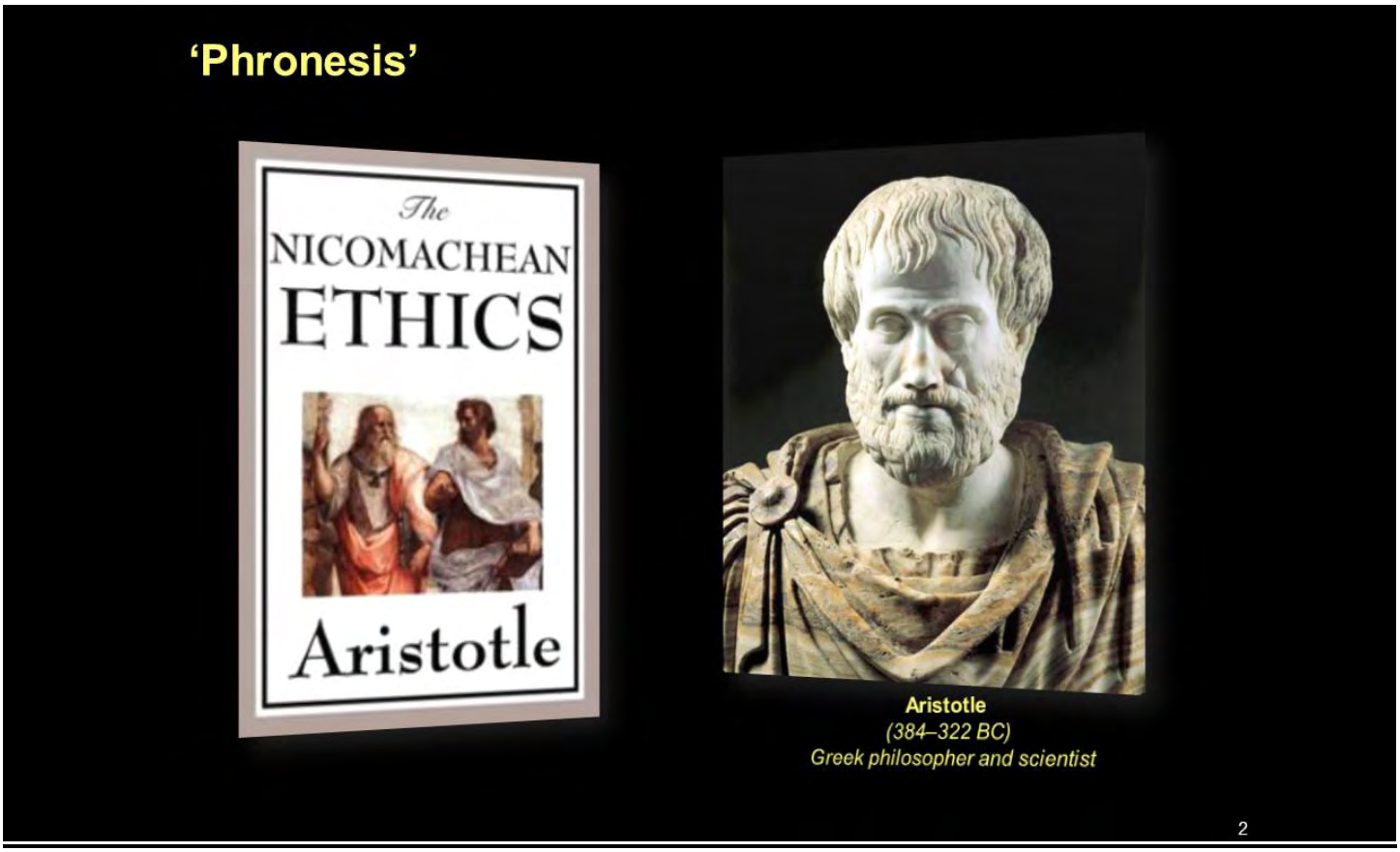
Presentation at OctoberQuest 2016 on
'Exploring the latticework: Some reflections and a list of around 100 cross-disciplinary mental models'
Held on 6th October 2016 at Hotel Hilton Towers, Sahar Airport Road, Mumbai

I'm thankful to the organizers of OctoberQuest for giving me an opportunity to talk on this platform. The topic I've chosen is something that was close to the heart of a very wise person whom I had the privilege to know, interact with and learn from. I would have dedicated this presentation to his memory, except that he would have frowned on such an act. His wisdom was based on a foundation of humility, simplicity, intellectual courage and great integrity. When I look at the manner in which he lived his life, I realise how much is lacking in my own. So before I turn to this presentation, I just want to say - Thank you, Chandrakantbhai, this is my way of remembering all the frequent meetings we used to have.



Phronesis. That is the word that Aristotle used for practical wisdom. And he disagreed with his teacher Plato that wisdom was theoretical and abstract. And Aristotle, I think, was right.

There is a famous quote of Aristotle and I have it in my office because I get angry more often than I should. Aristotle wrote: 'Anybody can become angry – that is easy, but to be angry with the right person and to the right degree and at the right time and for the right purpose, and in the right way – that is not within everybody's power and it is not easy.' Wisdom, according to Aristotle, was not about not getting angry but about perceiving a situation, having the right emotions about it, deliberating the appropriate action and then acting on a reasoned decision.

Acquiring practical wisdom, worldly wisdom, is multi-pronged. It requires good perception, good cognition, emotional balance and the courage of one's convictions**.**

Multidisciplinary knowledge and good thinking skills are important components of gaining worldly wisdom. But there are other dimensions, certain character traits and emotional habits that have to be strengthened without which knowledge alone would be blind. If I have chosen to focus on multidisciplinary knowledge in this talk, it is because it is the relatively easier part, not because it is the only part.

Whilst justice should be blind, wisdom never can be.

The British came to rule India through a ‘divide and conquer’ strategy. Looking at a complex or messy problem requires a similar mindset – to divide the problem into smaller, simpler and more fundamental parts. That is ‘disciplinary reductionism’ – studying a part of the problem from the lens of a narrow specialty. It is a valid approach and the evidence is the amount of knowledge that has been produced and continues to be produced in the world. The danger comes from 1) using only one lens 2) using the wrong lenses or 3) ignoring the context and in many cases all three.

Metaphorically it can be described as having a view of the world when seated in a silo or a tunnel and looking outside. If one were to stretch that analogy a bit further, the view looking inside the tunnel may well be what the prisoners in Plato’s Cave see – shadows of reality.

Going back, lets use a concept from accounting that all of us are familiar with - that of ‘stock’ and ‘flow’. The lenses that one uses are ‘stocks’ – mental models to use another familiar term. Those are important. But what I believe is equally, if not more important, is the ‘flow’ – the ability to draw connections, to see the relationships between different parts and to synthesize and all this whilst bearing the context in mind.

Let me digress a bit.

Some of you may have heard of Herbert Spencer and his theory of Social Evolutionism. Contrary to what the name of the theory suggests and what was once believed, Spencer did not borrow this theory from the far more illustrious Charles Darwin. Although they were contemporaries, Spencer's thinking developed ahead of Darwin's. Darwin's theory applied to a limited range of empirical facts – the origin of species. Spencer took a much broader view – a view that has been considered as dubious – that evolution applies to and is of the same character at all levels of scientific study.

How are all sciences the same? According to Spencer they are all concerned with some matter and the way in which the matter tends to move 'from a diffused imperceptible state to a concentrated perceptible state'. In the course of this movement simple forms and structures give rise to more complex ones by means of two simultaneous processes namely 1) differentiation which is a breakdown of simple unspecialized structures into many separate specialized parts and 2) integration which is the development of a specialized function or bond preserving unity among the different parts.

Differentiation and integration are the important bits. Differentiation and reductionism happens, but the integration that should happen in academia is over narrow and narrower parts. Synthesis is often missing within disciplines, leave alone across disciplines.

Charlie Munger in the 2016 AGM of Daily Journal Corporation said: ‘Synthesis is reality, because we live in a world of multiple models, and of course we’ve got to have synthesis to understand the situation.’

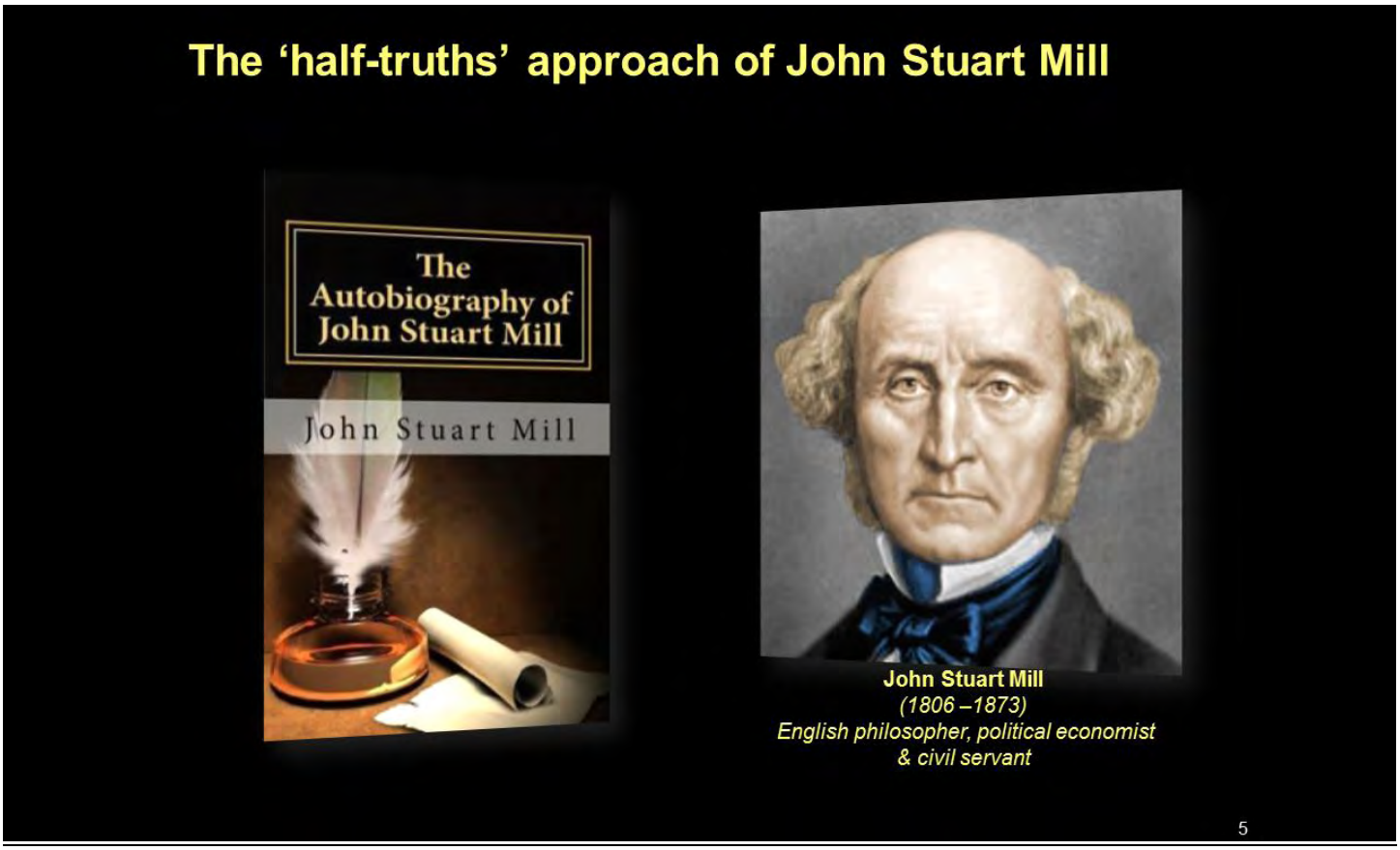
What does synthesis mean? In the context of this presentation, it would mean taking many relevant disciplinary perspectives and then transcending them. The result is, if one were to use the terminology of systems theory, an ‘emergent’ perspective.

Use two more metaphors that I came across – the fruitbowl and the smoothie. The reason for the explicit mention of metaphors is because using metaphors is one of the main tools of lateral thinking and present in all discourse. Metaphors shape the way we think, interpret and behave.

The bowl of fruit is basically a picture of multi disciplinarity. If one takes each fruit as representing a discipline, then the bowl represents many disciplines in close proximity to one another. Taking courses in two or more disciplines gives multidisciplinary knowledge.

The smoothie represents the blending and the integration of many disciplines. The distinctive flavor of each fruit is no longer identifiable, but what one tastes is an emergent flavor. The fruitbowl gives way to the smoothie. This is interdisciplinarity.

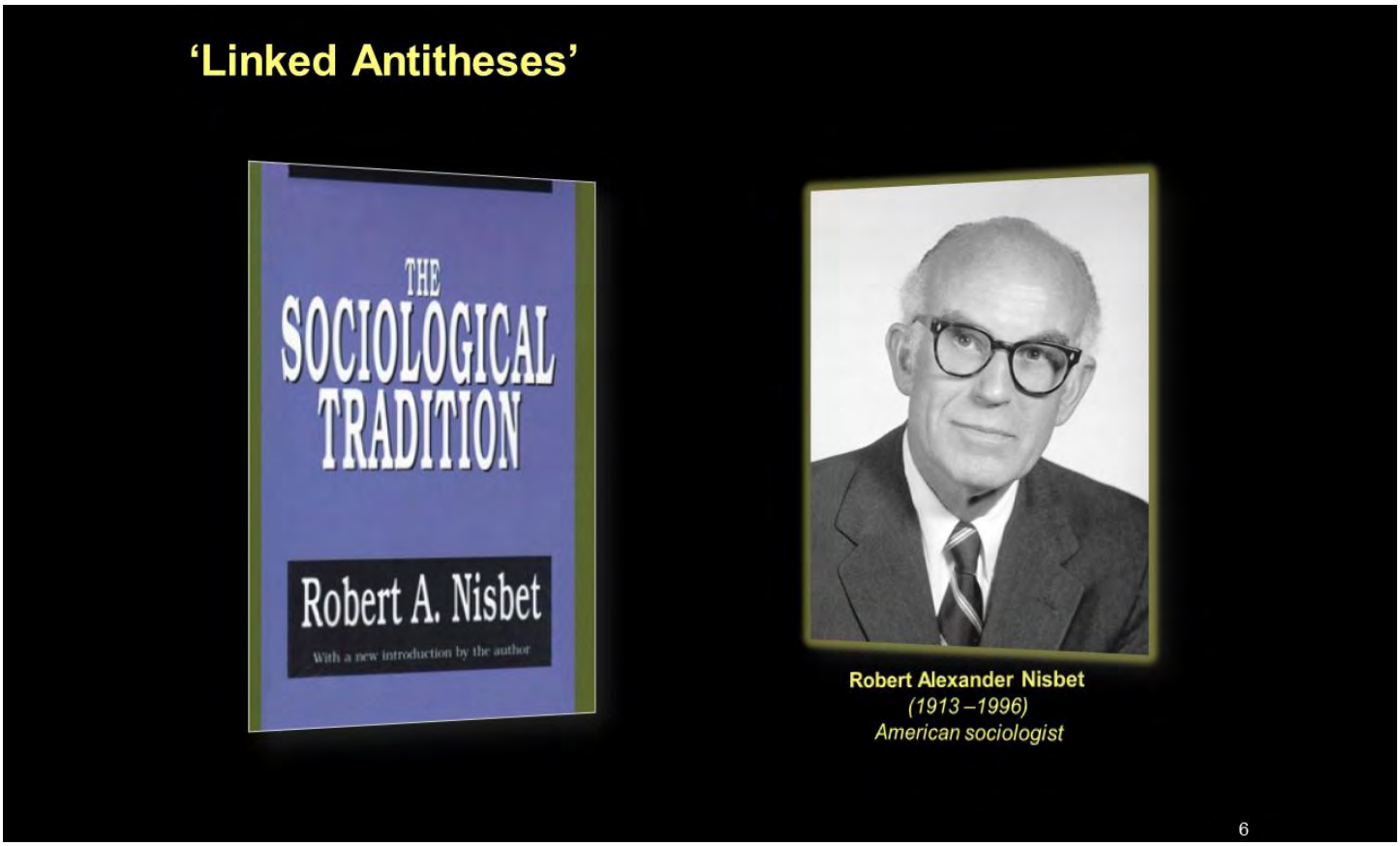
Multidisciplinary mental models help in the deconstruction (and I use the word ‘deconstruction’ here from an engineering and not a philosophical perspective) of a complex problem, But knowledge does not mean wisdom. Wisdom helps in mapping relationships accurately, in making the right connections. Wisdom is partly about understanding the implications of the connections as much as it is about the process of making connections.



Many of you who have had a background in economics would have heard of the mid nineteenth century economist and philosopher, John Staurt Mill. John Stuart Mill who had had been educated by his father, James Mill, on the strict ultitarian principles of Jeremy Bentham suffered a nervous breakdown at the age of twenty after an overdose of rational ‘analytical habits’. If you read Mill’s autobiography, in a chapter midway through the book ‘A crisis in my mental history’, he writes about the influence of the Romantic poet Samuel Talyor Coleridge and the German Enlightenment polymath Johann Wolfgang von Goethe: ‘Many of Coleridge’s sayings about half-truths, and Goethe’s device, ‘many-sidedness’, was one which I would most willingly, at this period, have taken for mine’.

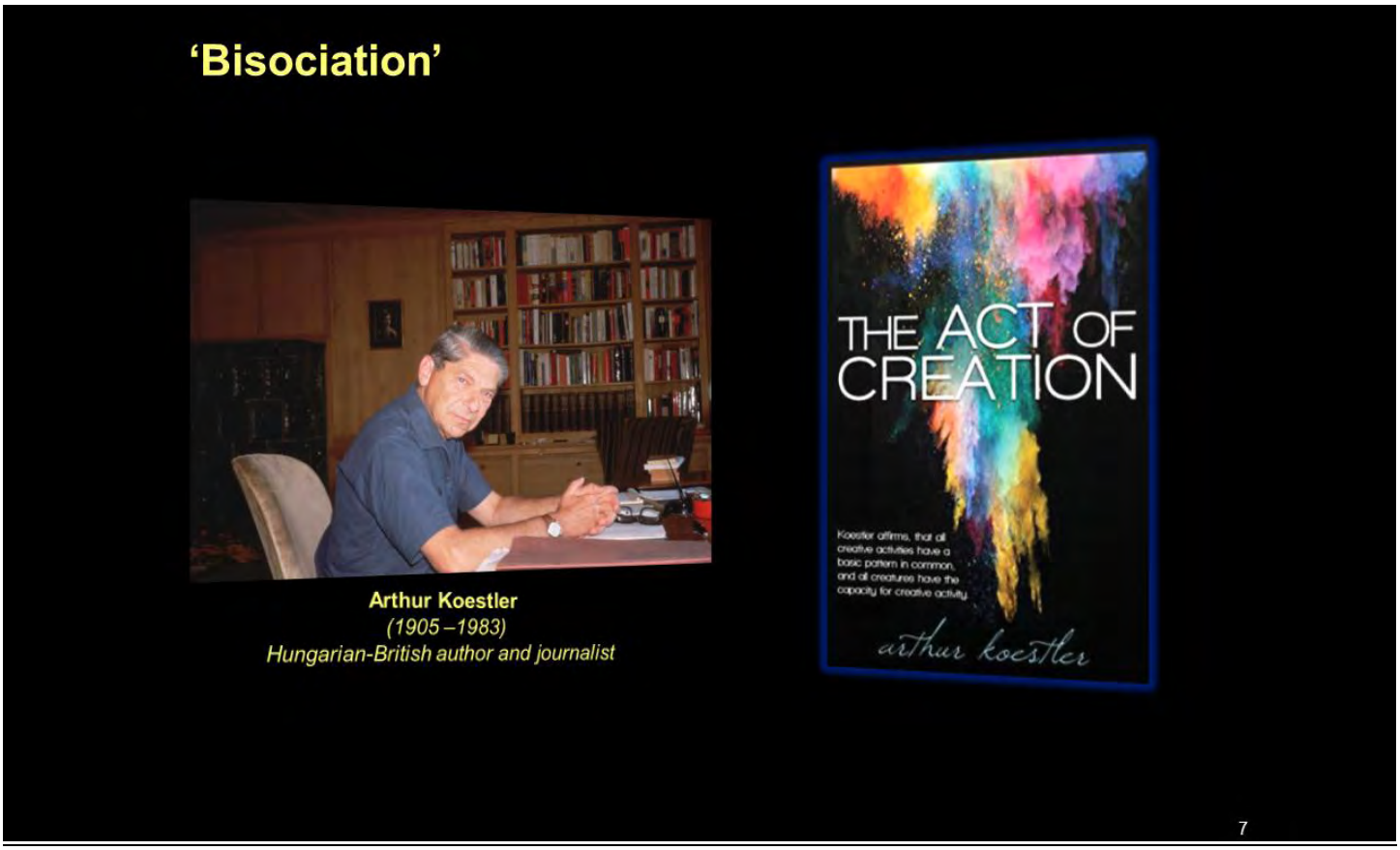
In the words of Mill, Bentham and Coleridge were ‘inhabitants of different worlds’. Mill criticized Bentham for ‘a deficiency of Imagination’, that he had no understanding of ‘the strongest feelings of human nature’. Mill’s assessment of Bentham was that he ‘could, with close and accurate logic, hunt half-truths to their consequences and practical applications’. Moreover, Mill argued that to reject Bentham’s ‘half of the truth because he overlooked the other half, would be to fall into his error without having his excuse’.

In his essays, Mill developed his main thesis that ‘no whole truth is possible but by developing the points of view of all the fractional truths’. Mill wrote further of the necessity of ‘antagonistic modes of thought’, something exemplified by Hegel’s dialectical model of intellectual progress – moving from thesis to antithesis, and then to a synthesis of the two that can in turn become a new thesis.



Almost all the nineteenth century sociological theorists came to view social change in terms of what American sociologist Robert Nisbet called 'linked antitheses'. This meant contrasting pairs of concepts, one of which applied to society before the Industrial Revolution and the American and French Revolutions and the other applied to the subsequent era. And 'linked antitheses' is a useful construct to take away from sociology.

One example. The financial world seems to have divided time into the period Before Lehman and After Lehman. And whilst people are generally disgusted with the behavior of bankers and that they have been lightly punished, financial reforms since 2008 have made banks less profitable and their shareholders have suffered. More capital, less risky activities and low interest rates have caused the industry's profitability to fall sharply.



Those of you who have read Arthur Koestler’s ‘Darkness at Noon’ and ‘The Sleepwalkers’ may be aware that he also wrote ‘The Act of Creation’. The book was an attempt to develop a general theory of human creativity looking at the similarities and differences between creativity in humour, science and the arts.

Koestler wrote that the essence of creativity was in ‘the perceiving of a situation or idea….in two self - consistent but habitually incompatible frames of reference.’ He used the word ‘bisociation’ to characterize this act. So analogies, metaphors, and allegories, to name a few, were all forms of ‘bisociation’ that Koestler considered as central to creation.

A good creative thinker will not only think in a logical, linear way but in an analogical, web-like manner – connecting all sorts of things that more conventional thinkers may not.

Talking of webs, take the World Wide Web, which was the brainchild of one man, Tim Berners-Lee. In his memoir, “Weaving the Web”, he wrote: ‘In an extreme view, the world can be seen only as connections, nothing else’. Earlier he had written when the web was gaining momentum: ‘The new web must allow me to learn by crossing boundaries. It has to help me to recognize the links in my own brain so that I can understand those in another person’s. It has to enable me to keep the frameworks I already have, and relate them to new ones…. When we fail, we have to figure out whether one framework or another is broken, or whether we just aren’t smart enough yet to relate them.’

The ‘alpha’ I’m talking about is not the ‘alpha’ most of you are familiar with – the excess risk-adjusted return that good fund managers and investors make.

It is the alpha in your brain.

Consider how the brain works. It is really about billions of neurons connecting – using electricity as a way to connect to one another. When the synapses are firing in synchrony, they create unified combinations of millions of neurons marching as if in an army parade, as a harmonized ‘neural network’. This is linked to a specific state of consciousness, thoughts and mood. This combination of synchronized electrical activity is called a ‘brain wave’ because it is cyclic and ‘wave like’ in nature. Brain waves are divided into five different bandwidths that scientists believe create a spectrum of human consciousness. These brain waves keep changing throughout the day, part of a feedback loop, influenced by thoughts, emotions and actions.

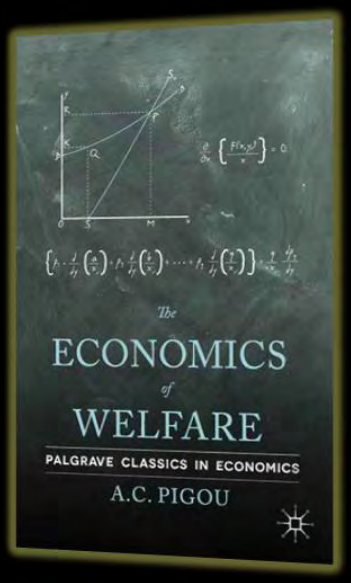
Those that concern us here are the alpha waves.

What causes alpha activity? The conscious practice of mindfulness, meditation and aerobic exercises. What happens in a state of alpha activity? That is a mental state that is ready for associative thinking – ready to see and make new connections. Mental boundaries get loosened and novel associations and connections are made.

Dan Harris, who has written a book ‘10% Happier’, has pointed out that human beings as a species should technically be classified as ‘Homo sapiens sapiens’ – sapiens comes twice - ‘the person who thinks and knows he thinks’. It has been shortened since to ‘Homo sapiens’. It is thinking about our thinking that makes our species unique. And that is what mindfulness is all about.

‘Light-bearing’ v/s ‘Fruit-bearing’ mental models

Arthur Cecil Pigou
(1877 –1959)
English economist



9

Probably the last of the great Classical economists, Professor Pigou wrote in his ‘The Economics of Welfare’: ‘When a man sets upon any course of inquiry, the object of his search maybe either light or fruit – either knowledge for its own sake or knowledge for the sake of the good things to which it leads. In various fields of study these two ideals play parts of varying importance. In the appeal made to our interest by all the great modern sciences some stress is laid both upon the light-bearing and upon the fruit-bearing quality, but the proportion of the blends are different in different sciences.’

It would not be a wrong premise to argue that most of us in the room are probably focused on the fruit-bearing bits of any knowledge. We may well label the light-bearing part as probably dull and impractical. And even when looking at what common conceptions of models are, words like prediction and mechanisms do seem to suggest a focus on the fruit-bearing part. However my construal of mental models would be consonant with the big ideas in each discipline even if they have no fruit-bearing properties. My belief is that light-bearing mental models used in conjunction with fruit-bearing mental models would probably lead to even larger fruit-bearing outcomes.

Some examples. To behavioral psychology’s mental model of ‘mental accounts’ in relation to the spending of windfall gains, could not the somewhat more light-bearing sociological mental models of norms and meaning (are purchases of goods considered frivolous or prudent) be added? A sociological perspective on informational asymmetries, which is a mental model from economics, would include informal social ties to mitigate buyer risk.

Having said that, economics has off and on been building bridges with other disciplines. Multidisciplinary thinkers who have also been Nobel Prize winners in economics like Friedrich von Hayek, Herbert Simon, Amartya Sen, Douglass North, Tom Schelling, Daniel Kahneman and Elinor Ostrom come readily to mind. ‘Physics envy’ though still remains, as demonstrated by a need to boil everything down to mathematical models.

Take the recent theory of the economics of motivated beliefs which recognized that there are some persistent belief distortions both at the individual and group levels arising for affective reasons i.e. feeling better or instrumental reasons i.e. performing better or both. They persist because of some of the reasons that psychology students are aware of – wilful blindness, denial and self-signaling. Self-signaling is another word for selectively acting to feel good about oneself.

Take the economic consequences of motivated beliefs. For example, moral hazard explanations for corporate misbehavior now is being enlarged in economics to include the persistence of bad beliefs with mental models imported from psychology and group dynamics of sociology. Economics has recognized that moral hazard is not only about bad incentives but also about bad beliefs both working together and they had to do some boundary crossing with psychology and sociology to achieve that. One hopes that academic economics is starting to recognize the wisdom of Mr. Munger's 'Psychology of Human Misjudgment'. Because distorted and motivated beliefs have already been extensively discussed by Mr. Munger in his 'Psychology of Human Misjudgment'.

Look at field theory, which are mental models from physics where the concept of fields originated from James Clerk Maxwell – well, now, biology has them – 'morphic fields' that are built up through the accumulation of skills as members of the same species learn something new and these help in patterning the behavior of new members of the species. Field theory is there in social psychology too, though in the fringes, with Kurt Lewin's concept of a person surrounded by 'life spaces'. And sociology has had them for some time – with Pierre Bourdieu's construct of fields and habitus with the 'field' being the social arena in which relationships are formed and 'habitus' being an essential asset of the individual upon which that field operates in the way of socialized norms and behavior that guide thinking. They are probably a mix of light-bearing and fruit-bearing mental models, although the field theory developed in algebra was probably wholly light-bearing.

The sociological perspective of fields may be of interest, underscoring the importance of organizational culture in shaping behavior. The culture of an organization can be an important economic moat. The metaphor of gravitational fields is useful in understanding what happens to profits in highly competitive markets.

'Additively separable' is a term taken from mathematics in which the effect of variations in one variable does not depend on the level of the other. When two things are additively separable, they are neither synergistic nor the opposite.

In a recent book by Samuel Bowles who directs the behavioral science program at Santa Fe Institute – "The Moral Economy' – the author argues for thinking deeply about incentives. It is not that incentives alone, as operant conditioning frameworks of psychology posit, do the trick. The message that goes with the incentive is also important because it can 'crowd-out' ethical and altruistic motives and thus the incentive may have unintended consequences.

So when a day-center brought in a modest fine for lateness by parents in picking up their children, lateness actually increased. There was no moral message as the fine seemed to convey that lateness was for sale. Contrast that with what happened in Ireland in 2002 when a small tax on plastic grocery bags was enacted. In two weeks following its introduction, the use of plastic bags dropped by 94 percent. But that tax was preceded by extensive public deliberations and a huge publicity campaign highlighting the bags' role in damaging the environment. There was a message of explicit social obligation which crowded-in civic motives. The fine thus worked.

There are so many disciplines that remind us to rethink what is 'additively separable' although their academic departments don't. Charles Darwin used the metaphor of an 'entangled bank' to remind us of species interacting at a local scale. Such poetic words formed the conclusion of his 'On the Origin of Species':

'It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing in the bushes, with various insects flitting about and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent on each other in so complex a manner, have all been produced by laws acting around us.'

Of course, these days we read in the media about banks getting entangled in a different way!

The same message of rethinking what is 'additively separable' comes from quantum physics. Danah Zohar in 'The Quantum Self' wrote about the futile search for finding elementary particles: 'In place of the tiny billiard balls moved around by contact forces, there are what amount to so many patterns of active relationship, electrons and photons, mesons and nucleons that tease us with their elusive double lives as they are now position, now momentum, now particle, now waves, now mass, now energy – and all in response to each other and to the environment.'

Mathematical economics has much to learn about keeping a large number of open variables – basically control variables. In a loose sense, assuming things are additively separable. This is a story from physics but is completely applicable to economics:

'When Freeman Dyson was a young theoretical physicist he brought Enrico Fermi a set of calculations he believed explained Fermi's empirical measurements of the scatter of mesons by protons. When Fermi asked how many arbitrary parameters Dyson had used, the younger man answered that his equations had four open variables, to which Fermi replied, "Johnny von Neumann used to say, with four parameters, I can fit an elephant and with five I can make him wiggle his trunk."'

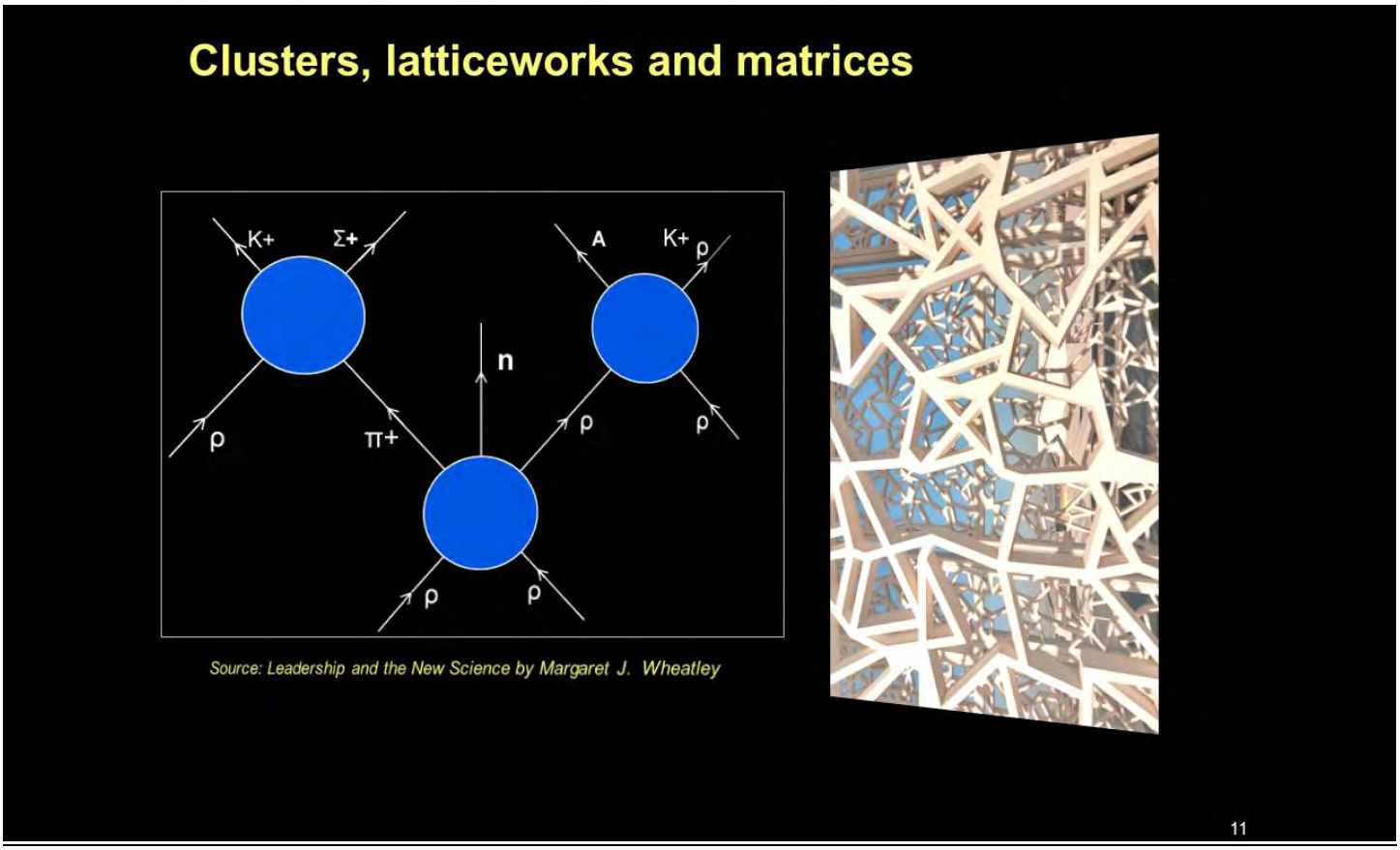
History has many examples of clever people who displayed poor judgment. For example, turn to a wonderful article by Phil Rosenzweig in the December 2010 issue of Harvard Business Review titled 'Robert S. McNamara and the Evolution of Modern Management.' I will quote parts of it:

'When he died in 2009, at age 93, the New York Times' obituary headline described him simply as the "architect of a futile war." Because of his role in it (as Secretary of Defense in the Kennedy Administration), he tends to be caricatured as smart but not wise, obsessed with narrow quantitative measures but lacking in human understanding…. The single-minded emphasis on rational analysis based on quantitative data led to grave errors. The problem was, data that was hard to quantify tended to be overlooked, and there was no way to measure intangibles like motivation, hope, resentment, or courage….

….The historian Margaret MacMillan has written that "McNamara spent much of his life in trying to come to terms with what went wrong with the American war in Vietnam."…. McNamara recalled: "We saw Vietnam as an element of the Cold War, not what they saw it as, a civil war." It was a tragic error that "reflected our profound ignorance of the history, culture, and politics of the people in the area and the personalities and habits of their leaders."…. In a 1995 interview, McNamara returned to this theme: "I don't believe there's a contradiction between a soft heart and hard head. Action should be founded on contemplation."….

….In 2005, months before his 89th birthday, McNamara returned to Harvard Business School and spoke with students on the subject of decision making. Among the lessons he stressed: That for all its power, rationality alone will not save us. That humans may be well-intentioned but are not all-knowing. That we must seek to empathize with our enemies, rather than demonize them, not only to understand them but also to probe whether our assumptions are correct….

….The final measure of a manager, more than amassing wealth or seeking to follow an oath, may be the willingness to examine one's own actions and seek a measure of wisdom.'



Imagine that you are looking into the quantum world of physics. It's a pretty weird world. I need to capture one metaphor from that world.

The metaphor is of the S-matrix diagram. Each of the lines in the diagram has a particle name attached to it. These lines are best understood not as particles, not as things, but as 'reaction channels', pathways in which energy takes temporary form. A subatomic particle is defined by its energy and the network of relationships in which it exchanges energy. The subatomic particles are not separate entities but interrelated energy patterns. It is a network of interactions.

So the metaphor to take away from the quantum world is the S-matrix diagram which is a network of interactions.

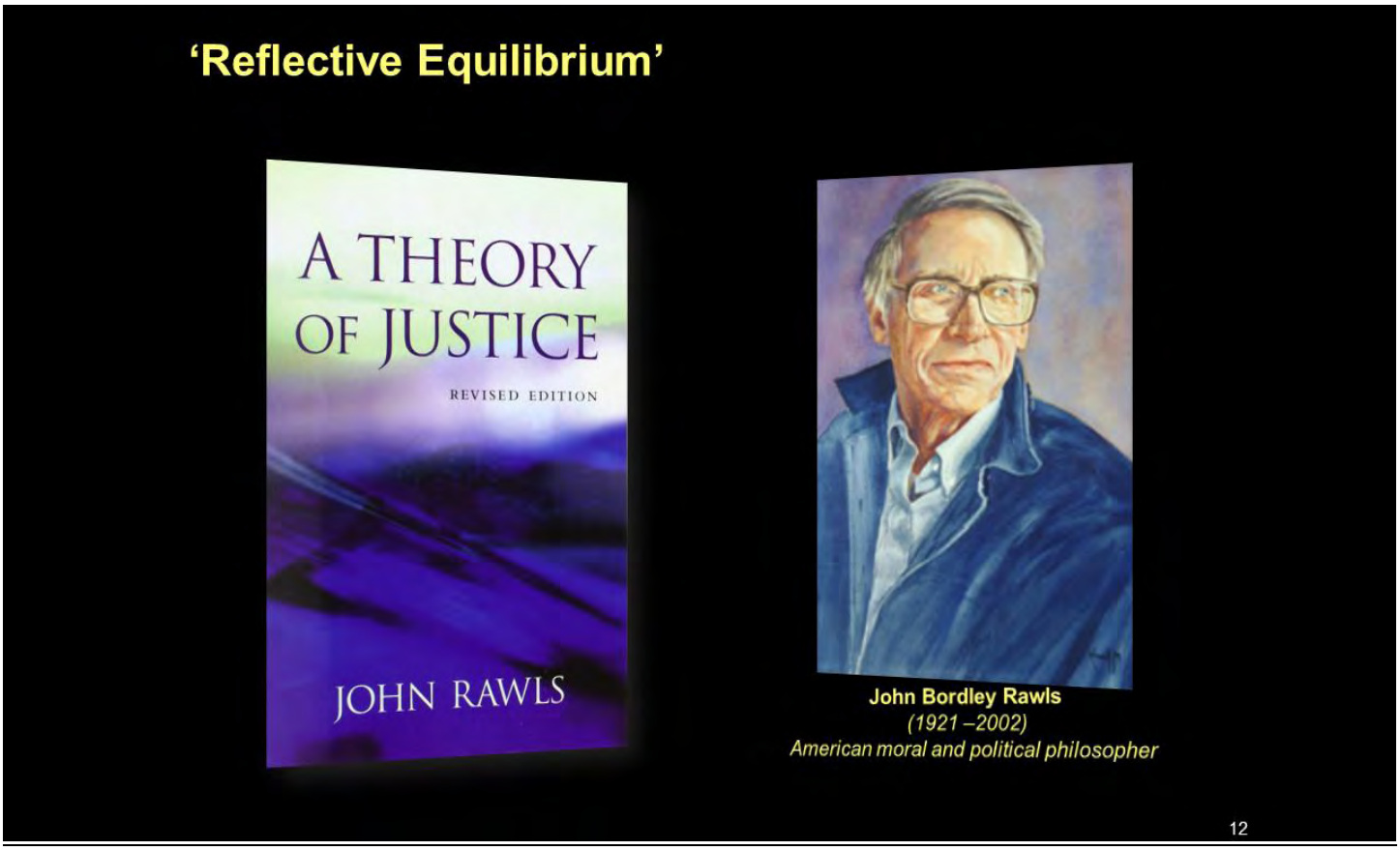
Now forget the quantum world, at least for the moment. There are various disciplines with which to understand the real world, various lenses from which to peer through. Each discipline has some big ideas and probably a lot of related ideas connected closely to the main concept. Taken together they form a cluster. I would like to think of such a cluster as a mental model.

Here's an example that probably all of us are familiar with. Mr. Munger's 'Psychology of Human Misjudgment' would be one such model with about twenty five 'principles' around it. It is syncretic, synthesizing over many of academic psychology's sub-disciplines.

Maybe there would be other big ideas of psychology which you find useful. As Mr. Munger has demonstrated, they need not necessarily meet traditional classifications of academic psychology departments, but you should be able to logically justify, at least to yourself, why they should be in one cluster and lumped together. And each of these clusters would be one mental model, one way of viewing the real world. Do it across disciplines and you will have a variety of cross disciplinary mental models. You would have participated in the creation of the lenses and frames with which you will view the world.

If you were to place these mental models on a mental lattice, you would have a latticework of mental models. When you want to use them, take the metaphor of the S-matrix diagram which is a network of interactions and mentally convert the latticework into a S-matrix diagram. And start connecting.

There would be other ways of thinking about and using mental models, but in the end they must meet the evolutionary criterion of fitness in the real world. As in investing, do what works best for you.



"Reflective equilibrium" is a term used in 'A Theory of Justice' by Harvard Professor John Rawls. It is used in ethics and the way Rawls meant it was a state of balance or coherence among a set of beliefs arrived at by a process of deliberative, mutual adjustments among general principles and individual cases. For example, we may start with a principle that we should never lie. But what if a lot of lives were at risk if we told the truth? Then the theory may need to be amended and modified.

Many mental models are not testable in the way some of the mental models of physics and chemistry are. We may juggle the mental models in a particular case until there is a sense of balance and coherence that comes from finding common ground and integrating. It is to that integration, to that coherence and to that balance that I would like to apply the term 'reflective equilibrium'. It is not easy because firstly, there is always the danger of overweighing certain disciplines, especially the ones we are familiar with, what could be termed as disciplinary bias and secondly, personal biases, no matter how much we try to guard against them. Some mental models are used more often than others and there may be a tendency to take shortcuts and use them even in situations where they may be inappropriate.

Here is an analogy. Lets go back to the famous figure from physics – James Clerk Maxwell. One of the areas he worked early on was color research and he found that there was a fundamental difference between mixing pigments, as with paints and dyes, and mixing lights. Pigments act as extractors of colors, so that the light seen after mixing two paints is the color the paints have failed to absorb. It is a subtractive process, whereas mixing lights is an additive process. In light, three primary colors – red, blue, and green - can be mixed to obtain all the colors of the rainbow. Mixing mental models should be done in a way that is additive to gaining insights and not subtractive. For example, to understand the current state of the global economy may require the additive mental models from economics of the Austrian School whilst Keynesianism may be subtractive.

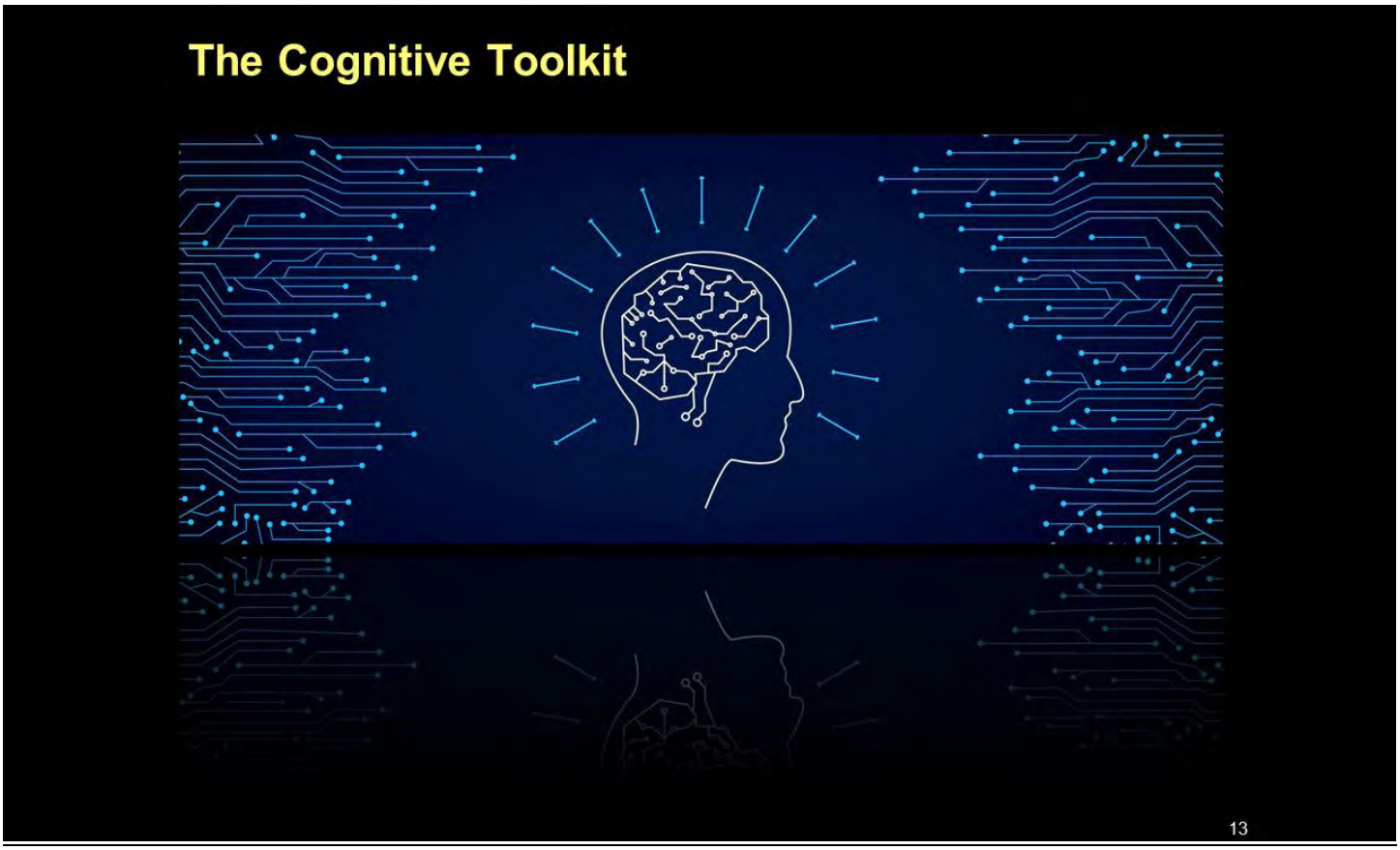
Edward Teller, the scientist remembered for his work on the hydrogen bomb wrote: "Outside of mathematics, it is too often possible to prove both a statement and its opposite."

Lets take another analogy, this one from chemistry, and that is the mental model of enthalpy - entropy compensation. In chemistry, enthalpy is correlated with the strength of the chemical bonds and entropy is a measure of disorder. And changes in free energy caused by a reaction is positively correlated with enthalpy and negatively with entropy. High melting solids have strong bonds and very little freedom of motion or low entropy. Gases with low boiling points are the opposite. And the way to use mental models would be to try to increase enthalpy and reduce entropy. That would generate some free energy or insights.

The best place to start becoming critical is with oneself with a positive view towards self-improvement. Some character traits are probably as important as intellectual traits – empathy and humility come readily to mind. Empathy helps to view a position from multiple angles and humility helps to be open-minded to new ideas and to consider views that one may not initially agree with.

Then there are some thinking concepts – inverting, magnifying, minimizing, modifying, asking disruptive questions like ‘what if’ and asking ecolate questions like ‘and then what’.

Always remember this line of the French film director Jean-Luc Godard: “It’s not where you take things from, it’s where you take them to.”



Literature and history are two disciplines that I have not covered by way of inclusion of any big ideas. It is not that they do not have anything to offer. If anything I could argue to the contrary.

Reading literature and history are probably the best methods of enlarging and expanding experience. These disciplines prepare you to be confronted by surprises and history, especially so, by discontinuities. Literature, in the words of the great poet John Keats, allows for the development of 'negative capability' i.e. the ability to be in uncertainties and doubts, to tolerate anxiety and fear, and allow for 'the emergence of new thoughts and perceptions.' Both these disciplines allow you to remain open to the world.

But there is one overarching reason to read literature. In any language, writers and poets have used similes and metaphors to persuade and entertain. Literature is one discipline that helps to illuminate one idea by connecting it to another. And there is one overarching reason to read history. Present actions usually contain the history of the past.

Whilst on the subject of history, let me talk a bit on invariances. In physics, the validity of the classical physical laws of nature are independent of the location where and the point of time when they are being considered. Invariances are things that do not change and the closest term to them is symmetry. For examples, the human face has invariance – is symmetrical, if a mirror can transform the left hand side and the right hand side into each other.

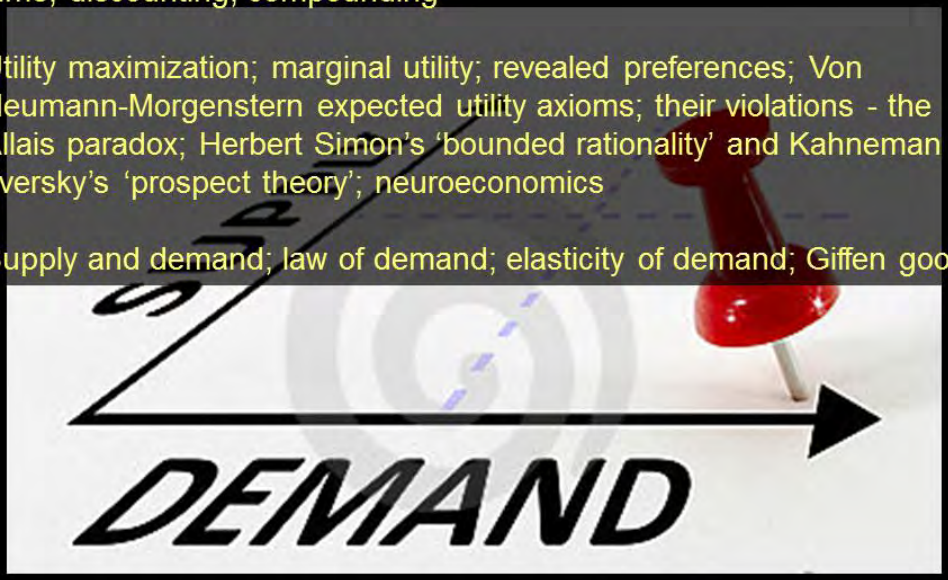
Some disciplines do not depend on initial conditions and are concerned with regularities. Examples are the classical laws of physics and mathematics. Others are dependent on factual descriptions. Example, geography. Many others fall in between, disciplines like the medical sciences. And this an interesting way to look at disciplines – how much does a particular discipline rely on looking at relevant history i.e. particular facts.

Before looking at some of the mental models, consider that the mental models of each discipline reflect the epistemic position of that discipline – the nature of how it views knowledge and how it determines its version of truth. The key challenge for the thinker is to be subtle and sophisticated, to be critical whilst at the same time being pluralistic. To have sufficient depth in each discipline and sufficient breadth across disciplines is a balancing act. It is not too difficult and is a lot of fun.

Mental Models from Economics

Mental Models from Economics

- Opportunity costs
- Time; discounting; compounding
- Utility maximization; marginal utility; revealed preferences; Von Neumann-Morgenstern expected utility axioms; their violations - the Allais paradox; Herbert Simon's 'bounded rationality' and Kahneman Tversky's 'prospect theory'; neuroeconomics
- Supply and demand; law of demand; elasticity of demand; Giffen goods



Mental Models from Economics

- The theory of the firm; profit maximization; transaction cost theory of Robert Coase; ownership control and corporate governance; production functions;

  ….the law of diminishing returns; average and marginal costs; economies of scale; sunk costs; division of labour;

  ….perfect competition; monopolies; natural monopolies and their regulation; oligopolies; cartels;

  ….price discrimination; predatory pricing; entry barriers and 'moats'; economic rents and economic profits

- Information asymmetry; principal - agent problem; moral hazard; adverse selection; Akerlof's 'market for lemons'; signaling and screening

Mental Models from Economics

- Tobin's Q; replacement costs; reproduction costs
- Minsky's Financial Instability Hypothesis; hedge finance; speculative finance and Ponzi finance
- Pareto optimality; market efficiency and welfare theorems; market failure; externalities; Coase theorem; Arrow's impossibility theorem; the theory of the second best
- Ricardo's theory of comparative advantage; the Heckscher-Ohlin model; the Stolper-Samuelson theorem; the factor-price equalization theorem
- Ricardian equivalence
- Austrian business cycle theory; time preference; the production possibility frontier; the loanable funds market; the structure of production; stage specific labour markets; sustainable growth (supported by savings); unsustainable growth (supported by credit creation); malinvestments and overconsumption

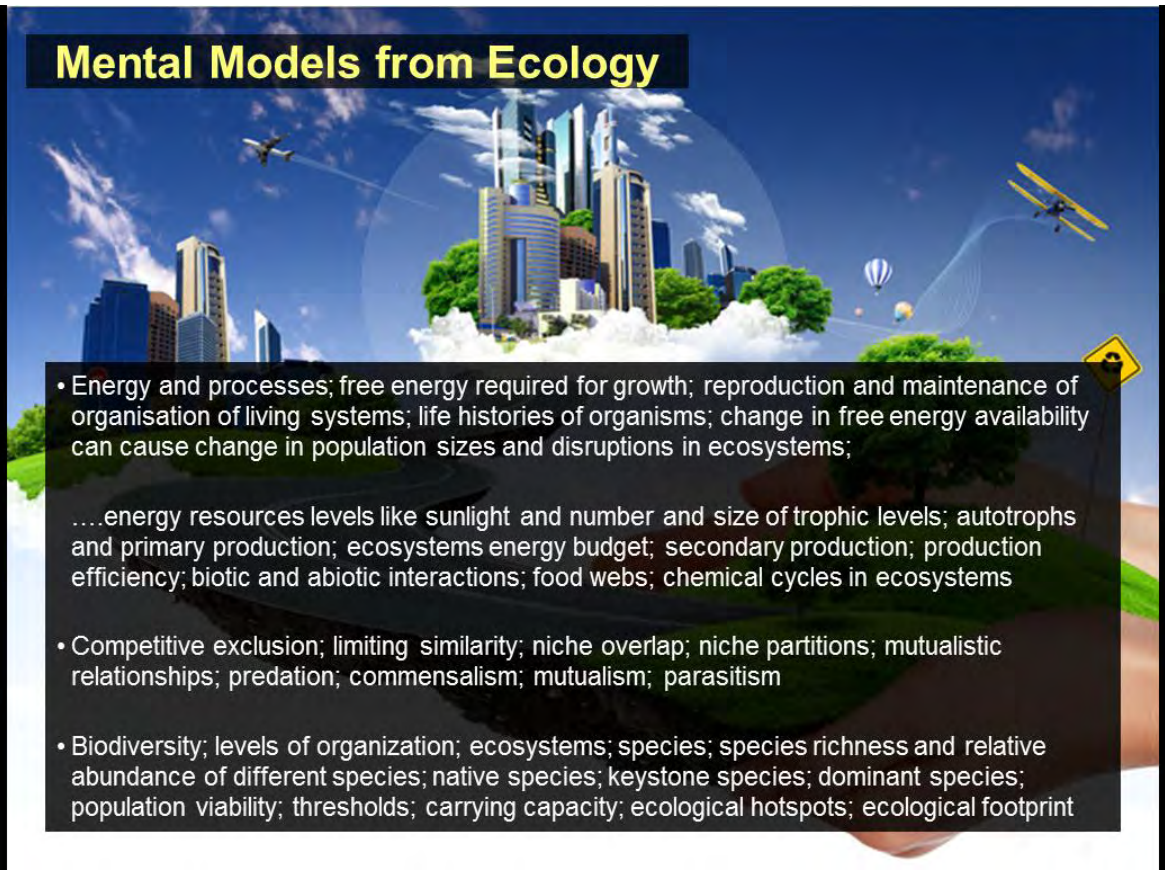
Mental Models from Economics

- Kondratieff long wave cycle; Joseph Schumpeter's 'creative destruction'; Irving Fisher's 'debt deflation' theory
- Monetarism; the quantity theory of money; money and credit creation; the 'natural' rate of interest; the Fisher effect; the Mundell-Fleming trilemma
- Game Theory; Nash Equilibrium; Prisoner's Dilemma; The Tragedy of the Commons; zero-sum games;

  ….co-ordination, chicken and battle of the sexes games; epistemic and evolutionary game theory; experimental economics
- Keynesianism

Mental Models from Ecology

Mental Models from Ecology



- Energy and processes; free energy required for growth; reproduction and maintenance of organisation of living systems; life histories of organisms; change in free energy availability can cause change in population sizes and disruptions in ecosystems;

  ….energy resources levels like sunlight and number and size of trophic levels; autotrophs and primary production; ecosystems energy budget; secondary production; production efficiency; biotic and abiotic interactions; food webs; chemical cycles in ecosystems

- Competitive exclusion; limiting similarity; niche overlap; niche partitions; mutualistic relationships; predation; commensalism; mutualism; parasitism

- Biodiversity; levels of organization; ecosystems; species; species richness and relative abundance of different species; native species; keystone species; dominant species; population viability; thresholds; carrying capacity; ecological hotspots; ecological footprint

Mental Models from Ecology

- Ecological regime shifts; resilience; disturbances; habitant connectivity/ fragmentation
- Information transmission in ecosystems; predator warnings; avoidance responses; signalling behavior; territorial marking; use of visual, audible, tactile, electrical and chemical signals to indicate dominance, find food,

….establish territory and ensure reproductive success; bee dancing; pheromones; courtship and mating behaviors; parent/offspring interactions; migration; Batesian mimicry; Mullerian mimicry; co-operative behavior like pack behavior to increase individual fitness and population survival

- Mechanisms driving biomenes; global warming; ozone depletion

Mental Models from Complexity Theory

Mental Models from Complexity Theory

- Chaos and nonlinear dynamics; 'the butterfly effect' – sensitivity to initial conditions; Poincare's 'three-body problem'; fractal systems and replicator dynamics; multiple speed variables
- Emergence; self organization; dissipitative structures; feedback loops; 'swarm intelligence'; autopoiesis; structural coupling; nested systems
- Multiple equilibria; 'basis of attraction'
- Path dependency; 'lock-in', first-mover advantage; cause and effect not proportional

Mental Models from Complexity Theory

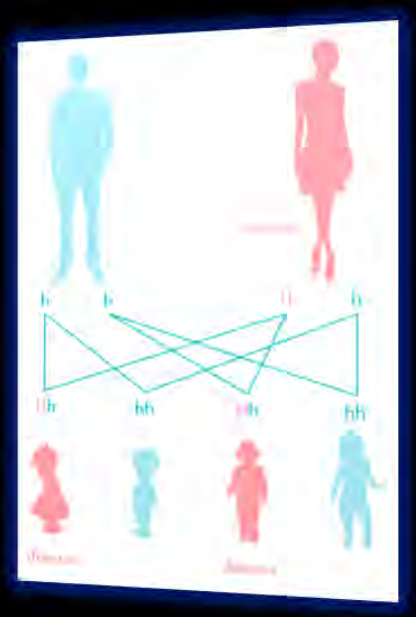
- Phase transitions and tipping points; bifurcation points; 'self-organised criticality'; power laws
- Diversity and resilience; 'the wisdom of the crowd'
- Networks and contagion; network topography; node degree distribution, normal or long-tailed; network robustness and stress at highly connected nodes; 'small world' property of connected networks; six degrees of separation
- Agent-based models

Mental Models from Biology

Mental Models from Biology

- Inheritance of traits; genes; Mendel's Laws; phenotype; genotype; alleles; the genome and the gene pool; hybrids; genetic dominance; recessive traits; co-dominance
- The cell; nucleus and organelles; mitochondria; Theodor Schwann's cell theory; chromosomes; mitosis and meiosis
- DNA; the double helix; base pairs; the genetic code; self-replication; junk DNA; RNA transcription and translation; amino acids; proteins; enzymes
- Evolution; Lamarckism; natural selection; competition; variation; mutation; survival of the fittest; fitness landscape;

  ….adaption; speciation; extinction; punctuated equilibrium; convergent evolution; population genetics and 'genetic drift'; sexual selection; Red queen races; coevolution

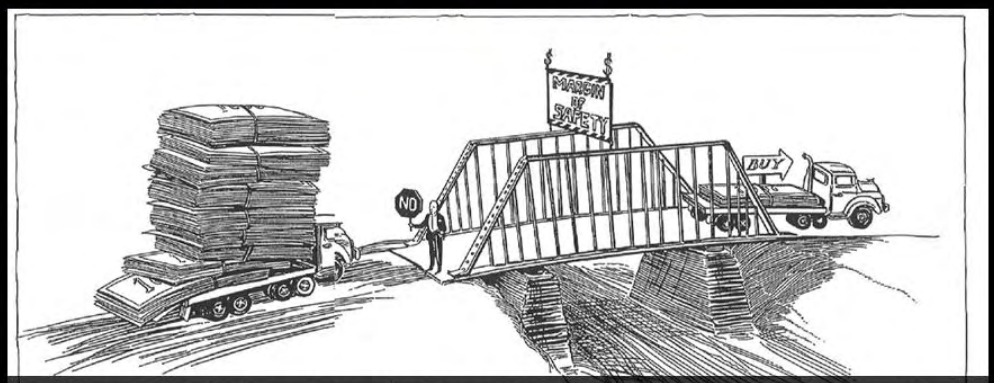


Mental Models from Biology

- Taxonomy; Linnaean naming; species; kingdoms and domains; Darwin's tree of life; molecular clock
- Symbiosis; parasites; predator-prey relationships; herding
- Selfish genes; altruism; relatedness; kin selection; neo-Darwinism and game – theoretic models e.g. Hawk-Dove 'games'
- Origins of life; autocatalysis; replicators and chemical evolution
- Nature v/s Nurture; epigenetics; memetics
- Genetics and technology; genetic modification; GM foods; cloning; gene testing; polymerase chain reaction; gene therapy

Mental Models from Engineering

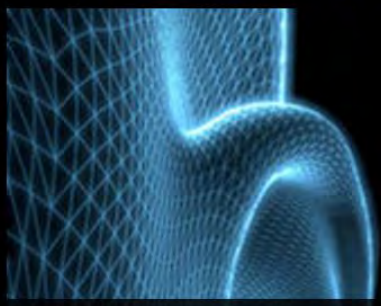
Mental Models from Engineering



- Modular systems thinking; deconstruction and reconstruction; stepwise refinement; optimisation under constraints; standardization; interpretive consistency; platform solutions
- Designing under constraints; negative constraints; positive constraints and possibilities; denormalisation – thinking about constraints in reverse; prototyping; test-driven development
- Dealing with trade-offs; margin of safety i.e. taking extra precautions, including failsafe options, factor in backups and establish redundancies; aggressive tradeoffs and conservative tradeoffs

Mental Models from Physics

Mental Models from Physics

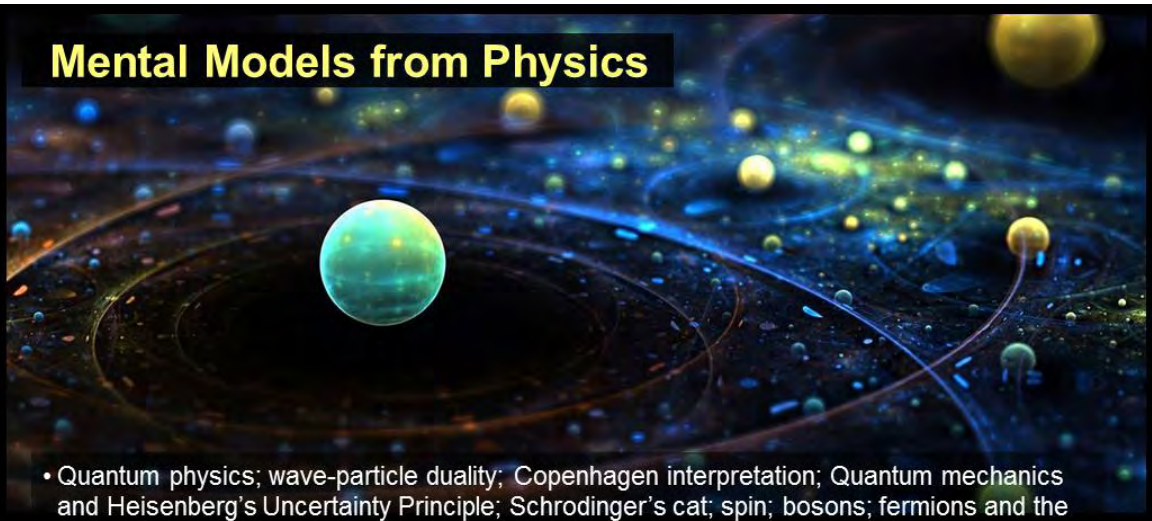


- Speed; velocity; acceleration; mass; inertia; momentum; weight; energy; power; friction; Newton's laws of motion; Newtonian gravity; centripetal and centrifugal forces
- Hooke's law; elasticity; stress and strain; deformation
- The behavior of gases and the laws governing them; kinetic theory of gases
- Fluid mechanics; viscosity; Archimedes' principle; Bernoulli's principle
- Waves and their properties; Huygens' principle; interference; modulation; sound waves and the Doppler effect; harmonics and resonance; optics; reflection and refraction; diffraction; resolution; polarization

Mental Models from Physics

- Thermodynamics; transfer of heat through convection, conduction and radiation; enthalpy and entropy; the laws of thermodynamics; heat capacity; phase transitions
- Visible light; infrared radiation; radio waves; ultraviolet radiation; X-rays; gamma rays; black body radiation; the Stephan-Boltzmann law
- Electricity; static electricity; potential difference; electromotive force; resistance and Ohm's law; magnetism; Coulomb's law and Ampere's force law; electromagnetism; Maxwell's Laws; electromagnetic induction
- Nuclear physics: alpha and beta decays; gamma emission; neutrinos; half life; binding energy; fission energy; fusion energy; critical mass; nuclear chain reactions

Mental Models from Physics



- Quantum physics; wave-particle duality; Copenhagen interpretation; Quantum mechanics and Heisenberg's Uncertainty Principle; Schrodinger's cat; spin; bosons; fermions and the Pauli exclusion principle; entanglement
- Particle physics; the standard model; Quarks; Leptons; the four fundamental forces – electromagnetic force, strong and weak nuclear force, gravitational force; Higgs boson; symmetry
- Relativity and cosmology; the speed of light; special relativity; time dilation; mass-energy equivalence; spacetime; general relativity; singularities and black holes; the Big Bang; dark matter; dark energy

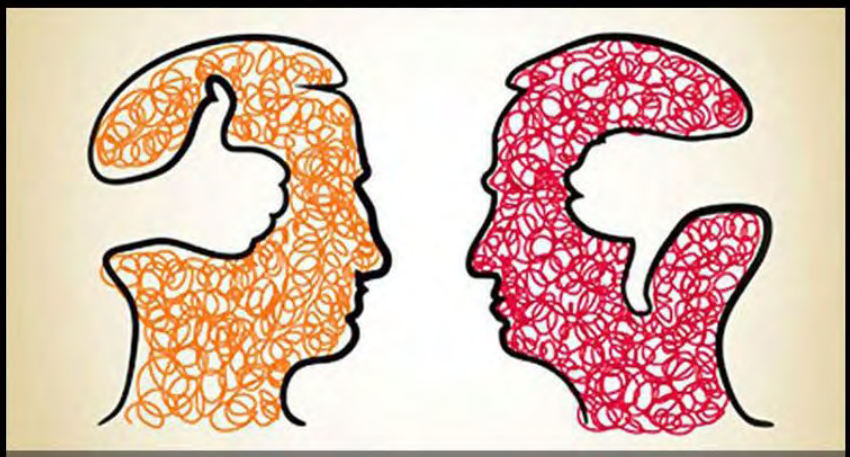
Mental Models from Chemistry

Mental Models from Chemistry

- The atomic nature of matter; periodicity of elements, the periodic table
- Chemical bonding; ionic bonds; covalent bonds; metallic bonds; molecular shape
- Chemical reactions; catalysts; energy changes associated with chemical change – endothermicity and exothermicity

Mental Models from Psychology

Mental Models from Psychology



- Charlie Munger's 'psychology of human misjudgment'; Kahneman and Tversky's heuristics, 'fast' and 'slow' thinking and cognitive biases in decision making
- Social psychology; Ringelmann's 'social loafing'; group cohesion, group decision making and leadership styles (McGregor's Theory X and Theory Y); Muzafer Sherif's 'ingroups' and 'outgroups'; the power of the social situation; mass communication and persuasion and social neuroscience

Mental Models from Psychology

- Psychoanalysis and psychodynamics; Freud's 'unconscious'; the id, the ego and the superego; 'the pleasure principle', the 'reality principle' and 'the judging principle'; anxiety; symptoms and defences; repression; free association and dream analysis; Jung's 'the collective unconscious'; archetypes; Adler's 'inferiority complex'; Winnicott's 'the true self' and 'the false self'; Victor Frankl's 'will to meaning'

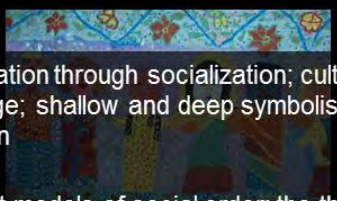
- Cognitive psychology; memorizing, recalling and forgetting; the Zeigarnik effect; long-term and short-term memory; Gestalt psychology; the Gestalt laws of perception; chunking and the 'magical' number 7; attention; 'filter' models; Schacter's seven sins of memory – transcience, absentmindedness, blocking, misattribution, suggestibility, bias and persistence; Loftus's 'false memory'; optical illusions

Mental Models from Psychology

- Personality; Alport's trait theory; Eysenck's 'type' theory of extraversion and neuroticism; Kelly's personal construct theory; Mischel's situationist theory of personality
- Emotion and motivation psychology; Maslow's hierarchy of needs; emotional intelligence
- Intelligence; multiple intelligences
- Developmental psychology; nature v/s nurture; Piaget's psychological stages; Bandura's social learning theory and 'role models'; chronological v/s subjective age; evolutionary psychology
- Mood and emotional disorders; Albert Ellis's rational emotive behavior therapy; Beck's cognitive behavioral theory; Seligman's 'learned helplessness theory'; Mihaly Csikszentmihalyi's 'flow'; mindfulness and meditation

Mental Models from Anthropology

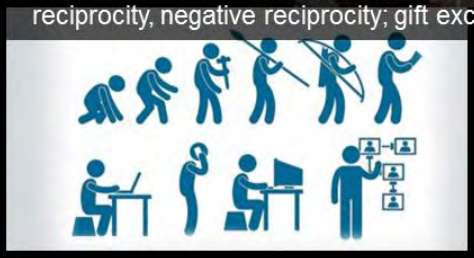
Mental Models from Anthropology



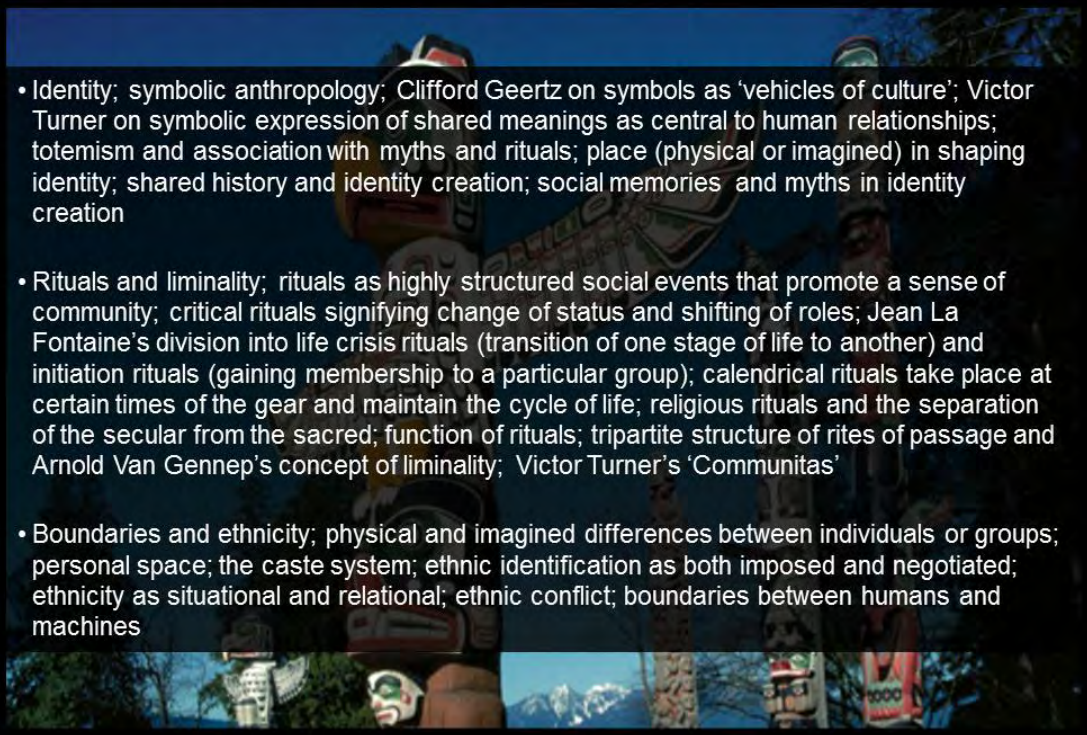
- Classification; culturally constructed ways of classification through socialization; cultural relativism; ethnocentrism; evolution of human language; shallow and deep symbolism; non-verbal communication; technology and communication

- Agent and agency; societies as systems; functionalist models of social order; the theory of social construction of reality by Berger and Luckmann; the theory and practice of habitus by Pierre Bourdieu; anthropological theories of the body – social construction, symbolic; personal symbolism and social meaning through tattooing

- Organisation of social relations; Marx and social class; caste; gender; gender roles; kinship; kinship patterns and rules; non biological and non-affinal ties - fictive kinship; technology – based social relations; Marcel Mauss "The Gift" – gift exchanges, reciprocity and power; three types of reciprocity (Sahlins): generalised reciprocity, balanced or symmetrical reciprocity, negative reciprocity; gift exchanges as systems of mutual recognition



Mental Models from Anthropology

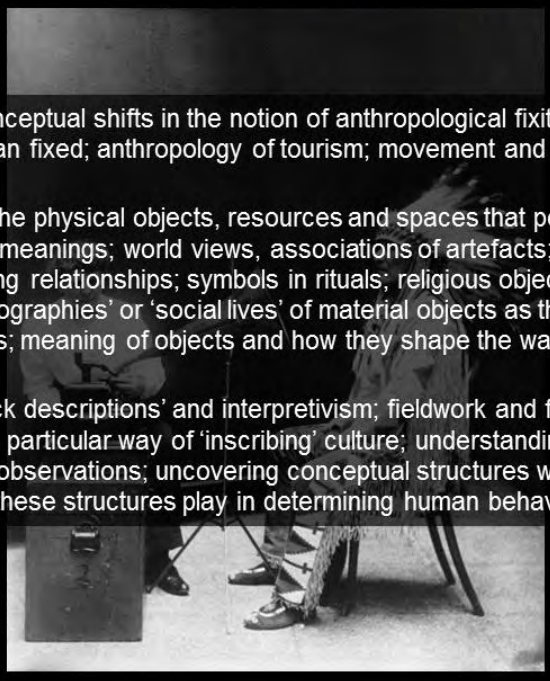


- Identity; symbolic anthropology; Clifford Geertz on symbols as 'vehicles of culture'; Victor Turner on symbolic expression of shared meanings as central to human relationships; totemism and association with myths and rituals; place (physical or imagined) in shaping identity; shared history and identity creation; social memories and myths in identity creation

- Rituals and liminality; rituals as highly structured social events that promote a sense of community; critical rituals signifying change of status and shifting of roles; Jean La Fontaine's division into life crisis rituals (transition of one stage of life to another) and initiation rituals (gaining membership to a particular group); calendrical rituals take place at certain times of the gear and maintain the cycle of life; religious rituals and the separation of the secular from the sacred; function of rituals; tripartite structure of rites of passage and Arnold Van Gennep's concept of liminality; Victor Turner's 'Communitas'

- Boundaries and ethnicity; physical and imagined differences between individuals or groups; personal space; the caste system; ethnic identification as both imposed and negotiated; ethnicity as situational and relational; ethnic conflict; boundaries between humans and machines

Mental Models from Anthropology



- Globalisation; conceptual shifts in the notion of anthropological fixity; culture framed as a process rather than fixed; anthropology of tourism; movement and identity
- Material culture; the physical objects, resources and spaces that people use to define their culture; symbolic meanings; world views, associations of artefacts; digital culture; material objects symbolizing relationships; symbols in rituals; religious objects and symbols; objectification; 'biographies' or 'social lives' of material objects as they go through a series of transformations; meaning of objects and how they shape the way people see the world
- Ethnography, 'thick descriptions' and interpretivism; fieldwork and first-hand observation; ethnography as a particular way of 'inscribing' culture; understanding layers of significance in behaviors and observations; uncovering conceptual structures which inform peoples' acts and the role that these structures play in determining human behavior; interpretvism

Mental Models from Sociology

Mental Models from Sociology

- Social constructionism, symbolic interactionism and role playing
- Social identity and group structure; group including roles, norms, values, communication patterns and status differentials; in-group favourtism v/s out-group negativity; deviance and conformity; social control
- The sociology of politics; C Wright Wills and 'The Power Elite'; Pareto and the rotation of elites in society;

  …..the media and political control; public opinions; ideologies; personalities; social movements and trends outside the formal institutions of political powers and its impact on formal politics

Mental Models from Sociology

- Economic sociology; Karl Polanyi's 'economistic fallacy'; formal v/s substantive concept of economics; 'embeddedness'; 'forms of integration' – reciprocity, redistribution and exchange;

……Granovetter's institutions as 'congealed networks'; trust; Weber's rational capitalism, political capitalism and traditional commercial capitalism; Weber's bureaucracy; organizational sociology – resource dependency, population ecology, network analysis and new institutionalism; sociology of markets; Granovetter's 'strong ties' and 'weak ties'; Bourdieu on markets as 'fields'; sociological perspective on the State in the economy; fiscal sociology; culture and economic development

- The sociology of religion; Weber on the relationship between religious belief and the social, cultural and economic developments of different countries; cults and the sociology of new religious movements; social constructionism in religion

Mental Models from Philosophy

Mental Models from Philosophy

- The way of truth; the 'correspondence theory' and the 'coherence theory'; 'pragmatism'; Heraclitus on change and 'the unity of opposites'; Pythagoras on a universe ruled by numbers; Xenophones on evidence and 'true belief'; Democritus, Leucippus and 'atomism'; Sophist ideas on relativism; Socrates and the 'dialectical method'; Plato's theory of forms and Plato's Cave;

…..Aristotle's knowledge from experience; Aristotle on logical argument; Aristotelian model of cause; the sceptics; Leibniz's 'two laws of truth: truths of reasoning and truth of facts'; necessary and contingent truths; Popper's falsifiability; Kuhn's 'paradigm shifts'; Feyerabend's 'Against method';

….Francis Bacon's four 'idols'; Bacon's 'ant', 'spider' and 'bee'; Hume's 'fork'; the problem of induction; Kant's 'transcendental idealism' – the phenomenon and the noumenon; Hegel's dialectic; Descartes and the mechanist view of the world; Cartesian certainty and Cartesian reductionism; Derrida's 'deconstruction'

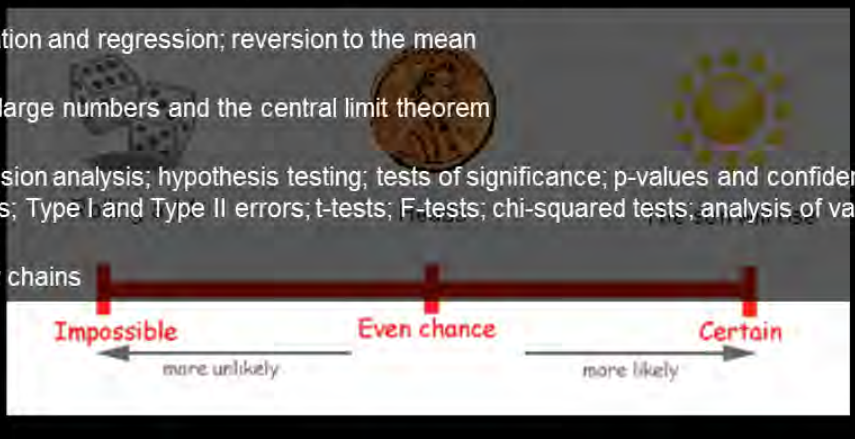
Mental Models from Philosophy

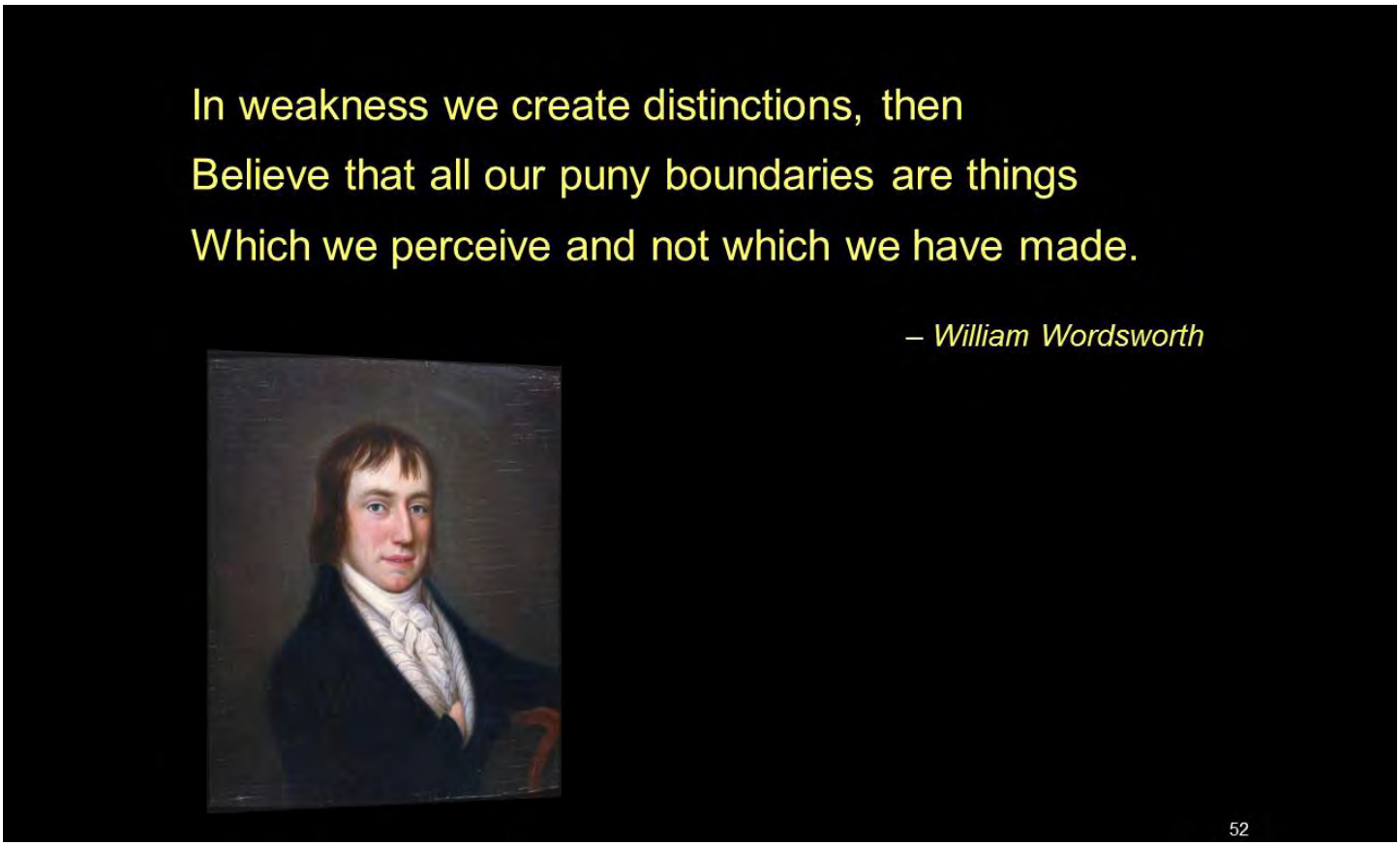
- Wisdom of the East; Confucius, Lao-Tzu, Mencius and Chuang Tzu on ethics and social policy; unity of all things and dynamic interplay of opposites; The Analects on virtuous behavior; Daoism and 'the way'; the golden rule; The Bhagvad Gita, dharma and karma, The Four Noble Truths of Buddhism
- Stoic philosophy
- Free will v/s determinism; reconciling faith with reason; Pascal's Wager; Averroes and allegory; Spinoza's God; Schopenhauer's 'Universal Will'
- Ockham's razor and Buridan's ass
- Ethical dilemmas; the 'trolley' problem; Hume's 'is' v/s 'ought'; Kant's deontological system of moral philosophy; moral luck; bounded ethicality
- Hobbes 'Leviathan'; the social contract; Berlin's 'two concept of liberty' – negative and positive freedom
- Existentialism; Husserl's phenomenology; Sartre's 'existence precedes essence'

Mental Models from Statistics

Mental Models from Statistics

- Probabilities; permutations and combinations; conditional probabilities; mathematical expectation; Bayes' theorem
- Mean; variance; covariance; skewness; kurtosis
- Random variables and their distribution; important distributions like the normal distribution, Poisson distribution, binomial distribution; percentiles; outliers
- Correlation and regression; reversion to the mean
- Law of large numbers and the central limit theorem
- Regression analysis; hypothesis testing; tests of significance; p-values and confidence intervals; Type I and Type II errors; t-tests; F-tests; chi-squared tests; analysis of variance
- Markov chains





The French mathematician and theoretical physicist Henri Poincare wrote: “Science is built up of facts as a house is built up of stones, but an accumulation of facts is no more a science than a heap of stones in a house”. The same can be said of a collection of mental models. Using them and connecting them to the real world is where the art lies and how the house of worldly wisdom is built. And after building it, keep refurbishing it and make it into a home.

But don’t just stop there. Although writing in a different context, do what Steven Johnson suggests in his book: ‘Where good ideas come from’:

‘Think of it as a house that magically expands with each door you open. You begin in a room with four doors, each leading to a new room that you haven’t visited yet. Those four rooms are the adjacent possible. But once you open one of those doors and stroll into the room, three new doors appear, each leading to a brand new room that you couldn’t have reached from your original starting point. Keep opening new doors and eventually you’ll have built a palace.’

JEETAY
Investments Pvt. Ltd.

jasmine
India Fund

capitalideasonline.com

Thank You

For any queries, comments or feedback please email to
chetan@jasmineindiafund.com / chetan@capitalideasonline.com

References:

1. 'Practical Wisdom' by Barry Schwartz
2. 'Introduction to Interdisciplinary Studies' by Allen F. Repko
3. 'The Problem of Sociology' by David Lee and Howard Newby
4. 'The Romantic Economist' by Richard Bronk
5. 'Autobiography' by John Stuart Mill
6. 'Complexity and the Art of Public Policy' by David Colander and Roland Kupers
7. 'Wounds from the 2008 financial crisis are still bleeding', John Authers, Financial Times, September 23, 2016
8. 'Shortcut' by John Pollack
9. 'The Secret of the Highly Creative Thinker' by Dorte Nielsen and Sarah Thurber
10. 'I Is an Other' by James Geary
11. 'Mindfulness' - Christopher Bergland, Psychology Today, August 9, 2015
12. 'The role of beliefs in economics' by Sumit Mishra, Mint, September 17, 2016
13. 'The Moral Economy' by Samuel Bowles
14. 'Leadership and the New Science' by Margaret J. Wheatley
15. 'The Three Cultures' by Jerome Kagan
16. 'The Act of Creation' by Arthur Koestler
17. 'A Theory of Justice' by John Rawls
18. 'Convergence' by Peter Watson
19. 'Where good ideas come from' by Steven Johnson
20. 2016 Daily Journal Annual General Meeting - Transcript by Whitney Tilson
21. 'Introducing Anthropology' by Laura Pountney and Tomislav Maric
22. 'Critical and Creative Thinking' by Robert Diyanni
23. 'Think like an engineer' by Guru Madhavan
24. 'Robert S. McNamara and the Evolution of Modern Management' by Phil Rosenzweig, Harvard Business Review, December 2010
25. 'Wisdom of the Martians of Science' by Balazs Hargittai and Istvan Hargittai