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SAMPLE THEORY

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- GESTALT AND PHYSIOLOGICAL APPROACHES
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GESTALT AND PHYSIOLOGICAL APPROACHES

Gestalt Psychology, founded by Max Wertheimer, was to some extent a rebellion against the molecularism of Wundt's program for psychology, in sympathy with many others at the time, including William James.

Gestalt Theory

Gestalt psychology is based on the observation that we often experience things that are not a part of our simple sensations. The original observation was Wertheimer's, when he noted that we perceive motion where there is nothing more than a rapid sequence of individual sensory events. This is what he saw in the toy stroboscope he bought at the Frankfurt train station, and what he saw in his laboratory when he experimented with lights flashing in rapid succession (like the Christmas lights that appear to course around the tree, or the fancy neon signs in Las Vegas that seem to move). The effect is called apparent motion, and it is actually the basic principle of motion pictures.

Wetheimer explained that you are seeing an effect of the whole event, not contained in the sum of the parts. We see a coursing string of lights, even though only one light lights at a time, because the whole event contains relationships among the individual lights that we experience as well.

Furthermore, say the Gestalt psychologists, we are built to experience the structured whole as well as the individual sensations. And not only do we have the ability to do so, we have a strong tendency to do so. We even add structure to events which do not have gestalt structural qualities.

In perception, there are many organizing principles called **gestalt laws**. The most general version is called the law of pragnanz. Pragnanz is German for pregnant, but in the sense of pregnant with meaning, rather than pregnant with child. This law says that we are innately driven to experience things in as good a gestalt as possible. "Good" can mean many things here, such a regular, orderly, simplicity, symmetry, and so on, which then refer to specific gestalt laws.

For example, a set of dots outlining the shape of a star is likely to be perceived as a star, not as a set of dots. Tend to complete the figure, make it the way it "should" be, finish it.

The law of closure says that, if something is missing in an otherwise complete figure, tend to add it. A triangle, for example, with a small part of its edge missing, will still be seen as a triangle. "Close" the gap.

The law of similarity says that we will tend to group similar items together, to see them as forming a gestalt, within a larger form. Here is a simple typographic example:

OXXXXXXXXX

XOXXXXXXXX

XXOXXXXXXX
XXXOXXXXXX
XXXXOXXXXX
XXXXXOXXXX
XXXXXXOXXX
XXXXXXXOXX
XXXXXXXXOX
XXXXXXXXXO

It is just natural for us to see the o's as a line within a field of x's.

Another law is the law of proximity. Things that are close together as seen as belonging together. For example...

****
****
****

You are much more likely to see three lines of close-together *'s than 14 vertical collections of 3 *'s each.

Next, there's the law of symmetry. Take a look at this example:

[ ][ ][ ]

Despite the pressure of proximity to group the brackets nearest each other together, symmetry overwhelms our perception and makes us see them as pairs of symmetrical brackets.

Another law is the law of continuity. When we see a line, for example, as continuing through another line, rather than stopping and starting, we will do so, as in this example, which we see as composed of two lines, not as a combination of two angles

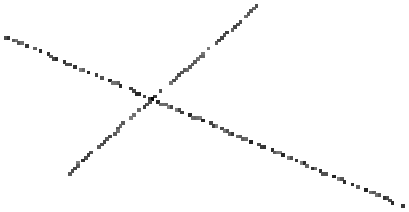
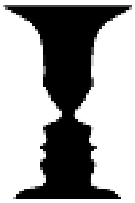


Figure-ground is another Gestalt psychology principle. It was first introduced by the Danish phenomenologist Edgar Rubin (1886-1951). The classic example is this one



Basically, it seems to have an innate tendency to perceive one aspect of an event as the figure or fore-ground and the other as the ground or back-ground. There is only one image here, and yet, by changing nothing but our attitude, two different things can be seen. It doesn't even seem to be possible to see them both at the same time.

But the gestalt principles are by no means restricted to perception that's just where they were first noticed. Take, for example, memory. That too seems to work by these laws. If an irregular saw-tooth figure is seen, it is likely that memory will straighten it out for a bit. Or, if you experience something that doesn't quite make sense to you, you will tend to remember it as having meaning that may not have been there.

Learning was something the Gestalt psychologists were particularly interested in. One thing they noticed right away is that we often learn, not the literal things in front of us, but the relations between them. For example, chickens can be made to peck at the lighter of two gray swatches. When they are then presented with another two swatches, one of which is the lighter of the two preceding swatches, and the other a swatch that is even lighter, they will peck not at the one they pecked at before, but at the lighter one. Even something as stupid as a chicken "understands" the idea of relative lightness and darkness.

Gestalt theory is well known for its concept of insight learning. People tend to misunderstand what is being suggested here: They are not so much talking about flashes of intuition, but rather solving a problem by means of the recognition of a gestalt or organizing principle.

The most famous example of insight learning involved a chimp named Sultan. He was presented with many different practical problems (most involving getting a hard-to-reach banana). When, for example, he had been allowed to play with sticks that could be put together like a fishing pole, he appeared to consider in a very human fashion the situation of the out-of-reach banana thoughtfully -- and then rather suddenly jump up, assemble the poles, and reach the banana.

A similar example involved a five year old girl, presented with a geometry problem way over her head: How do you figure the area of a parallelogram? She considered, then excitedly asked for a pair of scissors. She cut off a triangle from one end, and moved it around to the other side, turning the parallelogram into a simple rectangle. Wertheimer called this productive thinking.

The idea behind both of these examples, and much of the gestalt explanation of things, is that the world of our experiencing is meaningfully organized, to one degree or another. When we learn or solve problems, we are essentially recognizing meaning that is there, in the experience, for the "dis-covering."

Most of what we have just looked at has been absorbed into "mainstream" psychology to such a degree that many people forget to give credit to the people who discovered these principles. There is one more part of their theory that has less acceptance: Isomorphism.

Isomorphism suggests that there is some clear similarity in the gestalt patterning of stimuli and of the activity in the brain while we are perceiving the stimuli. There is a "map" of the

experience with the same structural order as the experience itself, albeit "constructed" of very different materials.

Figure-ground articulation

Figure 1 : Figure-ground articulation

If the visual field is homogeneous throughout, a situation labeled as Ganzfeld (German for 'whole field'), it has no consistent internal organization. A simple case of an inhomogeneous field is a display with a patch of one color surrounded by another color.

In such cases the visual field is perceived as articulated into two components, the figure (patch) on the ground (surround). This figure-ground articulation may seem obvious, but it is not trivial. This type of field organization has a number of remarkable features, first described in the work of Rubin (1915/1921), predating Wertheimer's publication. The two components are perceived as two segments of the visual field differing not only in color, but in some other phenomenal characteristics as well. The figure has an object-like character, whereas the ground has less perceptual saliency and appears as 'mere' background. The areas of the figure and the ground usually do not appear juxtaposed in a common plane, as in a mosaic, but rather as stratified in depth: there is a tendency to see the figure as positioned in front, and the ground at a further depth plane and continuing to extend behind the figure, as if occluded by it. Furthermore, the border separating the two segments is perceived as belonging to the figure rather than to the ground, and as delineating the figure's shape as its contour, whereas it is irrelevant to the shape of the ground. Certain displays are bi-stable, in that what is perceived as figure can also be perceived as ground and vice-versa. However, in displays structured such as Figure , in which a smaller region is

wholly surrounded by a larger region, it is usually the former that appears as figure (although it may also be seen as a hole), and the latter as ground.

Proximity principle

Figure 2 (a) contains six patches,each of which is perceived as a visual unit, a figure on a common ground. However, they are also collectively the elements of a higher-order visual unit, the horizontal row. According to Gestalt theory, this type integration of individual components into a superordinate whole can be accounted for by the proximity principle: elements tend to be perceived as aggregated into groups if they are near each other.

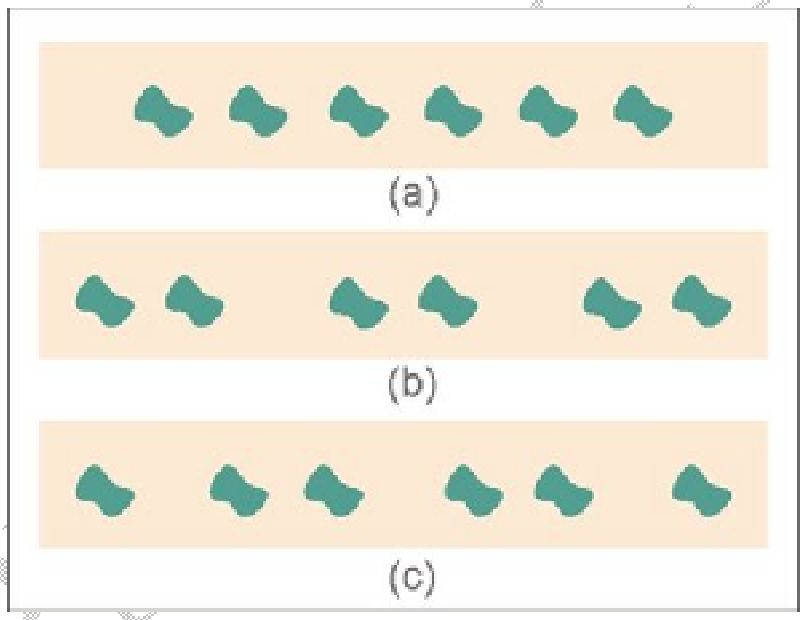


Figure 2 : Proximity principle.

The effect of varying proximity is illustrated in Figure 2b. Due to the change of distance between some of the components, here the patches are perceived not just collectively as a sextuple, but also as being subdivided into a triple of doublets, an organization that in Wertheimer's notation is designated as 12/34/56.

Note that a number of other potential partitions of the set in Figure 2b exist, such as into a doublet of triples (123/456), or into a quartet and a pair (1234/56), or even into combinations

of non-adjacent items such as 16/25/34/, or 135/246 etc. However, it is extremely hard, if not impossible, to actually perceive groupings of patches other than 12/34/56 in this figure. On the other hand, it is not impossible to see some subdivisions in Figure 2a.

With a different spatial distribution of the six components, such as in Figure 2c, another naturally perceived partition into sub-wholes arises, denoted as 1/23/45/6. The partition 12/34/56, although arguably simpler and more regular, is hard to perceptually realize in Figure 2c: it would violate the proximity principle, as it would involve grouping together some elements across relatively larger distances, but assigning other, relatively near elements, into different groups.

Similarity principle

The similarity principle claims that elements tend to be integrated into groups if they are similar to each other. It is illustrated in Figure 3 a-e, in which proximity is held constant, since the individual figures are at (approximately) the same distance from each other, as in Figure 2a. Nevertheless, they are perceptually partitioned into three adjacent pairs, due to the similarity of visual attributes such as lightness (Figure 3a), color (Figure 3b), size (Figure 3c), orientation (Figure 3d), or shape (Figure 3e).

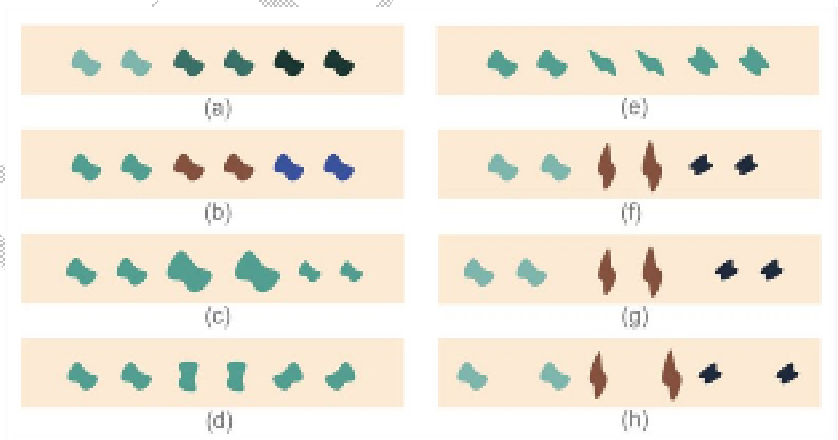


Figure 3 : Similarity principle.

The 12/34/56 partition becomes more salient when the within-group similarities and between-group differences are compounded, by making the doublets similar / different in more than one visual attribute (Figure 3f). An important manipulation, studied already by Wertheimer (1923), is to vary both similarity and proximity, in order to investigate their joint effects on perceived groupings. Note that by increasing the distance between elements 2 and 3, and elements 4 and 5 (as in Figure 2b), the salience of the 12/34/56 organization is strengthened (Figure 3g), since similarity and proximity co-operate by favoring the same organization. On the other hand, when the inter-element distances are changed as in Figure 2c, the resulting perceptual organization, Figure 3h, is less clear, because similarity still favors partition 12/34/56, but proximity favors partition 1/23/45/6. This type of manipulation can thus be used to quantify the effects of different Gestalt principles and compare their strength.

Continuity principle

The display in Figure 4a can be described as consisting of a number of elements arranged in three sub-wholes or branches, converging at X. According to the principle of proximity, one would expect branch BX to group with branch CX, but instead it groups with branch AX, forming the sub-whole AXB.

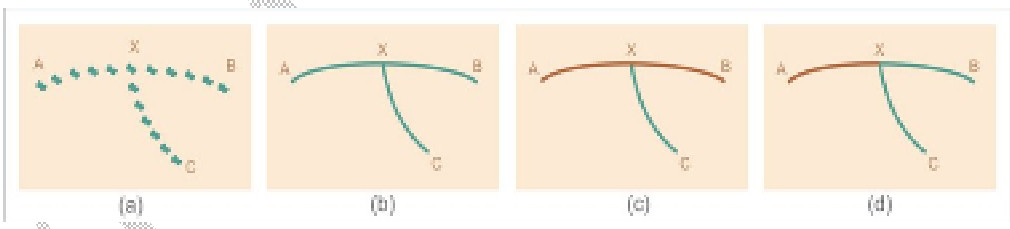


Figure 4 : Continuity principle.

This grouping is an instance of the continuity principle: oriented units or groups tend to be integrated into perceptual wholes if they are aligned with each other. The principle applies in the same way for elements arranged along lines (Figure 4a) as well as for patterns built from corresponding lines themselves (Figure 4b). The balance between continuity and proximity in the formation of salient sub-wholes may be shifted by varying similarity, which can be

accomplished by coloring different branches differently. Thus coloring BX same as AX but different from CX makes AXB a still more salient unit (Figure 4c), whereas coloring BX same as CX but different than AX tends to increase the saliency of CXB (Figure 4d).

Closure principle

Figure 5a-b is constructed by adding some appropriate elements to Figure 4a-b. Whereas in Figure 4a and Figure 4b the component BX is grouped with AX, in Figure 5a and Figure 5b there is a tendency for this component to rather group with CX, both BX and CX being sides of shape BCX, which itself constitutes one half of a bow-tie shaped figure. This is an instance of the closure principle: elements tend to be grouped together if they are parts of a closed figure. However, in this particular example, continuity is still relatively effective, and is in strong competition with closure. Using similarity, the salience of BCX as a visual sub-whole can be increased, as in Figure 5c, or decreased, as in Figure 5d.

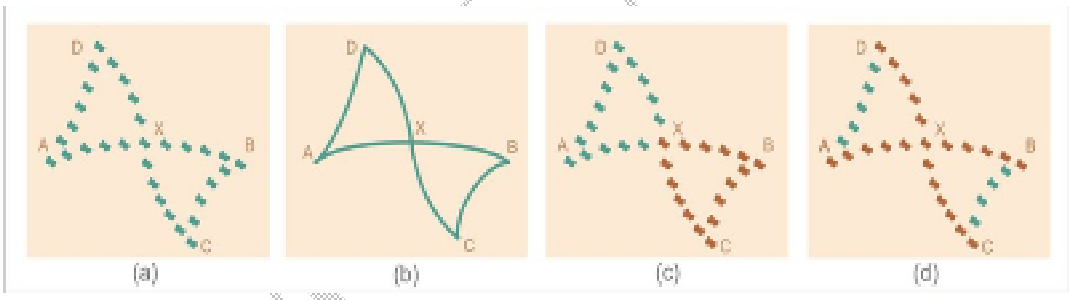


Figure 5: Closure principle.

The patterns in Figure 4a and Figure 4b, although physically contained in Figure 5a and Figure 5b, are hard to see there: they can be sought out with directed attention, but do not appear spontaneously as natural visual wholes. The reason for this is not simply that more elements are added in the display. This is demonstrated in Figure 7, in which the pattern in a is readily discernible in b in spite of many added elements, but is practically invisible in c, d, and e, although geometrically it is just as present there (and in the same place) as in a and b. The loss of the visual identity of the pattern is due to the effectiveness of the Gestalt principles, mainly continuity and closure, according to which its elements are perceptually

integrated with other present elements, and assigned to other, new visual wholes. One way in which its visual identity can be recovered is by simply changing its color to make it dissimilar from the surround. For a demonstration, position the cursor anywhere within the area of Figure 7. When the cursor is removed from the figure and the pattern again assumes the same color as the added elements, it quickly (though not necessarily instantaneously) fades from view, and no effort of attention can restore it to a salient visual whole. For a further demonstration, hold the left mouse button depressed while positioned within the area of the figure, which will remove the pattern and reveal only the added elements. A classical study of such 'hidden figure' effects was reported by Gottschaldt.

Good gestalt principle

The pattern in Figure 6a is readily partitioned into two components, a straight line and a wavy line that cross each other. This perceptual decomposition is strengthened by similarity (Figure 6b). An alternative decomposition of Figure 6a into two abutting corners, depicted in Figure 6c, does not seem to arise spontaneously; this can be explained by noting that it would violate the continuity principle. However, an appeal to continuity does not explain why the partition in Figure 6d does not spontaneously arise easily in Figure 6a either, although both of its components are continuous lines.

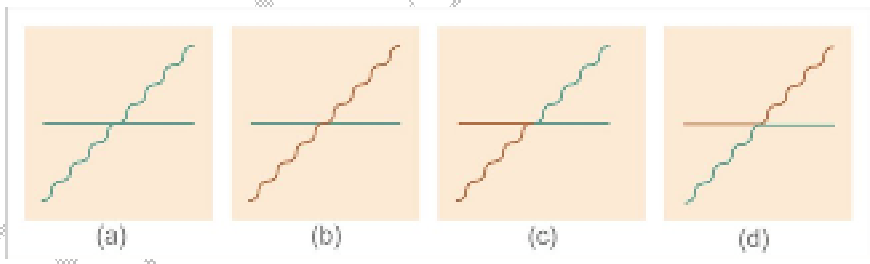


Figure 6 : Good Gestalt principle

Figure 7a spontaneously decomposes into a semi-wheel with curved cogs touching a rectangular 'snake'. However, this perceptual outcome actually violates the continuity principle, because at the point at which the two components touch, this decomposition involves angles, instead of following the directions of the crossing continuous lines. An even clearer decomposition is achieved by introducing similarity as well (Figure 7b). However,

similarity can also be used to enhance a radically different decomposition into two crossing twisted threads, favored by continuity, as indicated in Figure 7c.

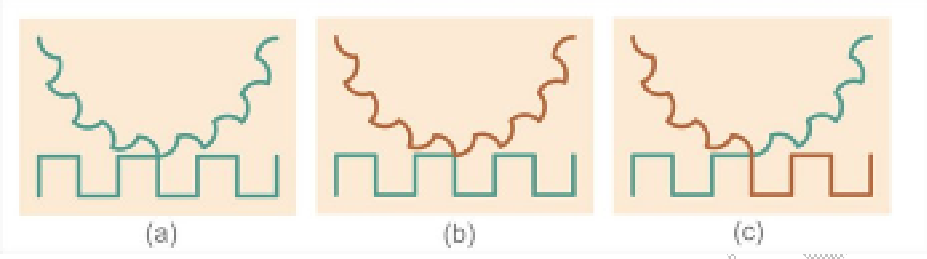


Figure 7 : Good Gestalt principle

According to the Gestalt viewpoint, the dominant percepts in Figure 6a and Figure 7a are instances of the good Gestalt principle: elements tend to be grouped together if they are parts of a pattern which is a good Gestalt, meaning as simple, orderly, balanced, unified, coherent, regular, etc as possible, given the input. In this sense, the straight line and the wavy line perceived in Figure 6a are better forms than the pairs of lines in Figure 6c and Figure 6d, and in Figure 7a the cog wheel and the snake are better forms than the hybrid shapes in Figure 7c, that would be generated in Figure 7a by conforming to the continuity principle at the crossing point. In such cases global regularity takes precedence over local relations. This principle is also called the 'law of good form' or the 'law of Pragnanz',

Past experience principle

In some cases the visual input is organized according to the past experience principle: elements tend to be grouped together if they were together often in the past experience of the observer.

For example, we tend to perceive the pattern in Figure 8a as a meaningful word, built up from strokes which are grouped to form particular letters of the Roman alphabet (such as 'm', 'i', 'n', etc). Note that the individual letters are rather clearly and distinctly perceived as 'natural' parts of the connected figure, and are only slightly easier to discern and discriminate if further individuated through separation (Figure 8b) or coloration (Figure 8c).

However, in addition to this standard segmentation into letters, the pattern Figure 8a has many other alternate partitions, such as the one demonstrated through separation and

coloration in Figure 8d and Figure 8e. But, in contrast to the standard segmentation, discerning and discriminating these alternate components (some of which are 'non-letters') within Figure 8a is a cumbersome task, similar to the laborious search for the hidden shape in Figures 6c-e; furthermore, the standard segmentation is to some extent perceivable even in Figure 8e, where it competes with the segmentation based on the similarity principle. The spontaneity and ease of the standard, dominantly perceived organization of the strokes into letters, is plausibly mainly due to past experience, that is, to our familiarity with words as written in the script form of the Roman alphabet.

This particular organization might not occur for observers lacking such familiarity; furthermore, the alternate partition would presumably be natural for observers used to an alphabet whose letters would correspond to the sub-wholes in Figure 8d and Figure 8e.

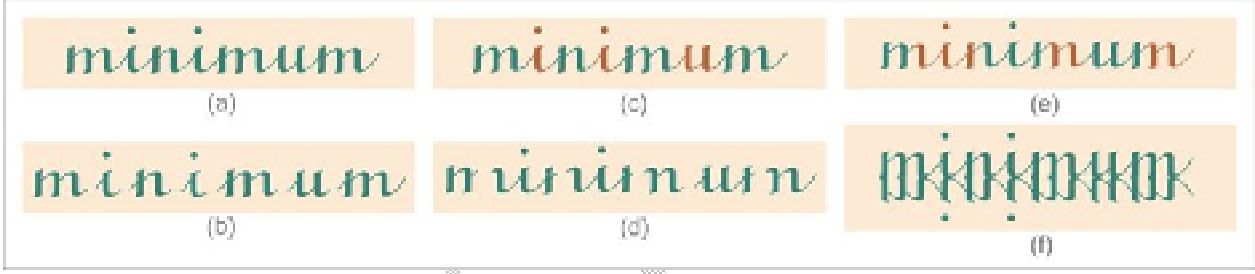


Figure 8 : Past experience principle

Although acknowledged by the gestaltists, the experience-based principle was deemed of secondary importance, compared with the other, stimulus-based principles, and easily dominated by them. As an example, in the pattern in Figure 8f, in which a slightly overlapping inverted version is added, the original stimulus is much harder to see, due to the appearance of numerous new salient sub-patterns, generated by continuity and closure.

Auditory Gestalten

The acoustic input is just a one-dimensional temporally varying air pressure waveform, but based on it we can perceive an auditory scene involving multiple sources of human speech,

vocal and instrumental music, animal sounds and other nature noises, occasionally all occurring at the same time, each with its own sub-phrasing and structure.

Some visual Gestalt principles directly apply in the acoustic domain, but mainly in a temporal rather than spatial form. For example, silence or background noise, interrupted by a loud sound, followed again by silence or noise, is an auditory analogue of a figure on a ground. Similarly, a regular series of identical short clicks is an analogue of Figure 2a, with equal temporal intervals between sound events playing the role of equal spatial distances. With deliberate attention, one can mentally superimpose a structure on this sequence, such as hearing consecutive pairs of clicks, as in 12/34/56. However, such a phenomenal segmentation is achieved much more naturally and easily by simply increasing the intervals between some clicks, analogously to Figure 2b. This is an instance of an auditory temporal analogue of the visual spatial proximity principle; there is also a spatial auditory variant, involving pairs of identical sounds separated by equal intervals, but coming from different directions, such as left, left/in front, in front/right, right. Auditory analogues of instances of the visual similarity principle, as illustrated in Figure 3, are also readily established, but with differences and similarities of color, size etc being replaced by differences and similarities of loudness, pitch, and timbre of sounds. Auditory analogues of some other Gestalt principles may also be constructed.

Contemporary work

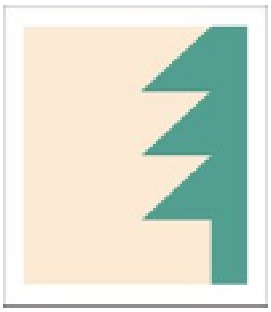


Figure 9 : Past experience principle

The principles described above, together with others not illustrated here, such as the symmetry principle (symmetrical components will tend to group together), the convexity

principle (convex rather than concave patterns will tend to be perceived as figures), and others, are part of the classical heritage of perception studies. In contemporary research, of which only a few examples will be noted below, the seminal insights and issues raised by the gestaltists are developed and extended in various directions.

For example, contrary to the classical views, more recent research has indicated that even such a basic feature as figure-ground articulation may in some instances be based on experience. For example, although in displays with two homogeneous regions, neither of which surrounds the other, assignment to figure and ground is often ambiguous, in some cases in which one region resembles an object, such as a tree in Figure 9, that region is preferably perceived as figure.

Palmer and colleagues have developed some new principles of visual field organization. For example, Palmer has proposed the common region principle: elements tend to be grouped together if they are located within the same closed region. An illustration is provided in Figure 10a. It depicts the same spatial distribution of elements which, in Figure 2c, elicited the grouping 1/23/45/6; however, with superimposed closed contours the preferred grouping becomes 12/34/56.

Palmer & Rock proposed the element connectedness principle: elements tend to be grouped together if they are connected by other elements. This principle is illustrated in Figure 10b. Like Figure 10a, Figure 10b is also based on Figure 2c, but, due to some elements being connected, the preferred perceived grouping is 12/34/56.

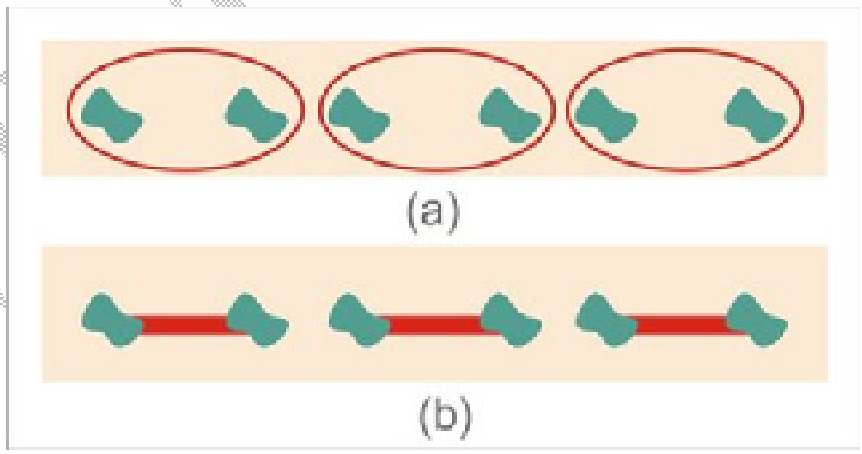


Figure 10 : Principles of common region and element connectedness.

Unresolved issues

- As formulated by Wertheimer, Gestalt principles involve a 'ceteris paribus' (all other things being equal) clause. That is, each principle is supposed to apply given that the other principles do not apply or are being held constant. In case two (or more) principles apply for the same input, and they favor the same grouping, it will tend to become strengthened; however, if they disagree, usually one wins or the organization of the percept is unclear. Several examples of the domination of one principle over another are presented above. However, although it has been addressed to some extent in the literature, the significant theoretical problem of how to predict which principle will win in which circumstances remains to be worked out in much more detail.
- Gestalt principles are usually illustrated with rather simple drawings, such as those above. Ideally, it should be possible to apply them to an arbitrarily complex image and, as a result, produce a hierarchical parsing of its content that corresponds to our perception of its wholes and sub-wholes. This ambitious goal is yet to be accomplished.
- It has been suggested that most Gestalt principles are special instances of the overarching Good Gestalt principle, in the sense that being continuous, closed, similar etc are ways of being maximally good, ordered, simple etc. However, although this idea achieves some explanatory economy and unity, it does so at the cost of clarity and operationalizability: whereas it may be relatively simple to point out the presence of continuity, closure, etc, it is more difficult to establish what exactly makes a pattern visually good, simple, unified etc.
- One important issue which was not discussed much in classical literature is the origin of Gestalt principles. Why is it that the perceptual input is organized in accord with proximity, continuity, closure etc? The gestaltists tended to favor the notion that these principles are among the fundamental properties of the perceptual system, providing the basis of our ability to make sense of the sensory signals.
- An opposed view is that the Gestalt principles are heuristics derived from some general features of the external world, based on our experience with things and their properties

(Rock, 1975): objects in the world are usually located in front of some background (figure-ground articulation), have an overall texture different from the texture of the background (similarity), consist of parts which are near each other (proximity), move as a whole (common fate), and have closed contours (closure) which are continuous (continuity).

INTELLIGENCE

Intelligence has been defined in many different ways including, but not limited to, abstract thought, understanding, self-awareness,communication, reasoning, learning, having emotional knowledge, retaining, planning, and problem solving.

According Robert J. Stemberg (Cognitive Psychologist)

"I define [intelligence] as your skill in achieving whatever it is you want to attain in your life within your sociocultural context.by capitalizing on your strengths and compensating for, or correcting, your weaknesses"

Intelligence is most widely studied in humans, but has also been observed in animals and in plants. Artificial intelligence is the simulation of intelligence in machines.

Within the discipline of psychology, various approaches to human intelligence have been adopted. The psychometric approach is especially familiar to the general public, as well as being the most researched and by far the most widely used in practical settings.

Intelligence derives from the Latin verb intelligere which derives from inter-legere meaning to "pick out" or discern.

DEFINITIONS

The definition of intelligence is controversial. Groups of scientists have stated the following:

1. A very general mental capability that, among other things, involves the ability to reason, plan, solve problems, think abstractly, comprehend complex ideas, learn quickly and learn from experience. It is not merely book learning, a narrow academic skill, or test-taking

smarts. Rather, it reflects a broader and deeper capability for comprehending our surroundings-"catching on," "making sense" of things, or "figuring out" what to do.

2. A form of this verb, intellectus, became the medieval technical term for understanding, and a translation for the Greek philosophical term nous. This term was however strongly linked to the metaphysical and cosmological theories of teleologicalscholasticism, including theories of the immortality of the soul, and the concept of the Active Intellect (also known as the Active Intelligence). This entire approach to the study of nature was strongly rejected by the early modern philosophers such as Francis Bacon, Thomas Hobbes, John Locke, and David Hume, all of whom preferred the word "understanding" in their English philosophical works. Hobbes for example, in his Latin De Corpore, used "intellectus intelligit" (translated in the English version as "the understanding understandeth") as a typical example of a logical absurdity. The term "intelligence" has therefore become less common in English language philosophy, but it has later been taken up in more contemporary psychology.

Individuals differ from one another in their ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought. Although these individual differences can be substantial, they are never entirely consistent: a given person's intellectual performance will vary on different occasions, in different domains, as judged by different criteria. Concepts of "intelligence" are attempts to clarify and organize this complex set of phenomena. Although considerable clarity has been achieved in some areas, no such conceptualization has yet answered all the important questions, and none commands universal assent. Indeed, when two dozen prominent theorists were recently asked to define intelligence, they gave two dozen, somewhat different, definitions.

BIOLOGICAL DETERMINANTS

Despite a history of attempts, neuroscience has thus far failed to identify a validated biological determinant of behavioral intelligence. Cognitive variables such as selective attention, expectancy and information processing workload modulate the amplitude of evoked cortical potentials (EPs), thereby demonstrating the operation of cognitive neural

adaptability. It seems reasonable to postulate that individual differences in this aspect of neural function could relate to individual differences in behavioral intelligence: the electrophysiologically adaptable brain should be the behaviorally bright brain.

To test this hypothesis, gathered auditory EPs from 109 normal and 52 mentally retarded adults under three stimulation conditions (periodic, self, and random) designed to manipulate temporal expectancy.

The normal adults showed a strong temporal expectancy effect on their EPs, giving smaller than average EPs to expected inputs and larger than average brain responses to unexpected stimuli. In contrast, the retarded adults failed to show a temporal expectancy effect on their EPs, indicating a deficit in neural adaptability.

A measure of neural adaptability derived from EP amplitude ratios correlated. 66 with IQ scores obtained on 74 normal adults, indicating a definite association between neural adaptability and behavioral intelligence. People who gave larger than average EPs to unexpected inputs and smaller than average EPs to stimuli whose timing they knew tended to have higher IQs.

Results suggest that the brain which efficiently inhibits its response to insignificant inputs and orients vigorously to unexpected, potentially dangerous stimuli is also the brain which manifests high behavioral intelligence. Neural adaptability as indexed by the temporal expectancy effect on evoked cortical potentials provides a biological determinant of behavioral intelligence.

SOCIAL DETERMINANTS

Social Determinants describes the exclusively human capacity to effectively navigate and negotiate complex social relationships and environments. Psychologist and professor at the London School of Economics Nicholas Humphrey believes it is social intelligence or the richness of our qualitative life, rather than our quantitative intelligence, that truly makes humans what they are - for example what it's like to be a human being living at the centre of the conscious present, surrounded by smells and tastes and feels and the sense of being an

extraordinary metaphysical entity with properties which hardly seem to belong to the physical world.

Social scientist Ross Honeywill believes social intelligence is an aggregated measure of self and social awareness, evolved social beliefs and attitudes, and a capacity and appetite to manage complex social change. A person with a high social intelligence quotient (SQ) is no better or worse than someone with a low SQ, they just have different attitudes, hopes, interests and desires.

Social determinants according to the original definition of Edward Thorndike, is "the ability to understand and manage men and women, boys and girls, to act wisely in human relations". It is equivalent to interpersonal intelligence, one of the types of intelligences identified in Howard Gardner's Theory of multiple intelligences, and closely related to theory of mind. Some authors have restricted the definition to deal only with knowledge of social situations, perhaps more properly called social cognition or social marketing intelligence, as it pertains to trending socio-psychological advertising and marketing strategies and tactics. According to Sean Foleno, Social intelligence is a person's competence to comprehend his or her environment optimally and react appropriately for socially successful conduct

Social intelligence quotient (SQ)

The social intelligence quotient or SQ is a statistical abstraction similar to the 'standard score' approach used in IQ tests with a mean of 100. Unlike the standard IQ test however it is not a fixed model. It leans more to Piaget's theory that intelligence is not a fixed attribute but a complex hierarchy of information-processing skills underlying an adaptive equilibrium between the individual and the environment. An individual can therefore change their SQ by altering their attitudes and behaviour in response to their complex social environment.

Social intelligence hypothesis

The 'Social Intelligence Hypothesis' in science asserts that complex socialization - politics, romance, family relationships, quarrels, making-up, collaboration, reciprocity, altruism - in short, social intelligence was the driving force in developing the size of human brains and

today provides our ability to use those large brains in complex social circumstances. It was the demands of living together that drove our need for intelligence. This idea is called the 'Social Intelligence Hypothesis'.

Professor of early history at Reading University, Steve Mithen, believes there are two key periods of brain expansion that contextualize the social intelligence hypothesis. The first was around two million years ago when brains expanded by about 50%. So humans went from brain size of around 450cc to a brain size of around 1,000cc by 1.8 million years ago. Archaeologists noting this change in primates asked; why are brains getting larger and what is it providing? Brains wouldn't get larger just for any reasons because brain tissue is metabolically very expensive, so has to be serving an important purpose. Mithen believes the social intelligence hypothesis suggests the expansion of brain size around two million years ago was because people were living in larger groups, more complex groups, having to keep track of different people, a larger number of social relationships that required a larger brain to do so. Social intelligence therefore gives us the answer to that first expansion of brain size two million years ago.

The second increase in brain size happened between 600,000 and 200,000 years ago, and during that period the brain reached its modern capacity. Trying to explain that second expansion in brain size is still a very challenging question. Mithen's view is that it is directly related to the evolution of language. Language is probably the most complex cognitive task we undertake. Language is directly related to social intelligence because we mainly use language to mediate our social relationships. So social intelligence was a critical factor in the expansions of brain size - there is a coevolution between social and cognitive complexity. And today social intelligence is pivotal in managing the complexity of being social animals.

Differences between intelligence and social intelligence

It's not enough just to be clever according to Professor Nicholas Humphrey. Autistic children, for example, are sometimes extremely clever. They're very good at making observations and remembering it all. However, it is argued they have low social intelligence.

Chimpanzees are very clever at the level of being able to make observations and remember things. They can remember better than humans can, but they, again, are inept at handling interpersonal relationships.So something else is needed. What is needed is a theory of mind, a theory of how other people work from the inside. For a long time the field was dominated by behaviourism. Scientists believed that one could understand human beings, rats, or pigeons (for example) only by observing their behavior and finding correlations. More recent theories indicate that this is not true; one must consider the inner structure behaviour.

Both Nicholas Humphrey and Ross Honeywill believe it is social intelligence or the richness of our qualitative life rather than our quantitative intelligence that truly makes humans what they are - for example what it's like to be a human being living at the centre of the conscious present, surrounded by smells and tastes and feels and the sense of being an extraordinary metaphysical entity with properties which hardly seem to belong to the physical world. This is social intelligence.

- **Additional views**

Social intelligence is closely related to cognition and emotional intelligence, and can also be seen as a first level in developing systems intelligence. Research psychologists studying social cognition and social neuroscience have discovered many principles which human social intelligence operates. In early work on this topic, psychologists Nancy Cantor and John Kihlstrom outlined the kinds of concepts people use to make sense of their social relations (e.g., "What situation am I in and what kind of person is this who is talking to me?"), and the rules they use to draw inferences ("What did he mean by that?") and plan actions ("What am I going to do about it?")

More recently, popular science writer Daniel Goleman has drawn on social neuroscience research to propose that social intelligence is made up of social awareness (including empathy, attunement, empathic accuracy, and social cognition) and social facility (including synchrony, self-presentation, influence, and concern). Goleman's immense research

indicates that our social relationships have a direct effect on our physical health and the deeper the relationship the deeper the impact. Goleman states that some physical effects of our relationships upon our health are the blood flow of one's body, one's breathing, one's mood (such as fatigue and depression), and even decreased power of one's immune system.

Educational researcher Raymond H. Hartjen asserts that expanded opportunities for social interaction enhances intelligence.Traditional classrooms do not permit the interaction of complex social behavior. Instead children in traditional settings are treated as learners who must be infused with more and more complex forms of information.

Few educational leaders he adduces have taken this position as a starting point to develop a school environment where social interaction could flourish If we follow this line of thinking then children must have an opportunity for continuous every day interpersonal experiences in order to develop a keen well developed 'interpersonal psychology'. As schools are structured today very few of these skills, critical for survival in the real world, are allowed to develop. Because we so limit the development of the skills of "natural psychologist" in traditional schools our students as graduates, enter the job market handicapped to the point of being incapable of surviving on their own.

In contrast those students that have had an ability to develop their skills as a "natural psychologist" in multiage classrooms and at democratic settings rise head and shoulders over their less socially skilled peers. They have a good sense of self, know what they want out of life and have the skills necessary to begin their quest.

The issue here is psychology versus social intelligence-as a separate and distinct perspective, seldom if ever articulated. An appropriate introduction contains certain hypothetical assumptions about social structure and function, as it relates to intelligence defined and expressed by groups, constrained by cultural expectations that assert potential realities, but make no claims or assertions that there is an "exterior" social truth to be defined and mapped-this perspective pursues the view that social structures can be defined with the admonition that what is mapped into the structure and how that information is

stored, retrieved, and decided upon are variable, but can be contained in an abstract and formal grammar-a sort of game of definitions and rules that permit and project an evolving intelligence.

Two halves of the coin: one half psychology; the other half social. Unfortunately, most references to social intelligence relate to an individual's social skills. Not mentioned, and more important, is how social intelligence (speaking of a group or assembly of groups) processes information about the world and shares it with participants in the group(s). Are there social structures or can they be designed to accumulate and reveal information to the individual or to other groups. Some social structures are obviously pathological: recently I came across a statement that describes a government as a pathocracy, run by sociopaths. The bigger question is how groups and societies map the environment (both ecological, social, and personal) into a social structure. How is that structure able to contain a worldview and to reveal that view to the participants? How are decisions made?

- **Measuring social intelligence**

Social Intelligence or SQ is a statistical abstraction similar to the 'standard score' approach used in IQ tests with a mean of 100. Scores of 140 or above are considered to be very high. SQ has until recently been measured by techniques such as question and answer sessions. These sessions assess the person's pragmatic abilities to test eligibility in certain special education courses, however some tests have been developed to measure social intelligence. This test can be used when diagnosing autism spectrum disorders, including autism and Asperger syndrome. Other, non-autistic or semi-autistic conditions such as semantic pragmatic disorder or SPD, schizophrenia, dyssemia and ADHD, are also of relevance. This test can also be used when assessing people that might have some sort of a disorder such as schizophrenia or ADHD.

People with low SQ are more suited to low customer contact roles, since they may not have the required interpersonal communication and social skills for success on the frontline These people may work better in an occupation that limits social interaction People with

SQs over 120 are considered socially skilled, and may work well with jobs that involve direct contact and communication with other people] The following example chart shows (assuming a person aged 17 is being tested, with an average SQ of 100 for that age) how a person's social age can be higher or lower based on scores in the SQ test:

ECO-CULTURAL DETERMINANTS

In understanding how the human person develops and learns, the age-old debate over nature versus nurture has been challenged by the growing body of contemporary wisdom affirming the latter's profound significance. Theorists and their theories--that have attempted to study humans in isolation--devoid of their embedded culture and specific socialization, have been critiqued, analyzed and found wanting. Many psychologists in the past have raised the issue of the developmental environment as a determinant in the overall development of the individual. However, psychology, being a science of the Western worldview, and its mainstream gatekeepers has insisted on studying the individual as though he or she develops and comes into full maturity of self without being affected by the social and eco-cultural environment in which the development occurs.

Not all Western psychologists and human scientists, though, are so naïve and lacking in intellectual prowess, for some, those affiliated with Critical Psychology and Cross-Cultural Psychology, have dared to acknowledge that the social context of the individual in fact, determined the very experimentation (the methods, tools and tasks) researchers used to determine development. Consider: The use of a paper and pen to answer researchers' questionnaires is a western socialized construct.

The problem with Western theories is that they are just that-Western theories.

Consequently, the assumption of universality-the belief that the findings (or the results) of studies done in narrow and unique cultural contexts (though few have been done with the sociocultural context in mind) are universal and applicable to all human contexts--is fraught with error, misconceptions and misinformation.

Definition of Terms

1. Apprenticeship (used metaphorically) is an activity in which novices advance their skills and understanding through participation with more skilled partners in culturally organized activities. The extended value of the apprenticeship model is that it includes "more people than a single expert and a single novice: the apprenticeship system often involves a group of novices (peers) who serve as resources for one another in exploring the new domain and aiding and challenging one another".

2. Ecology of human development involves the scientific study of the progressive, mutual accommodation between an active, growing human being and the changing properties of the immediate settings in which the developing person lives as this process is affected by relations between these settings and by the larger contexts in which the settings are embedded. It includes reciprocity.

3. Ecological environment is conceived topologically as a nested arrangement of concentric structures, each contained with the next. These structures are referred to as the micro-, meso-, exo-, and macrosystems.

   a) Micro-system - a pattern of activities, roles, and interpersonal relations experienced by the developing person in a given setting.

   b) Meso-system - comprises the interrelations among two or more settings in which the developing person actively participates (such as for a child, the relations among home, school, and neighborhood peer group; for an adult, among family, work, and social life).

   c) Exo-system refers to one or more settings that do not involve the developing person as an active participant, but in which events occur that affect, or are affected by what happens in setting containing the developing person.

   d) Macro-system refers to consistencies in the form and content of lower order systems (micro-, meso-, exo-) that exist or could exist at the level of the subculture or the culture as a whole, along with any belief systems or ideology underlying such consistencies.

4. Ecological experiment is an effort to investigate the progressive accommodation between the growing human organism and its environment through a systematic contrast between two or more environmental systems or their structural components, with a careful attempt to control other sources of influence either by random assignment (planned experiment) or by matching (natural experiment). The purpose of which is "not hypothesis testing but discovery-the identification of those systems properties and processes that affect and are affected by the behavior and development of the human beings"

5. Ecological transition occurs whenever a person's position in the ecological environment is altered as the result of a change in role, setting, or both

6. Ecological orientation to research emphasizes the subjects definitions of the situation and accord far more importance to the knowledge and initiative of the persons under study .

7. Experienced as used in micro-systems is used to indicate that scientifically relevant features of any environment including not only its objective properties but also the way in which these properties are perceived by the persons in that environment .Very few of the external influences significantly affecting human behavior and development can be described solely in terms of objective physical conditions or events: the aspects of the environment that are most powerful in shaping the course of psychological growth are overwhelmingly those that have meaning to the person in a given situation"

8. Human Development (in the environmental context) is the process through which the growing person acquires a more extended differentiated and valid conception of the ecological environment and becomes motivated and able to engage in activities that reveal the properties of, sustain, or restructure that environment at levels of similar or greater complexity in form and content

THEORIES OF INTELLIGENCE

While intelligence is one of the most talked about subjects within psychology, there is no standard definition of what exactly constitutes 'intelligence.' Some researchers have

suggested that intelligence is a single, general ability, while other believe that intelligence encompasses a range of aptitudes, skills and talents. The following are some of the major theories of intelligence that have emerged during the last 100 years.

Charles Spearman'Intelligence Theory

British psychologist Charles Spearman (1863-1945) was an English psychologist known for work in statistics, as a pioneer of factor analysis, and for Spearman's rank correlation coefficient. He also did seminal work on models for human intelligence, including his theory that disparate cognitive test scores reflect a single General intelligence factor. He coined the term g factor described a concept he referred to as general intelligence, or the g factor. After using a technique known as factor analysis to examine a number of mental aptitude tests, Spearman concluded that scores on these tests were remarkably similar. People who performed well on one cognitive test tended to perform well on other tests, while those who scored badly on one test tended to score badly on others. He concluded that intelligence is general cognitive ability that could be measured and numerically expressed.

Theory of intelligence

A wonderful record of Spearman's views on g (and also those of Godfrey Thomson and Edward Thorndike) was made in the course of the Andrew Carnegie sponsored International Examinations Inquiry Meetings .

Here, Spearman gives a compact summary of his findings and theory of g:

When asked what G is, one has to distinguish between the meanings of terms and the facts about things. G means a particular quantity derived from statistical operations. Under certain conditions the score of a person at a mental test can be divided into two factors, one of which is always the same in all tests, whereas the other varies from one test to another; the former is called the general factor or G, while the other is called the specific factor. This then is what the G term means, a score-factor and nothing more.

But this meaning is sufficient to render the term well defined so that the underlying thing is susceptible to scientific investigation; we can proceed to? and out facts about this score-

factor, or G. We can ascertain the kind of mental operations in which it plays a dominant part as compared with the other or specific factor. And so the discovery has been made that G is dominant in such operations as reasoning, or learning Latin; whereas it plays a very small part indeed in such operation (sic) as distinguishing one tone from another. G tends to dominate according as the performance involves the perceiving of relations, or as it requires that relations seen in one situation should be transferred to another. On weighing the evidence, many of us used to say that this G appears to measure some form of mental energy. But in the first place, such a suggestion is apt to invite needless controversy. This can be avoided by saying more cautiously that G behaves as if it measured an energy. In the second place, however, there seems to be good reason for changing the concept of energy to that of "power" (which, of course, is energy or work divided by time). In this way, one can talk about mind power in much the same manner as about horse power.G is in the normal course of events determined innately; a person can no more be trained to have it in higher degree than he can be trained to be taller.

There was also another cofactor as proposed by Spearman that was special intelligence. The special intelligence was for individuals who accomplished high success results in the some tests. However, later Spearman introduced group factor that was particular to those correlations that were not a result of factor g or s. His ideas were in 1938 criticized on paper by Louis L. Thurstone a psychologist saying that his experiments show that the correlation of intelligence can be categorized in seven primary categories. These categories were numerical, reasoning, spatial, perceptual, memory, verbal fluency and verbal comprehension. However Raymond B. Cattell in 1963 agreed with the concept theorized by Spearman but put forth his findings about intelligence analyses. His analyses were that intelligence is further subdivided in two divisions known as fluid and crystallized intelligence.

As time progressed, Spearman increasingly argued that g was not, from a psychological point of view, a single ability but composed of two very different abilities which normally worked closely together. These he called "eductive" ability and "reproductive" ability. The former term comes from the Latin root "educere" - which means to "draw out" and thus refers to the ability to make meaning out of confusion. He claimed that to understand these

different abilities "in their trenchant contrast, their ubiquitous cooperation, and their genetic interlinkage" would, for the study of "individual differences - and even cognition itself" - be "the very beginning of wisdom.".

Despite Spearman arguing that g was what emerged from a large battery of tests, i.e., that it was not measured perfectly by any single test, the fact that g-theory suggested that much of ability could be captured in a single factor, and his suggestion that "the eduction of relations and correlates" underlay this general factor led to the quest for tests of this general ability. Raven's Progressive Matrices might be regarded as one of these although Raven himself clearly stated that his tests should not be regarded as "intelligence" tests.

While arguing consistently that g accounted for much of individual differences in "ability" (as measured by tests which had "no place in schools"), Spearman also acknowledged that "Every normal man, woman, and child is a genius at something. It remains to discover at what " He thought that detecting these areas of genius required procedures very different from "any of the testing procedures at present in current usage", though he felt these to be capable of "vast improvement".

While, like Arthur Jensen after him, Spearman felt that though g could be detected in any broad set of cognitive measures, he felt that the tests from which his g had emerged "had no place in schools" because they "deflected" teachers', pupils', parents' and politicians' attention from the business of education which, as the Latin root of the word implies, should be concerned with "drawing out" whatever talents a student may have .

Spearman's model was influential, but was also critiqued by many authors, such as, for instance Godfrey Thomson. In particular the move from a psychological g to a biological g - that is a unitary biological mechanism or mechanisms has remained a matter of active research.

Louis L. Thurstone - Primary Mental Abilities

Louis Leon Thurstone (May 29, 1887 - September 29, 1955) was a U.S. Pioneer in psychometrics and an influential theorist of intelligence. He contributed greatly to the measurement of attitudes, and is well known for his contributions to factor analysis.

The study of intelligence has been fraught with controversy, particularly in relation to the evaluation of groups as of "higher" or "lower" intelligence than others. Thurstone's work emphasized different types of intelligence, rather than focusing on a single factor of general intelligence, and thus better recognizes the diversity of human abilities. Thurstone's attitudinal scale was very influential in encouraging others, such as Guttman and Coombs, to develop practical scaling procedures in the social sciences. Thus, his work, while not providing a complete understanding of human nature, offered a number of significant advances. He offered a differing theory of intelligence. Instead of viewing intelligence as a single, general ability, Thurstone's theory focused on seven different "primary mental abilities." The abilities that he described were:

Thurstone's Seven Primary Mental abilities - No general intelligence; 7 abilities are independent

a. Verbal comprehension - vocabulary, concepts, words

b. Number - use numbers in problem solving

c. Spatial relations - see & manipulate objects in space

d. Perceptual speed - how fast see similarities/differences

e. Word fluency - use words quickly & fluently

f. Memory - remember lists of digits & characters

g. Inductive reasoning - discover rules & relationships

Thurstone's main contributions to psychology and psychometrics are his method of factor analysis, his theory of intelligence, and his comparative judgment scale.

Factor Analysis

Although Charles Spearman is credited with inventing factor analysis, Thurstone is the one who first coined the term. In addition, Thurstone is recognized as the inventor of exploratory factor analysis, a more practical variation than the confirmatory factor analysis of Spearman. The goal of Thurstone's model is to determine the number of meaningful common factors in a correlation matrix. This produces simple structures that accounts for many of the correlations observed among the factors. Exploratory factor analysis determines the number and the nature of latent constructs within a set of observed variables. Analyzing the correlated factors can rank the factors in order of importance to the correlation. Thus, exploratory factor analysis is important tool in determining hierarchy of factors such as the contributors to intelligence.

Theory of Intelligence

Thurstone's theory of intelligence centered on the existence of Primary Mental Abilities (PMA). His approach was in direct contrast with Spearman's theory of general intelligence. Thurstone felt that differences in the results of intellectual tasks could be attributed to one or more of seven independent abilities. These seven abilities were named Space, Verbal Comprehension, Word Fluency, Number Facility, Induction, Perceptual Speed, Deduction, Rote Memory, and Arithmetic Reasoning.

The Space PMA represents the ability to recognize that two shapes are the same when one has been rotated. Perceptual Speed is the ability to recognize similarities and differences between pairs of stimuli. Verbal Comprehension involves recognizing synonyms and antonyms. Induction requires establishing a rule or pattern within a given set. Deduction involves drawing a logical inference from a set of facts or premises.

Thurstone's theory was well supported by his early research when the subjects were University of Chicago undergraduates. It did not hold up when he tested school aged children. Apparently, the more intellectually elite subjects at the University of Chicago did

not differ very much on their general intelligence. Their observable differences were noted among the PMAs. The grade school children were more diverse in their general intelligence. Therefore, the differences among their PMAs were not as notable as the differences among their general intelligence.

Comparative Judgment Scale

In psychology, the 'Thurstone scale' was the first formal technique for measuring an attitude. It was developed by Thurstone in 1928, as a means of measuring attitudes towards religion. It is made up of statements about a particular issue, and each statement has a numerical value indicating how favorable or unfavorable it is judged to be. People check each of the statements to which they agree, and a mean score is computed, indicating their attitude.

This methodological contribution of Thurstone has been noted as one of the first attempts at developing a comparative judgment scaling technique. This method of measuring attitudes on an interval scale allowed statements related to an attitude to be ranked in reference to each other. The extreme opposites of the attitude and the opinions representing the equally-distanced steps in between the opposites could be established.

This rank scale can be used to rank all possible feelings related to an issue and to categorize people expressing an opinion based on the rank of that opinion. It is used today mainly in basic research. Most researchers acknowledge that, while it is very accurate, it is too complex for applied settings.

Legacy

Thurstone's theory of intelligence was a major influence on later theories of multiple intelligences, such as those of Guilford, Gardner, and Sternberg. Guilford developed a three-dimensional model of intelligence composed of contents, operations, and processes. This model relied on the interactions of various factors similar to the interactions of the correlation of factors in Thurstone's theory. Although Gardner's multiple intelligences did not perfectly intersect with Thurstone's PMAs, both theories support a practical definition of

intelligence. Sternberg emphasized speed of perception and the practical application of inductive reasoning as an important part of his triarchic theory of intelligence.

Thurstone's attitudinal scale was very influential in encouraging others, such as Guttman and Coombs, to develop practical scaling procedures in the social sciences.

The early controversies raised by Thurstone lead to the effectiveness of factor analysis and, particularly multiple factor analysis, used today. His influence is seen in the development of the Minres method and Kaiser's verimax method, both founded upon multiple factor analysis.

J. P. Guilford

Joy Paul Guilford (March 7, 1897, Marquette, Nebraska - November 26, 1987, Los Angeles) was a US psychologist, best remembered for his psychometric study of human intelligence, including the important distinction between convergent and divergent production.

Developing the views of L. L. Thurstone, Guilford rejected Charles Spearman's view that intelligence could be characterized in a single numerical parameter and proposed that three dimensions were necessary for accurate description: operations, content and products.

- **Guilford's Structure of Intellect**

  According to Guilford's Structure of Intellect (SI) theory, an individual's performance on intelligence tests can be traced back to the underlying mental abilities or factors of intelligence. SI theory comprises up to 150 different intellectual abilities organized along three dimensions-Operations, Content, and Products.

- **Operations dimension**

  SI includes six operations or general intellectual processes:

  Cognition-The ability to understand, comprehend, discover, and become aware of information.

Memory recording-The ability to encode information.

Memory retention-The ability to recall information.

Divergent production-The ability to generate multiple solutions to a problem; creativity.

Convergent production-The ability to deduce a single solution to a problem; rule-following or problem-solving.

Evaluation-The ability to judge whether or not information is accurate, consistent, or valid.

- **Content dimension**

SI includes three broad areas of information to which the human intellect applies the six operations:

Figural - Concrete, real world information, tangible objects -- things in the environment. It includes visual-Information perceived through seeing, auditory-Information perceived through hearing and kinesthetic-Information perceived through one's own physical actions.

Symbolic-Information perceived as symbols or signs that stand for something else; e.g., Arabic numerals or the letters of an alphabet, musical and scientific notations..

Semantic-Which is concerned with verbal meaning and ideas. Generally considered to abstract in nature. Behavioral-Information perceived as acts of people. (This dimension was not fully researched in Guilfords project and remain theoretical and is generally not included in the final model that he proposed for describing human intelligence.)

- **Product dimension**

As the name suggests, this dimension contains results of applying particular operations to specific contents. The SI model includes six products, in increasing complexity:

Units-Single items of knowledge.

Classes-Sets of units sharing common attributes.

Relations-Units linked as opposites or in associations, sequences, or analogies.

Systems-Multiple relations interrelated to comprise structures or networks.

Transformations-Changes, perspectives, conversions, or mutations to knowledge.

Implications-Predictions, inferences, consequences, or anticipations of knowledge.

Therefore, according to Guilford there are 5 x 3 x 6 = 90 intellectual abilities or factors (his research only confirmed about three behavioral abilities, so it is generally not included in the model). Each ability stands for a particular operation in a particular content area and results in a specific product, such as Comprehension of Figural Units or Evaluation of Semantic Implications.

Guilford's original model was composed of 120 components (when the behavioral component is included) because he had not separated Figural Content into separate Auditory and Visual contents, nor had he separated Memory into Memory Recording and Memory Retention. When he separated Figural into Auditory and Visual contents, his model increased to 5 x 5 x 6 = 150 categories. When Guilford separated the Memory functions, his model finally increased to the final 180 factors

- **Criticism**

Various researchers have criticized the statistical techniques used by Guilford. According to Jensen (1998), Guilford's contention that a g-factor was untenable was influenced by his observation that cognitive tests of U.S. Air Force personnel did not show correlations significantly different from zero. According to one reanalysis, this resulted from artifacts and methodological errors. Applying more robust methodologies, the correlations in Guilford's data sets are positive. In another reanalysis, randomly generated models were found to be as well supported as Guilford's own theory.

Guilford's Structure-of-Intellect model of human abilities has few supporters today. Carroll (1993) summarized the view of later researchers:

"Guilford's SOI model must, therefore, be marked down as a somewhat eccentric aberration in the history of intelligence models; that so much attention has been paid to it is disturbing, to the extent that textbooks and other treatments of it have given the impression that the model is valid and widely accepted, when clearly it is not."