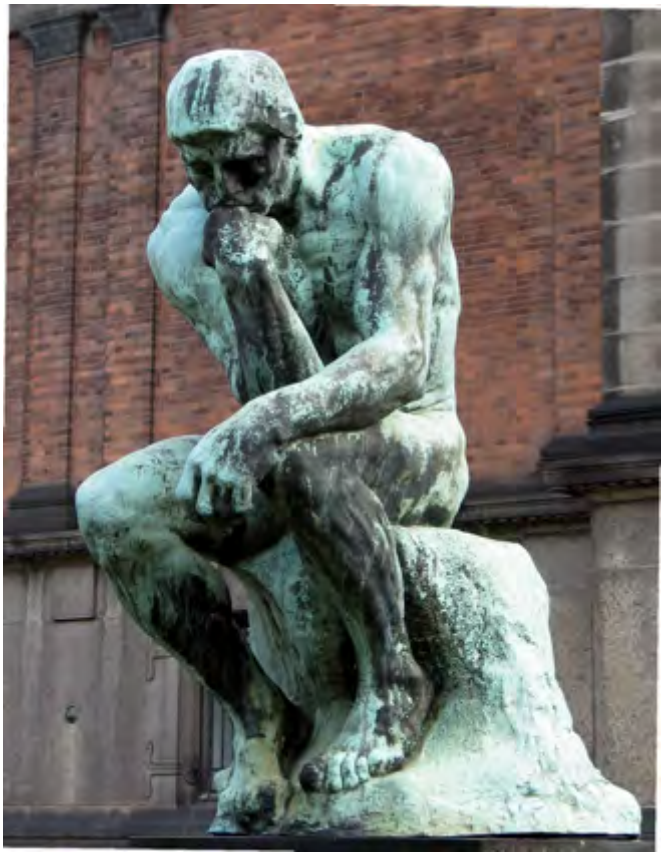


Human Intelligence(s)

(Genes, Brain, Politics)

Georges M. Halpern, MD, PhD

with Yves P. Huin

The current deluge of news reminds me of the obviously ignored wisdom of Socrates: *I know that I am intelligent, because I know that I know nothing.* Too many of the self-proclaimed world *leaders'* parade and proclaim their "intelligence" as if it were an obscenely gigantic erected penis. We watch in pain, knowing that *Arx tarpeia Capitoli proxima* [the Tarpeian Rock is close to the Capitol]. But these days such predictions do not seem to matter: filling their (and their *mafiosa famiglia*'s) pockets, bank accounts, portfolio of mansions and yachts; collecting covers of *People* Magazine or starring in (fake) 'reality' TV shows seem to beat a Nobel prize recognition. And always a Nobel *Peace* prize.

O tempora o mores…

Human Intelligence

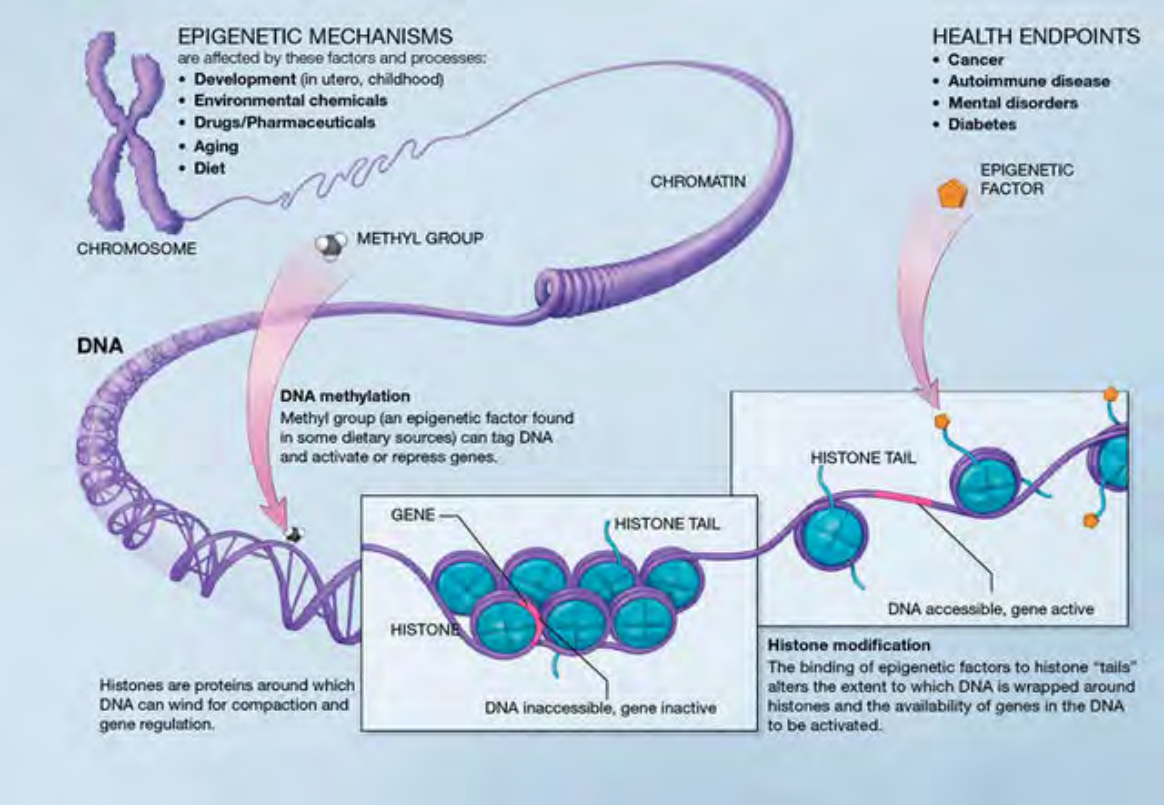
Credit: Journal Psyche

'***Human intelligence*** *is the intellectual prowess of humans, which is marked by high cognition, motivation, and self-awareness. Through their intelligence, humans possess the cognitive abilities to learn, form concepts, understand, apply logic, and reason, including the capacities to recognize patterns, comprehend ideas, plan, problem solve, make decisions, retain information, and use language to communicate. Intelligence enables humans to experience and think.*' (Wikipedia).

We have, can and will argue about certain persons possessing and mastering '*the cognitive abilities to learn form, concepts, understand, apply logic, and reason'* not to mention '*the capacities to recognize patterns, comprehend ideas, plan, problem solve, make decisions, retain information, and use language to communicate'* but that's not (yet) the point. The major issue is that we –humans- can and do *experience and think.* We may be getting closer, catching the end of a very, very long Ariadne's thread (but the Minotaur is still there, with its secrets and metamorphoses!). But on 22 May 2017, a large meta-analysis of genome-wide association studies of intelligence in 78,308 individuals identified 335 genome-wide significant genetic variants, located in 18 genomic loci. Moreover, this study implicated the role of ***52 genes linked to intelligence which were mostly involved in cell development and were highly expressed in brain tissue.*** Knowing that our template for intelligence starts with (at the very least) a large number of genes, their subdivisions, innumerable interactions, and (more on that later) the epigenetics of social and environmental interactions, the current worship of methods –e.g. the IQ- or theories like the ones of Howard Garner (Multiple Intelligences), Robert Sternberg (Triarchic), PASS, Piaget's, parieto-frontal integration, investment (*sic!*), intelligence compensation, Bandura's, PPIK, or latent inhibition- are destined to the dustbin of history. We need to consider facts, findings and not lucubrations of people who look at the skull and tell you everything that's inside and how it works!

That's where we are now: gene-searching and gene-sorting. It will not be easy, and we cannot expect a clear answer for everyone, at a given age, in a given environment in any foreseeable future. This does confirm what has been observed in some lineages, e.g. the one of Johann Sebastian Bach or the Coltrane for composers; the Constable or Wyeth as painters; the Bernouilli as mathematicians; the Casadesus as composers, musicians, singers; the Gauguin as painters or musicians; the Hart as wrestlers; the Jackson as musicians, singers, entertainers. The apple does not fall far from the tree… Besides our genome (the mast), ***epigenetics*** (the growing, quasi-seasonal branches) can –and does- shape human behavior. Nurture shapes nature – nature referring to biological heredity, and nurture refers to virtually everything that occurs during the life-span; e.g. social experiences and interactions, diet and nutrition, exposure to environmental toxins, etc.

Epigenetic gene regulation involves changes other than to the sequence of DNA and includes changes to histones (proteins around which DNA is wrapped) and DNA methylation. These epigenetic changes can influence the growth of neurons in the developing brain as well as modify activity of the neurons in the adult brain. Together, these epigenetic changes on neuron structure and function can have a marked influence on an organism's behavior.



Credit: Wikipedia

A small clinical research study showed the relationship between prenatal exposure to maternal mood and genetic expression resulting in increased reactivity to ***stress*** in offspring. Three groups of infants were examined: those born to mothers medicated for depression with serotonin reuptake inhibitors; those born to depressed mothers not being treated for depression; and those born to non-depressed mothers. Prenatal exposure to depressed/anxious mood was associated with increased DNA methylation at the glucocorticoid receptor gene and to increased HPA axis stress reactivity. The findings were independent of whether the mothers were being

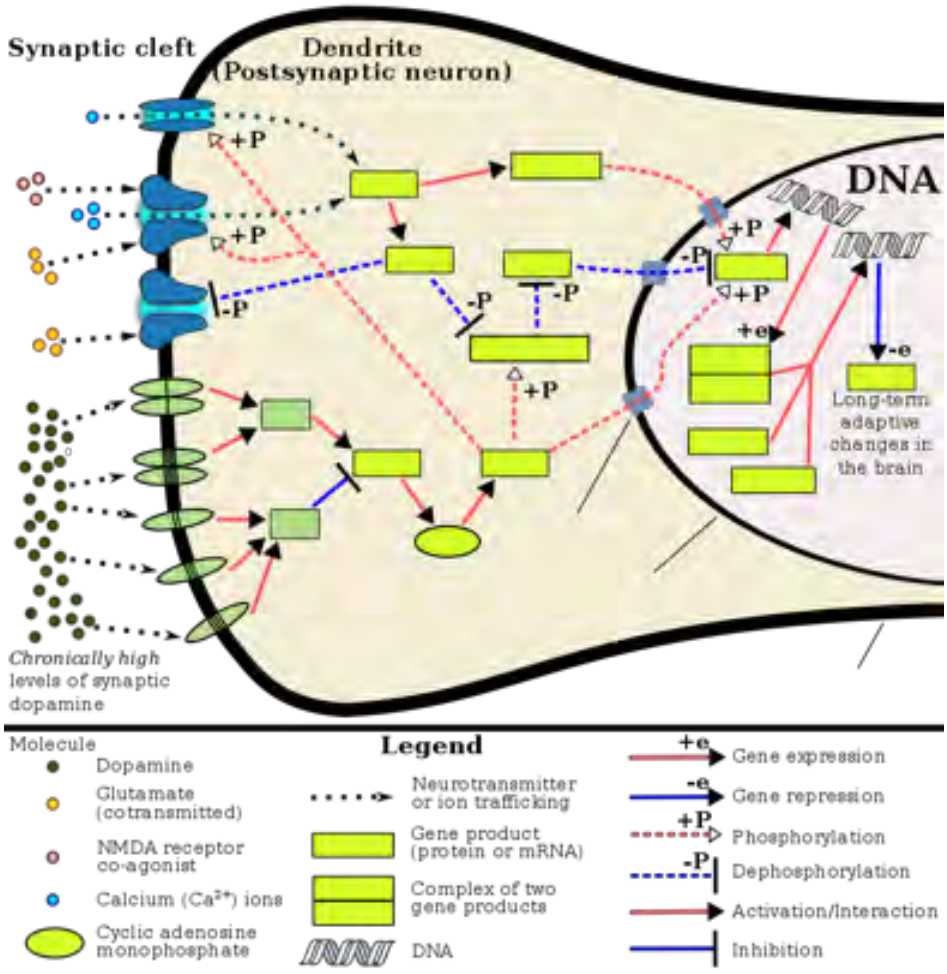
pharmaceutically treated for depression. Recent research has also shown the relationship of methylation of the maternal glucocorticoid receptor and maternal neural activity in response to mother-infant interactions on video. Longitudinal follow-up of those infants will be important to understand the impact of early caregiving in this high-risk population on child epigenetics and behavior.

Environmental and epigenetic influences seem to work together to increase the risk of ***addiction***. For example, environmental stress has been shown to increase the risk of substance abuse. In an attempt to cope with stress, alcohol and drugs can be used as an escape. Once substance abuse commences, however, epigenetic alterations may further exacerbate the biological and behavioral changes associated with addiction.

These epigenetic changes modify gene expression, which in turn increases the vulnerability of an individual to engage in repeated substance overdose in the future. In turn, increased substance abuse results in even greater epigenetic changes in various components of the reward system (e.g., in the *nucleus accumbens*). Hence, a cycle emerges whereby changes in the pleasure-reward areas contribute to the long-lasting neural and behavioral changes associated with the increased likelihood of addiction, the maintenance of addiction and relapse.

In humans, alcohol consumption has been shown to produce epigenetic changes that contribute to the increased craving of alcohol. As such, epigenetic modifications may play a part in the progression from the controlled intake to the loss of control of alcohol consumption.

These alterations may be long-term, as is evidenced in smokers who still possess nicotine-related epigenetic changes ten years after cessation. Therefore, epigenetic modifications may account for some of the behavioral changes generally associated with addiction.



Signaling cascade in the nucleus accumbens that results in psychostimulant addiction

These include: repetitive habits that increase the risk of disease, and personal and social problems; need for immediate gratification; high rates of relapse following treatment; and, the feeling of loss of control.

Epigenetic changes may also help to facilitate the development and maintenance of eating disorders via influences in the early environment and throughout the life-span. Pre-natal epigenetic changes due to maternal stress, behavior and diet may later predispose offspring to persistent, increased anxiety and anxiety disorders. These anxiety issues can precipitate the onset of eating disorders and obesity, and persist even after recovery from the eating disorders. Epigenetic differences

accumulating over the life-span may account for the incongruent differences in eating disorders observed in monozygotic twins. At puberty, sex hormones may exert epigenetic changes (via DNA methylation) on gene expression, thus accounting for higher rates of eating disorders in men as compared to women. Overall, epigenetics contribute to persistent, unregulated self-control behaviors related to the urge to binge.

Epigenetic changes including hypo-methylation of glutamatergic genes (i.e., NMDA-receptor-subunit gene NR3B and the promoter of the AMPA-receptor-subunit gene GRIA2) in the post-mortem human brains of ***schizophrenics*** are associated with increased levels of the neurotransmitter glutamate. Since glutamate is the most prevalent, fast, excitatory neurotransmitter, increased levels may result in the psychotic episodes related to schizophrenia. Interestingly, epigenetic changes affecting a greater number of genes have been detected in men with schizophrenia as compared to women with the illness. Population studies have established a strong association linking schizophrenia in children born to older fathers. Specifically, children born to fathers over the age of 35 years are up to three times more likely to develop schizophrenia. Epigenetic dysfunction in human male sperm cells, affecting numerous genes, have been shown to increase with age. This provides a possible explanation for increased rates of the disease in men. To this end, toxins (e.g., air pollutants) have been shown to increase epigenetic differentiation. Therefore, similar epigenetic changes in older human fathers are likely. Schizophrenia studies provide evidence that the nature versus nurture debate in the field of psychopathology should be re-evaluated to accommodate the concept that genes and the environment work in tandem. As such, many other environmental factors (e.g., nutritional deficiencies and cannabis use) have been proposed to increase the susceptibility of psychotic disorders like schizophrenia via epigenetics.

Epigenetics may be relevant to aspects of ***psychopathic behavior*** through methylation and histone modification. These processes are heritable but can also be influenced by environmental factors such as smoking and abuse. Epigenetics may be one of the mechanisms through which the environment can impact the expression of the genome. It is probable that epigenetic regulation as well as methylation profiling will play an increasingly important role in the study of the play between the environment and genetics of psychopaths.

Environment and Intelligence

This is one of the most important factors in understanding human group differences in IQ test scores and other measures of cognitive ability. It is estimated that genes contribute about 20–40% of the variance in intelligence in childhood and about 80% in old age. Thus, the environment and its interaction with genes account for a high proportion of the variation in intelligence seen in groups of young children, and for a small proportion of the variation observed in groups of mature adults. Historically, there has been great interest in the field of intelligence research to determine environmental influences on the development of cognitive functioning, e.g. fluid intelligence, as defined by its stabilization at 16 years of age. Even though intelligence stabilizes in early adulthood it is thought that genetic factors come to play more of a role in our intelligence during middle and old age and that the importance of the environment dissipates.

As babies, our neuronal connections are completely undifferentiated. Neurons make connections with neighboring neurons, and these become more complex and more idiosyncratic as the child ages, up until the age of 16, when this process halts. This is also the time frame for development of what is defined in psychometric studies as the general factor of intelligence, or g, as measured by IQ tests. A person's IQ is supposed to be relatively stable after they have reached maturity. It is likely that the growth in neuronal connections is largely due to an interaction with the environment, as there is not even enough genetic material to code for all the possible neural connections. Even if there was enough genetic material to code neural connections, it is unlikely that they could produce such fine-tuned connections. In contrast the environment causes meaningful processing as the neurons adapt to stimuli presented.

The capacity of the brain to adapt its connections to environmental stimuli diminishes over time, and therefore it would follow that there is a critical period for intellectual development as well. While the critical period for the visual cortex ends in early childhood, other cortical areas and abilities have a critical period that lasts up through maturity (age 16), the same time frame for the development of fluid intelligence. For a person to develop certain intellectual abilities, they need to be

provided with the appropriate environmental stimuli during childhood, before the critical period for adapting their neuronal connections ends. The existence of a critical period of language development is well established.

The **sociocultural environment** is critical. Having access to resources of the home, and having a home life conducive to learning is associated with scores on intelligence tests. However, it is difficult to disentangle possible genetic factors from a parent's attitude or use of language. A child's ordinal position in their ***family*** has also been shown to affect intelligence. Several studies have indicated that as birth order increases IQ decreases with first-borns having especially superior intelligence. Many explanations for this have been proposed but the most widely accepted idea is that first-borns receive more attention and resources from parents and are expected to focus on task achievement, whereas later-borns are more focused on sociability. The type and amount of praise received from family can also affect how intelligence develops.

Later, there is some evidence that ***peer groups*** influence tests of cognitive ability. The peer group an individual identifies with can also influence intelligence through the stereotypes associated with that group. This has been shown to be a factor in differences in intelligence test scores between different ethnic groups, men and women, people of low and high social status and young and old participants. For example, females who were told that women are worse at chess than men, performed worse in a game of chess than females who were not told this.

There is controversy, however, as to whether ***education*** affects intelligence – it may be both a dependent and independent variable regarding IQ. School may alter specific knowledge, rather than general ability or biological speed. In terms of what matters about school, it appears that simple quantity or years-in-school may be what underpins the linkage of education with performance on IQ tests.

Research on the effectiveness of ***interventions***, and the degree to which fluid intelligence can be increased, especially after age 16, is somewhat controversial. Fluid intelligence is typically thought of as something more innate, and defined as immutable after maturity.

Environmental enrichment affects cognition and intellectual development from a neurobiological perspective. More stimulating environments can increase the

number of synapses in the brain which increases synaptic activity. In humans, this is most likely to occur during the development of the brain but can also occur in adults. Research using educational attainment as an indicator of cognitive stimulation have found that those with higher levels of education show less signs of cognitive aging and that stimulating environments could be used in the treatment of cognitive aging dysfunctions such as dementia.

Nutrition has been shown to affect intelligence prenatally and postnatally. The idea that prenatal nutrition may affect intelligence comes from Barker's hypothesis of fetal programming, which states that during critical stages of development the intrauterine environment affects or 'programs' how the child will develop. Barker cited nutrition as being one of the most important intrauterine influences affecting development and that under-nutrition could permanently change the physiology and development of the child. It has been shown that under-nutrition, particularly protein malnutrition, can lead to irregular brain maturation and learning disabilities.

Post-natal malnutrition can also have a significant influence on intellectual development. This relationship has been harder to establish because the issue of malnutrition is often conflated with socioeconomic issues. However, it has been demonstrated in a few studies where preschoolers in two Guatemalan villages (where undernourishment is common) were given protein nutrition supplements for several years, and even in the lowest socioeconomic class, those children showed an increase in performance on intelligence tests, relative to controls with no dietary supplement.

Malnutrition has been shown to affect organizational processes of the brain such as neurogenesis, synaptic pruning, cell migration and cellular differentiation. This thus results in abnormalities in the formation of neural circuits and the development of neurotransmitter systems. However, some of these effects of malnutrition have been shown to be improved upon with a good diet and environment. Early nutrition can also affect brain structures that are correlated to IQ levels. Specifically, the caudate nucleus is particularly affected by early environmental factors and its volume correlates with IQ. In an experiment by Isaacs et al., infants born prematurely were either assigned a standard or high-nutrient diet during the weeks directly after birth. When the individuals were assessed later in adolescence, it was found that the high-nutrient group had significantly larger caudate volumes and scored significantly

higher on verbal IQ tests. This study also found that the extent to which the caudate volume size related selectively to verbal IQ was much greater in male participants, and not very significant in females. This may help explain the finding in other earlier research that the effects of early diet on intelligence are more predominant in males.

Breast feeding has long been purported to supply important nutrients to infants and has been correlated with increased cognitive gains later in childhood. The link between intelligence and breast feeding has even been shown to persist into adulthood.

Some studies have indicated that breast feeding may be particularly important for children born Small for Gestational Age (SGA). A study by Slykerman *et al*. found that there was no association between breast feeding and higher intelligence in their full sample but that when looking only at SGA babies there was a significant increase in intelligence for those who had been breastfed over those who had not. But in 2007, Caspi *et al.* found that whether breast feeding increased IQ was linked to whether the infant had a certain variant of the FADS2 gene. Children with the C variant of the gene showed an IQ advantage of 7 points when breastfed, whereas those with the GG variant showed no IQ advantages with breastfeeding.

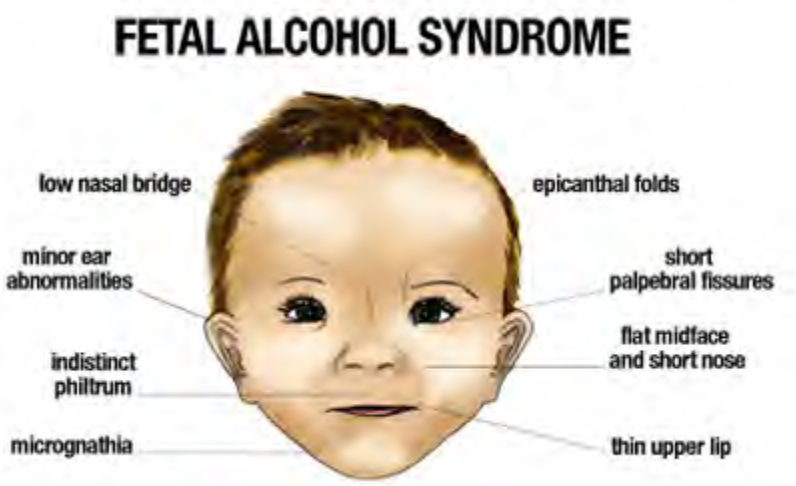
Maternal stress levels may affect the developing child's intelligence. The timing and duration of stress can greatly alter the fetus' brain development which can have long-term effects on intelligence. Maternal reactions to stress such as increased heart rate are dampened during pregnancy to protect the fetus. The impact of stress can be seen across many different species and can be an indicator of the outside environment which can help the fetus to adapt for surviving in the outside world. However, not all maternal stress has been perceived as bad as some has been seen to induce advantageous adaptions.

Stress during early childhood may also affect the child's development and have negative consequences on neural systems underlying fluid intelligence. A 2006 study found that IQ scores were related to the number of traumas and symptoms of Post-Traumatic Stress Disorder (PTSD) in children and adults. Similarly, another study found that exposure to violence in the community and the subsequent distress, were related to a significant decrease in intelligence scores and reading abilities in children aged 6–7 years. Exposure to violence in the community had similar cognitive effects as experiencing childhood maltreatment or trauma.

Exposure to ***toxic chemicals and other substances*** may severely affect the development of intelligence in children.

Lead exposure has been proven to have significant effects on the intellectual development of a child. In a long-term study done in1992, children who grew up next to a lead-smelting plant had significantly lower intelligence test scores, negatively correlated with their blood-lead level exposure. Even though lead levels have been reduced in our environment, too many areas in the United States, particularly inner cities, are still at risk for exposing their children.

Prenatal exposure to alcohol can greatly affect a child's performance on intelligence tests, and their intellectual growth. At high doses, fetal alcohol syndrome can develop, which causes mental retardation, as well as other physical symptoms, such as head and face deformities, heart defects and slow growth. It is estimated that 1 in 1,000 babies born in the general population are born with fetal alcohol syndrome, because of heavy use of alcohol during pregnancy.



Credit: Plano Children's Medical Clinic

However, studies have shown that even at slightly less severe doses, prenatal exposure to alcohol can still affect the intelligence of the child in development, without having the full syndrome.

Prenatal exposure to ***aspirin and antibiotics*** is correlated with lower performance on intelligence tests as well.

Prenatal ***recreational drug exposure*** was shown to have significantly negative effects on cognitive functioning, as measured at the age of five, compared again controls matched for socioeconomic status and inner-city environment. The researchers concluded that prenatally drug-exposed children are at greater risk for learning difficulties and attention problems in school, and therefore should be the subject of interventions to support educational success. It could be hypothesized that the effect of these drugs on the development of the brain prenatally, and axon guidance could be the root of the negative consequences on later deficits in intellectual development.

Exposure to ***tobacco smoking*** has been associated with diminished intelligence and attentional problems. One study indicated that children whose mothers had smoked 10 or more cigarettes a day were between 3 and 5 months behind schoolmates in reading, math and general ability.

There is also evidence that ***birth complications*** and other factors around the time of birth (***perinatal***) can have serious implications on intellectual development. For example, a prolonged period without access to oxygen during the delivery can lead to brain damage and mental retardation. Also, ***low birth weights*** have been linked to lower intelligence scores later in lives of the children. There are two reasons for low birth weight, either premature delivery or the infant's size is just lower than average for its gestational age; both contribute to intellectual deficits later in life. A meta-analysis of low birth weight babies found that there is a significant relationship between low birth weight and impaired cognitive abilities.

Intelligence alone is not enough for the development of ***genius*** but the pathways and neural connections for divergent thinking are also necessary. Thus, the home must encourage creativity. The parents of gifted children tend to supply enriching environments with intellectually and culturally stimulating materials thus increasing the child's likelihood to engage in creative activities.

There are many environmental influences on intelligence, typically divided into biological and non-biological factors, often involving social or cultural factors. The commonality between these two divisions is the exposure in early childhood. It appears that exposure to these various positive or negative influences on intelligence levels needs to happen early in the development of the brain, before the neuronal connections have ceased forming. Parents of gifted children also tend to have above

average educational achievement and at least one tends to work in an intellectual profession. There is also evidence that the probability of a gifted child becoming a genius may be increased if the child has had to face adversity or trauma and that a traditional upbringing may encourage conformity and discourage the necessary divergent thinking.

Music (more specifically a sonata by W.A. Mozart) and ***chess*** can improve IQ. Studies have shown that listening to Mozart before taking an IQ test will improve scores. This is called the *Mozart Effect*. The Mozart Effect improves spatial-temporal reasoning. For example, one study found that college students scores on a spatial abilities test increased by 8-9 points after they had listened to Mozart whereas there was no increase when they listened to relaxation instructions or silence.

Studies have shown that *chess* requires auditory-verbal-sequential skills, not visuospatial skills. A German study found that Garry Kasparov, a Russian former World Chess Champion, regarded by many as the greatest chess player of all time, has an IQ of 135 and an extremely good memory. Similarly, a study looking at young Belgian chess experts found that they have an average IQ of 121, a verbal IQ of 109 and a performance IQ of 129.

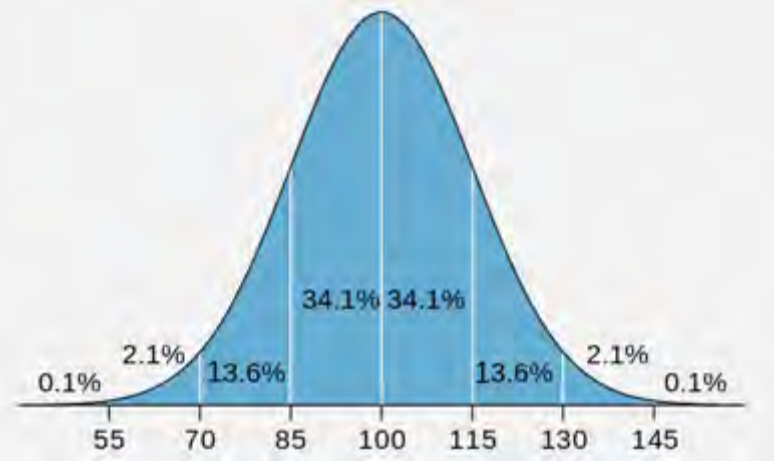
Political Intelligence

Is this an oxymoron? These days (in fact months) the US politicians, with a few rare exceptions, do not shine in IQ ratings.

And what about the Presidents of the United States?

Compared to the general population, presidents are smart people. The average IQ score in the general population is 100; about 118 for a college graduate. All the U.S. presidents have higher IQs than that. But some are geniuses. Anything over 130 is considered high or a genius-level IQ. From Washington to George W. Bush, 28 U.S. presidents met that mark. Only 3 percent of Americans score above 130. Bill Clinton had the fifth-highest IQ.

Note that neither Obama nor Trump is included in these data points.

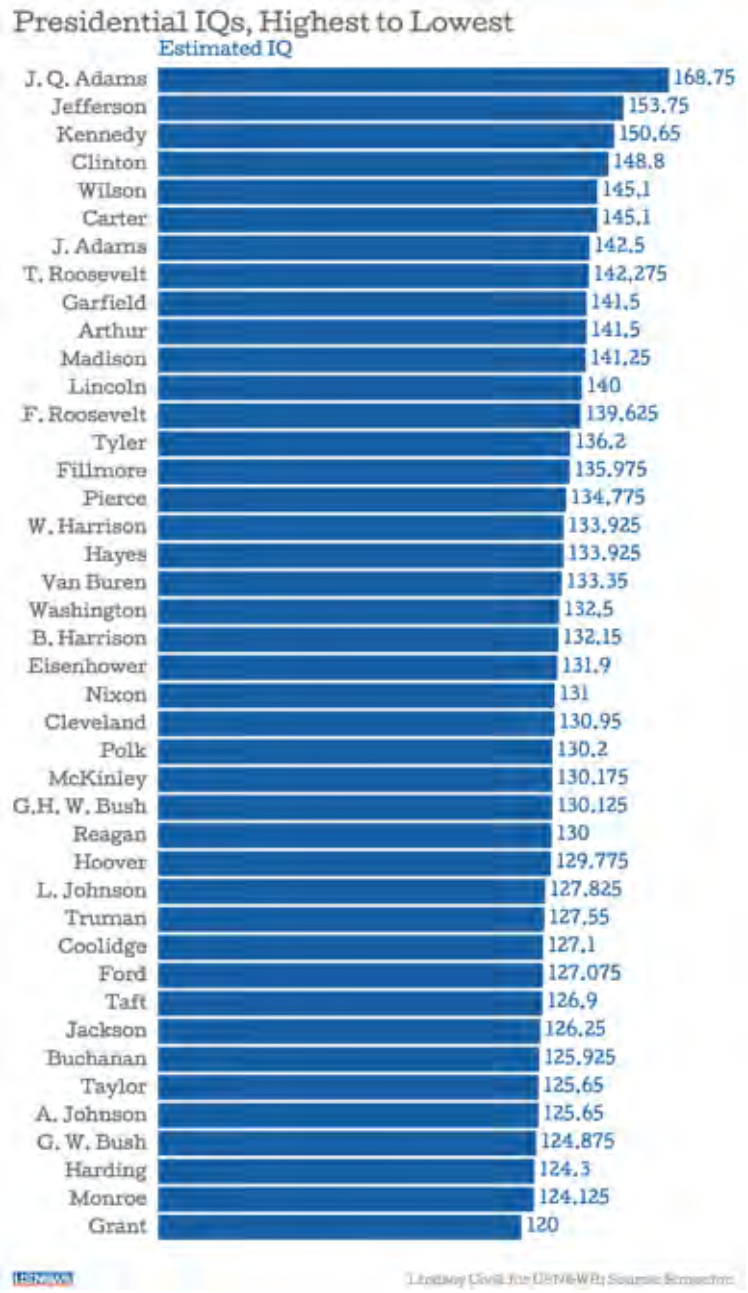


Credit: Iq-test.com

John Quincy Adams, the sixth president, had the highest IQ, according to the research. Before following in his father's presidential footsteps, Adams graduated from Harvard College, served internationally in several diplomatic posts and was secretary of state under President James Monroe. During his time in government, Adams was an avid supporter of the arts and sciences and advocated for the founding of the Smithsonian Institution.

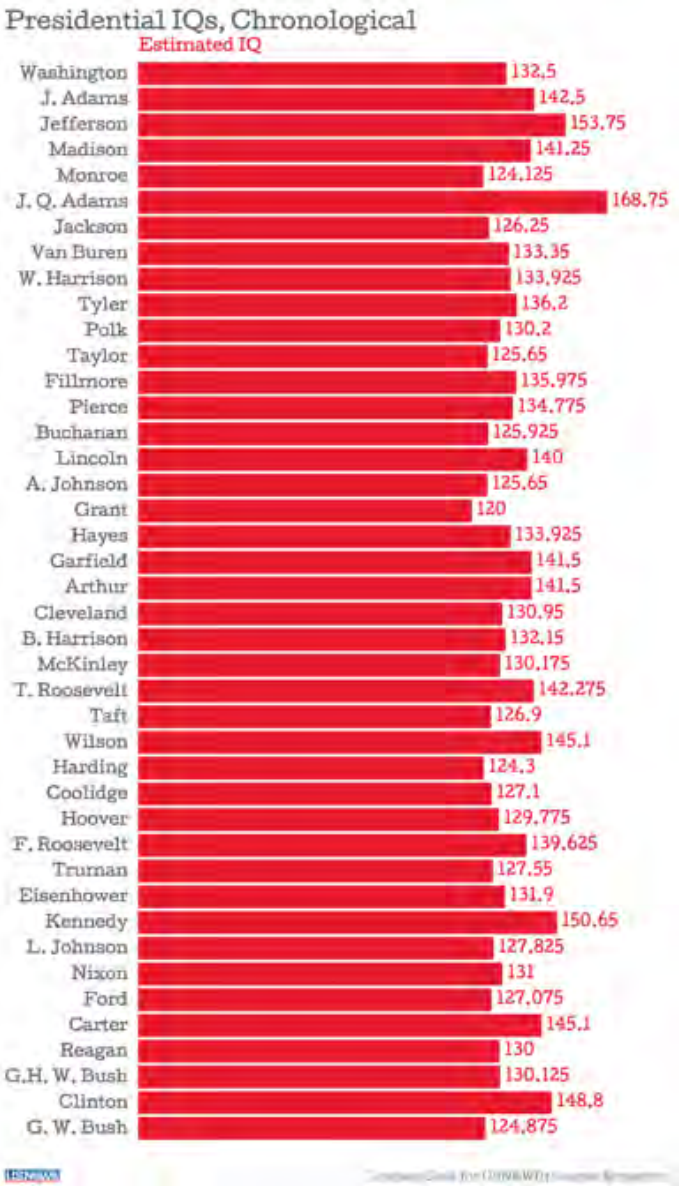
The president with the second-highest IQ was the perhaps more expected: Thomas

Jefferson. The third president was a founding father and drafted the Declaration of Independence. After serving two terms as president, Jefferson worked on his two pet projects — his grand estate, Monticello, and establishment of the University of Virginia.



Credit: Scoopnest.com

The data used for these graphs are an average of the four estimated IQ scores in the study. George W. Bush falls at the bottom of the list on graph #2 (in red, below). In fact, concerns that he may not be smart enough to be president initially drove researchers to complete the study, comparing his intelligence to that of other presidents.



Credit: Usnews.com

Do the smartest presidents make the best presidents?

There are three basic views on the relationship between IQ and success in the Oval Office. The first view says the smarter the president, the better. In line with this view, Gary Hart, the retired U.S. Senator and one-time presidential hopeful, argued that although a big part of success as president is picking smart people for key positions, "*it takes a pretty keen mind, honed by study, travel, experience, and exposure to competing ideas, to form good judgment and to know whom to trust on complex substantive issues.*" The second view holds that you only should be smart *enough* to be president. The idea behind this view is that IQ is a "threshold" variable, which loses its predictive power beyond a certain level. Malcolm Gladwell explained this idea in his book *Outliers*: "*The relationship between success and* IQ works only up to a point. *Once someone has reached an IQ of somewhere around 120, having additional IQ points doesn't seem to translate into any measurable real-world advantage.*" (The average IQ for the general population is 100; an IQ of 120 is at about the 91st percentile.) The final view is that the president can be *too* smart—because, for example, he or she may be unable to communicate on a level that less-intelligent colleagues and constituents can understand. According to one analysis, this is President Obama's problem: *"President Obama is too intelligent for Republicans to understand".* This view puts greater emphasis on interpersonal skills than intelligence. The president is someone you should want to have a beer with, or maybe go bowling with.

What does science say? For obvious reasons, it is not possible to have the 43 U.S. Presidents sit for an IQ test. Thus, in a 2006 study, the University of California Davis psychologist Dean Keith Simonton used a historiometric research approach to estimate the correlation between IQ and presidential success. In the conventional approach to measuring IQ, a person is given a standardized test, such as the Wechsler Adult Intelligence Scale, and their score on the test is assumed to reflect their level of intelligence (with some amount of random error). By contrast, in the historiometric approach, a person's IQ is quantitatively estimated based on variables having known correlations with IQ, such as highest level of education, academic honors, scores on college admissions exams, occupation, and preferences. In his study, Simonton found that IQ estimates for the first 42 presidents (Washington to G. W. Bush) ranged from 118 -around the average for a college graduate- to a

stratospheric 165 -well beyond the conventional cutoff for "genius." The three lowest, from the bottom, were Ulysses S. Grant, Warren Harding, and James Monroe. The three highest, from the top, were John Quincy Adams, Thomas Jefferson, and John F. Kennedy. What's more, IQ correlated positively with a measure of "presidential greatness" based on multiple rankings and ratings of presidents' leadership ability -and the relationship went in a straight line. The smarter the president, the better, roughly speaking. Simonton's IQ estimates also correlate positively with a ranking of presidential performance compiled by statistician Nate Silver, founder of the web site "fivethirtyeight.com".

This finding agrees with results of large-scale meta-analyses by the University of Iowa industrial psychologist Frank Schmidt demonstrating that general cognitive ability -the psychological trait underlying IQ- is the single best predictor of performance in the workplace. It is also consistent with findings from research that has directly tested the idea that IQ is a threshold variable. In a project known as the Study of Mathematically Precocious Youth, Vanderbilt psychologists David Lubinski, Camilla Benbow, and their colleagues found that, even among a sample of intellectually gifted people, a higher level of cognitive ability in childhood forecasted great accomplishment later in life, both in school and beyond. In another study, using four data sets with sample sizes in the thousands, a team of researchers led by the University of Minnesota psychologist Paul Sackett investigated the relationship between cognitive ability and both academic and work performance. In all cases, the relationship was positive and linear -the higher the level of cognitive ability, the better the performance. There was no evidence to support the threshold hypothesis, that there is a "*smart enough."*

There is also evidence that IQ is an important predictor of acquiring expertise in specific domains. For example, in a study of 90 Austrian tournament chess players, the psychologist Roland Grabner and his colleagues found that IQ correlated positively with tournament chess rating. (As it happens, over half of U.S. presidents reportedly played chess, and one -Jimmy Carter- aspired to become a chess master after leaving office.) Similarly, in a re-analysis of results of a previous study, Brooke Macnamara and David Z. Hambrick found that fluid intelligence -the general ability to reason and think logically- was a strong positive predictor of skill in the board game GO, as measured by a laboratory task that was specially designed to measure a

GO player's ability to evaluate game situations and select optimal moves. In turn, performance in this task was strongly related to a player's tournament GO rating.

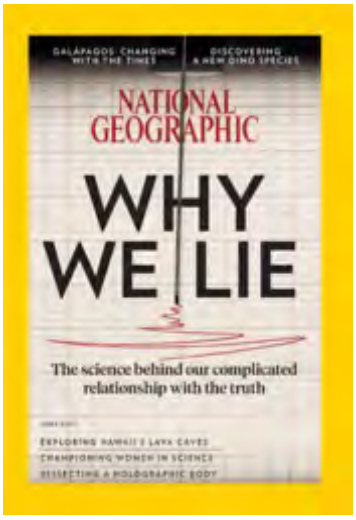
The job of president of the United States calls on a wide range of knowledge, skills, and abilities. The president must acquire vast amounts of knowledge about a dizzying array of topics, consider competing points-of-view and ideas in making decisions, and solve complex problems of all sorts. It goes without saying that IQ isn't the only predictor of success in this job. Many other factors matter, including experience, personality, motivation, interpersonal skill, and perhaps above all else, luck. Yet, what science tells us is that a high level of intellectual ability translates into a measurable advantage in the Oval Office. As Gary Hart noted, "*The Constitution imposes no IQ test*" -and it seems safe to assume that it never will. All the same, we should want smart people to run for president, and then we should wish the winner all the luck in the world. Now we are stuck with Donald J. Trump who claims that **he is** *the smartest person in the world*…

Hence the **President** of the United States of America should be ***intelligent***, as measured by the IQ. But does this apply to **politicians** of all levels: federal, state, county, district, town or city? If you read the local newspapers (or the *New York Times*, the *Washington Post* or *The New Yorker*, *the Atlantic*) you start getting skeptic. Some elected politicians seem at time to have just jumped out of *The Simpsons* or the movie *Hellzapoppin.* (At least both are very funny!).

Credit: Wikipedia

One human feature that ***all*** politicians demonstrate is their infinite, blatant, arrogant capacity to **lie**.

The cover story of the June 2017 *National Geographic* magazine is devoted to ***Why We Lie*** and is written by Yidhijit Bhattacharjee, a contributing and outstanding writer. Hereunder are excerpts from his article, edited and selected for clarity:



Credit: nationalgeographic,com

The history of humankind is strewn with crafty and seasoned liars. Many are criminals who spin lies and weave deceptions to gain unjust rewards—as the financier Bernie Madoff did for years, duping investors out of billions of dollars until his Ponzi scheme collapsed. Some are politicians who lie to come to power or cling to it, as Richard Nixon famously did when he denied any role in the Watergate scandal. Sometimes people lie to inflate their image –a motivation that might best explain President Donald Trump's demonstrably false assertion that his Inauguration crowd was bigger than President Barack Obama's first one. People lie to cover up bad behavior, as American swimmer Ryan Lochte did during the 2016 Summer Olympics by claiming to have been robbed at gunpoint at a gas station when, in fact, he and his teammates, drunk after a party, had been confronted by armed security guards after damaging property. Even academic science –a world largely inhabited by people devoted to the pursuit of truth- has been shown to contain a rogues' gallery of deceivers, such as physicist Jan Hendrik Schön, whose purported breakthroughs in molecular semiconductor research proved to be fraudulent.

These liars earned notoriety because of how egregious, brazen, or damaging their falsehoods were. But their deceit doesn't make them as much of an aberration as we might think. The lies that impostors, swindlers, and boasting politicians tell merely sit at the apex of a pyramid of untruths that have characterized human behavior for eons. Lying, it turns out, is something that most of us are very adept at. We lie with ease, in ways big and small, to strangers, co-workers, friends, and loved ones. Our capacity for dishonesty is as fundamental to us as our need to trust others, which ironically makes us terrible at detecting lies. Being deceitful is woven into our very fabric, so much so that it would be truthful to say that to lie is human.

The ubiquity of lying was first documented systematically by Bella DePaulo, a social psychologist at the University of California, Santa Barbara. Two decades ago DePaulo and her colleagues asked 147 adults to jot down for a week every instance they tried to mislead someone. The researchers found that the subjects lied on average one or two times a day. Most of these untruths were innocuous, intended to hide one's inadequacies or to protect the feelings of others. Some lies were excuses –one subject blamed the failure to take out the garbage on not knowing where it needed to go. Yet other lies –such as a claim of being a diplomat's son- were aimed at presenting a false image. While these were minor transgressions, a later study by DePaulo and other colleagues involving a similar sample indicated that most people have, at some point, told one or more "*serious lies*" –hiding an affair from a spouse, for example, or making false claims on a college application.

That human beings should universally possess a talent for deceiving one another shouldn't surprise us. Researchers speculate that lying as a behavior arose not long after the emergence of language. The ability to manipulate others without using physical force likely conferred an advantage in the competition for resources and mates, akin to the evolution of deceptive strategies in the animal kingdom, such as camouflage. "*Lying is so easy compared to other ways of gaining power*," notes Sissela Bok, an ethicist at Harvard University who's one of the most prominent thinkers on the subject. "*It's much easier to lie to get somebody's money or wealth than to hit them over the head or rob a bank*." As lying has come to be recognized as a deeply ingrained human trait, social science researchers and neuroscientists have sought to illuminate the nature and roots of the behavior. How and when do we learn to lie? What are the psychological and neurobiological underpinnings of dishonesty? Where do most of

us draw the line? Researchers are learning that we're prone to believe some lies even when they're unambiguously contradicted by clear evidence. These insights suggest that our proclivity for deceiving others, and our vulnerability to being deceived, are especially consequential in the age of social media. Our ability as a society to separate truth from lies is under unprecedented threat.

There appears to be no agreement among psychiatrists about the relationship between mental health and lying, even though people with certain psychiatric disorders seem to exhibit specific lying behaviors. Sociopathic individuals –those diagnosed with antisocial personality disorder- tend to tell manipulative lies, while narcissists may tell falsehoods to boost their image. But is there anything unique about the brains of individuals who lie more than others? In 2005 psychologist Yaling Yang and her colleagues compared the brain scans of three groups: 12 adults with a history of repeated lying, 16 who met the criteria for antisocial personality disorder but were not frequent liars, and 21 who were neither antisocial nor had a lying habit. The researchers found that the liars had at least 20 percent more neural fibers by volume in their prefrontal cortices, suggesting that habitual liars have greater connectivity within their brains. It's possible this predisposes them to lying because they can think up lies more readily than others, or it might be the result of repeated lying.

Psychologists Nobuhito Abe at Kyoto University and Joshua Greene at Harvard University scanned the brains of subjects using functional magnetic resonance imaging (fMRI) and found that those who acted dishonestly showed greater activation in the nucleus accumbens –a structure in the basal forebrain that plays a key role in reward processing. "*The more excited your reward system gets at the possibility of getting money –even in a perfectly honest context- the more likely you are to cheat*," explains Greene. In other words, greed may increase one's predisposition to lying. One lie can lead to another and another, as evidenced by the smooth, remorseless lying of serial con men. An experiment by Tali Sharot, a neuroscientist at University College London, and colleagues showed how the brain becomes inured to the stress or emotional discomfort that happens when we lie, making it easier to tell the next fib. In the fMRI scans of the participants, the team focused on the amygdala, a region that is involved in processing emotions. The researchers found that the *amygdala's response to lies got progressively weaker with each lie, even as the*

lies got bigger. "*Perhaps engaging in small acts of deception can lead to bigger acts of deception*," she says.

Much of the knowledge we use to navigate the world comes from what others have told us. Without the implicit trust that we place in human communication, we would be paralyzed as individuals and cease to have social relationships. "*We get so much from believing, and there's relatively little harm when we occasionally get duped*," says Tim Levine, a psychologist at the University of Alabama at Birmingham, who calls this idea the truth default theory. Being hardwired to be trusting makes us intrinsically gullible. "*If you say to someone,* 'I am a pilot*,' they are not sitting there thinking:* 'Maybe he's not a pilot. Why would he say he's a pilot?*' They don't think that way*," says Frank Abagnale, Jr., a security consultant whose cons as a young man, including forging checks and impersonating an airline pilot, inspired the 2002 movie Catch Me if You Can. "*This is why scams work, because when the phone rings and the caller ID says it's the Internal Revenue Service, people automatically believe it is the IRS. They don't realize that someone could manipulate the caller ID*."

Robert Feldman, a psychologist at the University of Massachusetts, calls that the liar's advantage. "*People are not expecting lies, people are not searching for lies,"* he says, "*and a lot of the time, people want to hear what they are hearing*." We put up little resistance to the deceptions that please us and comfort us –be it false praise or the promise of impossibly high investment returns. When we are fed falsehoods by people who have wealth, power, and status, they appear to be even easier to swallow, as evidenced by the media's credulous reporting of Lochte's robbery claim, which unraveled shortly thereafter. Researchers have shown that we are especially prone to accepting lies that affirm our worldview. Memes that claim Obama was not born in the United States, deny climate change, accuse the U.S. government of masterminding the terrorist strikes of September 11, 2001, and spread other "*alternative facts,"* as a Trump adviser called his inauguration crowd claims, have thrived on the Internet and social media because of this vulnerability. Debunking them does not demolish their power, because people assess the evidence presented to them through a framework of preexisting beliefs and prejudices, says George Lakoff, a cognitive linguist at the University of California, Berkeley. "*If a fact comes in that doesn't fit into your frame, you'll either not notice it, or ignore it, or ridicule it, or be puzzled by it –or attack it if it's threatening."*

A recent study led by Briony Swire-Thompson, a doctoral candidate in cognitive psychology at the University of Western Australia, documents the ineffectiveness of evidence-based information in refuting incorrect beliefs. In 2015 Swire-Thompson and her colleagues presented about 2,000 adult Americans with one of two statements: "*Vaccines cause autism*" or "*Donald Trump said that vaccines cause autism*." (Trump has repeatedly suggested there's a link, despite the lack of scientific evidence for it.)

Credit: Urkedfreelance.com

Not surprisingly, participants who were Trump supporters showed a decidedly stronger belief in the misinformation when it had Trump's name attached to it. Afterward the participants were given a short explanation –citing a large-scale study- for why the vaccine-autism link was false, and they were asked to reevaluate their belief in it. The participants –across the political spectrum- now accepted that the statements claiming the link were untrue, but testing them again a week later showed that their belief in the misinformation had bounced back to nearly the same level. Other studies have shown that evidence undermining lies may in fact strengthen belief in them. "People are likely to think that familiar information is true. So, any time you retract it, you run the risk of making it more familiar, which makes that retraction less effective, ironically, over the long term," says Swire-Thompson.

What then might be the best way to impede the fleet-footed advance of untruths into our collective lives? The answer isn't clear. Technology has opened a new frontier for deceit, adding a 21st-century twist to the age-old conflict between our lying and

trusting selves.

Historical perspective is always a useful thing and if history tells us anything about lying it tells us that people have always thought there was too much of it and however much of it there was, there was always more of it now than there had ever been before. The 12th-century English courtier and future Bishop of Chartres, John of Salisbury, feared no time had ever been so dangerous for men of honest virtue. According to John, the royal and ecclesiastical courts of Europe teemed with every sort of deceiver and falsifier, with timeservers and wheedlers, gift-givers, actors, mimics, procurers and gossipmongers. The only thing that surpassed their variety was their number "for the foul inundation of their cancerous disease seeps into all so that there is rarely anyone left uncontaminated". Long before John, scripture had already warned that "*every man is a liar*" and after John, throughout the Middle Ages, into and beyond the Renaissance, few people would deny that the problem of lies had reached never-before-witnessed proportions. Writing late in the 16th century, the French skeptic Pierre Charron asked his readers to "*observe how all mankind are made up of falsehood and deceit, of tricks and lies, how unfaithful and dangerous, how full of disguise and design all conversation is at present become, but especially, how much more it abounds near [the prince], and how manifestly hypocrisy and dissimulation are the reigning qualities of princes' courts.*"

Until the French Revolution, the problem of lying and hypocrisy often seemed to be experienced most keenly in the courts of the European elite, those hybrid spaces, both public and private, political and domestic, in which eager bureaucrats and all manner of hangers-on sought their fortunes. A zero-sum game, fortune hunting required the self-serving courtier to deceive and slander his competitors, to fawn over and flatter his superiors. In a place seemingly constructed to promote lying and flattery, a breeding ground for plots, conspiracies and coups, in which every friendly face might well conceal devious designs, how should a person respond? Is it acceptable to fight fire with fire, to lie to the liars? Again, and again courtiers asked, is it ever acceptable to lie? And again and again they answered, Yes.

Actually, people rarely came out in whole-hearted favor of lies. Almost to a person, medieval and Renaissance writers condemned lies as vile and pernicious. There was tradition behind this opinion. The early fifth-century bishop Augustine had argued that every lie was a **sin** and every sin must be avoided. No good can come from evil,

and even lies told with the best of intentions are sins nonetheless. Augustine's definition would be repeated incessantly throughout the ensuing centuries, repeated so frequently that historians have too often argued that we can distinguish the Middle Ages from the Renaissance in terms of how people thought about lies. During the Middle Ages, so this story goes, every lie was prohibited (which is different than claiming no one lied – we always have and always will do all sorts of things we shouldn't), whereas in the Renaissance people became a bit more realistic about what it takes to get on in the world.

A sad truth supported this rather pragmatic line of ethical thinking. We live in a fallen and corrupt world, a world so morally adrift and complicated, knotted and entangled, that there are few, perhaps no, moral certainties, and all too many situations in which we will have no choice but to sin to avoid greater sins. We need moral principles to guide our actions, but principles can conflict with one another, the demand that we be truthful in all our actions may run afoul the demand that we always act with charity towards others. In other words, courtly proponents of mendacity were, more often than not, skeptics and probabilists, finding refuge not in Aristotle's ethics, but in Cicero's rhetoric. Like a skilled orator, we must adjust our words and actions to the moment, to the circumstances. Depending upon the circumstances, even the most secure of moral principles may have to give way to others.

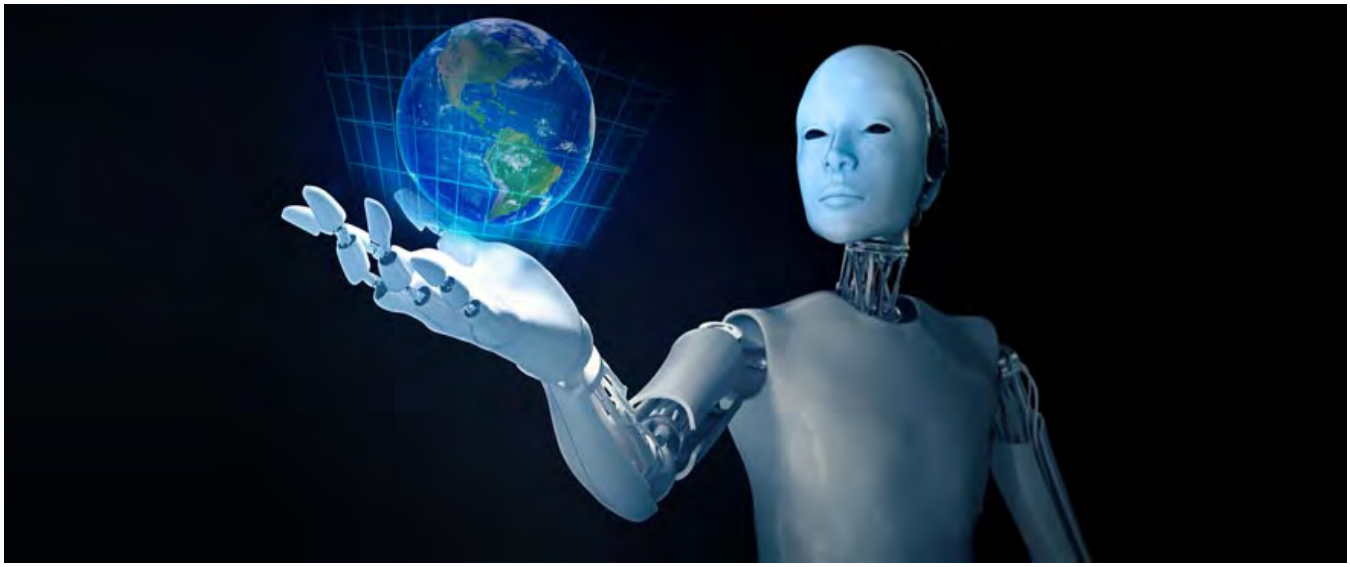
This account of social harmony in no way matched the experience of the members of the European courts, neither in the Middle Ages, nor in the Renaissance. From their vantage point, lies seemed very much like the very substance of social cohesion. We lie to protect ourselves and to advance ourselves. We lie to avoid conflict and simply to grease the wheels of social interaction. "*The gentleman courtier is not subject to himself*," wrote Philibert de Vienne in his mid-sixteenth-century satire, *The Philosopher of the Court*, "*if it is necessary to laugh, he laughs, if it is necessary to grieve, he cries, if it is necessary to eat, he eats, and if it is necessary to fast, he fasts.*" He says and does whatever the moment requires, regardless of how he feels or what he thinks. Medieval and early modern courtiers labelled this sort of sycophancy flattery, considered it little more than base mendacity, condemned it roundly, and recommended its practice absolutely. In his Renaissance bestseller, *Civil Conversation*, Stefano Guazo writes, "*The world is full of and subsists by flattery, which is more in fashion than peeked beards and large ruffs. You see how all persons for the*

sake of peace, and to avoid contention, and that they may appear agreeable in company, comport themselves in the best manner they can to other men's talk and behavior." Without lies, they realized, society would fall apart.

So, the next time we hear some pundit railing against lying politicians or read some study about the newfound prominence of lying in modern society, maybe we should look between the lines. Rather than worry about the fact that everyone lies, we should concern ourselves with the reasons why we lie. We will always be liars, but that doesn't mean we shouldn't always ask ourselves when it is acceptable to lie and when it isn't.

Indeed, when humans were just bands of migrating hunters-gatherers, communication was limited to the strict indispensable. Truth was no problem. But that changed when humans (c. 10,000 years ago) organized in sedentary societies, with agriculture –vs. nomadic herding- at the core. Hierarchy and division of labor generated **power**, and mendacity, lies plus all the features of politicians that thrived until today. Telling the truth was **never** the goal of kings and priests. Keeping the ruled masses in unquestioned belief, crass ignorance, and blind following was. Hence lies, blatant lies, repeated lies, obscene lies, repeated ad nauseam until they became **truths**.

Artificial Intelligence



Credit: sociable.co

Artificial intelligence (**AI**) is intelligence exhibited by machines. In computer science, the field of AI research defines itself as the study of "*intelligent agents*": any device that perceives its environment and takes actions that maximize its chance of success at some goal. Colloquially, the term "*artificial intelligence*" is applied when a machine mimics "cognitive" functions that humans associate with other human minds, such as "*learning*" and "*problem solving*".

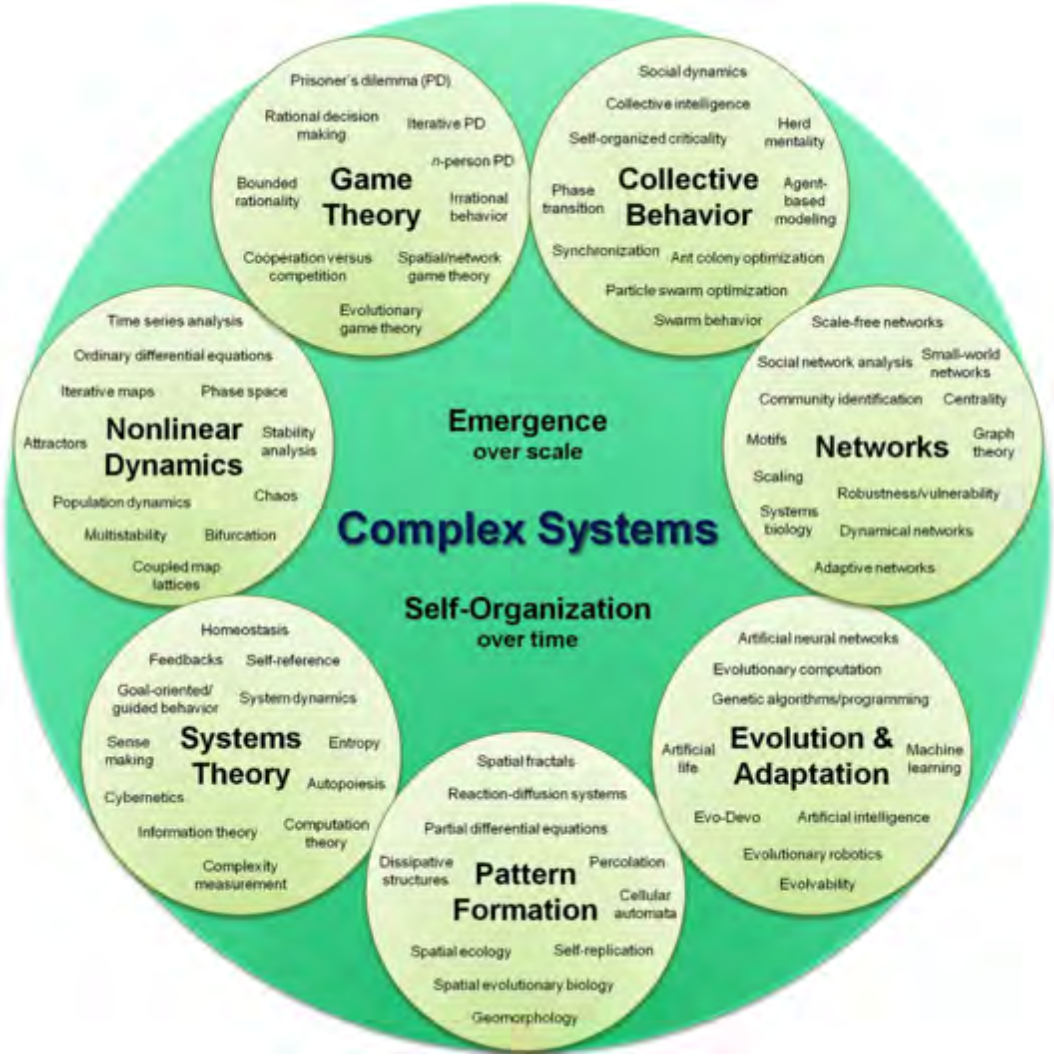
As machines become increasingly capable, mental facilities once thought to require intelligence are removed from the definition. For instance, optical character recognition is no longer perceived as an example of "*artificial intelligence*", having become a routine technology. Capabilities currently classified as AI include successfully understanding human speech, competing and winning- at a high level in strategic game systems (such as chess and Go), self-driving cars, intelligent routing in content delivery networks, military simulations, and interpreting complex data.

AI research is divided into subfields that focus on specific problems, approaches, the use of a particular tool, or towards satisfying particular applications.

The central problems (or goals) of AI research include reasoning, knowledge, planning, learning, natural language processing (communication), perception and the ability to move and manipulate objects. General intelligence is among the field's long-term goals. Approaches include statistical methods, computational intelligence, and traditional symbolic AI. Many tools are used in AI, including versions of search and mathematical optimization, logic, methods based on probability and economics. The AI field draws upon computer science, mathematics, psychology, linguistics, philosophy, neuroscience, artificial psychology plus many others.

The field was founded on the claim that human intelligence "*can be so precisely described that a machine can be made to simulate it*". This raises philosophical arguments about the nature of the mind and the ethics of creating artificial beings endowed with human-like intelligence, issues which have been explored by myth, fiction and philosophy since antiquity. Some people also consider AI a danger to humanity if it progresses unabatedly. Attempts to create artificial intelligence have experienced many setbacks, including the ALPAC report of 1966, the abandonment of perceptrons in 1970, the Lighthill Report of 1973, the second AI winter 1987–1993 and the collapse of the Lisp machine market in 1987.

In the twenty-first century, AI techniques, both hard (using a symbolic approach) and soft (sub-symbolic), have experienced a resurgence following concurrent advances in computer power, sizes of training sets, and theoretical understanding, and AI techniques have become an essential part of the technology industry, helping to solve many challenging problems in computer science. The overall research goal of artificial intelligence is to create technology that allows computers and machines to function in an intelligent manner. The general problem of simulating (or creating) intelligence has been broken down into sub-problems. These consist of traits or capabilities that researchers expect an intelligent system to display.



This is a visual, organizational map of complex systems broken into seven sub-groups.

Recent advancements in AI, and specifically in machine learning, have contributed to the growth of Autonomous Things such as drones and self-driving cars, becoming the main driver of innovation in the automotive industry.

Is there Hope for Human Reasoning?

Maybe. I want to cling to that concept, but the History of humankind is not in favor of such an outcome. It is so much easier to address irrational feelings, fears, prejudices, resentments, envy, jealousy, hate of the non-similarity, and use manipulation to spread false promises and fake news. Despite repeated appeals to **reason** by the scientific community, the current state of the United States is not comforting. But many other countries have taken a different path, focusing on education, science development, clean energies, environmental and cultural protect ion, human rights for all, respected institutions and politicians, and even for some *happiness.* Hereunder is a short list of these countries or states that I have visited and where I did work:

- In North America: Justin Trudeau's Canada; the states of California, Oregon, Washington, Vermont;
- In Latin America: Costa Rica; Uruguay; Michelle Bachelet's Chile;
- In Europe: Germany; Switzerland; the Netherlands, Estonia; the five 'Northern' countries: Denmark, Iceland, Norway, Sweden, Finland;
- In Asia: Singapore; Oman; Bhutan; Japan; Taiwan; hopefully soon South Korea;
- In Africa: Cabo Verde; Botswana; Mauritius;
- In the South Pacific: New Zealand.

Francis Bacon (1561-1626) argued for the possibility of scientific knowledge based only upon inductive reasoning and careful observation of events in nature. Most importantly, he argued this could be achieved by use of a skeptical and methodical approach whereby scientists aim to avoid misleading themselves; the general idea of the importance and possibility of a skeptical methodology makes Bacon the father of *scientific method*. This marked a new turn in the rhetorical and theoretical framework for science, the practical details of which are still central in debates about science and methodology today. In 1733 Voltaire introduced him to a French audience as the *"father*" of the scientific method, an understanding which had become widespread by the 1750s. In the 19th century his emphasis on induction was

revived and developed by William Whewell, among others. He has been reputed as the "*Father of Experimental Philosophy*".

"Bacon's influence in the modern world is so great that every man who rides in a train, sends a telegram, follows a steam plough, sits in an easy chair, crosses the channel or the Atlantic, eats a good dinner, enjoys a beautiful garden, or undergoes a painless surgical operation, owes him something." (W. Hepworth Dixon, 1862)

How many Presidents, lawmakers, politicians, members of the 'Intelligence Community", or educators have read *Novum Organum*, or his *History of Life and Death* –a superb, and still valid, treatise on Medicine?

Credit: Wikipedia

Today, and in the foreseeable future, the fight for *intelligence*, *reason*, and *scientific evidence* is more than ever needed. The education provided in too many countries does not seem to emphasize this approach. Socrates, Laozi, Confucius, Cicero, Erasmus, or Sir Francis Bacon must be sad.

Everyday discoveries on human brain functions and interactions are presented, then published. The jargon of scientists is getting more arcane, and it repels most people who could not benefit of higher education; this is not new: even Socrates pestered against that gap. But it benefited the powerful, the Church, the slave traders and owners, the warmongers and warlords: in the 12th century CE, in Chartres, the **only** tools for education were the incredibly beautiful stained-glass windows of the Cathedral. That was to persist until the 18th century CE in Europe and the Americas. Myths, legends, faith were the fate of the poor kept in abyssal ignorance; the snake of knowledge was the perfect symbol of evil, and the key to damnation.

Most developed countries (and the list includes now much of East, Southeast and South Asia, as well as the Americas) have access to science-based knowledge. It will not help to make a *genius* overnight, but it should reassure most of us on our capacity for judgement, sound choices, and –why not? - **intelligence.**

Watch this short video: https://youtu.be/91qx0LMdJtI

I do know that my students (and now my grandsons) are taking up this challenge.

Indeed, there is **hope**.

Acknowledgements

This essay was triggered by the publication in *Nature Genetics*, on May 22, 2017, of the (first) 52 genes linked to *Human Intelligence* (Ref. #4); it developed in more complex questions fueled by our political turmoil, attacks by enemies of reason and science, and regression in too many countries of the evidence/science-based education and information.

The sources are listed and –as usual- are mostly Wikipedia (often *verbatim*) and other printed articles. The illustrations were copied from Google Images, and links allow for more information.

Initially I considered other '*intelligences*', e.g. **military** intelligence, or intelligence **agencies**, but Yves P. Huin who remains the friend, editor, counsellor, critic and webmaster easily convinced me of my error; he transformed my draft into an acceptable reading piece; my gratitude is immense.

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