
- Items ranged from the ability to touch one's ear when asked, to draw designs from memory and define abstract concepts.
- ***Core of intelligence consists of more complex mental processes such as memory, imagery, comprehension and judgment***

- The Binet-Simon test was revised and expanded in 1908 where he introduced the concept of ***mental age***
- Another version came out in 1911
- William Stern introduced the concept of ***mental quotient*** in 1912(MA/CA)

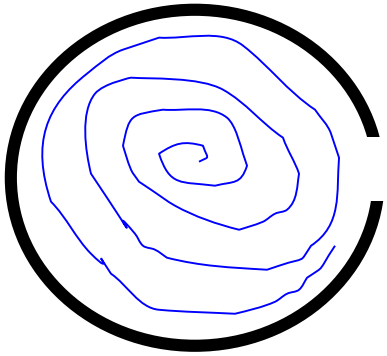
- First US intelligence test introduced by **Lewis Terman** in 1916
- Revision of Binet-Simon test at Stanford University
- Stanford-Binet test
- Currently 4^{th} revision of SB test in use
- **Converted MQ to intelligence quotient (MA/CA x100)**

1916 Stanford-Binet
Sample Items for 12 yr olds

Vocabulary

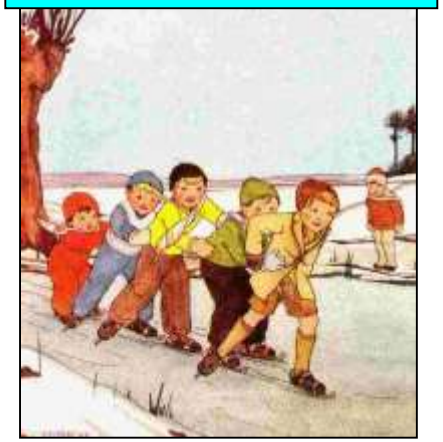
1. Orange.
45. Sportive.
80. Exaltation.
92. Theosophy

Practical Problem Solving



Grammar

Interpretation



Similarities

- Snake, cow, sparrow
- Book, teacher, newspaper
- Wool, cotton, leather

Memory

3-1-8-7-9

6-9-4-8-2

5-2-9-6-1

- David Wechsler criticized SB test and he introduced ***Wechsler-Belluve Intelligence scale*** form(WBI)in 1939 that yields separate verbal, performance and global scale
- Constructed at New York University medical centre and ***Belluve Psychiatric Hospital***
  - He introduced ***Deviation IQ***
  - Developed Verbal and Performance IQ scores and normal distribution
  - Most widely used intelligence scales in the world at present

Types of IQ

- Ratio IQ
- First type of IQ
- Stern (1938)
- IQ = MA/CA x 100
- Same IQ has different meanings at different ages
- Not used as often now

- Deviation IQ
- A type of standard score
- Mean = 100, SD = 15/16
- Compares IQ to same age peers
- Normal distribution
- WISC uses this

Psychological testing

- ***"A psychological test is an objective and standardised measure of a sample of behaviour"(A Anastasi)***
- A psychological test is an organised succession of stimuli designed to measure quantitatively or to evaluate qualitatively some mental process or characteristics
- The chief characteristics of a psychological tests are ***objectivity, standardization , reliability and validity***
- ***Psychological tests are classified on the basis of the psychological variable that is being tested. Psychological tests include intelligence tests, interest tests, attitude tests, aptitude tests, achievement tests, personality tests etc.***

Types of Intelligence tests

Intelligence tests are broadly divided into two types based on administrative condition

- Group tests and individual tests

Based on the nature of tests, intelligence tests are divided into

- Verbal
- Nonverbal and
- Performance

Based on the time limit they are divided into

- Speed tests and
- Power tests

Individual test

- Administered to one person at a time
- Time consuming
- Allows the examiner to establish proper rapport
- Help in diagnosis and remediation of individual learning difficulties
- Standardised on relatively small samples

Group test

- Administered on a mass scale
- Less time-consuming
- Minimal role of the examiner
- Used for mass screening
- Standardised on ultra large samples

Verbal ,Non-verbal and Performance tests

Verbal test demands understanding of written words

- Can only be administered to literates
- e. g. Verbal Adult Intelligence scale (VAIS)

Non verbal tests

Use picture or illustration as items

- e. g Raven's Progressive Matrices

Performance tests are made up of certain concrete tasks

e.g. Koh's Block Design Test, WAPIS

- In speed tests there is a prescribed time limit to complete the test, Individual differences depend entirely on the speed of performance e. g. WAPIS
- In power tests there is no time limit to finish the test. A pure power test has a time limit long enough to permit everyone to attempt all items e. g Raven's Progressive Matrices

Wechsler's Intelligence tests

- Best standardised and most widely used intelligence tests in the world
- Designed in 1939 by David Wechsler

There are three types of Wechsler's Intelligence tests

- WPPSI-Wechsler's Preschool and Primary Scale of Intelligence for the age range of 4-6.5 years
- WISC-IV-Wechsler's Intelligence Scale for Children for the age range of 6-15 years
- WAIS-III-Wechsler's Adult intelligence Scale (16-24 Years)
- ***WAPIS- Wechsler's Adult Performance Intelligence Scale (15-44 years) is the Indian adaptation of WAIS scale standardised by Prabha Ramalingaswamy in 1974***

WAIS

- The first was Wechsler-Belluve Intelligence Scale with age range 16-64 years
- Replaced in 1955 by the Wechsler's Adult Intelligence Scale (WAIS)
- 1981 Revision is WAIS-R
- 1997 revision is currently in use known as WAIS-III
- It consists of 11 subtests(6 Verbal and 5 performance tests)
- It gives full scale IQ score, Performance and Verbal IQ score
- If the difference between VQ and PQ is more than 20 points brain dysfunction is indicated
- Interpretation by converting raw score into scaled score(gives IQ)

Verbal Scales

- Information
- Digit span
- Vocabulary
- Arithmetic
- Comprehension
- Similarities

Performance scales

- Picture completion
- Picture arrangement
- Block design
- Digit symbol
- Object assembly

Hold test and Don't hold test

- Hold tests -don't deteriorate with age-

vocabulary

information

object assembly,

picture completion

- Don't hold tests- deteriorate with age-

Digit symbol

Digit span

Similarities

Block design

DQ =H-DH X 100/H

where

DQ=BRAIN DYSFUNCTION

H=Hold test

DH=Don t hold test

WISC

- First published in 1949
- Revised in 1974 known as WISC-R
- WISC-IV currently in use
- Administration time varies from 1-3 hours
- Must be trained in order to administer – complicated rules

- Provides
  - Full Scale IQ--Global estimate of child's general intellectual capacity/potential/level of cognitive ability and the relative standing compared to the normative population
  - Verbal Comprehension Index –verbal reasoning skills
  - Perceptual Reasoning Index – nonverbal reasoning skills
  - Working Memory –ability to attend to and hold information in memory to formulate responses
  - Processing Speed – speed of processing information
  - Uses the deviation IQ (mean = 100, SD = 15)
- WISC standardised on Indian population by Malin known as Malin's Intelligence Scale for Indian Children(MISIC) for the age group of 6-15 years-15 subtests

WAPIS

- Performance part of WAIS adopted for Indian population by Prabharamalingaswamy in 1974

Performance scale consists of

- Picture completion(26 cards)
- Picture arrangement(9 items)
- Block design (10 items)
- Digit symbol(90 items)
- Object assembly(4 items)

Indicators of Wechsler's Tests

SUBTEST	HIGH SCORE	LOW SCORE
INFORMATION	OBSESSIVE-COMPULSIVES	CHRONIC SCHIZOPHRENICS
DIGIT SPAN	SCHIZOIDS	DEPRESSIVE PSYCHOTICS
PICTURE ARRANGEMENT	NARCISSITIC CHARACTER DISORDERS	PARANOID CONDITIONS
BLOCK DESIGN	SCHIZOPHRENICS	DEPRESSIVES
OBJECT ASSEMBLY	DETERIORATED SCHIZOPHRENICS	ORGANICITY, DEPRESSION
DIGIT SYMBOL	OBSESSIVES, MANICS	DEPRESSIVE NEUROTICS
ARITHMETIC	OBSESSIVE COMPULSIVES	NARCISSITIC PATIENTS, ORGANICS

Bhatia's Battery of Performance Intelligence Test

- Chander Mohan Bhatia developed this test
- For illiterates most amenable

Consists of 5 subtests

- Block Design(10 cards)
- Pass along test(8 patterns)
- Pattern drawing test(8 patterns)
- Immediate memory span(sounds/digits)
- Picture construction test (5 items)

Verbal tests

Binet- Kulakshetra Test(3-22 years)

- Revised and adapted for Indian conditions
- Gives pattern analysis for 7 primary abilities namely language, memory , conceptual thinking, reasoning, numerical reasoning, visuo-motor coordination and social intelligence

Verbal Adult Intelligence Scale (VAIS) ,Indian adaptation of WAIS Verbal part

- Consists of information , arithmetic, digit span and comprehension subtests

Seguin form board test

- French physician Seguin devised it
- It is a performance test used mostly with children(3-11 years) and illiterates
- J Bharath Raj and SK Goel derived the norms for Indian population
- Consists of a wooden board in which the individual is required to insert 10 variously shaped blocks in the corresponding recesses as quickly as possible

Differential Ability Tests

- Developed by Elliott
- Used for analyzing and diagnosing children's learning difficulties
- To identify, select and classify children(2.5 to 17 years) with learning disabilities

- Consists of 20 subtests including 12 core subtests, 5 diagnostic subtests and 3 achievement subtests
- Provide useful information for understanding child's cognitive strengths and weaknesses

Peabody Picture Vocabulary Test

- Used when testing time is limited or/are subject's reading skills are poor
- It uses only pictures as test materials
- Used for age level 2.5 to 85 years

Tests for hearing handicapped

- Hiskey-Nebraska Test of learning Aptitude
- Consists of 12 nonverbal subtests administered with pantomimic directions to deaf children
- Wechsler's performance subtests can also be used

Tests for visually handicapped

- Haptic intelligence Scale for Adult Blind
- Wechsler's verbal subtests can be used for blind and partially sighted
- Perkin-Binet test of intelligence

Developmental schedules

- Used with severely retarded children who are not receptive to verbal, nonverbal and performance tests
- Also used with small children and infants
- Testing with infants are difficult because of short attention span and greater susceptibility to fatigue

1. **Brazelton neonatal behavioral assessment scale**

- Age range is 3 days to 4 weeks
- Scored on 26 behavioral items and 20 elicited responses including measures of neurological, behavioral and social functioning

2. **Bayley Scales of Infant Development**

- Age range-1 to 30 months
- Consists of 3 parts

Mental scale

Motor scale

Behavioral rating scale

3.McCarty Scales of children abilities

- Age range-2.5 to 8.5 years
- Consists of 6 measures of intellectual and motor development

Verbal

Perceptual performance

Quantitative

General cognitive

Memory and

Motor

4.Koffman's Intelligence tests

Koffman's Assessment battery for children(K-ABC) designed by A S Koffman and N L Koffman

- Age range -2.5 to 12.5 years
- It measures simultaneous and sequential mental processing

Group Intelligence tests

- Multilevel Group intelligence Tests

Used to compare intellectual growth of children over several years

1. Otis-Lennon School Ability Test(OLSAT)
2. Cognitive Ability Test
3. Wonderic Personnel Test

Culture free and culture fair tests

- Culture free tests are tests yielding scores that are completely independent of all cultural influences
- Culture fair tests are tests which are fair and appropriate for respondents of all cultures and subcultures e. g Cattell Culture Fair series, Learning Potential Assessment Device, Raven's Progressive Matrices

Raven's Progressive Matrices

- It is a nonverbal test of observation and clear thinking
- It consists of 3 matrices(Subtests)

1. Standard progressive matrices(6-80 years)
2. Coloured progressive matrices (5-11 years)
3. Adult progressive matrices for average adults

- RPM assesses the two components of g identified by Spearman as educative ability and reproductive ability
- Educative ability refers to making meaning out of confusion, developing new insights and decision making
- Reproductive ability involves mastering, recalling and reproducing material which forms a cultural store of explicit, verbalised knowledge

Intelligence derived from Rorschach

Above average Intelligence

- more than 7 W(whole) responses with good form level,
- M (Movement) responses more than 5
- Pure color responses 3 to 4
- Percent good form responses 79% & above
- Low animal responses

Intelligence testing in India

- First systematic attempt to standardize a test of intelligence (Binet's test) was made by Dr Rice in 1930 in Urdu &Punjabi
- First doctorate on test construction was awarded to K G Desai in 1954 for the development of group test of intelligence in Gujarati
- National Library of Educational and Psychological Tests(NLEPT) at National Council Of Educational Research and training(NCERT) has documented Indian tests

Some tests developed in India

Verbal tests

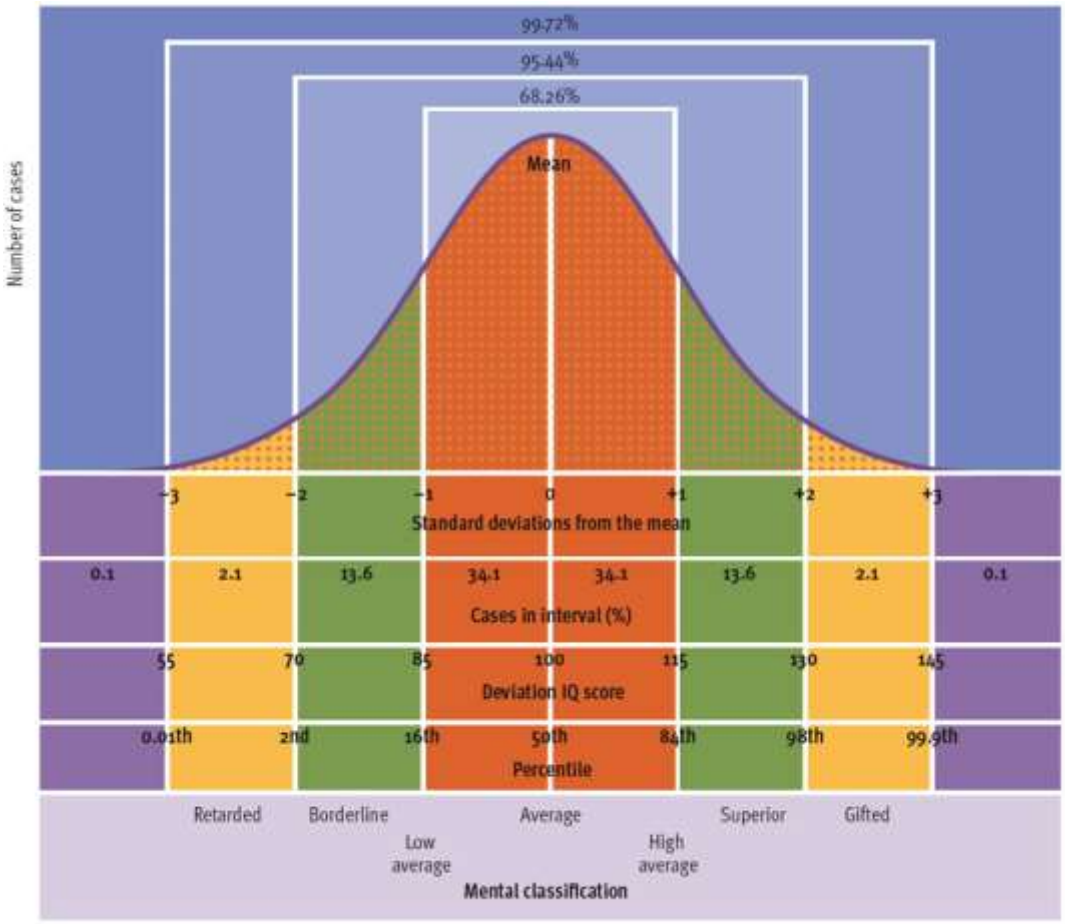
1. Group test of intelligence by Prayag Mehta
2. Group test of mental ability by S Jalota
3. Indian adaptation of Binet-Simon Scale by S K Kulshreshta
4. Test of general mental ability by M C Joshi
5. Bihar test of intelligence by S M Mohsin

Performance tests

1. Adaptation of WAPIS by R Ramalingaswamy
2. Draw –a- Man test by Pramila Pathak
3. Performance test of intelligence by C M Bhatia

Classification of IQ Range

CLASSIFICATION	IQ RANGE
PROFOUND MR	BELOW 20
SEVERE MR	20-34
MODERATE MR	35-49
MILD MR	50-69
BORDERLINE INTELLIGENCE	70-89
AVERAGE INTELLIGENCE	90-109
BRIGHT NORMAL	110-119
SUPERIOR	120-130
VERY SUPERIOR	ABOVE 130



Intelligence Classification according to IQ

CLASSIFICATION	IQ LIMITS	PERCENT INCLUDED
DEFECTIVE	65 AND BELOW	2.2
BORDERLINE	66-79	6.7
DULL NORMAL	80-90	16.1
AVERAGE	91-110	50
BRIGHT NORMAL	111-119	16.1
SUPERIOR	120-127	6.7
VERY SUPERIOR	128 AND ABOVE	2.2

Biological measures of intelligence

- **Reaction time :** refers to the time gap (in seconds) between presentations of a stimulus and the beginning of a response by the individual. Intelligent person takes less time to process information
- **Inspection time :** is the minimum amount of time a particular stimulus must be exposed to an individual to make a judgment about it that meets some pre-established criteria of accuracy
- Shorter the IT, faster the cognitive operations

Applications of intelligence testing

- Utilized in various settings like schools, hospitals
- Foremost reason is to measure cognitive capacity
- Need to obtain clinically relevant information about cognitive strength and weaknesses
- Assess the functional integrity of the brain
- Assist in determining appropriate vocational or educational placement

- reliable measure of individual differences – important for identifying need, allocating resources
- reliable predictor of school achievement
- identify discrepancies between expected and actual performance
- allow for accountability, measurement of change and evaluation of program effectiveness

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