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## GLOBAL COGNITIVE THEORY

## INTELLIGENCE, INTUITION AND CREATIVITY





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# INTELLIGENCE, INTUITION AND CREATIVITY

## 1. Theory of intelligence

This online book of the *Global Cognitive Theory* is dedicated to the various **concepts or definitions of intelligence** and intelligence as a knowledge manager:

- I have tried to define the different forms of its internal workings from the preconcepts and automatic responses to the responses generated by **logic** and the system of **language**. The organization criterion chosen is the degree of reliability associated with the response of intelligence when its system faces a problem or requirement.
- An approach to **creativity**, in the sense of creativity being formed by complex functions or packets of basic functions of intelligence that support certain complex abilities of the brain.
- The next step is to speculate on **the physiological structure** that is most apt to execute the required functions, its **genetic nature** and, as a consequence, the way in which intelligence is transmitted to following generations.
- The coherence of the proposals of this theory of intelligence need an additional element, evolutionary psychology or the way in which intelligence grows and develops. It seems slightly complicated that it develops and improves its efficiency through random mutations.

After the previous comments, we should have a better understanding of the different concepts of the word intelligence, particularly about terms used for **relational intelligence** and **conditional intelligence**.

The section of **related links** includes the four online books of the **Global Cognitive Theory**:

- *The brain and modern computers.*
- *Intelligence, intuition and creativity.*
- *Memory, language and other brain abilities.*
- *The will, decision making process and artificial intelligence.*

Another related link is referred to the online book of the *Global Theory of the Conditional Evolution of Life*.

There is also a link to the on-line book of the *Global Scientific Method* and the philosophy of science. It includes the design of **new scientific methods** and the classification of the stages and steps of the scientific method; understanding the scientific method in the broad sense as the application of logic to the generation of common knowledge with a high level of reliability.

The **scientific method** works fine in general, but it works much better in its developmental phase than in its phase of general acceptance. All types of social interests affect the last phase, from the realm of sociology as in the case of *Darwin's theory*, to the technician nature as in the case of the *Theory of Relativity*.

The last item of the *related links* is *The EDI Study* about **Evolution and Design of Intelligence**, a complete **statistical survey on the heritability of intelligence** performed on the fieldwork database of the *Young Adulthood Study, 1939-1967*

This statistical study is an **empirical research** about some considerations of the *Global Cognitive Theory* related with the brain and evolution, in particular the *definition of intelligence*.

The results of the statistical survey *The EDI Study* regarding an **elegant intelligence** show some important considerations:

- The hereditary nature of **relational intelligence** is confirmed.
- The genetic information with less intellectual potential is the significant one, as the GTCEL states regarding the concept of conditional intelligence.
- Likewise, it seems that the main functions of intelligence, or those evolving faster, are fairly concentrated in only one chromosome.
- The most innovative element of this work on cognitive psychology is undoubtedly the section relating to simulation. This section contains the explanation of how the **artificial intelligence quotient vectors** are generated by using the previsions of the new theory of evolution; they practically behave

like the variables that were actually observed, in despite of the intrinsic complexity involved.

- As if that were not enough, with the due caution this subject deserves, the existence of a **finalistic or teleological evolution** is scientifically proven to agree with that indicated by the *General Theory of Conditional Evolution of Life*.

Given that the current results in this book suggest a **fairly radical change** from the common opinions held by the majority of the scientific community and society, the logical deduction is that more extensive studies on cognitive psychology using the same methodology need to be performed.

An example of further exploration of this study is found in the section that has been added subsequently, which is related to **partner choice and intelligence**. In this section a hypothesis regarding a concrete requisite of the *acceptable limit of the difference in intelligence when forming a couple*, is confirmed and simultaneously reinforces the model's overall coherence. In fact, the requirement refers to the unconscious choice of an unknown intelligence for current cognitive psychology.

## INTELLIGENCE

### 2. Definition of intelligence

**Colloquial language** has numerous definitions for intelligence, and some of the meanings are opposite from what you would expect.

The **doctrine** is very divided and influenced for the social acceptance of its proposals. An author who proposed a definition of intelligence that everyone has a very similar endowment of intelligence and that everyone can become very intelligent would have a lot more possibilities for the publicity and promotion of his/her ideas than if he/she had proposed the contrary.

Another promising and complementary path, different from the previous, is minimizing the importance of the classic concept or definition of intelligence and associating the marvellous word to other aspects of life, such as social or emotional success; so, exaggerating a little, we could find that the lottery could be considered a representation of the winner's economic intelligence or that having lots of "*friends*" could represent **emotional intelligence**.

These doctrinal tendencies, even the most serious and scientific ones, such as the **theory of multiple intelligences**, suffer from an additional problem, which is that they reach the general public with a fairly distorted content, who are victims of

their accelerated acceptance.

In short, I would say to both professionals in this subject and the general public that the false humbleness is not humbleness but rather falseness, which of course does not help scientific development at all, especially in the planning of an educative system. The supposed quasi-equality of the genetic endowment of intelligence could impede the comprehension of complex social phenomenon...

From the Vox General Dictionary of the Spanish Language, we can stress the following two meanings:

- *The ability to understand, a greater or lesser capacity to know or learn.*
- *A group of all the functions whose objective is knowledge (sensation, association, memory, imagination, understanding, reason, conscience).*

In my opinion, they are good and acceptable definitions in the sphere of language, but somewhat imprecise technically. In the first definition of intelligence, aspects related to learning that do not have much to do with intelligence, such as memory in its distinct dimension of the memory manager, are included. The second is excessively generic.

The reflections made about the multifunctional and multifaceted nature of intelligence, the conditions or requirements associated to the desired responses and its hereditary nature, allow us to make a conceptual approximation to the different meanings used to propose a new definition of intelligence

## 2.a) Relational intelligence

This name is an attempt to gather what we have expressed on various occasions, that we understand intelligence as a **capacity for making abstract relations**. Therefore, it will be formed by the group of abstract elemental relational functions that allow for any fairly complex relational operation to be carried out.

So, we can cite the following relations as known examples: above / below, large / small, general / specific, deep / high-pitched, smooth / rough, dark / light, matt / shiny, in front / behind, kind / rude, sour / mild, direct / refined, sweet / bitter, intense / light, good / bad, etc.

These conceptual relations are surely not as elemental as they seem. For example, all appear slightly binary, but this is not a necessary condition in order to be considered a basic relation. Also, they can be understood in an increasing linear order, some may be better represented in two dimensions. In any case, I hope that they serve to express what we are trying to say.

## 2.b) Conditional intelligence

As we have seen, the cognitive functions work depending on the demanded requirements regarding **response reliability**. Surely we could specify another type of operating conditions for intelligence and we would obtain other classifications for it.

These demands as for its articulation define conditional intelligence for us, indicating that the same group of functions of relational intelligence can assume different conditional intelligences depending on the operative form.

The concept is important given that, on one hand, it provides us with an instrument for identifying certain cases of special significance, and on the other hand, it reminds us that elemental functions are the same when the only variation of the particular case refers to the operative conditions.

## 2.c) Multiple intelligences

Regardless the mentioned *Theory of Multiple Intelligences* of **Howard Gardner** to consider it somewhat opportunistic or a bit commercial, it seems clear that multiple intelligences or a multiple intelligence exist.

Multiple intelligences will be identified not only by the different types of elementary relations (space, odor, color, etc.) involved but also by the operational mechanisms or any other criterion that we could associate.

The classification of **multiple intelligences** could be as extensive as wanted because in any act or concept it is possible to find basic relations, although calling intelligence to everything would not make but eliminate its own differentiating concept and, therefore, the same utility of the word intelligence.

In other sections some type of multiple intelligences are dealt with. Below I will point out some cases that are particularly interesting:

### 2.c.1) Intelligence in strict sense of the word

This is keeping with that shown in the section related to the knowledge manager's secure responses. Strictly speaking, intelligence can be understood as the capacity for making relations but with the added condition of a high degree of reliability.

In other words it corresponds with **conditional intelligence** when the previously mentioned **high degree of reliability** is associated with it. The majority of times we mention the word "*intelligence*" without referring to a specific type, we

are referring to this concept in accordance with what we think **colloquial language and part of the doctrine** constitute.

The verification of responses to obtain the desired reliability implies some specific biological mechanisms explained in detail in the GTCEL book and make the genetic information of the progenitor with lesser potential more significant than the other because it is closer to the common relational functions in both

Generally speaking, I think that the main factors of intelligence perception are the depth and originality of ideas along with the absence of errors in reasoning. *Do not confuse this with those people who do not express their reasoning so as not to commit apparent errors!*

The characteristics of this new type of intelligence may be not easy to understand but it is of the maximum importance to appreciate the new approach to the study of multiple intelligences or, simply, different types of expression of the functional relations.

#### 2.c.2) **"g" factor or general intelligence**

In this idea of multiple intelligences, the concept of general intelligence is the result of adding the condition that the relational functions in strict sense of the word have to be common to a large quantity of the intellect's processes.

The relevance of this factor is derived from the fact that its measurement is very useful in relation to intelligence in the strict sense of the word. Also, it is the one that comes the closest to the concept of intelligence measured by classic intelligence or **typical IQ tests**.

These measurements have a great advantage of being independent of cultural factors because they are based on dot matrix or chart tests.

The study of the hereditary nature of intelligence uses information about IQ that, to a great extent, fit in this category. In any case, if some specific relational functions are hereditary, it is logical to assume that others would also be, but with different mechanisms of expression.

#### 2.c.3) **Modern intelligence quotients**

Different dot matrix and language test batteries are integrated in just one intelligent quotient and, therefore, they gather in greater measurement the potential of multiple intelligences. Although, as I have expressed previously, I believe it is much better to say that these modern intelligent quotients are closer to the concept of relational intelligence than to the one of multiple intelligences.

To broadly determine a person's intellectual ability they are more complete, but, for me, they suffer from two basic problems: when including language tests, they incorporate aspects other than intelligence in the strict sense of the word, and have a strong cultural influence.

#### 2.c.4) Woman and man intelligence

At this point, I wanted to embark on a delicate subject, that of the **possible sexual differentiation in intelligence between woman and man**. I would say that there is a general consensus that great differences exist between female and male sensitivity. Consequently, the groups of basic relational functions that support these sensitivities should be somewhat different.

From there, if a determined test of intelligence is used that collects, to a great extent, the feminine sensitivity of men and women, we would have to wait for women to obtain better results and vice versa.

A curious act is that, to some extent, all of us memorize a representation of others where, on top of their image, we include some characteristics, needless to say, from our point of view. Among them is an intuitive estimation of that person's intelligence.

As this approximation is carried out on a personal scale, it should not be surprising that many women are completely convinced that they are much more intelligent than men, and vice versa. In fact, all men and all women are right from their point of view or scale of reference.

An example of how complicated the subject of sexual differentiation in intelligence between woman and man is would be to speak about the beauty of intelligence and the intelligence of beauty. In a certain respect, both affirmations are correct and, therefore, elemental relational functions that support them should exist. In relation to this subject, without wanting to go any deeper in it, we can cite the existence of certain symmetries.

Another example could be the different results that come out of complicated mathematical calculations if we are working with variables rounded to whole numbers or with decimals. Sometimes one way is better and other times, the other way; but, if the program is very complicated, perhaps both should not, or would not be efficient if maintained simultaneously.

In the calculations used (that were complicated due to their quantity) in the demonstration of the heritability of intelligence, the variables are ordered with different criteria, and the results may sensitively vary depending on the criterion of

organization prior to the last variable used.

If the absolute scale cannot be discovered, a good solution is to use a neutral scale in respect to gender for **pure convention**. This is what some of the most important tests of today do as far different batteries of forms or questions are concerned; through adequate ponderation they achieve that the overall evaluation of the tests to be neutral.

In some cases, the values are corrected with a different scale according to gender; the TC1 test is an example that is based on a series of dominoes.

In other cases, the results are corrected according to age. For ages above 30, the result is compensated considering that there is a fall in performance although not in potential.

In short, it deals with obtaining equality by age in a conventional fashion. It could also go the other way, that is to say, theoretical inequality. For example, the youngest may be more intelligent due to evolutionary reasons; the statistical work in the annex obtains better adjustments in the studied correlations for an "*average*" 10% improvement in each generation

### **3. Human knowledge management process**

From this point, we are going to study the behaviour or normal operation of relational intelligence within the *human knowledge management process* when producing responses or conclusions on the base of determined information, whether from the exterior, interior, or a mix.

#### **3.a) Automatic or unconscious brain functions:**

- **Preconcepts and emotions**

The preconcepts are hardly negative in the *theory of knowledge*, rather, they are necessary to **avoid thought repetition** and constant mental reasoning; at the same time, the preconcepts can act as a true limit of knowledge or of its innovation.

When the **knowledge management process** has sufficiently developed an idea and reached a conclusion, it incorporates the idea into the memory to avoid repeating the entire process over again. Normally, the most important preconcepts are immediately loaded in the memory every day, forming an important part of what is called "*a person's character*."

Regarding **computer knowledge**, we can assimilate the preconcepts to direct

links, association of files, or other similar mechanisms.

One of the first characteristics of computer abilities that stands out is their capacity to repeat or carry out instructions that have been previously saved (their automatism), but for this, computers need a program and have it loaded in the memory.

The **human knowledge management system** is much more powerful than any existing computer but it also needs previously developed programs that are *loaded in operative or immediate memory* in order to function. These programs or **cognitive processes** are somewhat similar to the preconcepts but have a functional nature, and are usually programs, small functions, or groups of them.

We will examine some relevant knowledge processes in the *theory of knowledge*:

- *Drive a car.*

When we are not driving, the relevant knowledge and experiences related to driving are saved in our brain but they are not active; once we enter a car, these are activated or made more present, or are loaded into operative memory. This cognitive process would be much more intense if we were sitting in the driver's seat.

- *Personal security.*

Another clarifying example influencing whether we are relaxed or not is how much control of our immediate surroundings we have. Regarding security problems a security program is loaded by the **knowledge management process** that affects how the senses operate and the capacity of rapid response of a large part of our body's muscles; we are not, however, referring to the effect that adrenaline produces.

- *Languages.*

People who speak various languages know perfectly well that, when you do not practice a language, you lose a lot of what you have learned, but this can be almost miraculously recovered with a little bit of additional practice. This effect of the cognitive capacities is much more accentuated when people speak more than one foreign language because they tend to be replaced in the operative memory due to the brain's limited capacity because it cannot maintain so many concepts and different grammatical structures active.

It seems reasonable to assume that everyday when we wake up, the knowledge management system boots the programs or information that it knows it is going to use throughout the entire day, and, on the other hand, that the group of words that we habitually speak with is in direct relation with our potential medium. That is, as our **cognitive development** develops as human specie,

the number of words in a language increases.

Naturally, the programs have to be previously developed, and with each new experience they become enriched and perfected, in other words, there is a constant **cognitive development** that produces the evolution of the knowledge management system. It is just like how a programmer perfects his work until he/she obtains a certain level.

The brain's power notably increases with this automation and response velocity will be quite superior for two reasons.

First, because the information from the outset is placed directly in the subprograms or functions' prepared fields, and once all the information is received, the specific operation is triggered.

The second is, that just a few responses from the knowledge system are enough to validate the start or result of the operation. In this respect, the speed can be similar or even faster than the ultra-fast responses of the language manager.

Aside from the examples in the previous section, we can cite two more cognitive processes where internal function development can be easily perceived:

- *Typing.*  
their life to reorganization, simplification, rationalization, and development without consciously noticing.
- *Dreams.*  
We have also discussed the cognitive functions our dreams have when we talked about the optimisation of operation.

### 3.b) **Reliable brain functions:**

- **Mathematical logic and math memory**

Both the preconcepts and the automatic responses are previously created by the intellect throughout the individual cognitive development, on the other hand, the secure responses, that have a certain degree of reliability, and the ultrafast or similar ones are a result of the **direct logic** of the intellect.

A specific vision is set out in the GTCEL about the mathematical logic and math memory when speaking about the method of verification of transmitted genetic information, of the possible models for contrasting the theory and in the appendix regarding the technological development of the breaks in the automobile industry.

A part of this exposition is reproduced in the section dealing with the genetic structure of intelligence.

Briefly summarising, both operate on the result that billions of neurons are created with the genetic information of a progenitor and another group of neurons with the other progenitor. That is, the result of the two groups of neurons have to be waited for, and, to the extent that both results coincide, we are guaranteed their correction. In other words, the *nature of logic* requires these two mechanisms of logic control will only operate with the brain functions created from the two sources of genetic information that offer an identical result.

This mechanism implies a significant consumption of time, taking into account that, it is also looking for the certainty of responses. As soon as the results are not identical, pure reasoning or **formal logic** will stop.

### 3.c) Less reliable brain functions:

- Intuition and non-mathematical memory

The fact that formal logic control is stopped when there is not a 100% certainty that the results are correct does not mean that somewhat less certain but perhaps operative conclusions cannot be made within a reasonable margin of error. It is also possible that at the end of this non mathematical logic, a conclusion is reached that can be checked or verified by other means or with another perspective.

In any case, it is clear that intuition reaches much beyond simple reasoning. This cognitive processes bring the key idea to a **definition of intuition**.

From this perspective of the **cognitive science**, it can easily be gathered that each person will have a fair amount of intuition in comparison with their mathematical logic or intelligence (in the strict sense of the word) according to the equilibrium or imbalance of the capacities inherited from their progenitors.

This *cognitive theory* about the nature of logic can be applied to **mathematical and normal memory**. Consequently, normal memory is much more powerful than mathematical memory because it does not demand absolute certainty from its results.

Given that we are not worried about error, when the cognitive processes of non-mathematical memory are used, it is accompanied by personal calmness. It is worth pointing out that not having internal certainty of responses does not mean that the results are not objectively correct.

When 100% reliability is demanded by the cognitive process, response time can be excessively long, for example, about voice-recognizing programs. In complicated

programs when there is not very serious error, 100% reliability could never be worked with; you would have to find a balance between risk of error and loosing time and energy to reduce this risk, just **like the human brain**.

It is interesting that **logic computer** works better in cases that require 100% reliability such as calculations and mathematical memory, and, on the other hand, is worse when the required reliability of cognitive process is low, such as with languages.

### 3.d) Ultrafast brain functions.

- Theory of language

The human **brain functions** for language is also discussed in the model section of possibly verifications of the GTCEL.

Linguistic memory behaves like normal memory with a low degree of reliability. Think that if mathematical memory works with 98-100%, normal memory could work with 90 or 95% and linguistic memory could be around 80%.

In other words, not selecting the word that best says what we want to say, does not mean, that the word we have said does not say what we wanted to say with enough precision.

*The previous paragraph is an example of itself!* I mean of the nature of linguistic memory.

Continuing with the line of argument about cognitive theory of the memory and remembering that the memory manager is the intelligence; the linguistic memory manager acts by selecting the first proposals that its internal mechanisms or cognitive processes offer.

That is, the overall language mechanism is made up of linguistic memory and the previously mentioned manager; it will not apply the method of verification of information, rather, it will apply a different one that will act intuitively but quicker than intuition.

The **cognitive ability of complementariness** of two elements that, in this case, do not demand the VGI (*Verification Genetic Information*) should be fairly greater than individual elements when the VGI is applied. This could be the reason that the capacity of human language is truly surprising.

From another point of view, with this cognitive theory is also not surprising that any malfunction of memory or its manager, as little as it may be, may have a

significant effect on oral expression. Specifically, these malfunctions are well known and problems related to language and its written expression are fairly widespread, like problems related with dyslexia.

### 3.e) Definition of creativity

To begin with, I believe that creativity is another of the qualities that is essential to the life of living beings. Keeping to the topic of human ability, it seems clear that all people are creative to a greater or lesser extent, just like with intelligence and beauty.

When the concept of creativity is used in reference to language, it is as an adjective that refers to a person who is particularly talented in comparison to the average of the rest of the population. *A slightly creative person is definitely more creative than a very creative cat!*

For me, a good definition of creativity is a **subset of intelligence**, meaning a group of basic relational or elemental functions with a high association of reliability; that is a particular subset of conditional intelligence. Strictly speaking, this last requirement is essential for intelligence; if the brain's functions responsible for creating logical relations often make mistakes, this would not be intelligence, but rather something else that I call intuition, but, if mistakes were almost always made, this would be called a lack of intelligence.

This subset is formed by those functions that make the creation, design, invention, imagination, etc. of new concepts or ideas easier.

The demand of high reliability for creativity appears paradoxical because it does not seem that the same justification of "*gravity of possible error*" that we used for intelligence, can be applied in this instance.

Not only is an error not considered something serious in creative processes, but mistakes are also considered normal. Nonetheless, given that creativity requires various successive operations to be carried out in order to exist, if errors are made by elemental functions, it is not very likely that the final result will be good; we may find new creations due to chance but not creativity.

However, we should not lose sight of the fact that an absolute conceptual definition of creativity is not easy, as we have also previously cited, language is precisely characterized by the contrary of this. The possibility that one of the important causes behind creation is due to a defective function in sensorial perception is widely accepted in regards to certain important artistic creations.

On the other hand, if we think about the specific subset of the functions of creativity, we will realize that they deal with particularly complex functions of intelligence; that is, if we were talking about more packets of elemental functions in which all should operate with a high degree of reliability. Therefore, it is not so much that the complex function (creativity) does not generate errors, but rather that the elemental functions or parts (intelligence) do not generate them.

So, a more concrete **definition of creativity** would be formed by **complex functions or packets of basic functions of intelligence** that support the capacities of:

- Carrying out extrapolations and estimations of the result, given the existing relations.
- Understanding the limits of the parameters involved in the relations.
- Detect the change in relation caused by a change in the parameters, otherwise said, qualitative implications for quantitative changes.
- Simultaneous management of various dimensions.
- Perform changes in scale or model variables, changing new parameters, and returning to the initial scale or model variable in the appropriate point of the corresponding changes of the original parameters. That is, the concepts related to the different types of applications defined in the relatively modern math of groups.
- Functions related to advanced statistical thought such as distinction between an average value and a normal value, a different value and a rare value, and distinction between a particular case and general values.
- Any others that respond to the stated concept.

Plausibly, to be creative in a specific subject, it is not necessary to have all the previous functions. Nonetheless, aside from some of the previous common functions, the following should also be present: both elemental capacities of intelligence associated to this subject and the specific capacities that do not form a part of intelligence, whether dealing with music, football, economics, etc.

Consequently, I think that intelligent people tend to be more creative, and this tendency is more apparent the more intelligent someone is. This tendency also exists the other way around (the less intelligent, the less creative), but, in my opinion, it is not as strong because of the particular intelligence associated and the specific capacities.

*A person can be very intelligent and have a subset of creativity functions that are not very operative! A person can be very creative and not very intelligent if other important elemental functions fail!*

From another point of view, we can see how **colloquial language** practically depicts these meanings perfectly. A genius is a person who is very intelligent and creative. Ok, but if we are referring to an intellectual genius, we understand that he/she is (or was) very creative, but if we are talking about a genius known for his/her creativity we understand that he/she probably is (or was) fairly intelligent, but we cannot be as sure as in the first case.

In the next point we will speak about the genetic structure of intelligence. Creativity, **in regards to its hereditary nature, is a special example because it has two sides to it**; one side, being or forming a part of intelligence, and the other dealing with the specific subject of creativity, such as, music for example.

Continuing with this example, we could say that while the VGI method is not applied to the genetic transmission of musical or specific ability and that the capacities associated to the genetic information received from both progenitors (**union**) will be expressed; in the transmission of musical creativity the rules of the stated method will be applied for the relational functions being part or a subset of intelligence, only showing the capacities derived from genetic information that is present simultaneously in the two sources of information received from the progenitors (**intersection**).

## **4. Genetics and intelligence**

Ups to today, numerous statistical studies have been done on the IQ heritability. The observed correlation in the IQ is low, except in identical twins which is 80-85% among them; nevertheless, if they had considered the relationship with their parents, they would also have obtained a low correlation.

The problem is that they have not defined correctly the composition of the variable to be studied. It seems that if they would study the correlation of the colour of the sisters' flowers or rats, as in the typical examples of Mendel's laws, they would have obtained low correlations!

It is clear that it is not a question of a simple linear relation, *there exists jumps in continuous variables with random processes governed by laws intrinsic to evolutionary genetics*. Establishing the relations implied by the GTCEL, it is possible to obtain high IQ correlation between the parents and their children. Therefore, it is indirectly proved the coherence of this theory of evolution.

The influence of genetics on **cognitive abilities** has been and continues to be an intense topic of debate because of the consequences that come from one stance or the other.

As I have previously stated, **The EDI Study** in my opinion shows both the hereditary nature of intelligence, strictly speaking and therefore relational intelligence in general, and a large part of the GTCEL itself.

Although statistics is a famous science due to its vulnerability to manipulation, it is also certain that this argument is often used when people do not want to recognize the facts as clear as they may be.

We will briefly look at a few points in favour and a few points against a high correlation between *genetics and intelligence* and at the difficulties or elements that allow for the coexistence of such different positions.

#### 4.a) **Genetic predisposition**

##### 4.a.1 **Highly gifted children**

##### 4.a.2 **Cognitive processes and genetics**

If the conceptual accuracy made on formal logic or intelligence and intuition, as variations of the cognitive processes. Indirectly, we are accepting the genetic base of intelligence.

The method of *Verification of Genetic Information* is performed, in this case, at the moment subsequent to the genetic transmission and even after the initial development of a new being. However, we want to conserve the adjective related to genetics in the name of this method to indicate that the genes determine the operative structure.

Due to its importance, being the theoretical base of the statistical model previously cited, it would be a good idea to read the graphic explanation of its operativity in the case of intelligence that is included in the book GTCEL (*General Theory of the Conditional Evolution of Life*) about the **nature of intelligence and genetics** with or without the application of the method of *Verification of Genetic Information* from a functional point of view.

##### 4.a.3 **Identical twin studies.**

I think that it is generally accepted that diverse studies among *identical twin brothers*, with identical genes, have shown correlations in intelligence of 80% or close to this figure.

For me, this argument regarding **twin studies** is definitive, because it would not make much sense if **intelligence** had a genetic component that was so powerful in some cases and in others just the opposite.

Other question would be why it does not appear always like that. I believe **mendelian genetics** is the cause of the apparent inconsistency.

An interesting aspect about twin studies is that if the correlation of the twin's IQ with their respective parents were studied; the explained variance would probably be noticeably less than the mentioned percentage due to the genetic combination derived from Mendel's laws.

One of the authors that is most well known for his *IQ studies with twin brothers* and his articles in favour of genetic influence on intelligence quotients is **Arthur Jensen**.

In their book, *The Bell Curve*; **Charles Murray and Richard J. Herrnstein** present an intermediate analysis regarding heritability of intelligence; it brings together articles about twin brothers, adopted and normal siblings and works with different even contradictory conclusions. Its ideas are categorized as sociology and the consequences on education, basically say that the genetic and environmental influence are fairly correlated and could generate pockets of populations with slower development

#### 4.a.4 Siblings and non identical twin studies.

From the measurements of intelligence carried out on siblings, we can make two independent commentaries.

On one hand, in the statistical twin studies, if the observed correlation in one case is 40% and, taking into account mendelian genetics, the expected is 50%, the degree of heritability will be determined by the ratio between both correlations; that is  $40\% / 50\% = 80\%$

To determine the expected correlation we would have to start with some theoretical hypotheses. It would not be the same if we knew the rules for determining which is the supposed dominant and recessive gene, or if there were various **genes or chromosomes** intervening in the characteristic being studied, it would be quite complicated in this ultimate case.

The second comment refers to if environmental circumstances were really important, it would be worth waiting for a greater resemblance between the intelligence quotients in siblings than that actually observed. I think that these circumstances are fundamentally equal within the same family, except if we pay disproportionate attention to the influence that having a different math teacher or

of any other subject or circumstance could have; we might find that the sum of all the parameters would be greater than the unit.

#### **4.a.5 Studies among families: father, mother and one sibling.**

There is not very much of this type of work, or it is less known; normally the results on the correlation of the IQ is fairly low. If the indicated correlation were made at the previous point regarding the observed and expected correlations, the results may not have been so low.

The statistical study included in the annex belongs to this group. If the same results are maintained in additional studies, the debate over the heritability of intelligence could be brought to a close, at least in its current scale. At the same time, it is possible that more profound debates are becoming more important.

The obtained correlation was higher than 80% in many cases, reaching 96% and 99% in some of them.

The key of success doubled. On one hand, the GTCEL model was incorporated, and on the other, the information was grouped so that it would compensate for variations due to the random component of the combination.

In fact, with the grouping, it is not necessary to correct the rising correlation observed according to the expected correlation. There is the advantage that the expected correlation does not need to be known; and also that other possible variable, which could affect both intelligence and the problems in its manifestation and measurement, of small intensity and random distribution can be compensated for.

The multiple dimensions that the different groupings imply, has allowed an analysis of sensitivity to be carried out in respect to the function being studied; altering partial aspects of the model's structure and the parameters involved with a reasonable guarantee that the results are not due to somewhat random coincidences of the sample information.

#### **4.b) Heredity vs environment**

The following points have been grouped together because it is not easy to separate the arguments against what is being stated and current difficulties; if both things are not due, to a great extent, to the lack of a true interest in the subject, both on a personal and political level for philosophical or sociological reasons.

We will site the following paragraph by way of example, which contains a study on

inheritance in continuous variables:

*"Given that there is currently not a definition or an objective measurement of intelligence, it is not reliable to use the methods of quantitative genetics to research the heritability of this characteristic."*

Many of the following points have this common denominator.

#### 4.b.1) **Modern materialism**

A typical stance refers to the environmental influence on the development of human intelligence; this means referring to the small variations that have existed both between individuals and occurrences in the last thousand years of the human species. Furthermore, they are minimum, if we compare them to the differences between the intelligence of diverse species.

This vision of reality is without a doubt, the greatest obstacle for the acceptance of our postulates; it deals with a subjective attitude impregnated with a kind-hearted egalitarianism and a so-called idealism.

I do not want to say that this idea is necessarily mistaken but rather that its arguments are not scientific and are slightly contradictory. It seems that there is a certain philosophical correlation between this idealism and egalitarianism and what we could call historical materialism, or if you prefer, modern materialism.

To me, it seems obvious that human intelligence has developed a lot in the last thousands of years. In the same way, the great difference in intelligence between different individuals is easily observable.

This could perhaps be much greater than what is politically desirable, and for this, is denied in advance in order to try to obtain certain measurements of intelligence that are slightly less relative than the current intelligence quotients. The curious results of certain studies are deliberately hidden or silenced while publicity is given to other studies that we could call '*substitutes*.'

At the same time, the connotations of the Nazi idea that intelligence can be hereditary is often indicated. The danger of this way of thinking is that if we end up demonstrating that intelligence is like this, it would be proving that the Nazis' ideology is correct. I would say that it is clearly better not to mix politics with science if you want to maintain a scientific point of view.

As this point does not take us anywhere, we will finalize it with a quote from **Galileo Galilei**'s personal point of view: "*Although there is a vast difference between man and other animals, we could say that this abyss is no deeper than what separates some men from others.*" He had his reasons!

#### 4.b.2) Theory of natural selection

It is generally accepted that a certain degree of intelligence has to be hereditary; this is demonstrated by the visible difference of intelligence between different species of animals.

If genetic intelligence were very similar for all members of one species, it would be very complicated to explain the appearance of new species with a highly superior intelligence.

Saying that the evolution of animal intelligence has been produced by random mutations of DNA chains is **hardly convincing** (it sounds like science-fiction) due to the evolutionary lottery that it would be implying. This consequence is another one of the great difficulties in the fundamentally hereditary nature of intelligence; it means having to directly face the evolutionary theory of natural selection.

Along these lines, ideas have come up that human intelligence has not changed in the last thousands of years, that we do not use out full potential, etc. Although the only thing this achieves, if you think about it, is augment the problem. At some point, intelligence should increase, and logically, it is even more improbable that this big increase would be produced by random mutations. This does not however prove to be problematic; everything eases over time.

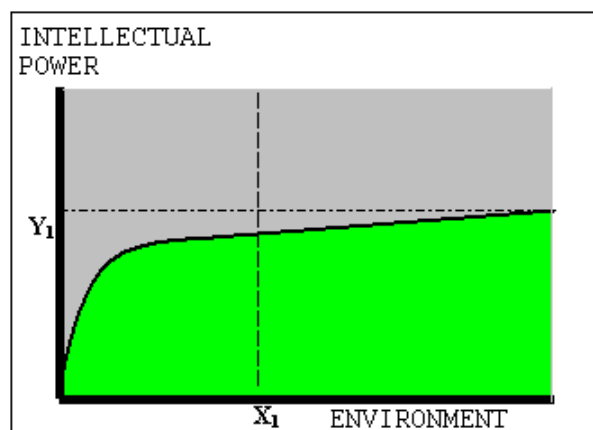
In addition, the problem would change dimensions because, upon rejecting the theory of mutations, an alternative theory of evolution would have to be found that would provide a coherent model.

#### 4.b.3) Environment and intelligence

Presumably the environmental conditions that could affect the development of intelligence will be related to a greater and lesser extent to the intelligence quotient of the people who share a living space, and other variables likewise related.

These interrelations could partially hinder or hide the true origin or cause of the capacities studied in multiple regression studies.

The need for certain environmental conditions for human development is another aspect of the environment and intelligence issue. In very adverse conditions such as the lack of oxygen during birth, children rose by wolves, alcoholism during pregnancy, meningitis, or other extreme situations, there is not doubt that intellectual potential will be seriously affected.



However, in the absence of these serious limitations, the development of the intellectual potential, in my opinion, will be slightly less than its maximum. In other words, the wide majority of the population in a developed country or a country without serious food shortages will find itself in environmental conditions superior to those corresponding at point  $X_1$  of the graph.

The GTCEL section includes a different focus to what is generally said as far as the environmental influence on the intelligence. According to this, intelligence and all genetic traits are developed throughout individuals' lives and these improvements are also incorporated into genetic information.

The two stances can be clarified with a slightly radical metaphor: those in favour of the environmental influence on intelligence would say that birds are all born with the potential to fly like an eagle, but some remain as ostriches, others as chickens, etc. On the contrary, the GTCEL would state that the birds are born with a determined structure and that, of course, normal growth takes place in practically all of them; they perfect the art of flying during their development and the children will maintain this structure.

Consequently, both stances are not that contradictory if we think of them as existing in different scales of the analysis of intelligence. I hope that the results of the annex's statistical work will allow some approximation between both perspectives.

#### 4.b.4) **Training and IQ testing**

It is worth pointing out that an intelligence test is designed to measure certain capacities that do not increase easily when the test is repeated. Of course, if we dedicated ourselves intensely to the preparation of these tests, our results would be higher; but in this case, it would not even be a permanent quality.

A comparison often made to justify the environmental effect on intelligence is how physical exercise changes athletes' performance.

In these instances, we all unconsciously think about top-ranking athletes or sports professionals. First of all, it is not normal for individuals in society to be intelligence professionals in the same sense as in sports; they seem to be paid less. On the contrary, a large part of the population presumably uses intelligence daily, even though it sometimes may not seem so for some people.

Secondly, aside from exceptions of sports professionals and people who do not exercise at all, I think that a person's speed in a 100-metre flat race is fundamentally determined by inheritance, that is, by the physical constitution of each individual.

Sometimes I ask myself: is there a scientific base to say that intelligence and effort or performance made in a marathon behave the same as for the development of a person's potential? Are there coefficients of marathon potential with normal distribution in the population? Is the conventional male/female equality maintained in these variables? Can the difference in physical strength be justified bearing in mind educational disparities at an early age without straying away from the scientific method?

On the other hand, maybe tobacco, alcohol, and some traffic accidents would have a similar effect in both cases.

#### 4.c) Cognitive science and intelligence test

##### 4.c.1) Hereditary versus predetermination

It is important to stress that having a *hereditary intelligence* or any other hereditary character does not mean following a linear ratio or a predetermination of a particular value. The combination of genes offers a wide array of possibilities.

For this purpose, just remember that pink flowers may have red, pink, or white descendants in the typical examples of **Mendel's laws**.

The chart relating to the concordance in **identical twins** and just **twin brothers** can help us see the difference more clearly.

RELATION OF THE HEREDITARINESS DEGREE AMONG TWINS		
Character	Monozygotics	Dizygotics
Blood group	1	0,66
Eyes colour	0,99	0,28
Measles	0,95	0,87
Schizophrenia	0,69	0,10
Diabetes	0,65	0,18
Tuberculosis	0,57	0,23
Breast cancer	0,06	0,03

The comparison between these percentages of concordance not only allows us to perfectly differentiate between hereditary character and predetermination of a particular character but rather also to deduce information about the number of genes or chromosomes involved and the number of possible different expressions or characteristics.

For example, it seems that the blood group depends on just one gene while schizophrenia depends on various, possibly six or seven, although it is difficult to know with just this information. Also, for schizophrenia, the heritability of parents to children is very low even though it has a genetic concordance of 69%

The concordance of intelligence is not presented because it changes with the different studies. Although from the information available, I would say that it is mainly found on one chromosome.

#### 4.c.2) **Multiple functions and facets of intelligence**

Another problem as we have seen, is the definition of intelligence. Multiple functions and operatives modes configuring the cognitive processes affect the ability of measurement of intelligence test

However, it is not as serious as it seems; the fact that intelligence can be formed by various elemental faculties that are somewhat independent does not mean that they cannot be hereditary brain functions. Furthermore, if it turns out that one group of them has this characteristic; they will probably all have it.

On the other hand, the lack of a generally accepted definition of intelligence is very inconvenient given that I really think that there are many ways to deal with this concept. Even so, a way of avoiding this *byzantine* discussion is to reverse the concept so that it meets our needs:

**-We will study the heritability of intelligence by understanding it as a group of faculties of intellectual reasoning measured by what is commonly called the intelligence test-**

Afterwards, we may analyse if the results of the study can be generalized.

#### 4.c.3) Continuous variable

Intelligence is a continuous variable of Nature, which complicates the quantitative research of its heritability.

Normally, studies performed on continuous variables are based on the treatment of these variables as a sum of more elemental discreet variables. You have to take into account that, in general, the change of continuous variables is not easily compatible with the idea of change by random mutations.

Intelligence can be understood as a sum of relational functions such as above / below, larger / smaller, general / specific, etc. Although the appearance of a new relation could be understood due to random causes, the improvement or greater precision of an existing relation that could be produced in a similar fashion could turn out to be incomprehensible.

#### 4.c.4) Cognitive ability test

We find ourselves with two large problems when measuring these **intellectual abilities**. The first is derived from the fact that the display of these brain functions is very much influenced by the moment in which they are performed.

Tiredness, moods, and other various factors can significantly affect their expression from one day to the next or between the beginning and end of the same day.

The second is that each particular measurement uses a specific test and the results can vary according to: whether the individual has done a similar ability test in the past, the individual's personality or cultural affinity with the ability test. However, if it is well designed, this aspect should be fairly reduced.

In the quantitative data used from the longitudinal *Young Adulthood study* for the statistical analysis included in the **IDI Study**, the correlations between the different measurements of the same children of intellectual abilities are very low. The maximum is 33% in spite of the fact that the same people are being measured.

A simple conclusion would be to think that the brain functions of intelligence are not stable throughout life and that they are highly influenced by the environment. However, some experts believe that intellectual abilities are greatly stable

throughout life, especially from 6 years of age on.

Popular language, as an expression of the collective unconscious, clearly expresses that intelligence is a fixed quality given that it uses the verb to be referring to permanent not transitory characteristics in expressions such as, "*That person is very intelligent.*" Well, at least in Spanish this aspect is obvious.

#### 4.d) Social and technical issues

##### 4.d.1) Shortage of statistical studies with adequate IQ data

The studies of intelligence quotients in families with a large sample are relatively scarce, because the fieldwork that includes these type of variables tend to be more directed at studies of identical twins, twin brothers or adoption programs, and do not include the two progenitors.

Anyway, if there is another one! I would like have access to its *raw data*.

They are also quite costly if you want to the results to have a guarantee of objectivity. A good sample design is needed and, there is the additional difficulty of obtaining volunteers for this type of statistical study, the performance of the **intelligence test** by specialized personnel, etc.

##### 4.d.2) Access to quantitative data source

Nevertheless, the most complicated thing for me was being able to find and access the original quantitative data source in order to perform my own statistical research and estimations.

In spite of the small magnitude of the analysed sample, the generation of variables by different groupings and criteria of the available values has allowed for the accessibility of a model that is very sensitive to the information. This characteristic, in my opinion, is one of the model's strong points; in spite of the vulnerability of the researched correlations, it is significant that some determination coefficients have been obtained that border close to the unit and that the thousands of checks carried out have a high level of consistency.

In defence of my small sample of **quantitative data**, I would like to say that I have been virtually travelling for more than one year to numerous worlds of professionals, national and international organizations dedicated to the study of intelligence, public organisms, universities, Internet news groups, international studies on twins, etc., asking for statistical data on intelligence quotients (IQ) of families. I even turned over the search to a psychometric company, but there were no results.

In the end, a search performed by the Google server's paid service found four different sites for me. I had entered three of them and not found the information. Fortunately the fourth bore its fruits, although with a certain amount of difficulty. At least I obtained a sample of quantitative data, even though it was small.

I suppose that the personal character of the statistical data and its social and political implications hinders its access.

Likewise, I imagine that the authors of the majority of the thousands of *statistical research articles* published on this subject probably did not have access to the quantitative data source and limited themselves to commenting on the results published by other works and theoretical justifications of their personal point of views.

#### 4.d.3) Modern computer technology

The analysis of the correlations of variables and the models of regression by **ordinary least squares** have been easily made for quite some time.

Nonetheless, the computer capacity of calculation has spectacularly multiplied in recent years. The use of this great capacity of modern computer technology has been totally necessary in order to obtain the results achieved in the statistical research of the *IDI Study*.

For this purpose, it is worth pointing out that each time the quantitative data is brought up to date, the Excel math worksheet generates more than 10,000 random numbers, hundreds of variables, more than 100,000 coefficients of determination of linear regression for ordinary least squares of the different variants of the model, and presents me a 200 graphs with 16,000 values, that are, of course, in colour.

It used to take 3 to 7 seconds.

## 5. The metaphor of the semaphore.

In spite of all the reflection on the previous points, I may not have explained the different concepts of intelligence and their main characteristics with the desired clarity. In this respect, I think that there is a **terminological difficulty** due to the nature of language.

Consequently, I am going to establish a relation between the functioning of our mind and its different parts with the world of automobiles, trying to find parallelisms that help to differentiate the concepts with **precision and simplicity**.

It is worth taking into account that when a fair amount of people, I suppose for emotional reasons, use the word intelligence they use it like the equivalent of the infrastructure of State highways along with international technology of the automobile industry plus something strange in case they someone tries to understand them. *His or her initial premise is that nobody knows for sure what intelligence is!*

The idea is to give an example to clear up what I have said previously, not to demonstrate that that it is the truth. All right, upon better understanding of the ideas there may be a tendency to understand and accept them as true or very possible.

Analysing the concept of automobiles, we can compare the degree of conceptual complexity and derivations that it could present us with. Any **vital impulse system** will probably be fine for our purpose, but the automobile example is very graphic and everybody is familiar with automobiles.

### 5.a) Concept and parts of automobile.

An automobile is not the same as a car, or a train, a truck, a boat, a plane, etc. That is, its meaning is more complicated than the solely literal "*something that moves itself*", and although we all know what an automobile is, **its definition is not simple**. Just the same, intelligence is not memory, creativity, mathematical or musical ability, nor other abilities or intellectual capacities.



Another subject that is more obscure than the concept of automobiles -because it demands an additional step- is evaluation in regards to power in order to make comparisons between different automobiles, models, and brands; in short, **the goodness or measurement of the capacity and efficiency** of a specific automobile. An approximation would be the average velocity reached, but the velocity is more of a final effect than a capacity.

The subject becomes even more complicated if we suppose that we can not see the automobile, that we can only observe its effects, that is, people or things that are moved from one place to another in a certain time with certain comfort, safety, etc.

- Relational automobile.

A solution for identifying the concept of the automobile is to turn to **all of its parts**; if we manage to determine all of its elements, in theory, we should be able to specify the concept referred to the group of its parts.

So, as common **parts of automobile** we have the motor, the wheels, the breaks, and the windows. These *parts of the car* are present in the concept of an automobile. Well, in fact, the first three are parts, but the windows are not necessary, some automobiles do not have windows (sometimes I use the words car and vehicle for comfort and variety).

Although this concept of group of **parts of automobile** is important, and it helps us understand its characteristics, it does not seem that it would be very useful for a generic definition and much less so for an estimation of goodness, measurement, or evaluation of its capacity.

It is enough to indicate that the breaks fulfil an important technical function in cars but they cannot perform the typical function of a car alone and they are not exclusive to cars. The wheels and the motor can at least move by themselves, etc.

In fact, broadly speaking, even workshops, garages, parking, streets, and roads would form a part of the **relational world of automobile**.

- Conditional automobile.

We can strengthen the circle of the searched for concept if we associate a **sub-group of the relational parts of an automobile** with some specific operation conditions; for example, the group of *parts of the car* that can allow for the moving of people or things from one place to another that has a means of propulsion.

We could also associate different operative modes to the same *sub-group of parts automobile* and we would have different **conditional automobiles**.

Now we start to be able to observe the goodness of a particular automobile, for example, to know how long it will take to go from one city to another, but

for this, we have to take into account the number of passengers, the state and preparation of the driver, if it is daytime or night time, if it is raining or not, etc. As we can see, there are a multitude of conditions associated to the concept of a car's goodness or even of the goodness of a *group of part of an automobile*.

- Multiple automobiles.

We can think about the existence of very different **cars, parts of cars** or **groups of parts of cars** as the power of the motor, number of spaces, size of the car, of the trunk, all terrain, four-wheel drive, chains for snow, etc. There are also various conditions such as curves and highway lanes, etc.

There will really exist automobiles prepared for certain conditions that are very different from one another so that their **comparison will be very arduous**, even artificial or without real meaning.

An additional characteristic of automobiles is the **incorporating a high degree of security** for the passengers; it would not be considered a vehicle apt for its function if it were not secure.

### 5.b) The driver and technology of automobile.

Now we are in a better situation to understand one of the important reasons of the polemic about genetic structure of intelligence and environmental influence.

If by intelligence we are referring to **the time that it takes an automobile to go from one specific city to another**, we have to recognize that this depends to a large extent on the type of highway, curves, the meteorological conditions, whether it is daytime or night time, the driver, etc.; all of these "*environmental*" conditions are more important than the car's power.

On the other hand, if by intelligence we are referring to the **goodness of a automobile** to perform any route, in any meteorological condition, with an average driver, etc., then, doubtlessly, the power of the car's motor will be one of the best indicators; a small group of indicators related to the **fabric design** - genetic structure- can make up a very significant index in respect to the searched for goodness.

Of course, other factors count, and flawed maintenance can make a car crash, but normally; this is prevented with **minimum maintenance**. A real example is a car that made the running-in in three cylinders, by the implicit will of the corresponding technicians. *Real nice!* There were never any particular problems with the motor afterwards.

Another interesting aspect of this metaphor is that many elements of an automobile are **highly correlated from the technological point of view** or "*modernity*" in spite of fulfilling functions that are independent of the vehicle's activity.

The subject of **training** can also be studied; a driver can learn the curves of a mountain highway and substantially improve the time needed for a specific route. However, this does not mean that the driver is better, or that the automobile is more powerful, or that if two years go by without travelling this route, or if the driver changes to another highway, he/she will maintain the advantages obtained from the training, etc.

On the other hand: "*a good automobile will always be a good automobile*", even though it has a flat tire and does not move.

Finally, I want to point out that if we do not have the means to know the technical characteristics of a car **when estimating them** according to the time it takes for a specific route, **we will make many errors** -or the variance of the estimators will be great- due to the **large amount of factors** that influence the specific results of a particular route with a specific driver...

Take note that the mentioned **factors cannot be easily isolated** because each one of them has multiple factors that condition them. We cited that the same driver may be tired, happy, rushed...or the other way around.

### 5.c) Goodness indicators.

Now, if what we really want is a measure of the goodness of the car in the performance of any function and be able to compare some with others in a simple somewhat precise fashion we would have to look for some type of **indicator**.

A good indicator of **general goodness** could be its price, but this depends on the market and includes aspects like "*famous people's cars or cars seen in movies*", "*old cars*", the effect of the brand and publicity, special accessories, taxes, etc. Also, this would not be useful to us for the case of intelligence, although there is a certain correlation between intelligence and economic power.

The motor's cylinder is a good and probably the most used indicator of a car's **specific goodness**. It is very good because it is independent of the external conditions, highly related to the price, to average velocity, to safety, to technology, etc.

If that corresponding to the consumption is added to the indicator we could have a compound more precise indicator than the previous. If it is of common use we

could call it the "**g**" factor of the automobiles. Even if it were not the perfect indicator, it would be very comfortable, it would allow for simple comparisons and would be understood by everyone.



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*M<sup>a</sup> José T. Molina*

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