

THEORIES OF INTELLIGENCE

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At present, intelligence is a diffuse concept and there are multitudes of theories that attempt to explain it. Some involve a 'general intelligence', some involve situational factors, and some involve both. None of them satisfactorily deals with the scope of intelligence.

INTRODUCTION

To be labeled as being “intelligent” imparts positive feelings, encourages self esteem and a sense of worth. Yet, what is intelligent and smart? This has been the focus of theories, definitions and philosophies dating as far back as Plato (428 BC); yet most presumably, dating prior to this historical figure, might be due to the fact that humankind is himself intelligent. One way to seek understanding of intelligence is simply to define what it is. Sternberg (1986) purports two principal classifications of definition of intelligence—the operational definition and the “real” definition. Operational intelligence is measurable. Real intelligence is one that inquires the true nature of the thing being defined. As with the plethora of definitions of intelligence, there are numerous theories of intelligence. From examining how smart one is to how to measure one’s smartness, how to measure how one is smart, theories have come and gone and some have endured to be pondered and proven over time.

THEORIES OF INTELLIGENCE

There are different theories about intelligence,

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none of which agree with each other. Every approach to thinking comes up with its own different perspective and assumptions, often contradicting at least one earlier theory.

Faculty theory: It is the oldest theory regarding the nature of intelligence and flourished during 18th and 19th century. According to this theory, mind is made up of different faculties like reasoning, memory, discrimination, imagination, etc. These faculties are independent of each other and can be developed by vigorous training. Faculty Theory had been under criticism by experimental psychologists who disproved the existence of independent faculties in the brain.

One factor/UNI factor theory: It reduces all abilities to a single capacity of general intelligence or ‘common sense’. This would imply that they are all perfectly correlated, and would make no allowance for the unevenness of people i.e. abilities along different lines. Since it goes against the common observation that “an individual does possess different levels of different abilities and does not shine equally in all directions”—it has no ground to stand.

Spearman’s two-factor theory: It was developed in 1904 by an English Psychologist,

Charles Spearman, who proposed that intellectual abilities were comprised of two factors : one general ability or common ability known as 'G' factor and the other a group of specific abilities known as 'S' factor. 'G' factor is universal inborn ability. Greater 'G' in an individual leads to greater success in life. 'S' factor is acquired from the environment. It varies from activity to activity in the same individual.

Thorndike's multifactor theory : Thorndike believed that there was nothing like General Ability. Each mental activity requires an aggregate of different set of abilities. He distinguished the following four attributes of intelligence :

- (a) Level—refers to the level of difficulty of a task that can be solved.
- (b) Range—refers to a number of tasks at any given degree of difficulty.
- (c) Area—means the total number of situations at each level to which the individual is able to respond.
- (d) Speed—is the rapidity with which we can respond to the items.

Thurstone's theory : Primary mental abilities/Group factor theory : States that Intelligent Activities are not an expression of innumerable highly specific factors, as Thorndike claimed. Nor is it the expression primarily of a general factor that pervades all mental activities. It is the essence of intelligence, as Spearman held. Instead, the analysis of interpretation of Spearman and others led them to the conclusion that 'certain' mental operations have in common a 'primary' factor that gives them psychological and functional unity and that differentiates them

from other mental operations. These mental operations then constitute a group. A second group of mental operation has its own unifying primary factor, and so on. In other words, there are a number of groups of mental abilities, each of which has its own primary factor, giving the group a functional unity and cohesiveness. Each of these primary factors is said to be relatively independent of the others.

Thurstone has given the following six primary factors :

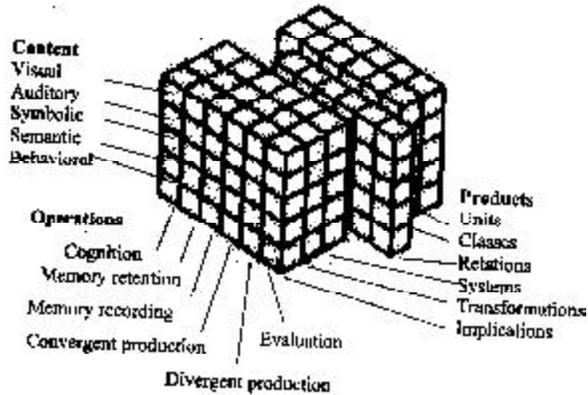
- (i) The Number Factor (N)—Ability to do Numerical Calculations rapidly and accurately.
- (ii) The Verbal Factor (V)—Found in tests involving Verbal Comprehension.
- (iii) The Space Factor (S)—Involved in any task in which the subject manipulates the imaginary object in space.
- (iv) Memory (M)—Involving ability to memorize quickly.
- (v) The Word Fluency Factor (W)—Involved whenever the subject is asked to think of isolated words at a rapid rate.
- (vi) The Reasoning Factor (R)—Found in tasks that require a subject to discover a rule or principle involved in a series or groups of letters.

Based on these factors Thurstone constructed a new test of intelligence known as "Test of Primary Mental Abilities (PMA)."

GUILFORD'S MODEL OF STRUCTURE OF INTELLECT

Guilford (1967, 1985, 1988) proposed a three dimensional structure of intellect model. According to Guilford every intellectual task

can be classified according to its (1) content, (2) the mental operation involved and (3) the



product resulting from the operation. He further classified content into five categories, namely, Visual, Auditory, Symbolic, Semantic and Behavioral. He classified operations into five categories, namely, Cognition, Memory retention, Memory recording, Divergent production, Convergent production and evaluation. He classified products into six categories, namely, Units, Classes, Relations, Systems, Transformations and Implications.

VERNON'S HIERARCHICAL THEORY :

Vernon' description of different levels of intelligence may fill the gaps between two extreme theories, the two-factor theory of Spearman, which did not allow for the existence of group factors, and the multiple-factor theory of Turstone, which did not allow a "g" factor. Intelligence can be described as comprising abilities at varying levels of generality :

1. The highest level : "g" (general intelligence) factor with the largest source of variance between individuals. (Spearman)
2. The next level : major group factors such as verbal-numerical-educational (v.ed) and

practical-mechanical-spatial-physical (k.m.) ability.

3. The next level : minor group factors are divided from major group factors.
4. The bottom level : "s"(specific) factor. (Spearman)

Beginning in 1969, Vernon became increasingly involved in studying the contributions of environmental and genetic factors to intellectual development. Vernon continued to analyze the effects of genes and the environment on both individual and group difference in intelligence. He concludes that individual difference in intelligence are approximately 60 percent attributable to genetic factors, and that there is some evidence implicating genes in racial group differences in average levels of mental ability.

CATTELL'S FLUID AND CRYSTALLIZED THEORY

The fluid aspect of this theory says that intelligence is a basic capacity due to genetic potentiality. While this is affected by the past and new experiences, the crystallized theory is a capacity resultant of experiences, learning and environment.

GARDENER'S THEORY OF MULTIPLE INTELLIGENCE :

Howard Gardner in his book "Frames of Mind, The Theory of Multiple Intelligence" (1983), puts forth a new and different view of human intellectual competencies. He argues boldly and cogently that we are all born with potential to develop a multiplicity of Intelligence, most of which have been overlooked in our testing society, and all of which can be drawn

upon to make us competent individuals. The potential for musical accomplishments, bodily mastery and spatial reasoning, and the capacities to understand ourselves as well as others are, Gardner argues, “the multiple forms of intelligence that we must add to the conventional—and typical tested—logical and linguistic skills long called I.Q.”.

The multiple intelligence theory is that people possess eight types of intelligence : linguistic, logical, spatial, musical, motor ability, interpersonal, intrapersonal and naturalistic intelligence.

Sternberg’s triarchic theory: Psychologist Robert Sternberg (1985) has constructed a three—pronged, or triarchic theory of intelligence. The Three types are :

Analytical Intelligence—is what we generally think of as academic ability. It enables us to solve problems and to acquire new knowledge. Problem—solving skill include encoding information, combining and comparing pieces of information and generating a solution.

Creative Intelligence—is defined by the abilities to cope with novel situations and to profit from experience. The ability to quickly relate novel situations to familiar situations (that is, to perceive similarities and differences) fosters adaptation. Moreover, as a result of experience, we also become able to solve problems more rapidly.

Practical Intelligence—or “street smarts”, enable people to adapt to the demands of their environment. For example, keeping a job by adapting one’s behavior to the employer’s requirements is adaptive. But if the employer is

making unreasonable demands, reshaping the environment (by changing the employer’s attitudes) or selecting an alternate environment (by finding a more suitable job) is also adaptive.

ANDERSON’S THEORY : COGNITIVE DEVELOPMENT

Anderson proposes that human cognitive architectures will have adapted optimally to the problems posed in their environment. Therefore, discovering the optimal solution to the problem posed by the environment, independent of the architecture, is equivalent to discovering the mechanism used by the architecture. A ‘Rational Analysis’, as it is called, takes into account the available information in the environment, the goals of the agent, some basic assumptions about computational cost (in terms of a ‘general’ architecture mechanism), and produces the optimal behavioral function. This function then of course can be tested empirically and assumptions modified if it proves inaccurate. A contrasting point of view to this is espoused by Simon, and is centered around the claim that, in a rational analysis, the assumptions about the architecture actually do most of the work.

EYSENCK’S STRUCTURAL THEORY

Eysenck discovered the neurological correlates of intelligence. He identified three correlates of intelligence i.e. reaction time, inspection time and average evoked potential. First two are observed behavior. Third behavior, is description of mental waves. Brighter individual progressively takes less time in responding. They show less variability in reaction time. Their inspection time is also less as compared to less intelligent. Average evoked potential is often measured by the wavelength

in electroencephalogram and complexities of waveform. He found that the waves of intelligent individuals are complex.

Ceci's Biological Theory

Ceci (1990) proposes that there are multiple cognitive potentials. These multiple intelligence's are biologically based and place limits on mental processes. These are closely linked to the challenges and opportunities in the individual's environment. In his view, context is essential to the demonstration of cognitive abilities. By context, he means domain of knowledge and other factors such as personalities, motivation and education. Context can be mental, social or physical.

THEORY OF EMOTIONAL INTELLIGENCE

According to Goleman (1995), Emotional Intelligence consists of "abilities such as being able to motivate oneself and persist in the face of frustrations; to control impulse and delay gratification; to regulate one's moods and keep distress from swamping the ability to think : to empathize, and to hope". The main areas are : knowing one's emotions, managing emotions, motivating oneself, recognizing emotions in others, and handling relationships.

CONCLUSION

Until a clear-cut definition of intelligence can be given, theories will continue not to be able to explain it. The likelihood of such a definition occurring is virtually zero, as there will always be alternatives given, and so theories of intelligence are bound to be self-defeating.

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SHORT COMMUNICATION

GENES THAT CONTROL FOOD PREFERENCE (SOME LIKE IT HOT, SOME LIKE IT COLD)

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INTRODUCTION

It is often said that there is no telling about food preferences. One person eats rice to the exclusion of *rotis*, while his neighbour does the exact opposite. There is clearly an element of getting used to something here and sticking to it. All my childhood I did not touch *rotis*, but it is my preferred staple food now. Enjoying some food items appears to involve an acquired taste. Beer is an excellent example, and caviar is another. Sticky, dark, salty and mildly smelly, it does take some getting used to before one can really enjoy caviar, the eggs or the roe of the fish called sturgeon. It is such a delicacy that you should know how to like it or enjoy it, or else you cannot belong to "high society"!

Is all preference for food a cultural determinant? How does then one account for individual preferences? One basic feature of animal behaviour is individuality. This is determined largely by the variations in the sensory perception between individuals. People differ in their sense of smell and their preferences of perfumes—a fact exploited by the perfumeries and cologne makers. herein also lies the reason

why many people do not like some fruits like the jackfruit—more than the taste, it is the smell that turns them off. Indeed A F Blakeslee described as early as in 1918 that people differ in their sense of smell and that each individual lives in his or her own unique sensory world, thus generating individual preferences and tastes. The phrase "one man's meat is another man's poison" is true in more ways than one.

A puzzle in animal behaviour that has stymied us since the Blakeslee discovery is the basis of this sensory diversity. It is "learned" or nurtured, or is it built-in or genetically determined? In matters of this sort, it becomes simpler to work with lower organisms for several reasons. First of all, they have more stereotyped behaviour patterns. Secondly, their brains are not as complex and elaborate as ours. These allow us to address the question of genetic control of food preference in a more focussed manner. Then again, the time scale of operation of the experiments gets to be more convenient, since the life cycles of birth, development, growth and death of lower forms of life are in the order of weeks and months—or even shorter if we move down to invertebrates. Perhaps, the greatest advantage in working with them is the ready availability of genetic variants, also called allelomorphs. Alleles are several

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forms of a gene that usually arise through mutation, and are responsible for hereditary variation in organisms. With insects, invertebrates and similar little life forms, it becomes easy to choose specific alleles of a given gene for a chosen protein or trait and study a number of these. These can be studied in great detail, with a large number of allelic individuals and in a statistically significant fashion, and with none of the problems of ethics that are associated with experiments involving animals or man.

Early on, scientists had studied a variety of examples where allelic variations could be correlated with habitat or food habits. This is a correspondence that relates to the genotype or the genes themselves rather than the phenotype or the behaviour at the external level, where the gene in question may not be directly identified. More recently, Dr. R. L. Borowsky and his associates at the biology department of New York University have been concerned with the question of how genotype could influence feeding behaviour. They have chosen to concentrate on a lowly crustacean, called *Gammarus*, that lives on the roots of certain water plants at the Jamaica Bay in New York city. They chose this little amphipod because of its feeding habits—it likes to have starch as its staple diet, and gets it from the algae that grows in the bay. But even while indulging in such a spartan diet, these amphipods are a little finicky. Some of them prefer eating the alga called *Enteromorpha* (we shall call it E), while others in the same colony prefer the alga called *Ulva* (call it U).

Borowsky went ahead to analyze the differences that might exist between the E-

eating *gammarus* and the U-preferring ones. The difference could not really be cultural or through a brain-based decision since these crustaceans do not have any brains! The differences should then lie in the biochemistry and genetics of the animal. Pursuit of this trail led the scientists to establish that there are differences in the enzyme amylase that the individual *gammarus* have in them. Individuals that prefer the alga E seem to have one allelic variant number 52 of the enzyme amylase, while those that prefer to eat U have the allele 55 of the enzyme. It is the variation in the enzyme molecules that correlates with the food preference for E or U. There is thus a possible connection between genotype and food preference in these amphipods.

How could genotype influence feeding behaviour? Could it be through difference in the enzyme properties of the alleles? Or could it be that there are components in the alga other than starch alone that add some special flavour, aroma or taste that some *gammarus* like more than others? After all, there are varieties of the same food that differ in their special flavours, as anyone who prefers basmati rice to Nellore samba for pulav will tell you— or one who likes cow's milk more than buffalo milk can testify. Thus, if one wishes to correlate enzyme behaviour to the starch preference, the experiment needs to be done on the starch itself rather than on the composite mixture in the algae. Only then will we know that it is the starch-enzyme connection rather than any other extra ingredient in the alga.

Thus, Borowsky along with his student M M Guarna decided to isolate starch from E and

from U and to work with the E-starch and U-starch. Similarly they isolated the amylase enzyme-52 from certain *gammarus* and the allele enzyme-55 from others. The experiment now involves reacting the two starches separately with each amylase enzyme and seeing whether there are any differences in the way the enzyme digests and breaks down the starch. And the results should provide the clue regarding the preferences.

When starch is broken down by amylase, it yields a series of smaller sugars such as maltose, maltotriose and maltotetraose. It was in the ratio of the three sugars that the starch-enzyme reactions of the two alleles differed. When starch E was digested for about 15 minutes with enzyme-52, it gave 69% maltose, 16% maltotriose and 15% maltotetraose. In contrast, the same enzyme gave the ratio of 61 : 21 : 18 of the three sugars upon digesting the starch-U from the alga, ulva. Likewise, the ratios were different for the combinations starch E : enzyme-55 and U-55. In other words, the digested product distribution varies, depending on which alga the starch comes from and which *gammarus* the enzyme comes from.

Would this product distribution be the clue to the differences in the food preference? Yes, argue Guarna and Borowsky. They suggest that the product mix of sugars actually acts as a *feeding stimulant*. Some mixes are more effective

than others. The preference the *gammarus* with the enzyme allele 52 has for the alga E is thought to be because of the product ratio 69 : 16 : 15 that stimulates this amphipod to feed on E, while the product distribution obtained from U stimulates the amphipod 55 to prefer this alga. As they eat, the amphipods spill the enzyme onto the food. This helps in predigesting and conditioning the food, allowing for the stimulants to accumulate.

If this is true, it should then be possible to feed the *gammarus* artificially prepared starch food that contains the chosen product mix as the feeding stimulant. That would take the experiment from the "test tube" (actually glass vessels or *in vitro*, to the actual living organisms, or *in vivo*). To do so, Guarna and Borowsky bought maltose, maltotriose and maltotetraose from chemical suppliers, mixed them in various proportions, spiked them with the starch and placed them before the amphipods. True to style, *gammarus*-52 preferred to eat the artificial food that contained the 69 : 16 : 15 ratio, just as if it were from the alga E. Likewise, *gammarus*-55 preferred to eat a product mix that corresponded to the starch-U situation!

This suggests that the perception of the environment (food) varies with genotype because of genetically caused differences in enzymatic properties.

—conclude these New York sicentists.

KNOW THY INSTITUTIONS



GOVERNMENT EXAMINER OF QUESTIONED DOCUMENT, HYDERABAD

BACKGROUND

The Institution of Government Examiner of Questioned Document (GEQD) is one of the oldest in the world in the field of forensic document sciences. In 1906, on the recommendation of the Police Commission, the first unit of the Government Examiner of Questioned Document (GEQD) was established at Shimla. The second unit of the GEQD started functioning in 1964 at Kolkata. The third unit of the GEQD came into existence in 1968 at Hyderabad. The administrative control of these institutions was initially under the Intelligence

Bureau (IB), under the then Bureau of Police Research and Development (BPR & D), and presently it is being controlled by the Directorate of Forensic Science, New Delhi. Min. of Home Affairs, Govt. of India. The main activities of this premier organization through R&D are carried out in the following fields :

1. Conventional Document Science
2. Computer Forensics
3. Cyber Forensics
4. Digital Forensics
5. Digitized Document Frauds.

The GEQD located at Ramanthapur, Hyderabad has a campus comprising own separate building along with residential quarters for its staff and access to all the necessary facilities. Additional separate building for GEQD is about to be completed owing to increase in number of cases and laboratory requirement for Computer Forensic Division.

LABORATORIES DOCUMENT SCIENCE

LABORATORY: It comprises state of the art equipment like VSC 2000, VSC 4, VSC 1, Leica MZ8 High resolution microscope, RAMAN Spectra, ESDA, Universal Comparator Projectina and other sophisticated instruments for the decipherment of peculiar characteristics in establishing the facts about questioned documents for the sake of Justice.

COMPUTER FORENSIC LABORATORY: It is entertaining all kinds of computer frauds and cyber crime cases throughout India from various state and central organization. The experts in computer forensics division follow the cardinal rules of computer forensics as per international standard and IT Act 2000 of India. The lab is well equipped with the licensed genuine software for the forensic imaging and analysis of digital evidence.

ANALYTICAL WORK : The forensic document division of this laboratory undertake the examination of forensic documents which can be broadly divided in two groups, one that requires the comparison of unknown exhibits with the known sample for establishing the authorship or otherwise, the other that requires a study of crime exhibit alone. Most of the documents that are referred to the expert are to identify the writing, typewriting, printed matter and seal impression only. The rest may be to

distinguish forgery from genuineness; to analyze inks, papers or other constituents of the documents; to reveal additions and substitutions; to decipher erased, obliterated writings or writings on a charred document etc.

Specialization can only endorse excellence in forensic document science. To remain on a par with the fast growing trend, GEQD Hyderabad evolved the concept of establishing the specialized divisions in forensic document science. Consequently, the following specialized divisions have been setup, dealing with all types of document problem, computer frauds and cyber crimes.

TAMPERED DOCUMENT DIVISION: To examine tampering on the documents, decipherment of the originals in cases of obliteration, erasures, alterations, etc.

IMPRINT DIVISION : To examine typewriting, printing, computer printouts, seal impressions, plastic currency, spurious currency, watermarks, holograms, stamps, photographs, painting etc.

WRITING MEDIA DIVISION : To examine the chemical and physical analysis of ink, paper or other writing surfaces, instruments and other constituents of the document used in its preparation.

COMPUTER FORENSIC DIVISION: This division deals with forensic analysis of Digital evidence, forensic imaging of various storage media, cracking of passwords, email tracing, stegano-analysis and GSM reader for mobile forensics, etc. "GEQD Hyderabad has established the Premier computer forensic laboratory for tackling computer frauds & cyber crimes."

RESEARCH & DEVELOPMENT :

- | Development of technique and software for signature identification.
- | Development of set of software tools for the decipherment of erased/obliterated writings in collaboration with University of Hyderabad.
- | Creation of internet related crime analysis facility (Cyber Forensic Laboratory)
- | Creation of Computer Forensics Laboratory at Kolkata, Chandigarh and upgradation of Hyderabad Laboratory.
- | Development of tagging procedure by suitable taggants for forensi analysis of ink.

TRAINING & HRD : Conducts short-term training courses for the benefit of forensic scientists of various state and central laboratories, IOs of CBI and other Police Organizations, Vigilance Officers of Central Govt. Organizations, Banks, PSUs etc., on the

following subjects. Forensic Document Science, Computer Forensics, Expert Testimony in Court of Law.

SPECIAL SERVICES OFFERED :

- | This laboratory can help the other organizations in establishing a Computer Forensic Division or upgrade the Cyber Crime Unit already existing.
- | This laboratory can conduct exclusive training programs separately for the benefit of any particular organization like Banks, PSUs or Central Govt. Departments.
- | In case of necessity, experts can be deputed to the scene of crime to help the IOs in searching and seizure of digital evidence.

On the request of investigative agencies "Tatkal Service" for quick disposal of certain cases was introduced in GEQD Hyderabad since April, 2003 . For further information please contact Director; GEQD, Hyderabad. email : gaurav—jindalin@rediffmail.com.