



BITS Pilani
WILP

Decision Analysis

ZG535

Module 0 – Course Introduction

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Course Details

- Course name: Decision Analysis
- Course code: MM ZG535 / QM ZG535 / MBA ZG535
- Credit units: 4 [128 hours of student investment]
- Instructor: Prof. PB Venkataraman
- Contact mail: pb.venkataraman@pilani.bits-pilani.ac.in
- Contact number: +91 9036091967
- Course assistants: Lt. Col. Cheryl Carol and Ms. HK Amrutavarshini
- Total number of lectures: 16 x 1.5 hours
- Lecture hours: Saturday 1:30-3:00pm
- Lecture access: Teams
- Textbook: Michael A. Roberto., The Art of Critical Decision Making,
www.audible.com, 2013. & Decision Making – Harvard Business Essentials
- Ronald A.Howard., Ali E.Abbas., Foundations of Decision Analysis (eLibrary)

Course Structure



- Modules – Eight
- Focus – Descriptive, Normative & Ethical
- Pedagogy – Flipped, Gamified and Group Learning
- Student learning outcomes:
 1. Explain the fundamentals of decision making process and define the quality of a decision.
 2. Relate to the cognitive biases and interpret one's decision objectively.
 3. Apply methods to reduce the impact of cognitive biases in organization and personal decisions.
 4. Lead teams in decision making.
 5. Select appropriate decision making tool and apply it in a given situation.
- Assessments: Experiment (1) – 10%; Simulations (2) – 20%; Mid-sem – 30%; Compre – 40%

Expectations

1. Please audit the pre-class materials before attending live sessions. Making them interesting to watch is my commitment.
2. Listen to Michael A Roberto lectures on 'Art of Critical Decision Making'. They are interesting, mobile friendly and comes with a lecture note. It is free but valuable.
3. Participate in games, which are essential part of the learning. My lecture depends upon them.
4. Attempt simulation exercises within time. Please do not ask for extension. Cannot help.
5. In answering exam questions be brief. I am only expecting to see your understanding of the concepts.
6. Be fair in evaluation components.



End of Slides



Decision Analysis ZG535

The premise

Lecture 2

History of the topic

- Classical period – Ways of thought-leaders (morality based)
- 18th Century – Adam Smith, Psychological insights in market activity
- 1930s – John Keynes, Instincts (animal spirits)
- 1930+ - Samuelson, Arrow and Debrue, Neo classical economics (Normative models)
- 1970s – Daniel Kahneman & Amos Tversky, Behavioral economics
- 1990s - Antonio Damasio, Neuroeconomics, Systematic study of decision making deficits following brain damage

Paul W. Glimcher, Colin F. Camerer, Ernst Fehr, Russell A. Poldrack, Chapter 1 - Introduction: A Brief History of Neuroeconomics,
Editor(s): Paul W. Glimcher, Colin F. Camerer, Ernst Fehr, Russell A. Poldrack, Neuroeconomics, Academic Press,
2009,

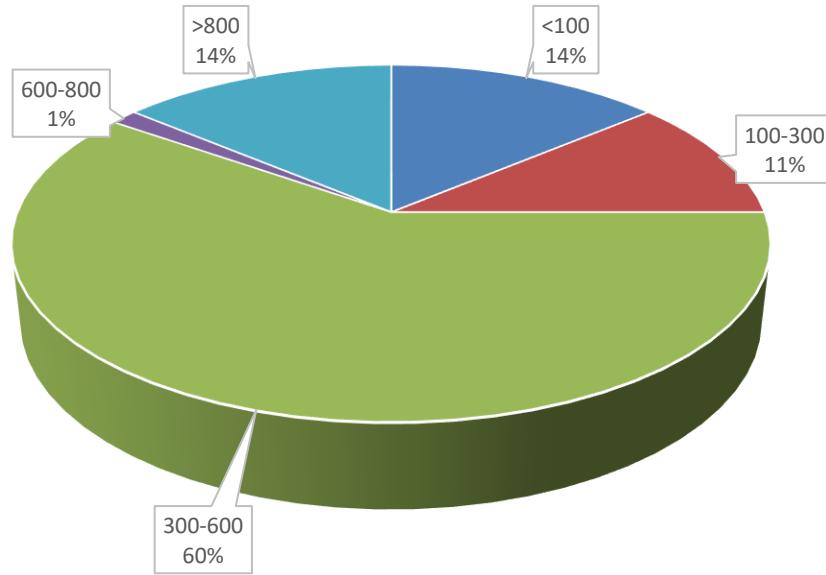
NEO CLASSICAL ECONOMICS

The Three Axioms of Neo-classical Economics

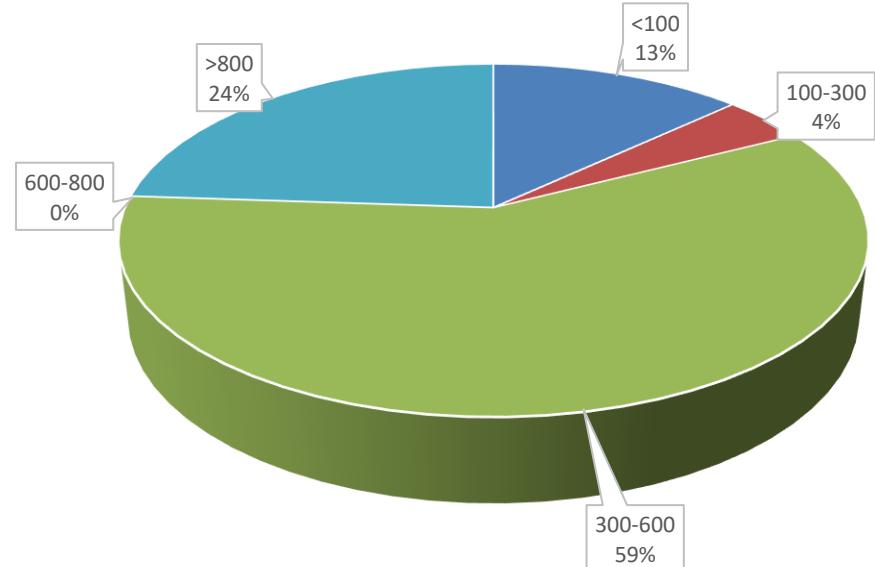
- **Methodological Individualism:** In the social sciences, methodological individualism is the principle that subjective individual motivation explains social phenomena, rather than class or group dynamics which are illusory or artificial and therefore cannot truly explain market or social phenomena. [Humans are rational and act on self-interest]. *Ultimatum Game* [1](#), [2](#)
- **Methodological Instrumentalism:** All behavior is preference-driven or, more precisely, it is to be understood as a means for maximizing preference-satisfaction. [Humans will act to maximize their value]. *Buridan's Ass*
- **Methodological Equilibration:** Neoclassical theoretical exercises begin by postulating the agents' utility functions, specifying their constraints, and stating their 'information' or 'belief'. Then, and here is the crux, they pose the standard question: "What behavior should we expect in equilibrium?" [Humans will behave to achieve equilibrium]. *Prisoner's dilemma*.

Humans will act to maximize their value

How much will you share with a stranger?



How much will you accept?



Ultimatum game results

Humans are rational and act on self-interest

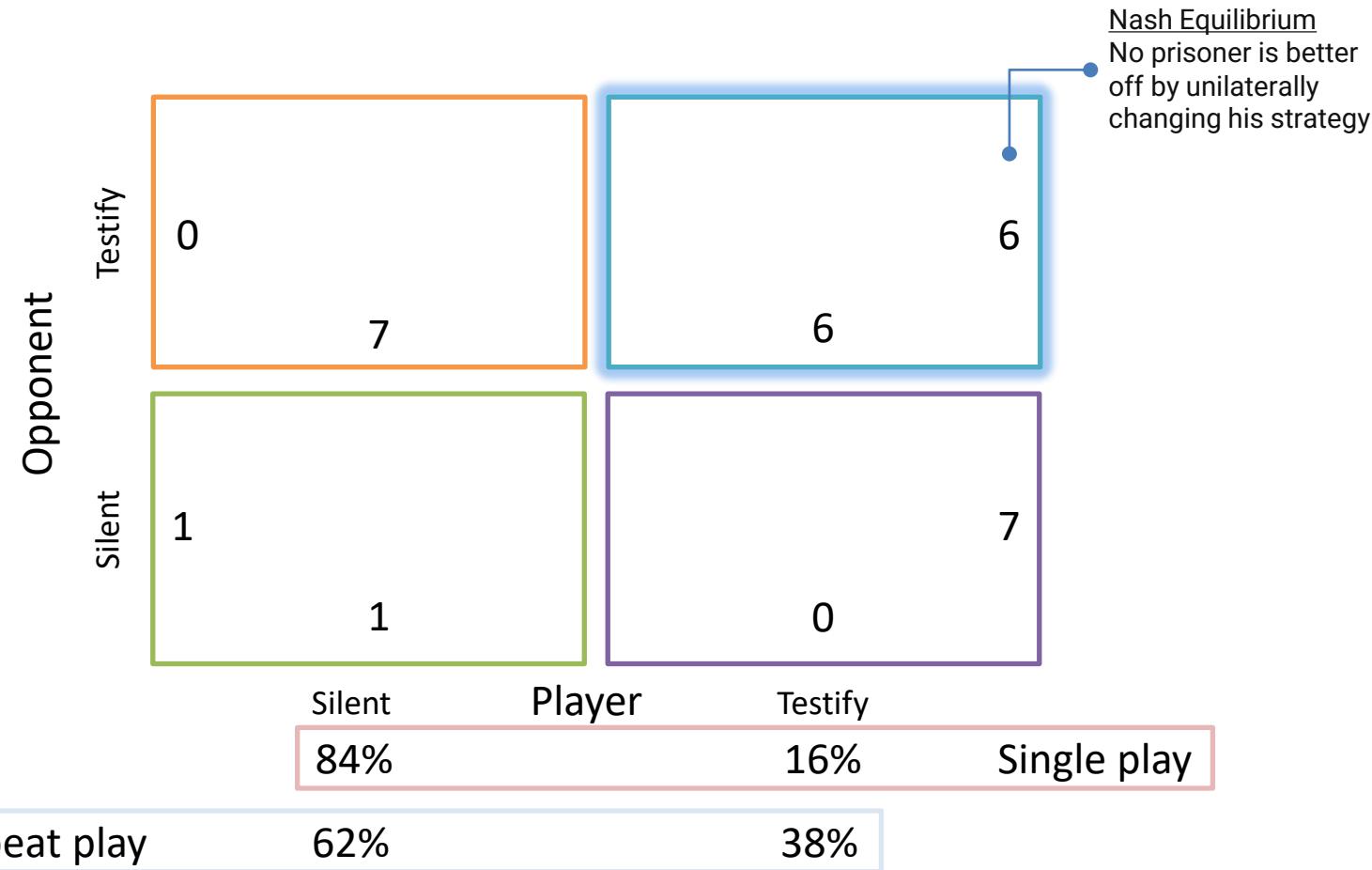


BURIDAN'S ASS

"...a man, being just as hungry as thirsty, and placed in between food and drink, must necessarily remain where he is and starve to death."

– Aristotle, On the Heavens 295b, c. 350 BC

Humans will behave to achieve equilibrium



Prisoner's dilemma results

BEHAVIORAL ECONOMICS

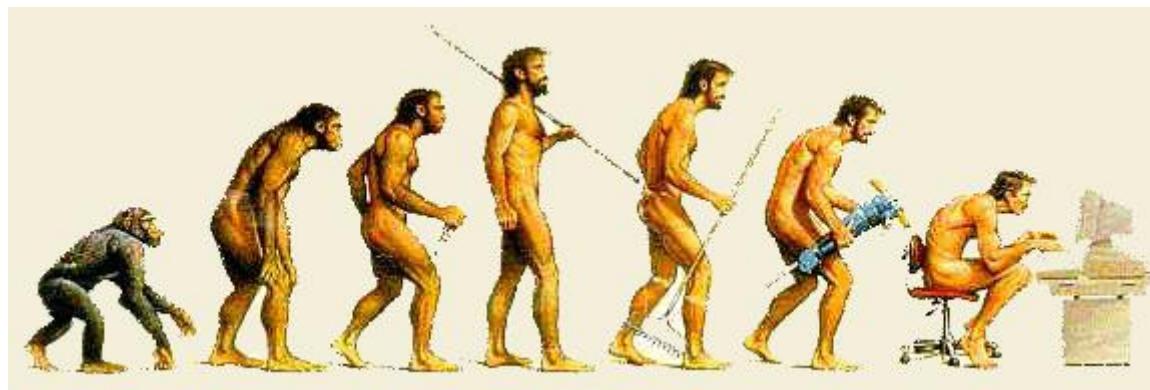
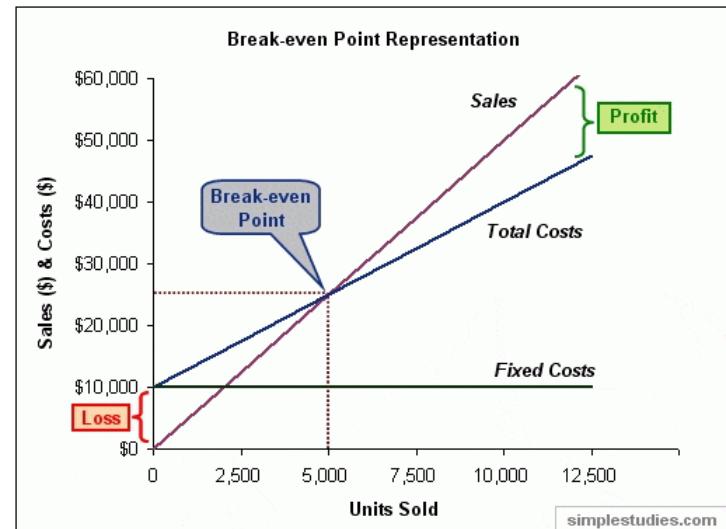
The way we decide

Descriptive



The way we think we should decide

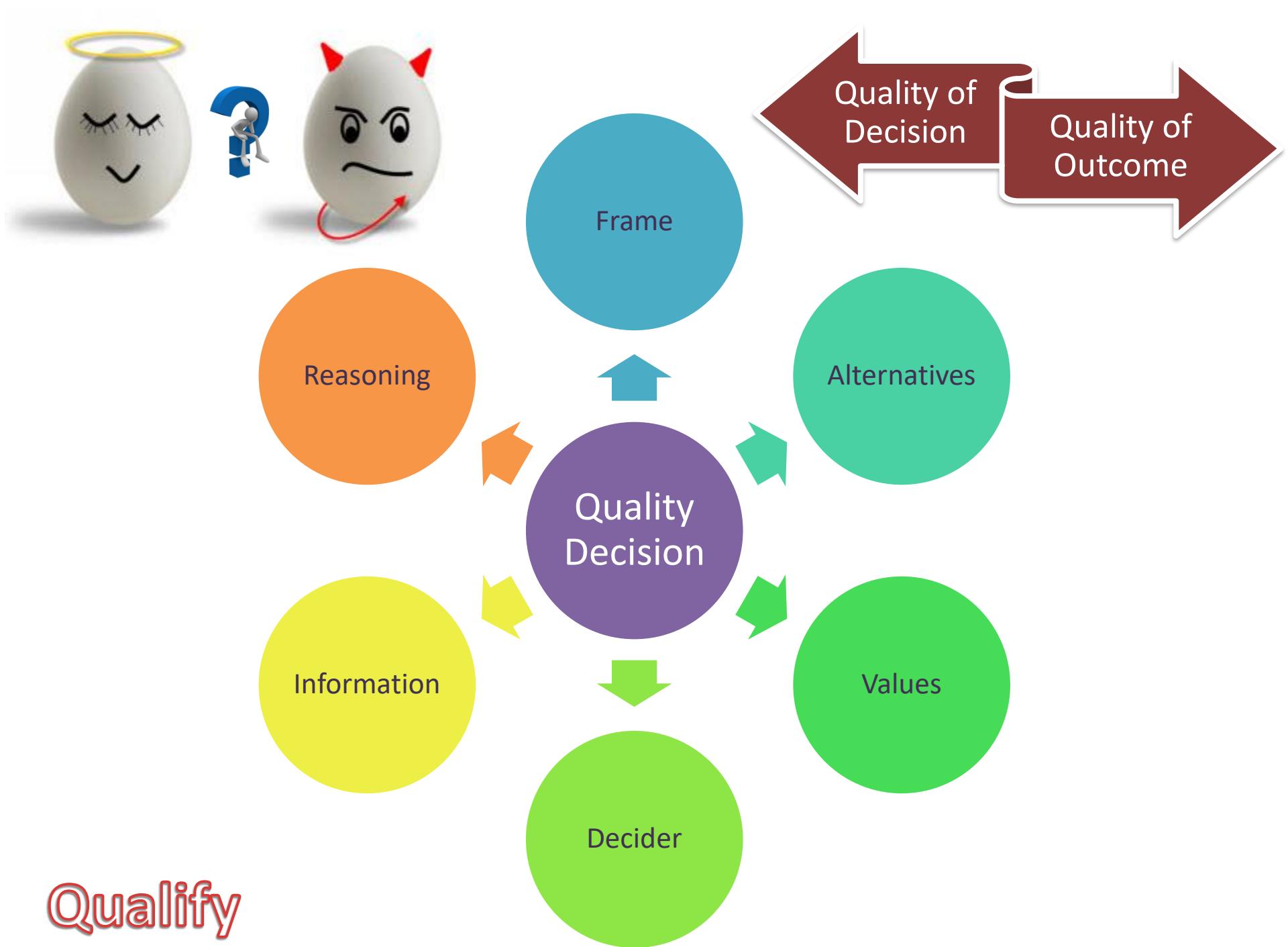
Normative

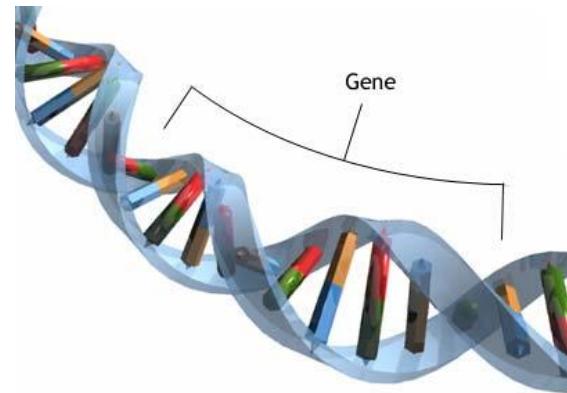
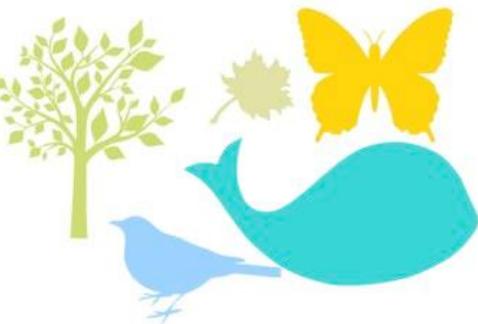




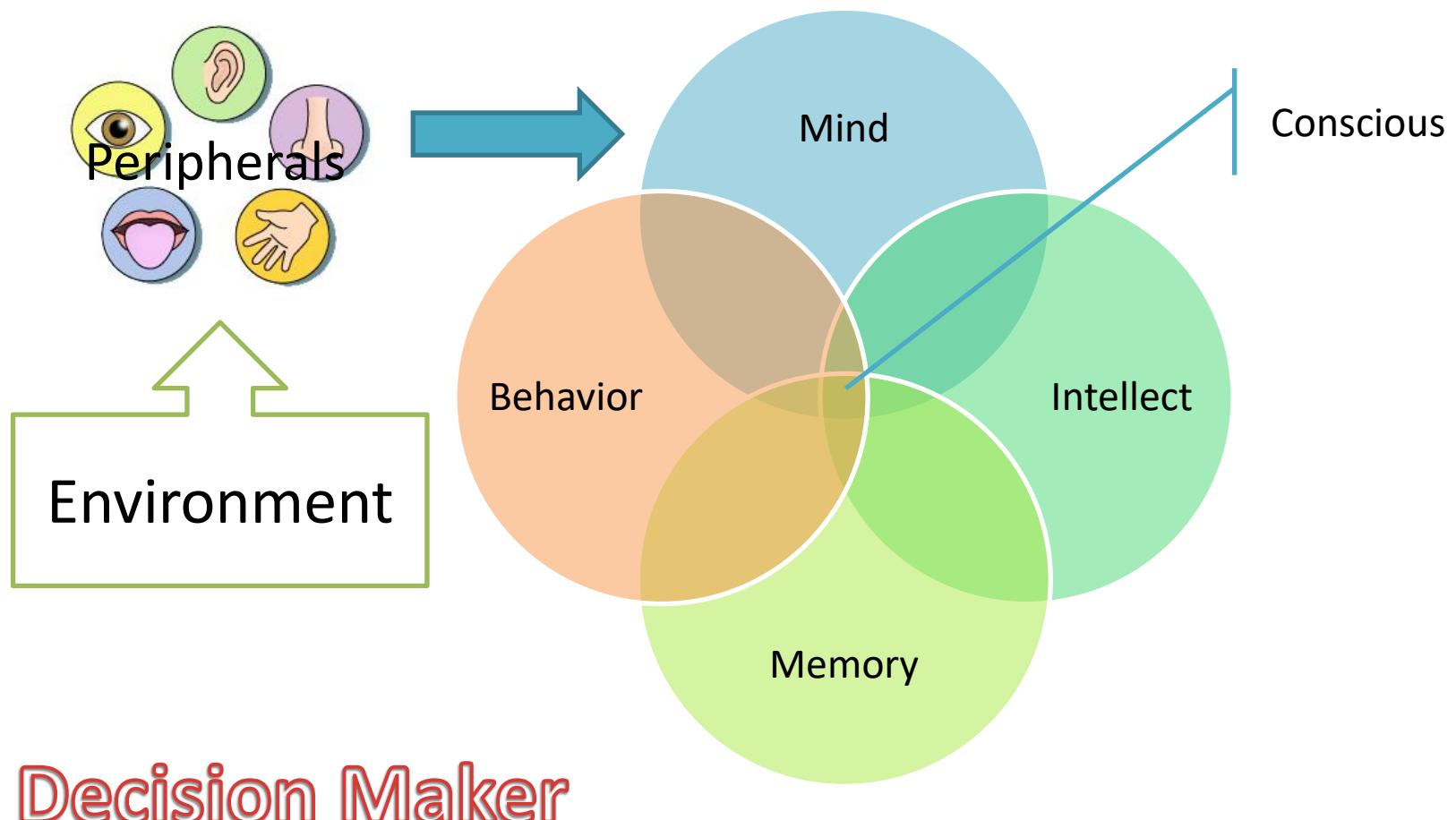
Decision Analysis

Qualifying a Decision





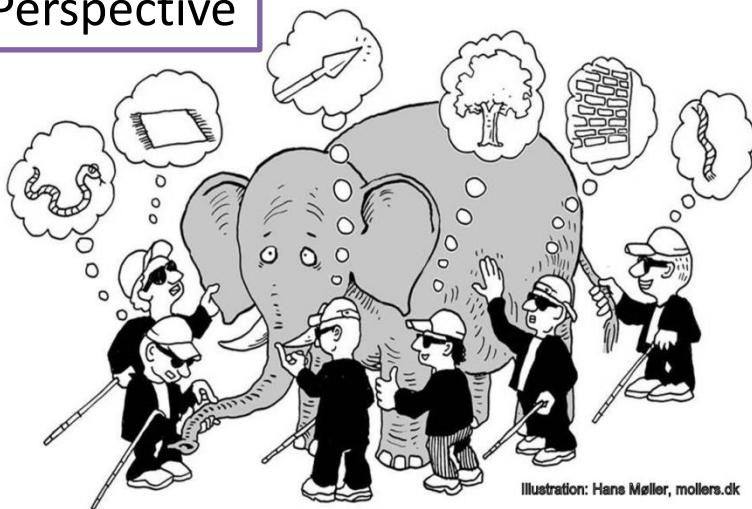
ADAM





"My team has created a very innovative solution, but we're still looking for a problem to go with it."

Perspective



The Space Shuttle Columbia disaster occurred on February 1, 2003, when Columbia disintegrated over Texas and Louisiana as it reentered Earth's atmosphere, killing all seven crew members.

During the launch of STS-107, Columbia's 28th mission, a piece of foam insulation broke off from the Space Shuttle external tank and struck the left wing. A few previous shuttle launches had seen minor damage from foam shedding, but some engineers suspected that the damage to Columbia was more serious. NASA managers limited the investigation, reasoning that the crew could not have fixed the problem if it had been confirmed.

When Columbia reentered the atmosphere of Earth, the damage allowed hot atmospheric gases to penetrate and destroy the internal wing structure, which caused the spacecraft to become unstable and slowly break apart.

Creativity begins at finding new alternatives



An alternative is one that is under your control

List all the known alternatives

Put them away, and find new set of alternatives

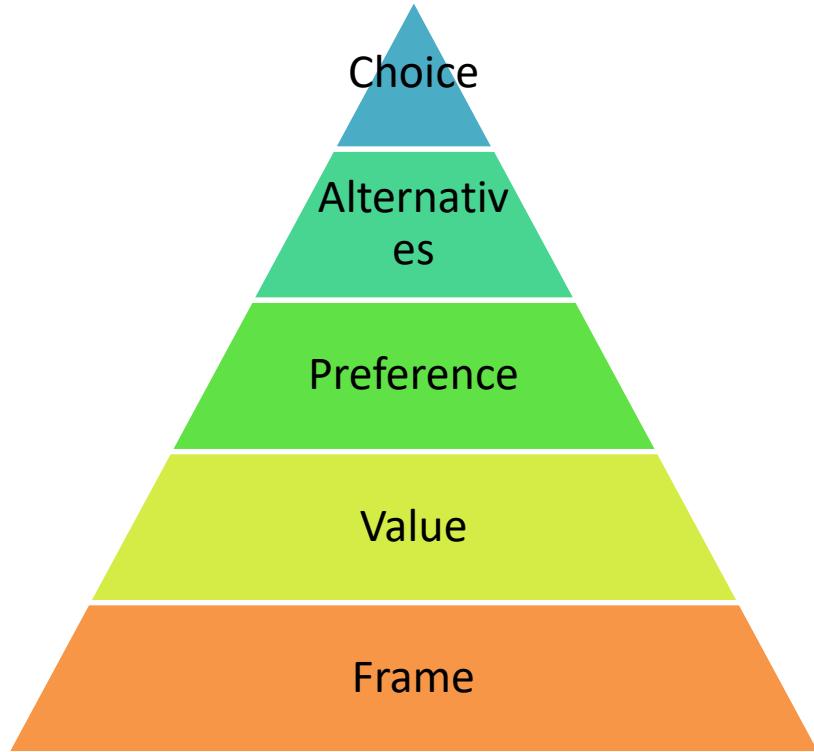
Decision without alternatives leads to frustration

Alternatives without decision leads to analysis-paralysis

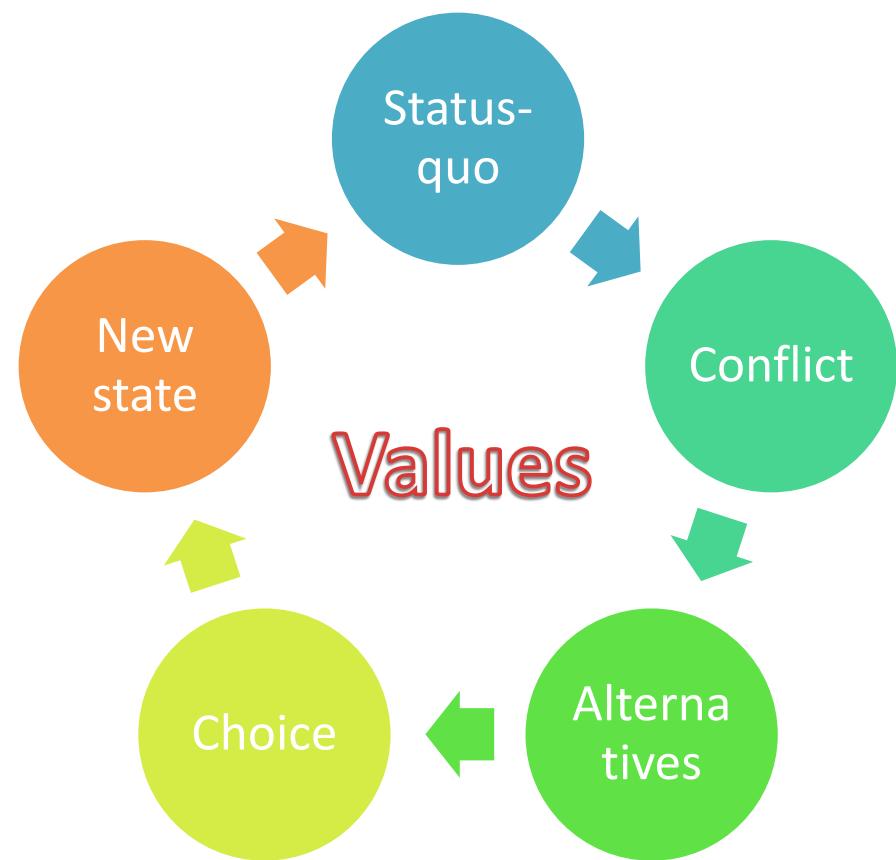
Excessive alternatives result in confusion and stress

Alternatives

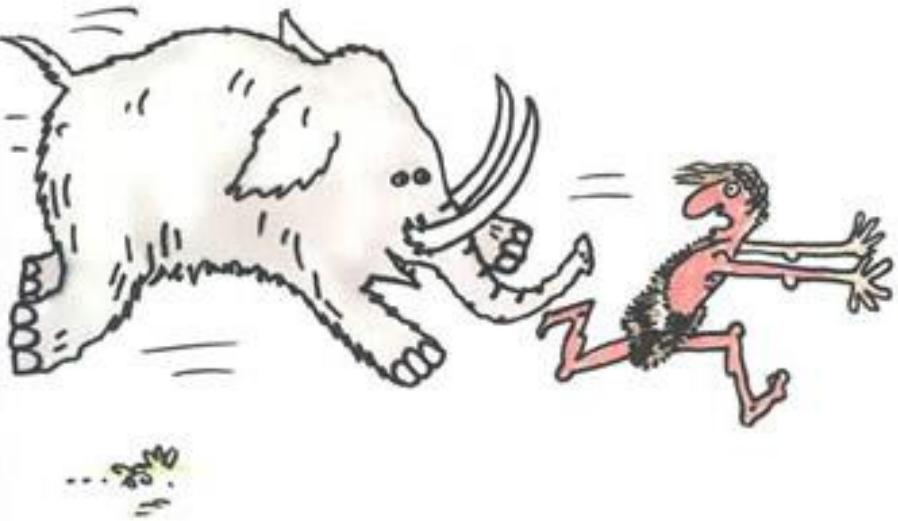
https://www.youtube.com/watch?v=VKi4_u3vijk
https://www.youtube.com/watch?v=S3MW0juUrrY&list=FLipXv88beKLH_UsgXta9Vg



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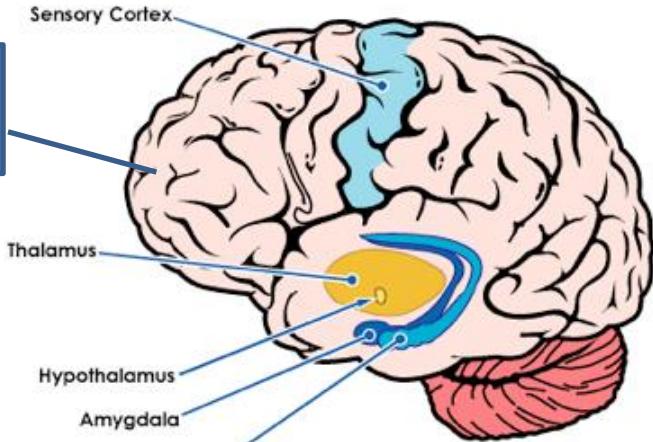


Values



Parts of the Brain Involved in Fear Response

Tough task



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Information

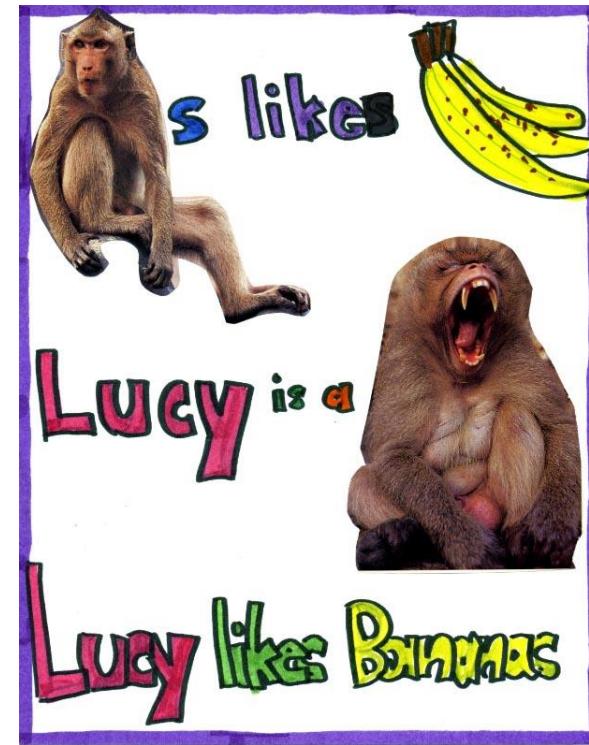
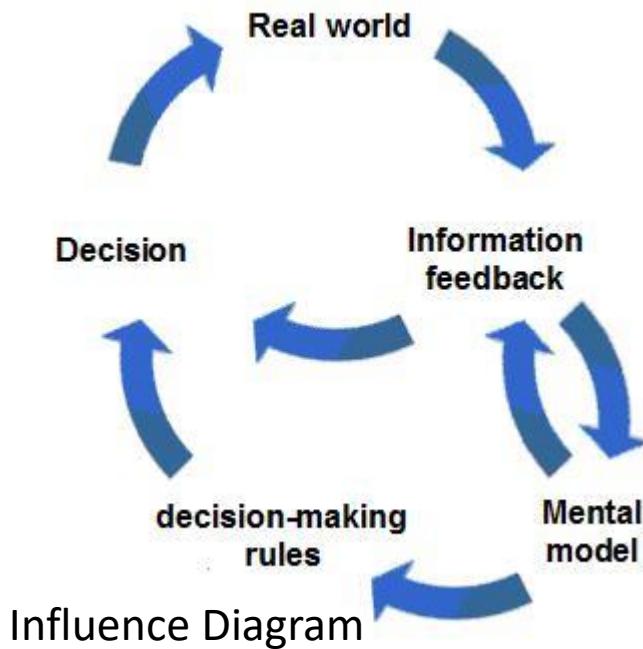
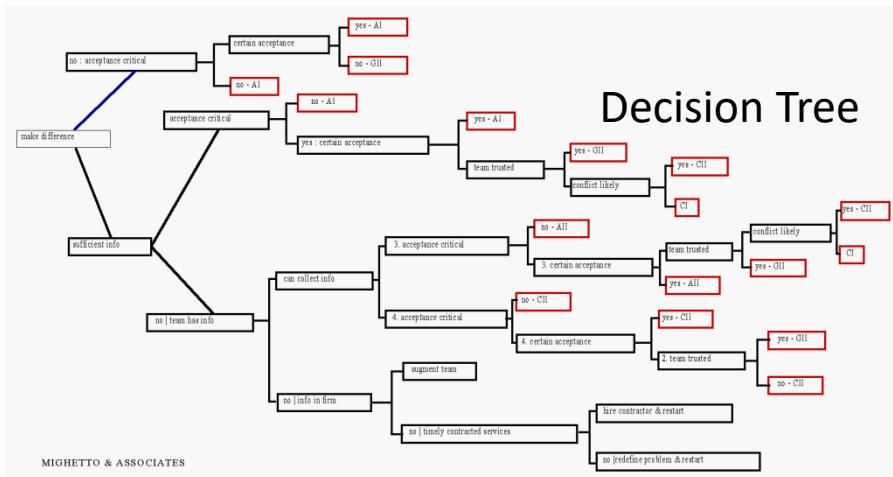
Uncertainty



Why do we need information for decision making?

- Humans depend on external systems for survival
- Each system is a network of subsystems
- Each subsystem has its own reliability
- Subsystems in series reduce system reliability
- Reduced reliability means increased uncertainty
- Uncertainty is reduced by:
 - Redundancy
 - Improving predictability

Information



Logic

Reasoning



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Module 2 – Two Systems of Thinking

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Mechanical Engineering





Puzzle



Brain Myths

Brain Myths:

1. You only use 10 percent of your brain
2. You are born with all the brain cells you will ever have
3. The brain is hard-wired
4. Brain injury is always permanent
5. It's all downhill after 40
6. Listening to Mozart makes you smarter
7. Some people are left-brain thinkers while others are right-brain thinkers
8. People learn better when the teaching matches their learning style
9. You can learn through subliminal messages
10. Women are better at multitasking than men

Human Brain – Popular Models

-
- 1. Functional/ modular model
 - 2. Network model
 - 3. Electrochemical model
 - 4. Triune System
 - 5. Two systems of thinking
 - 6. Fuzzy-Trace theory
-

Functional Model

The functional model of the brain describes how different regions of the brain interact with each other to perform various mental processes. The brain is a complex network of neurons that communicate with each other through electrical and chemical signals to perform a wide range of functions, such as perception, movement, thought, emotion, and memory.

There are several different theories and models that describe the functional organization of the brain, but most of them suggest that different regions of the brain are specialized for specific tasks and that there is a large amount of communication and integration between these regions.

For example, the somatosensory cortex is responsible for processing sensory information from the body, while the visual cortex processes information from the eyes. The frontal lobe is involved in higher-level cognitive functions such as decision making, planning, and problem solving, while the temporal lobe is involved in processing language and memory.

Overall, the functional model of the brain is a constantly evolving field of study, and researchers are continually making new discoveries about the intricacies of brain function and how different regions of the brain work together to produce our thoughts, emotions, and actions.

Network Model

A network model of the brain is a mathematical representation of the brain as a complex network of interconnected nodes. In this model, each node represents a specific region of the brain, and the connections between nodes represent the communication between those regions. This approach has been applied to study various aspects of brain function, such as the organization of functional networks, the flow of information across the brain, and the changes in brain connectivity associated with different states or disorders.

The network model of the brain is based on the idea that the brain is a complex system of interconnected regions that work together to produce behavior and mental processes. The model takes into account the fact that brain regions can be connected to multiple other regions and that the strength of these connections can change over time.

This type of model can be used to study the functional connectivity between different regions of the brain and to explore the changes in connectivity that occur in various conditions, such as disease, injury, or development. It can also be used to study the impact of different interventions, such as drugs or stimulation, on the brain network.

Overall, the network model of the brain is a powerful tool for exploring the complex relationships between different regions of the brain and for advancing our understanding of brain function and its underlying mechanisms.

Electrochemical Model

There is a view that our brain is a mere electrochemical system. This perspective is often associated with reductionist or materialist approaches to understanding the brain and mind. According to this view, the workings of the brain can be reduced to the interactions between neurons and the electrical and chemical signals they transmit, and the mental processes and experiences that we have can be explained in terms of these underlying brain processes.

This view has been supported by a great deal of scientific evidence, including studies of the brain using techniques such as neuroimaging and electrophysiology, as well as research on brain disorders and injuries and their effects on behavior and cognition.

However, it is worth noting that this view is not without its criticisms and limitations, and many scientists and philosophers argue that there may be aspects of the mind and brain that cannot be fully explained in terms of mere electrochemical processes.

Triune Model



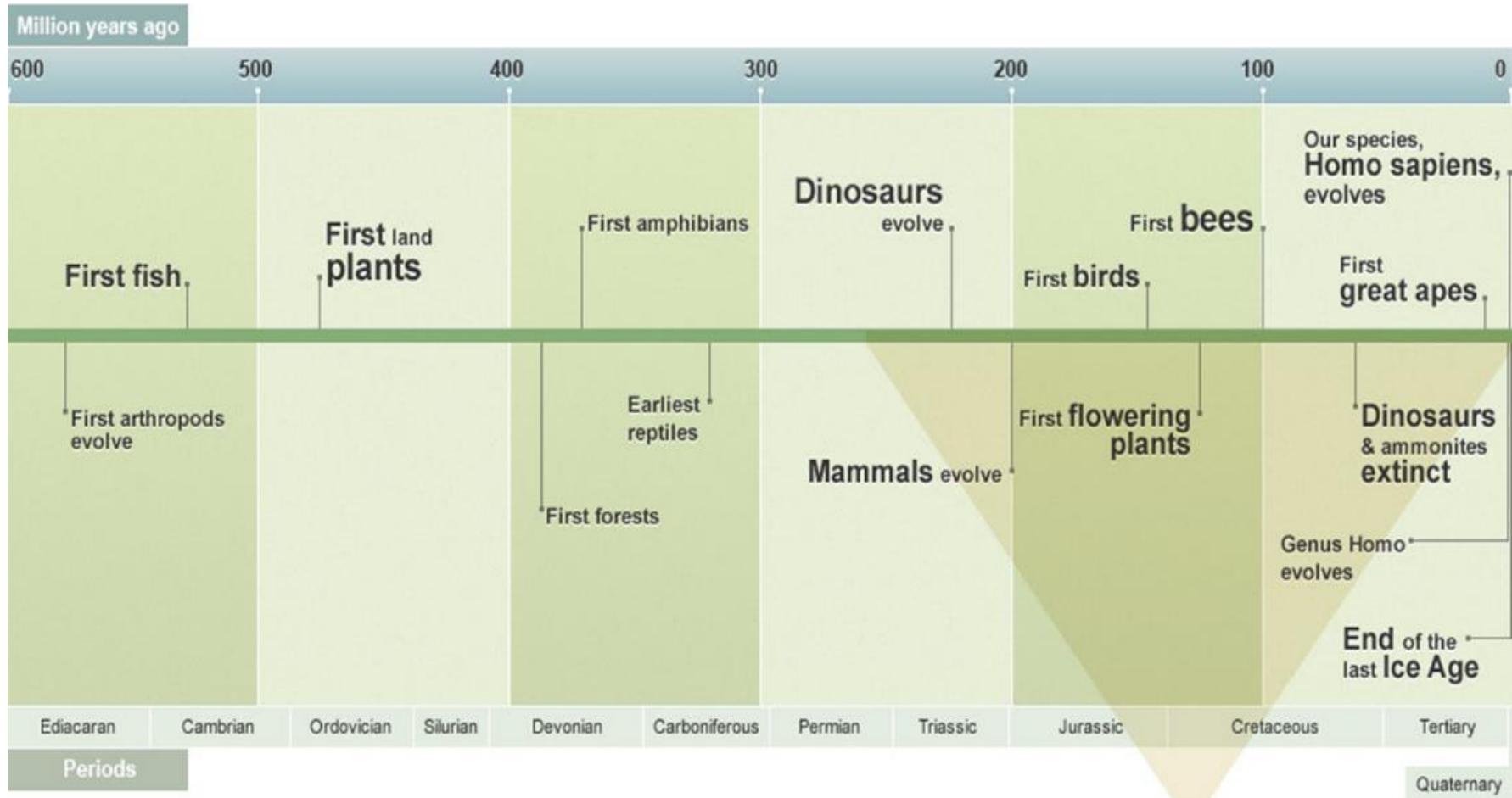
<https://youtu.be/xNbNrdX2-zc>

Survival Brain
- Reptilian
Emotional Brain
- Limbic
Thinking Brain
- Neo-cortex

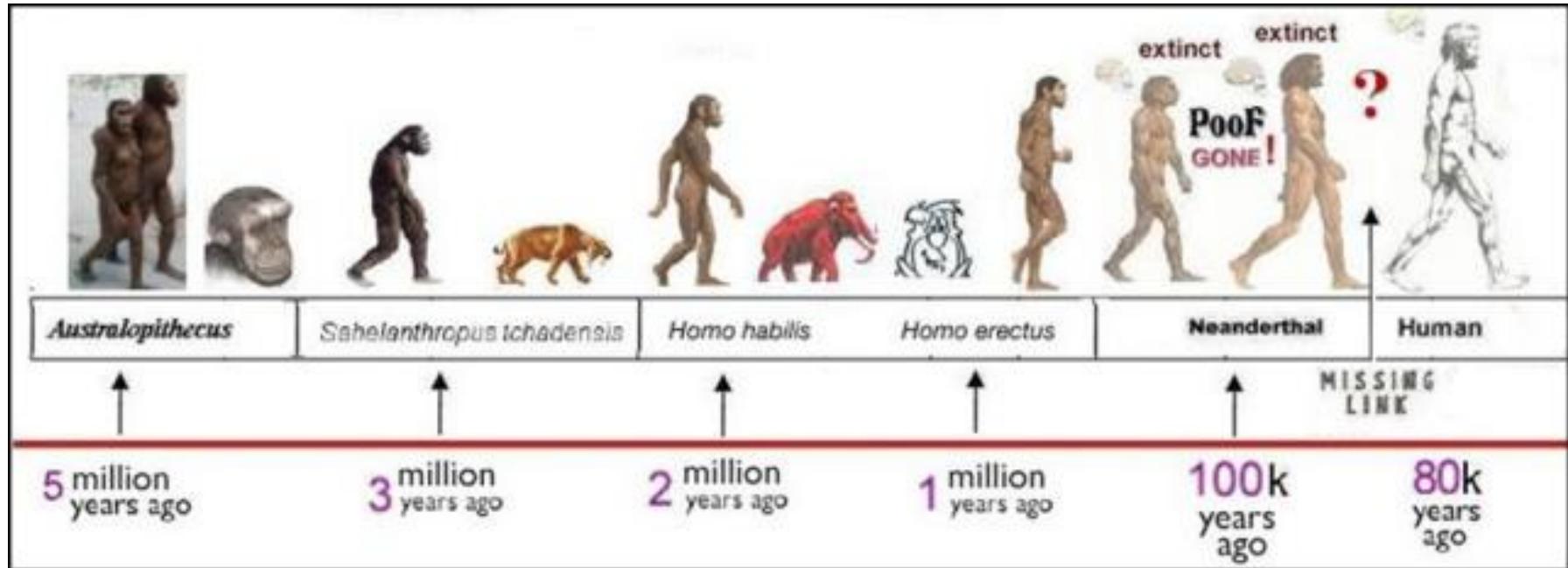
Fuzzy Trace

You go to the shop to buy a bat and a ball for your boy. The shopkeeper says they together cost Rs. 110/-. Your wife intervenes and says we have several new balls at home so just buy the bat. On inquiry the shopkeeper says, the bat costs Rs. 100/- more than the ball. How much have you saved? (Just write the numerical number)

Evolution of Species



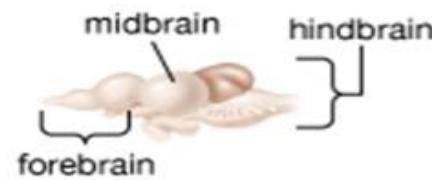
Evolution of Humans



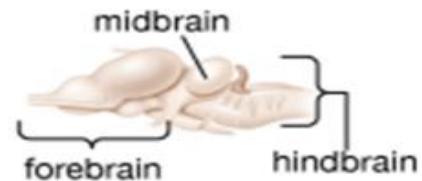
Evolution of Brain

Animal Brains

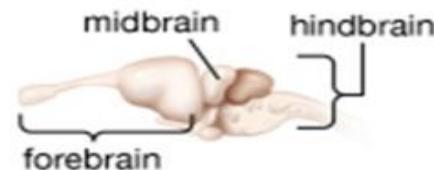
Fish



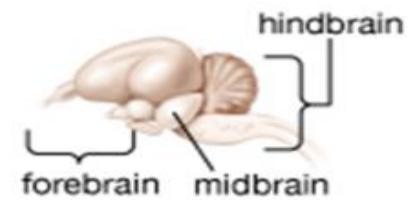
Amphibian



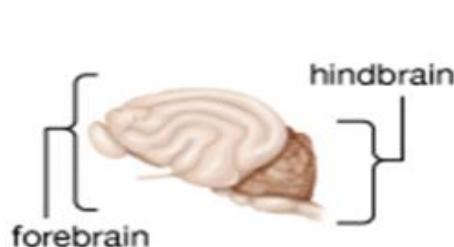
Reptile



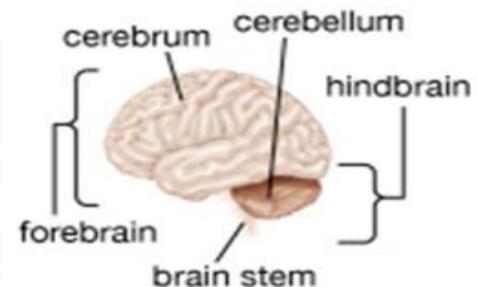
Bird



Mammal: Cat

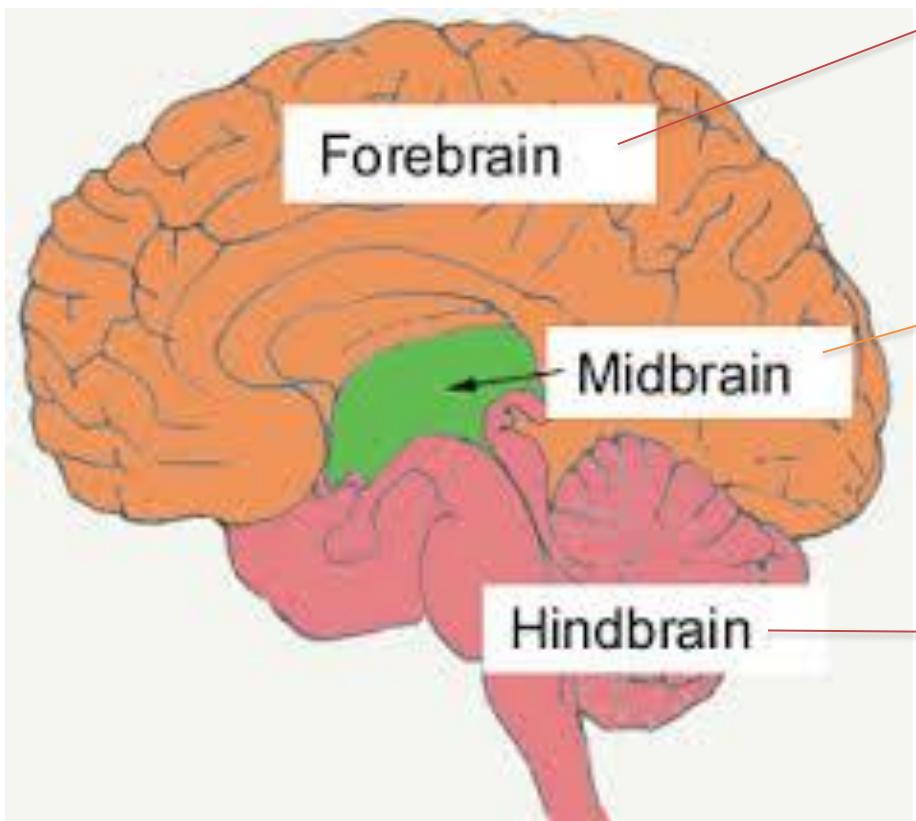


Mammal: Human



Parts of Brain

<https://youtu.be/D8gpV-xjECM>



Memory, Planning,
Organizing, Emotional
control, Problem solving

Vision, hearing and motor
control, Sleep, Awake,
Arousal, Temperature
regulation

Balance, Movement,
Coordination, Breathing,
Heart rate, BP,
Swallowing

Cognitive – Intuitive

Objective – Fulfillment

Approach – Optimization

Effort – Conscious

Tools – Data, analysis, logic

Language – Human language, math

Support systems – Computation

Advantage – Explicable,
reproducible, appeal

Disadvantage – Limited (rationality
& bandwidth), emotionless,
complex, time consuming, tiring

Reasoning

Objective – Reproductive survival

Approach – Sufficiency

Effort – Subconscious

Tools – Evolution, tacit knowledge

Language – Non verbal

Support systems – Deliberate
practice, team support, health

Advantage – Speed, natural

Disadvantage – Illusions, rational
anomalies, biases

Intuitive

Homework

Which is better? Why?



End of Slides



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Module 3 – Heuristics

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Mechanical Engineering

Rational – Intuitive Which enables

better decision making?

Objective – Fulfillment

Objective – Reproductive survival

Approach – Optimization

Approach – Sufficiency

Effort – Conscious

Effort – Subconscious

Tools – Data, analysis, logic

Tools – Evolution, tacit knowledge

Language – Human language, math

Language – Non verbal

Support systems – Computation

Support systems – Deliberate practice, team support, health

Advantage – Explicable, reproducible, appeal

Advantage – Speed, natural

Disadvantage – Limited, emotionless, complex, time consuming, tiring

Disadvantage – Illusions, rational anomalies, biases

Rational

Intuitive

Mate-selection Heuristics

https://www.youtube.com/watch?v=N_6eHe3YWVY



Bigger = Stronger
[It is not male chauvinism]



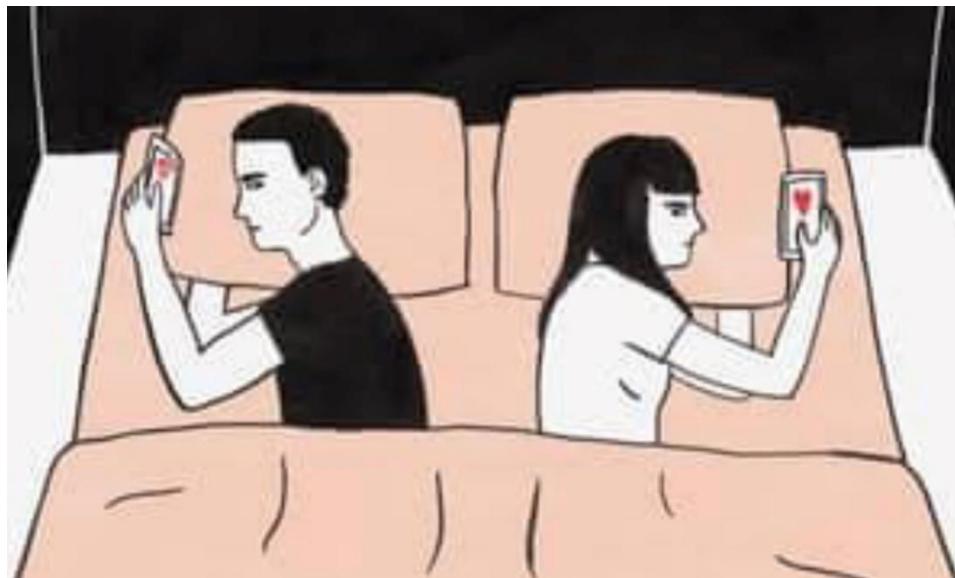
Pigmentation = Healthier
[Parlours are meant for men]



**Social behaviour =
Caring**

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What we do?



The first time i
ever saw your
face. i thought the
sun rose in your
eyes. and the moon
and the stars
were the gifts
you gave to the
dark and the end
and the endless
skies.

Gaze Heuristics

<https://www.youtube.com/watch?v=DdEEwoKkfMA>

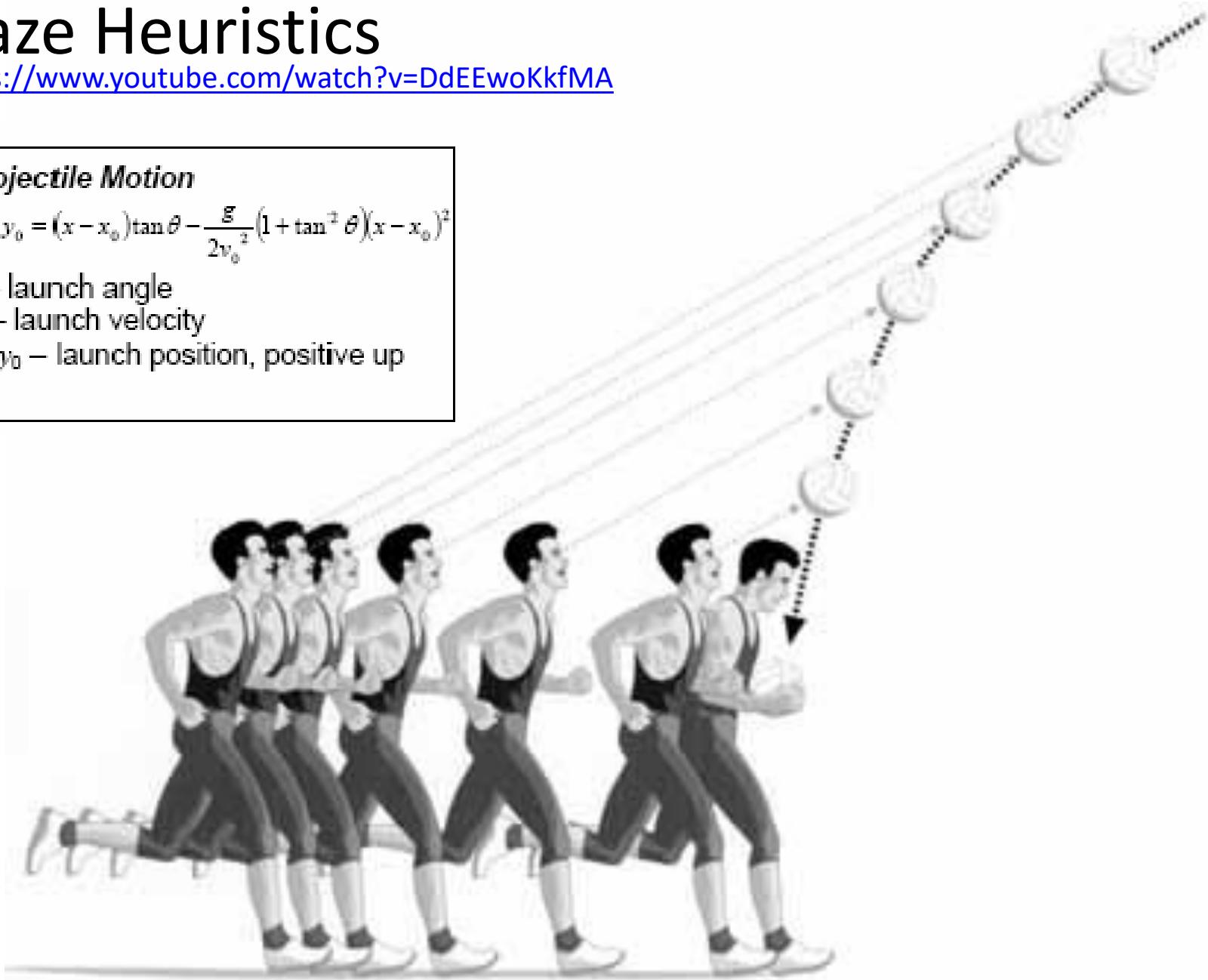
Projectile Motion

$$y - y_0 = (x - x_0) \tan \theta - \frac{g}{2v_0^2} (1 + \tan^2 \theta)(x - x_0)^2$$

θ – launch angle

v_0 – launch velocity

x_0, y_0 – launch position, positive up



Recognition Heuristics

Which city has the largest population? <https://goo.gl/forms/urDLIUEPMYDZP04x2>
[Answer within 30 seconds. Don't Google]

1. Respondents should be novice not ignorant.
2. Brand value is rooted in 'recognition heuristics' – known products = quality products
3. Emerges out of evolutionary practice – When we had to select food from an unknown place.
4. Works even for stock market [Google stock picking contest 2000 capital]
5. Works better than detailed analysis by experts *[Only value of stock forecasters is to make fortunetellers look good – Warren Buffet]*.
6. Suitable when time is limited, options are too many and situation is chaotic

Recognition Heuristics

1. Hebb's Rule:

- Neurons that fire together, wire together.
- When an unrecognized object is presented with a well recognized object our brain connects them with the latter's attributes.
- For example, when Sachin Tendulkar endorses Luminous Batteries the unrecognized latter gets associated with the master including his qualities such as consistency, hard work, precision, quality etc.

2. Pavlovian Conditioning:

- A behavioral procedure in which a biologically potent stimulus (e.g. food) is paired with a previously neutral stimulus (e.g. a bell).
- An unconnected but known object can be conditioned with an unknown object.
- Pierce Brosnan selling Pan Parag.

Clear = Near; Hazy = Far

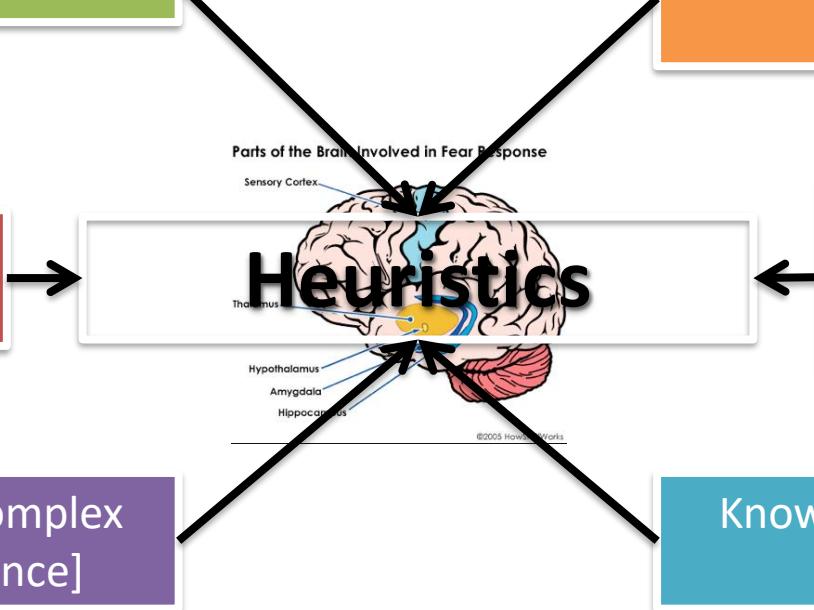
High price = High Quality
[Pizza Vs Dosa]

Natural = Healthy
[Fresh curd]

Fair skin = Honest; Dark
skin = Strong
[Semantics]

Complex problem = Complex
solution [Rocket science]

Known Brand = High Quality
[BITS, Pilani]



Speed – Accuracy Tradeoff!!!!

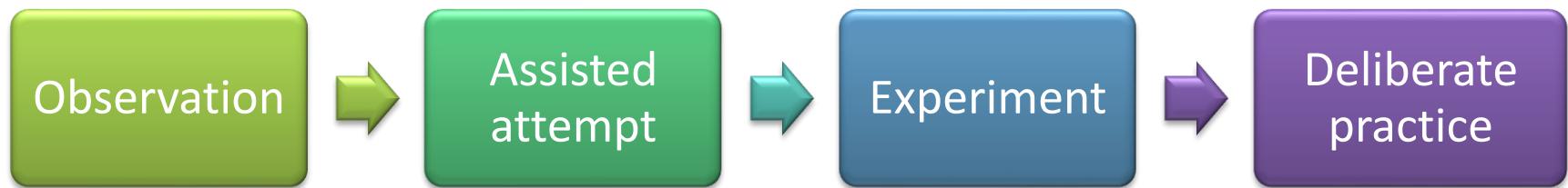
- Why would the athlete miss her gold when she missed the first hurdle!
- Why would Sachin Tendulkar go out of form after becoming world #1!
- Why do amateur golfers are distracted by music but the experts get better with it?
- Why drivers sleep off if none to talk to them but learners get disturbed when someone talks to them?

Tacit Knowledge

Tacit Knowledge

<http://video.nationalgeographic.com/video/london-taxi-sci>

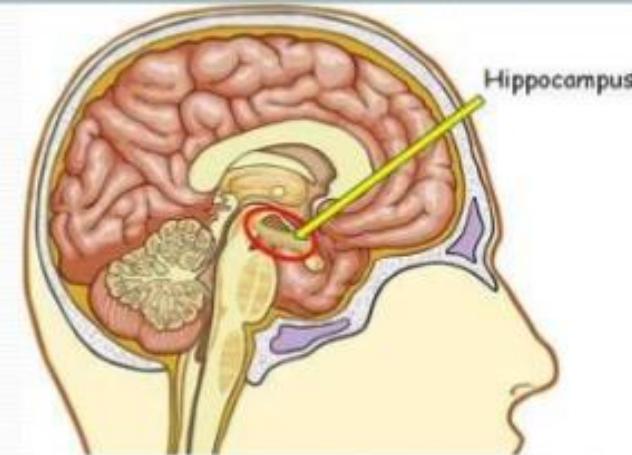
- We can know more than we can tell – *Michael Polanyi* (1967)
- We can bicycle without understanding ‘Center of Gravity’, but just the knowledge of CoG alone cannot make you a cyclist.
- Those with insights are called ‘Deep Smarts’.
- They can make smart decisions but cannot explain it.
- Anders Ericsson argues, such an insight can be achieved by anyone with ‘deliberate practice’.



<http://video.nationalgeographic.com/video/london-taxi-sci>

Hippocampus

- Part of the Limbic system, in each temporal lobe
- Responsible for processing of long term memory and emotional responses
- It not only assists with the storage of long term memories, but is also responsible for the memory of the location of objects or people. We would not even be able to remember where our house is without the work of the hippocampus.



Heuristics Summary

- Any approach to problem solving, learning, or discovery that employs a practical methodology not guaranteed to be optimal or perfect, but sufficient for the immediate goals.
- Heuristics can be mental shortcuts that ease the cognitive load of making a decision.
- Where finding an optimal solution is impossible or impractical, heuristic methods can be used to speed up the process of finding a satisfactory solution.
- Other terms used include rule of thumb, an educated guess, an intuitive judgment, stereotyping, profiling, or common sense.
- Evolutionary instincts and tacit knowledge are the two sources of heuristics.

Heuristics – When to use?

- When you need to decide instantly.
- When there are too many options.
- In an unfamiliar situation.
- When the situation is ambiguous.

Heuristics – The Three Limitations?

1. Sensory illusions leading to mismatched abilities.

- https://www.youtube.com/watch?v=IGQmdoK_ZfY
- <https://www.youtube.com/watch?v=kzo45hWXRWU>
- <https://www.youtube.com/watch?v=GDAzsZLvfPw>
- <https://www.youtube.com/watch?v=sxwn1w7MJvk>
- <https://www.youtube.com/watch?v=ZfIIMBxylak>

2. Rational anomalies leading erroneous decisions.

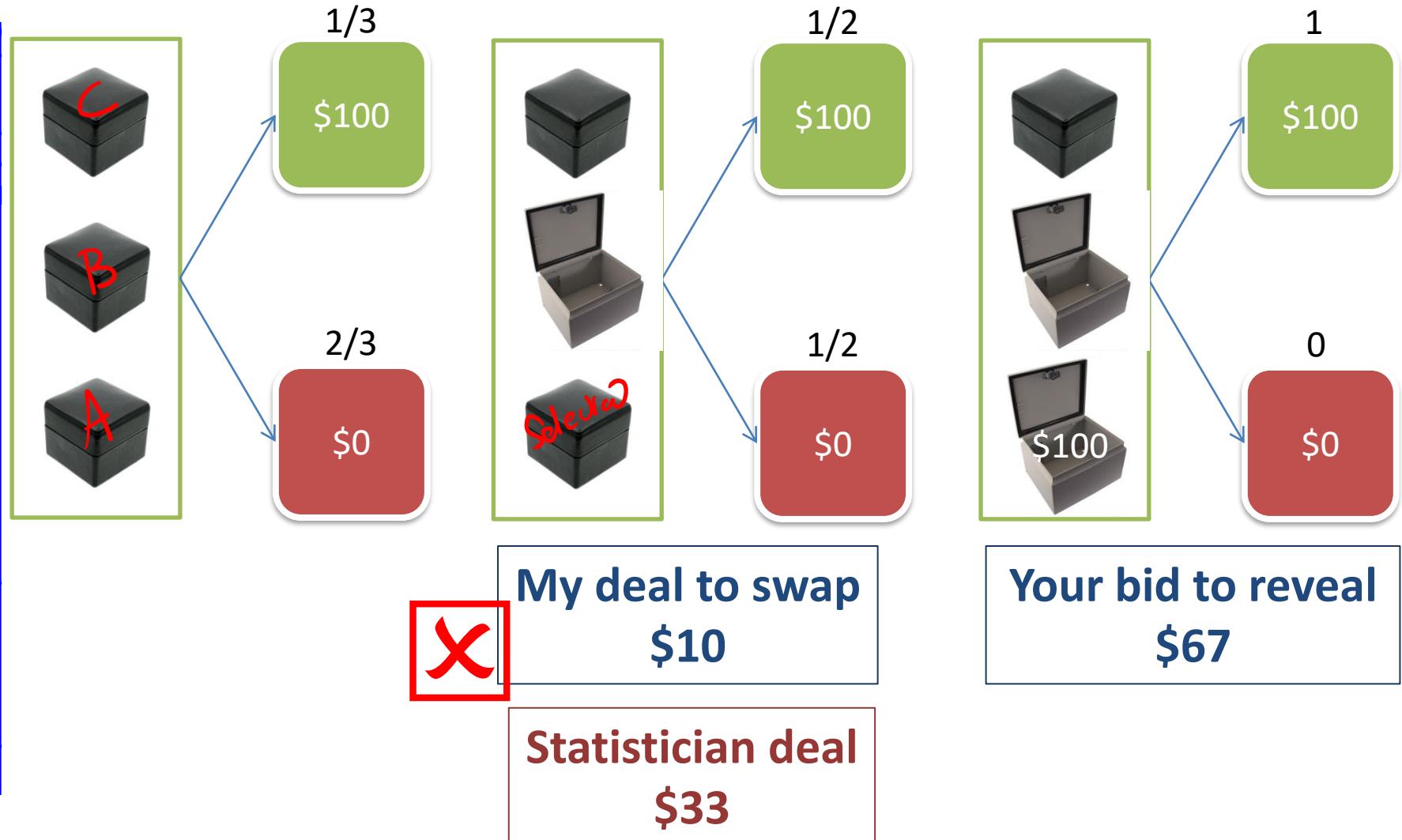
- <https://goo.gl/forms/TAQGxUA2dkJGCmJ12>
- <https://goo.gl/forms/iGOHLzkYT2YtTmm22>
- <https://goo.gl/forms/lb1Lei35SiaKArYT2>

3. Cognitive biases.

- Status-quo, Sunk-cost, Overconfidence, Anchoring, Confirmation, Prudence, Recency bias.

How much to pay for Information?

Value of Clairvoyance



Never pay more than the value of Clairvoyance. Probability is a function of information.

FOOT NOTE OF PREVIOUS SLIDE

Information is wealth. How much of value to pay, to obtain that information? Let us derive it using a simple experiment, which is quite popular as Monty Hall Problem. There are three black boxes. I have kept a \$100 bill in one of the boxes. The other two are empty. What is the probability of you picking the \$100 bill box? One third, right? You pick one of the boxes at random. I open a different box which does not contain \$100 bill. Now, what is the probability of you winning the \$100? 0.5, you will say. I offer you a deal. You can swap your box if you wish, but it will cost you \$10. Will you swap? Of course not, because you believe the probability to be 0.5 and swapping doesn't better that probability. At this moment, a statistician watching the game offers to purchase your turn for \$33. Notwithstanding this, I offer you to reveal the box containing \$100 for a price. What will be your bid to me? \$67 right? Because, that is the price at which, it doesn't make any difference to you. From this muddle of game, we see three people bidding for three different prices. All of us are using probability for our decisions. This is because, each one of us have a certain class of information. This is known as the value of clairvoyance. The maximum amount we are prepared to pay for a given information. We should never pay more than this value. As a corollary, this experiment also proves that the probability is a function of information. Your instructor will demonstrate this game to you during the forthcoming live lecture. Don't miss it.



End of Slides



Decision Analysis

Anchoring

Anchoring

Irrational anomalies
Sensory illusions
Biases

Confirmation Bias

Status-Quo

Over-Confidence

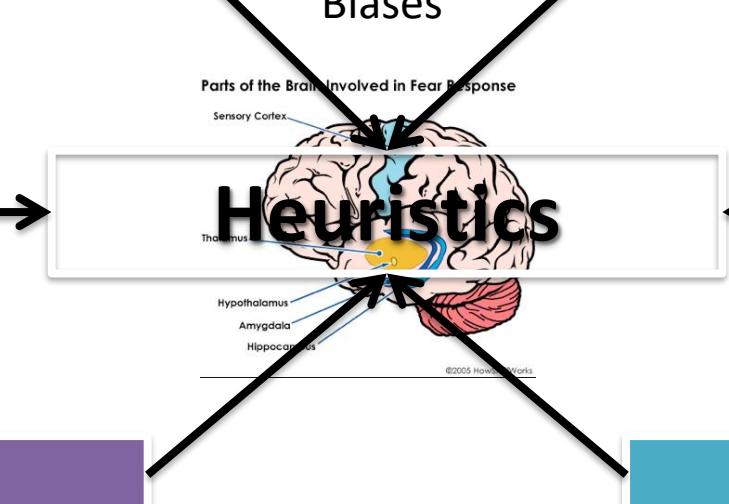
Sunk-Cost Fallacy

Framing Trap

Examples

Cases

Tips

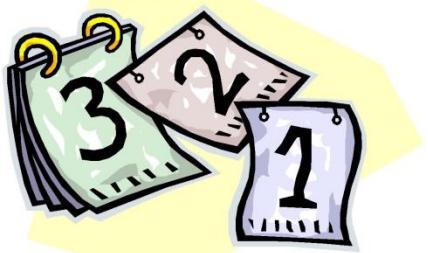


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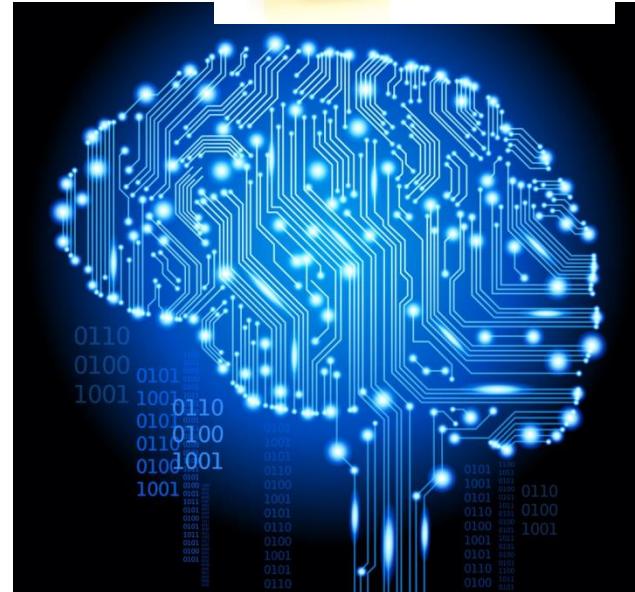
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Giving disproportionate weight to the first information we receive is due to 'Anchoring'.



Heuristic:
Recent = More Real
Past = Less Real



Foot Note of Previous Slide

Imagine you are Gazelle in Savannah and you have spotted a tiger in the bushes. What you do? Run away from it. You had spotted a pack of lions yesterday in the direction where you are running towards now. But you don't care. For you yesterday's information is less real than today. Just imagine you remembering every single spotting of your predator, which direction will you run into? Our brains have developed a survival capability to attach more reality thus importance, to the recent events and diminishing reality to the past. What was your dinner yesterday? The day before? The day before that? If you remember them all, you will expect your wife to know 365 different dinner menus. It is an important quality of brain to lose its memory to time. We are a survival machine, unlike the computers. They can remember and retrieve a file stored now and the one saved a year ago with same precision. After all they are stupid machines not built for their survival. The heuristic our brain plays is, 'recent is more real, past is less real'. 'Reality impacts us more, imaginary things impact us less'. 'So give more importance to recent events'.

- Write down the last three digits of your phone numbers
- Add 400 to this number
- Now answer this question
- Confucius lived in AD or BC?
- What is your estimate of his period?

A similar exercise produced the following result:

Phone number + 400	Average estimate of Confucius period
400 - 599	629
600 - 799	680
800 - 999	789
1000 - 1199	885
1200 - 1399	988

Foot Note of Previous Slide

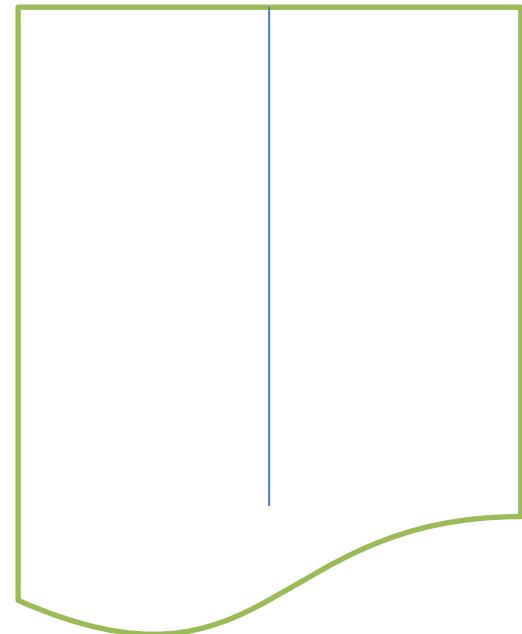
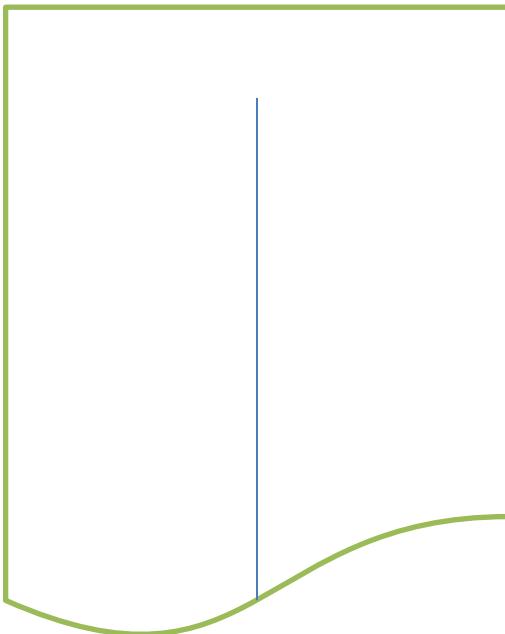
Let us see a few examples of Anchoring. Listen to these statements and answer the following questions. ‘My weight is 58 kilos, what was the age of Ronald Reagan when he passed away?’ The peak of Everest is over 8000 meters, what was the age of Ronald Reagan when he passed away? If you asked this question to two different sets of people, you will get two different sets of answers, the former around 65 and the latter around 90. The two numbers, 58 and 8000 though irrelevant to the question, will bias the answerers. Incidentally, Reagan died when he was 94. In a classroom, the students were asked to write down the last three digits of their telephone number. Then they were instructed to add 400 to it. Now all of them were asked to estimate the period of a historic event. The summary of their answers are tabulated here. Note how they are anchored to their phone numbers.

First year target
\$38m

Current sales
Revenue \$25m

First year actual
sales \$29m

Second year
budget \$35m



Foot Note of Previous Slide

During my industry days, we acquired a company with a sales-revenue of about \$25 million. Our initial assessment suggested a lot of areas for improvements, hence estimated the first year revenue could be \$38 million, thanks to the attribution error. We were strictly instructed to use a zero base estimate hence ignored their present sales numbers. On the completion of the first year, our actual sales stood at \$29 million. The second year plan was promptly anchored by this number and we budgeted our sales to be \$35 million, which was much less than our first year budget. This was not unique to this company. It happens in every organization. The performance targets are always anchored to the previous performance. We can demonstrate the impact of anchoring through still simpler experiment. Take a blank sheet of paper. Draw a line from bottom to top. Stop it before an inch. Now draw another line from top to bottom, stopping before an inch. Measure the inch long distance. The gap in the former will be bigger. Your mind was anchored to the bottom in the first case. To know how this anchoring is used against us, watch the video: <https://www.youtube.com/watch?v=9xSe604627c>

What Can We Do About It?

- Always view a problem from different perspectives. Listen to all concerned like a judge. This will also enhance your credibility.
- Try using different starting points and approaches rather than sticking with the first line of thought that occurs to you. Hold on the decision for a while. Avoid being impulsive.
- Think about the problem on your own before consulting others to avoid becoming anchored by their ideas. Writing down the views is a good idea.
- While seeking suggestions do not put forth your views first. Tell them as little as possible. Phrasing the question is the key.
- If you are leading a discussion never ever make others know your views till the culmination. Good bosses do not lead decisions but only the process.
- Be open-minded. When you have ‘yes’ men around you, one of you is redundant. Encourage dissent. Have dissimilar members.
- Be particularly wary of anchors in negotiations. When someone is proposing a number first, tell openly that you are not anchoring to that number. This self affirmation also helps psychologically.

Foot Note of Previous Slide

If Anchoring is so powerful, how do we manage it? Here are some tips: Always view a problem from different perspectives. Group thinking can be very useful. Try using different starting points and approaches rather than sticking with the first line of thought that occurs to you. Think about the problem on your own before consulting others to avoid becoming anchored by their ideas. While seeking suggestions, do not put forth your views first. Tell them as little as possible. Phrasing the question is the key. If you are leading a discussion never ever make others know your views till the culmination. Good bosses do not lead decisions but only the process. Be open-minded. When you have 'yes' men around you, one of you is redundant. Encourage dissent. Have dissimilar members. Be particularly wary of anchors in negotiations.



Decision Analysis

Status-Quo

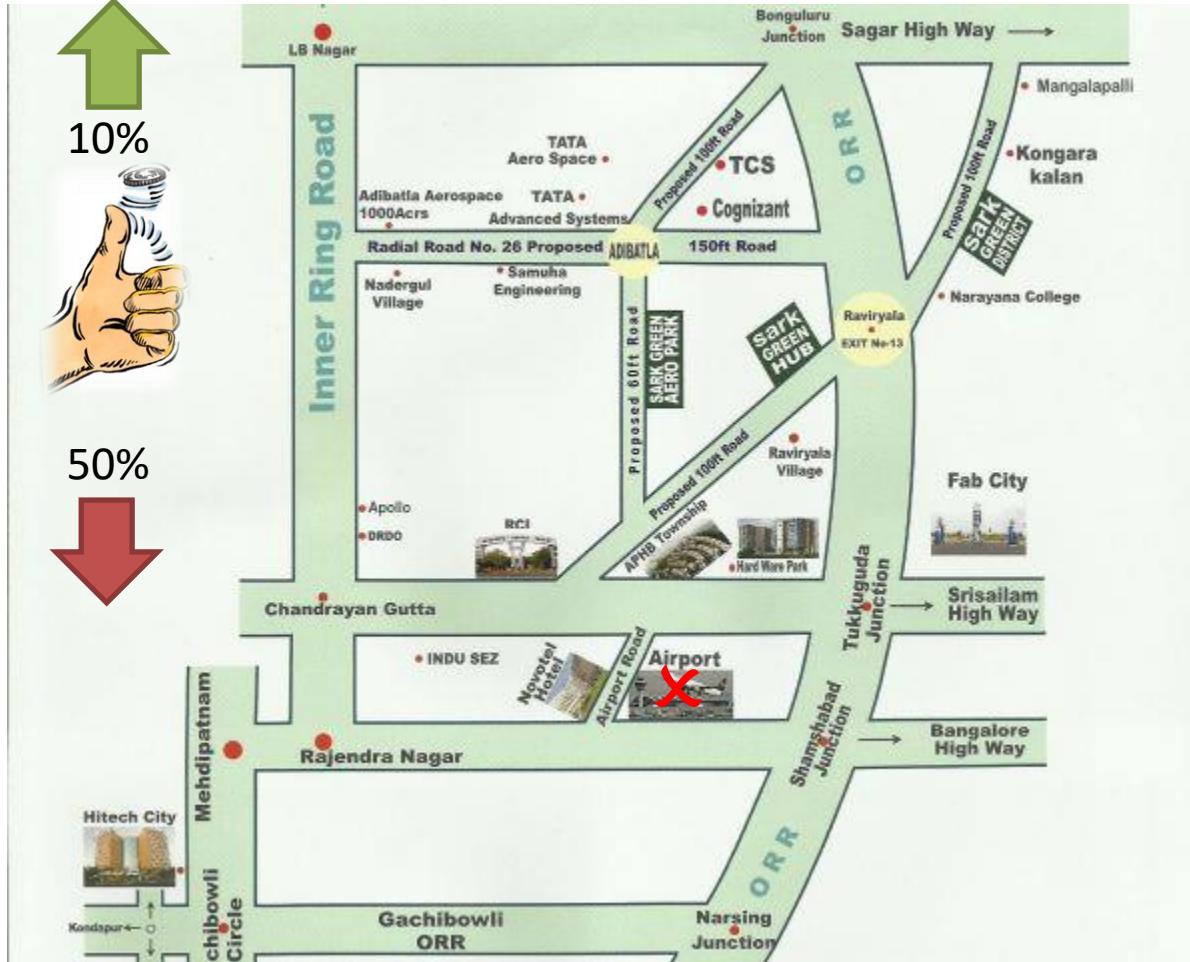
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SELL IT!



10%

50%

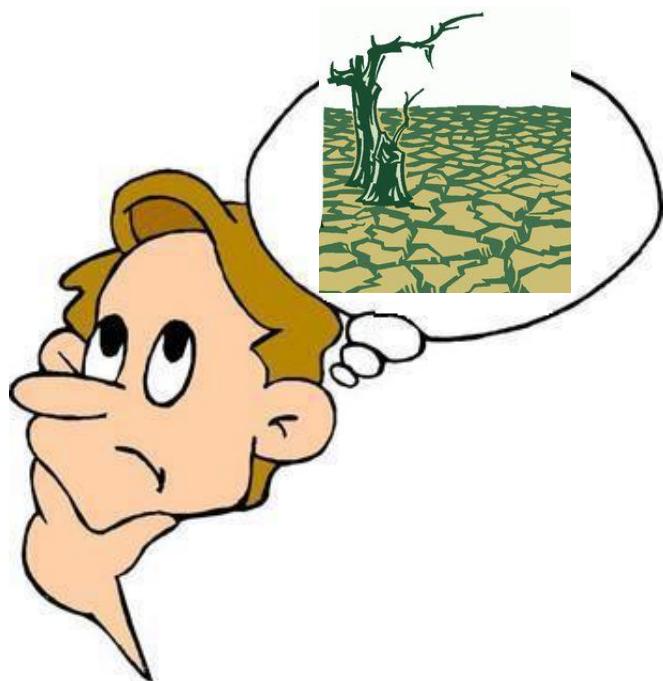


Fence it

Breaking from status-quo means taking action, for which we have to take responsibility, thus opening ourselves to criticisms and to regret.

Foot Note of Previous Slide

You purchased a piece of land near a would-be airport. The airport project was cancelled due to land acquisition issues. Your land has remained without much appreciation for years. You have a 50% chance that the investment will yield 10% returns year-on-year. At the same time there is a 50% chance that someone could encroach your land. A real estate agent offers to buy your land. You have two options, sell it off or fence it. You are not in need of funds. What is your choice? If you decide to sell, you are one among a few. Breaking from status-quo means taking action, for which we have to take responsibility, thus opening ourselves to criticisms and to regret. Naturally we look for reasons to do nothing. Sticking with the status quo avoids all these risks. Even choices are found to deepen this trap. Every new choice is a disturbance to the status quo.



present is real but the future is uncertain

Future is Uncertain



Remain in Status-Quo

Foot Note of Previous Slide

The heuristics at work here is, 'present is real but the future is uncertain'. Future provides both opportunity and threat, but evolutionary history has proved that organisms that treat threats more urgent than opportunities have better chance to survive and reproduce. If you are a Gazelle in the Savannah, which will you treat more seriously, a panther in the bush or the grazing field? You can forego a meal or two but can't risk your life.

Future is uncertain; threat is risky, so remain status-quo, quite a useful heuristics. But its influence has created a new science called change management.



Merger Syndrome



Foot Note of Previous Slide

Let us demonstrate how we are hardwired to maintain status-quo. Take three jars. Fill the left one with ice cold water, the right one with warm water and the middle one with water at ambient temperature. Keep your left and right hands in the respective jars for a minute. Now move both your hands to the middle jar. How do you feel? Your left hand cold and the right hand warm. It takes some time for the brain to change to the new condition. A group of people were randomly given two gifts of approximately same value-half received a mug, the other half a Swiss chocolate bar. They were then told that they could easily exchange the gift they received for the other gift. While you might expect that about half would have wanted to make the exchange, only one in ten actually did. The status-quo exerted its power even though it had been arbitrarily established only minutes before. We as decision makers show a strong bias towards alternatives that perpetuate the status-quo. On a broad scale, we can see this tendency whenever a radically new product is introduced. The first automobiles, revealingly called ‘horseless carriages,’ looked like the buggies they replaced. In business, where sins of commission tend to be punished more severely than sins of omission, the status-quo holds a particularly strong attraction. Many mergers, flounder because the acquiring company avoids swift action to impose a new, more appropriate management structure on the acquired company. “Let’s not rock the boat right now,” the typical reason goes, fearing a backlash with the native team. “Let’s wait till the situation stabilizes.” But as the time passes, the existing structure becomes more entrenched. Having failed to seize the opportunity, management finds itself stuck with the status-quo.

INR 700/-



SELL IT!

Raise
price!



Map Not to Scale

Foot Note of Previous Slide

My friend runs a small business in South. He has a modular structure by which he creates small manufacturing units across the non-metro towns. One of the units was making cash loss of Rs. 700/- per day. He had two choices, selling the unit to a local businessman or increasing the selling price. The status-quo trap was preventing him from taking either decision so he kept postponing the decision to the subsequent month. I suggested him to donate Rs. 700/- daily to a poor boy instead of running the business, which he naturally refused, though either of them had the same impact to him. Rationale hardly wins against the status-quo trap.

What Can We Do About It?

- Always remind yourself of the objectives and examine how the status-quo would help.
- Never think of the status-quo as the only option.
- Ask yourself whether you would choose the status-quo alternative if, in fact, it weren't the status-quo.
- Avoid exaggerating the effort or cost involved in switching from the status-quo.
- While comparing alternatives (including the status-quo) consider the present and future requirements.
- If you have several alternatives that are superior to the status-quo, don't default to the status-quo just because you're having a hard time picking the best alternative. Force yourself to choose.
- At times, maintaining the status-quo may be the best alternative but you don't want to choose it because it is comfortable.

Foot Note of Previous Slide

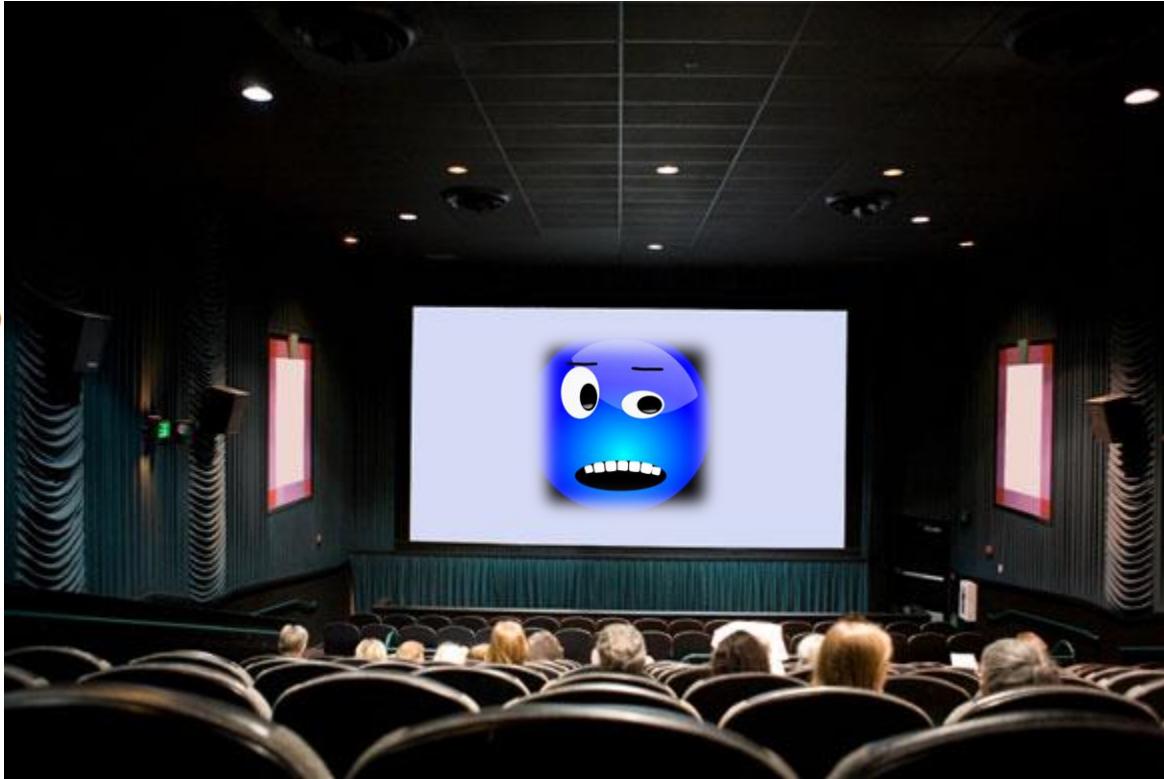
- If status-quo trap is so powerful, what do we do? Here are some tips, always remind yourself of the objectives and examine how the status-quo would help.
- Never think of the status-quo as the only option. Ask yourself whether you would choose the status-quo alternative if, in fact, it weren't the status-quo. Avoid exaggerating the effort or cost involved in switching from the status-quo. While comparing alternatives (including the status-quo) consider the present and future requirements. If you have several alternatives that are superior to the status-quo, don't default to the status-quo just because you're having a hard time picking the best alternative. Force yourself to choose. At times, maintaining the status-quo may be the best alternative but you don't want to choose it because it is comfortable.



Decision Analysis

Sunk-Cost

<https://goo.gl/forms/8Xw7DsVbrUOW3WMy1>



- The sunk-cost effect refers to the tendency for people to escalate commitment to a course of action in which they have made substantial prior investments of time, money, or other resources.
- If people behaved rationally, they would make choices based on the marginal costs and benefits of their actions. They would ignore sunk-costs.
- In the face of high sunk costs, people become overly committed to certain activities even if the results are quite poor.

Foot Note previous Slide

With great difficulty you obtained a movie ticket first day, first show. Half-way-through the movie you find it boring. You are disappointed. You feel upset for all the effort. What will you do? Will you wait for the movie to finish or leave the theatre midway through the movie? How many of us have actually left a movie midway? Does that mean that we liked all the movies we watched? If you knew the movie, would you venture to watch it? If you stay till the end, despite disliking it half-way through, you are suffering from sunk-cost fallacy. The sunk-cost effect refers to the tendency for people to escalate commitment to a course of action in which they have made substantial prior investments of time, money, or other resources. If people behaved rationally, they would make choices based on the marginal costs and benefits of their actions. They would ignore sunk-costs. In the face of high sunk costs, people become overly committed to certain activities even if the results are quite poor.



Turn-around time

CEO replaced!
Inter-division transfers!



One of the most powerful examples of sunk-cost is the 1996 Mount Everest tragedy. The tragedy occurred when 2 expedition teams got caught in a storm, high on the mountain, on May 10–11, 1996. Both expedition team leaders, as well as 3 team members, died during the storm. The climbers did not want to “waste” the time, money, and other resources that they had spent over many months to prepare for the final summit push even in the face of evidence that things could turn out quite badly. They had spent \$65,000 plus many months of training and preparing. The sunk costs were substantial. Thus, they violated the turnaround-time rule, and they kept climbing. Some have described it as “summit fever,” when you are so close to the top and just can’t turn back. At one point, climber Doug Hansen said, “I’ve put too much of myself into this mountain to quit now, without giving it everything I’ve got.” Guide Guy Cotter has said, “It’s very difficult to turn someone around high on the mountain. If a client sees that the summit is close and they’re dead set on getting there, they’re going to laugh in your face and keep going.” One of the banks in the U.S. had many bad loans to foreign businesses.

It was found that the bankers responsible for originating the bad loans were far more likely to advance additional funds repeatedly, in many cases than were bankers who took over the accounts after the original loans were made. Too often, the original bankers' strategy ended in failure. Having been trapped by an escalation of commitment, they had tried, consciously or unconsciously, to protect their earlier, flawed decisions. They were throwing good money after bad.

Why do CEOs get replaced? Why are there inter-division transfers? The incoming executives are devoid of sunk-cost fallacy so that they can take a fresh, unbiased look at the merit of the past decisions. Why do we spend more on a credit card than cash? The plastic currency reduces our loss aversion.



When you find yourself in a hole, the best thing you can do is stop digging. – Warren Buffet



Foot Note of Previous Slide

I had a colleague who moved from a large organization to ours to accept a senior position. Three months into the new role, he found himself out of place. He was very confused. Should he change the job or continue to seek the best out of the existing? A change would invite wide-spread criticism in the professional circles. I narrated him a Chinese proverb, ‘if the road taken is wrong, one has to get back, irrespective of the distance he travelled in it.’ He left the job and found a more suitable one. He was smart enough to overcome the sunk-cost fallacy. When you find yourself in a hole, the best thing you can do is stop digging. – Warren Buffet

What Can We Do About It?

- Seek out and listen carefully to the views of people who were uninvolved with the earlier decisions and who are hence unlikely to be committed to them.
- Examine why admitting to an earlier mistake distresses you. If the problem lies in your own wounded self-esteem, deal with it head-on. Avoid self-pity. Bad outcomes are not always due to bad decisions. To err is human, accept it.
- Be on lookout for the influence of sunk-cost biases in the decisions and recommendations made by your subordinates.
- Reshuffle responsibilities as a matter of routine.
- Don't cultivate a failure-fearing culture that leads employees to perpetuate their mistakes.
- In rewarding people, look at the quality of their decision making, not just the quality of the outcomes.

Foot Note of Previous Slide

- The lecture showed, how dangerous sunk-cost fallacy could be. Here are some tips to overcome it: Seek out and listen carefully to the views of people who were uninvolved with the earlier decisions and who are hence unlikely to be committed to them. Examine why admitting to an earlier mistake distresses you. If the problem lies in your own wounded self-esteem, deal with it head-on. Avoid self-pity. Bad outcomes are not always due to bad decisions. To err is human, accept it. Be on lookout for the influence of sunk-cost biases in the decisions and recommendations made by your subordinates. Reshuffle responsibilities as a matter of routine. Don't cultivate a failure-fearing culture that leads employees to perpetuate their mistakes. In rewarding people, look at the quality of their decision making, not just the quality of the outcomes.



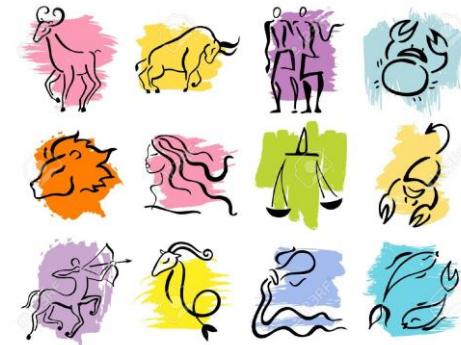
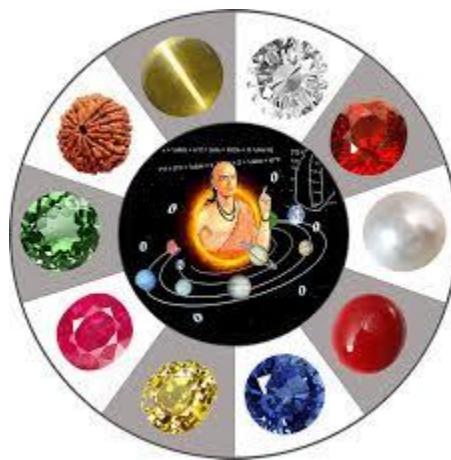
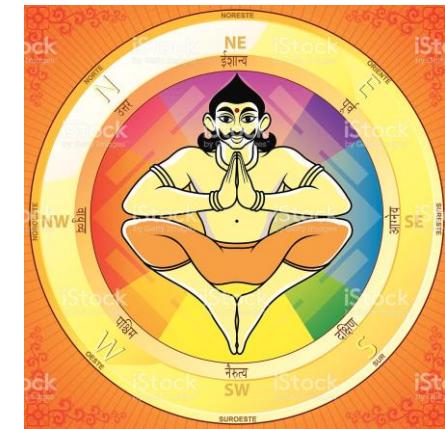
Decision Analysis

Confirmation Bias

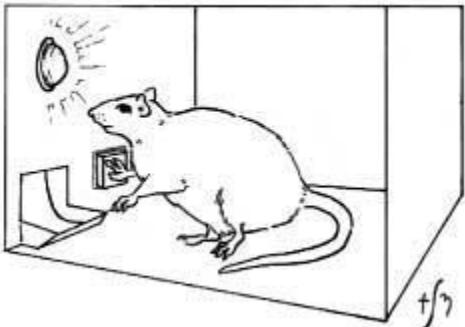
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© Can Stock Photo - csp6438605



Heuristics



1846
1860

1946
1960

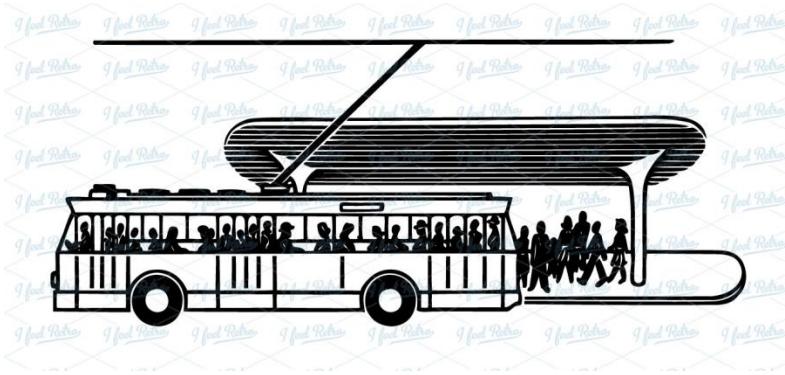
Shot in Head
Shot on Friday
Lost a son during presidency
Both assassins died in the same month as their victim



Pursue efforts that rewards



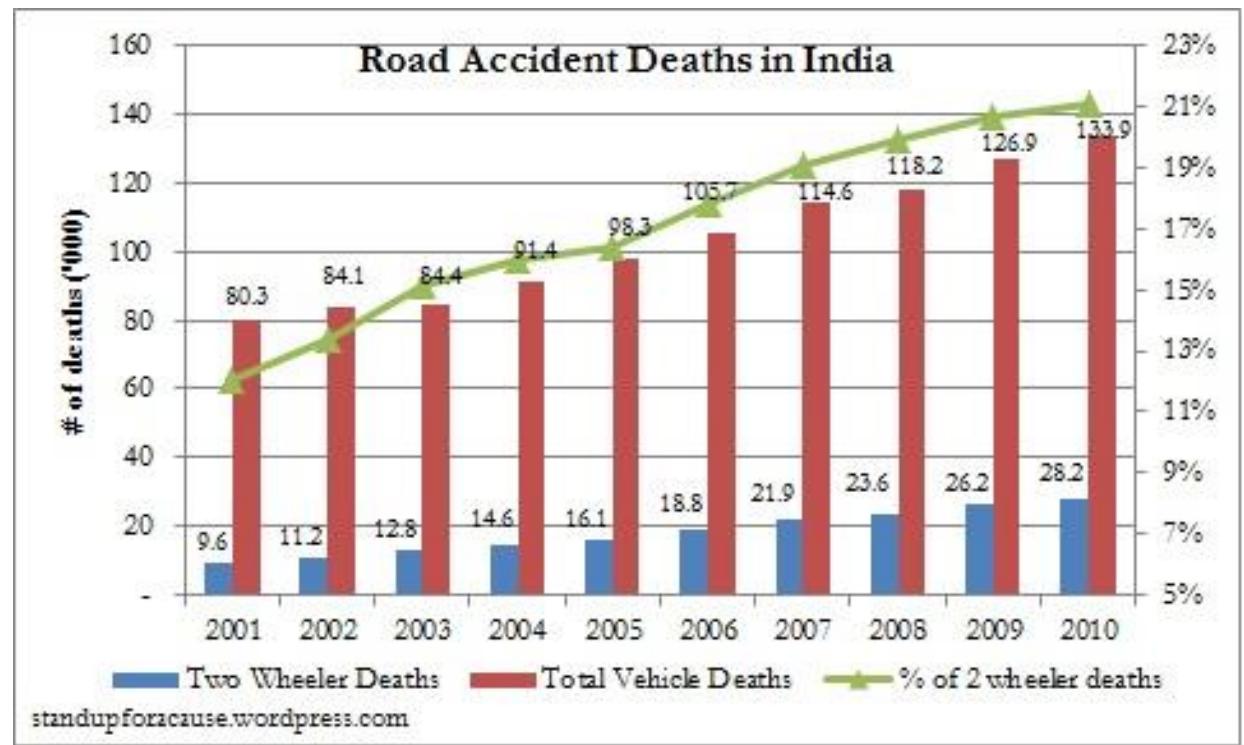
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H	H	T	H	H	T	T	H	H	H	H	H	H	H	T	H	T	H	T	H
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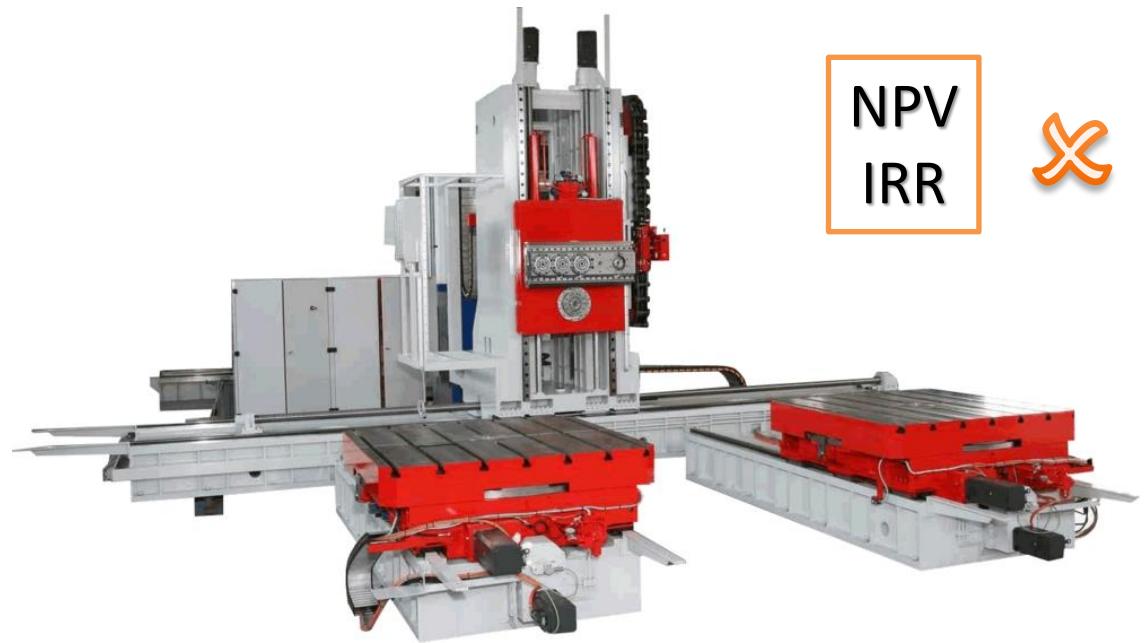
Confirmation bias is the one on which the entire animal experiments on ‘conditioning’ are built. A lab mouse that is rewarded a few times for an act is conditioned to repeat it endlessly. Once conditioned, the inhibitors do not deter the mouse from attempting the act. It requires a more audacious ‘reverse-conditioning’ to get rid of the habit. The heuristics is ‘pursue effort leading to reward’. I flipped a coin 100 times and I got seven heads in a row. Do you believe this possible? Probabilistically, yes. Every result in a coin flip is independent of the previous and each result has a 0.5 probability. They are just random events. But when we review the 100 flips, we ignore all other results but these 7 heads in a row. Seeing what we wish to see ignoring all other details is due to our confirmation bias. Listen to this list of coincidences between Abraham Lincoln and John F Kennedy. Both presidents were elected to the House of Representatives in '46. Both were elected to the presidency in '60. Both presidents were shot in the head on a Friday seated beside their wives. Both presidents had a son die during their presidency. Lincoln was shot by John Wilkes Booth at Ford's Theatre; Kennedy was shot by Lee Harvey Oswald in a Lincoln automobile, made by Ford. After shooting Lincoln, Booth ran from a theatre to a warehouse; after shooting Kennedy, Oswald ran from a warehouse to a theatre. Both assassins died in the same month as their victim. The list is endless. It is relatively easy to find seemingly meaningful patterns relating any two people or events, but such patterns often do not stand up to rigorous scrutiny. You have experienced this, when you are waiting for your bus, you find so many of them go in the other direction and not just one on your side. Have you wondered why is this, such a common experience? Confirmation bias is the reason.



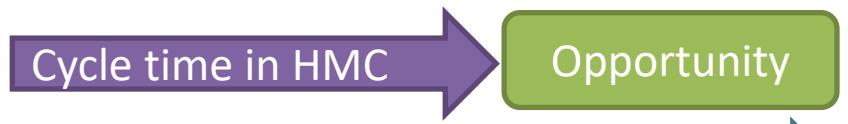
- There are two fundamental psychological forces at work here.
- The first is our tendency to subconsciously decide what we want to do before we figure out why we want to do it.
- The second is our inclination to be more engaged by things we like than by things we dislike.
- Naturally, then, we are drawn to information that supports our subconscious leanings.

Foot Note of Previous Slide

Why do we not wear helmet or seat belt, despite knowing the statistics of road accidents? As engineers we know how a helmet protects our head. But this rational knowledge has the least effect on our preference to ride without head gear. Every time we take the ride without the helmet and return home safely, we reconfirm our belief. This irrational reconfirmation offers a pseudo-confidence, which prevents us from using the safety gear. Confirmation bias is at work, despite a rational reason and statutory rule. There are two fundamental psychological forces at work here. The first is our tendency to subconsciously decide what we want to do before we figure out why we want to do it. The second is our inclination to be more engaged by things we like than by things we dislike – a tendency well documented even in babies. Naturally, then, we are drawn to information that supports our subconscious leanings.



NPV
IRR



Raw material

Machining

Assembly

Testing

Packing

Foot Note of Previous Slide

A valve manufacturing company had serious issues in their on-time performance. The operations head concluded the machine shop to be the bottleneck. He decided to invest in a machining-centre that would cost \$3 million. All financial computations discouraged the proposal. He came up with an argument. He estimated the ‘time saving in machining’ using new equipment, converted this time into opportunity to serve new markets and projected the profits that would be realized through this new business. The equipment was installed but the on-time performance worsened. The plant got busy engaging the new equipment but the constraints were found in assembly. Even to this day the on-time performance remains abysmally low.

What Can We Do About It?

- Always check to see whether you are examining all the evidence with equal rigor. Avoid the tendency to accept confirming evidence without question.
- Get someone you respect to play devil's advocate, to argue against the decision you are contemplating. Better yet, build the counterarguments yourself. What is the strongest reason to do something else? The second strongest reason? The third? Consider the position with an open mind.
- Be honest with yourself about your motives. Are you really gathering information to help you make a smart choice, or are you just looking for evidence confirming what you think you would like to do?
- In seeking the advice of others, don't ask leading questions that invite confirming evidence. And if you find that an adviser always seems to support your point of view, find a new adviser. Don't surround yourself with yes-men.

Foot Note of Previous Slide

- It is not that you should not make the choice taking leads from your tacit knowledge. It is just that you want to be sure it's the smart choice. You need to put it to the test. Here is how: Always check to see whether you are examining all the evidence with equal rigor. Avoid the tendency to accept confirming evidence without question. Get someone you respect to play devil's advocate, to argue against the decision you are contemplating. Better yet, build the counterarguments yourself. What is the strongest reason to do something else? The second strongest reason? The third? Consider the position with an open mind. Be honest with yourself about your motives. Are you really gathering information to help you make a smart choice, or are you just looking for evidence confirming what you think you would like to do? In seeking the advice of others, don't ask leading questions that invite confirming evidence. And if you find that an adviser always seems to support your point of view, find a new adviser. Don't surround yourself with yes-men.



Decision Analysis

More Decision Traps

Overconfidence Bias

Are you an ethical person?

Do you treat your colleagues fairly?

Are you honest in your dealing?

‘What would I eliminate if I had a magic wand? Overconfidence’

-Daniel Kahneman

Experts are often called on to predict the performance of novices, but cognitive heuristics may interfere with experts' ability to capitalize on their superior knowledge in predicting novice task performance. In Study 1, experts, intermediate users, and novices predicted the time it would take novices to complete a complex task. In Study 2, expertise was experimentally manipulated. In both studies, those with more **expertise were worse predictors** of novice performance times and were **resistant to debiasing techniques** intended to reduce underestimation. Findings from these studies suggest that **experts may have a cognitive handicap** that leads to underestimating the difficulty novices face and that those with an **intermediate level of expertise may be more accurate** in predicting novices' performance.

Pamela J. Hinds Stanford University
The Curse of Expertise, JEPA, 1999

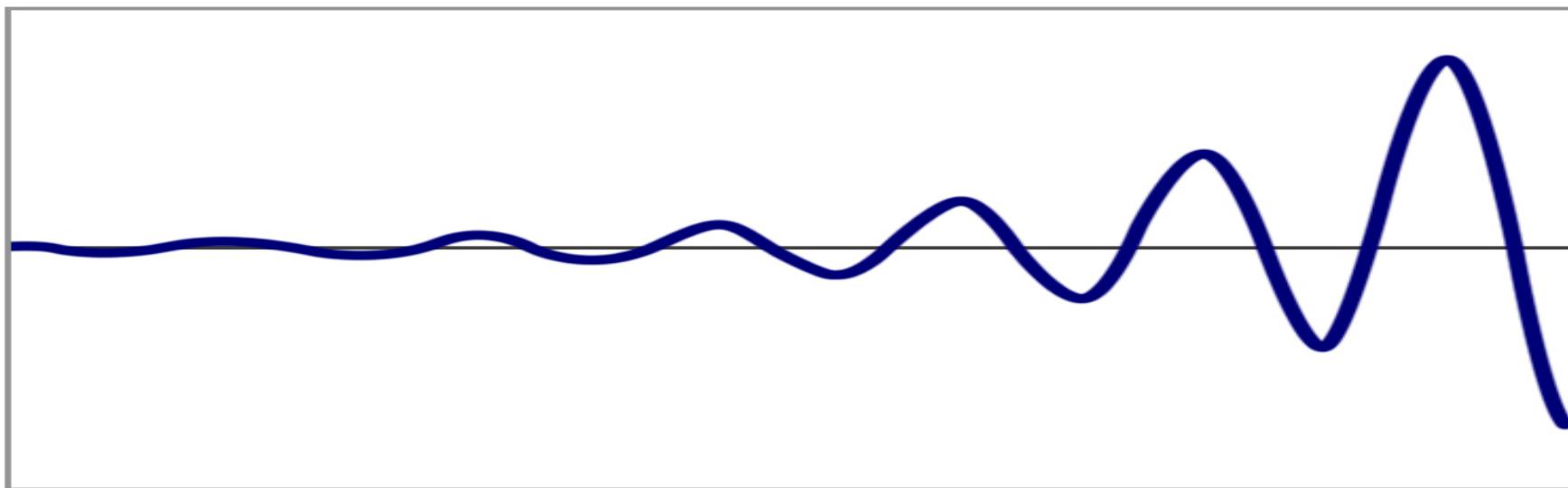
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Overconfidence Bias: Even though most of us are not very good at making estimates of forecasts, we actually tend to be overconfident about our accuracy. That can lead to errors in judgements and, in turn bad decisions. The error of overconfidence is found more profound in experts in their fields. Several tests have proved their judgement to be overtly biased than the novices. Ask anyone how good are they in ethics, fairness and honesty. We always have a good opinion about ourselves. Watch this video:

<https://www.youtube.com/watch?v=o4wv4RYFuE4>

Prudence Trap

The Bullwhip Effect



Consumer Demand → Manufacturer Predictions

scenario. It rarely goes down as you imagine it will, and if by some fluke it does, you will have lived it twice."

Confidence level	Z score	
90%	1.645	19%
95%	1.960	41%
98%	2.326	
99%	2.576	57%

Just-In-Case

Foot Note of Previous Slide

Prudence Trap: The most vivid example of Prudence Trap is ‘Bull-Whip Effect’ that lead to a new field in Operations Management namely, Supply Chain Management. The safety factor added at every stage of the supply chain eventually result in a huge over-production to meet a known demand.

Worst-Case Analysis is another classic approach that leads to prudence trap. Products and systems designed to perform in worst-case scenarios are over-designed at the cost of resources, which never found usage in real-life situations. Improving confidence level from 60% to 80% is not expensive. But beyond that level, every single % increases the cost exponentially. A system with a confidence level of 99% is higher than the one with 95% in manifolds. ‘Just-to-be-safe’ approach drains the resources and makes the projects unviable.

Recallability Trap



1 in 4.7m



1 in 9300

We frequently base our predictions about future events on our memory of past events-those that leave a strong impression on our memory.



Foot Note

Recallability Trap: We frequently base our predictions about future events on our memory of past events-those that leave a strong impression on our memory. We all, for example, exaggerate the probability of rare but catastrophic occurrences such as plane crashes because they get disproportionate attention in the media. You will assign a higher probability to traffic accidents if you have passed one on the way to work, and you will assign a higher chance of someday dying of cancer yourself if a close friend has died of the disease. Corporate lawyers often get caught in the Recallability trap when defending liability suits. Their decision to settle whether to settle a claim or take it to court usually hinge on their assessments of the possible outcomes of a trial. Because the media tend to aggressively publicize massive damage awards (while ignoring other, far more common trial outcomes), lawyers can overestimate the probability of a large award for the plaintiff. As a result, they offer larger settlements than are actually warranted.

What Can We Do About It?

- Use objective tools for estimating and forecasting
- Always consider the low and high ends of the possible range of values. Then challenge your estimates of the extremes. Try to imagine circumstances where the actual figure would fall below your low or above your high, and adjust your range accordingly.
- Always state your estimates honestly and accurately. Inform the safety-factor in your estimates upfront. For example, if you expect to receive an order for 100 units, and you wish to consider placing an order for 110 units to your supplier, state the facts to her.
- Carefully examine all your assumptions and state them. Get actual statistics wherever possible. Beware of impressions.

Foot note

- What can we do about them? Use objective tools for estimating and forecasting. Always consider the low and high ends of the possible range of values. Then challenge your estimates of the extremes. Try to imagine circumstances where the actual figure would fall below your low or above your high, and adjust your range accordingly. Always state your estimates honestly and accurately. Inform the safety-factor in your estimates upfront. For example, if you expect to receive an order for 100 units, and you wish to consider placing an order for 110 units to your supplier, state the facts to her. Carefully examine all your assumptions and state them. Get actual statistics wherever possible. Beware of impressions.

Bias Summary

Bias	Description
Anchoring	Giving disproportionate weight to the first information we receive.
Prudence	Adding a margin of error to all our estimates at all stages.
Status-quo	Resistance to change.
Sunk cost	Allowing past dead investments influence present decisions.
Confirmation bias	Being selective to the information that align with our beliefs.
Overconfidence trap	Compensating uncertainty with confidence.
Recallability	Predicting future events based on past memories imprinted in our brain.



THE WISDOM OF CROWDS

Why the Many Are Smarter Than the Few

JAMES SUROWIECKI



'Dazzling . . . the most brilliant book on business, society and everyday life that I've read in years'
Malcolm Gladwell,
author of *The Tipping Point*

A NEW YORK TIMES BUSINESS BESTSELLER

"As entertaining and thought-provoking as *The Tipping Point* by Malcolm Gladwell. . . . *The Wisdom of Crowds* ranges far and wide."

—The Boston Globe

THE WISDOM OF CROWDS

JAMES
SUROWIECKI

WITH A NEW AFTERWORD BY THE AUTHOR



A warm-up exercise

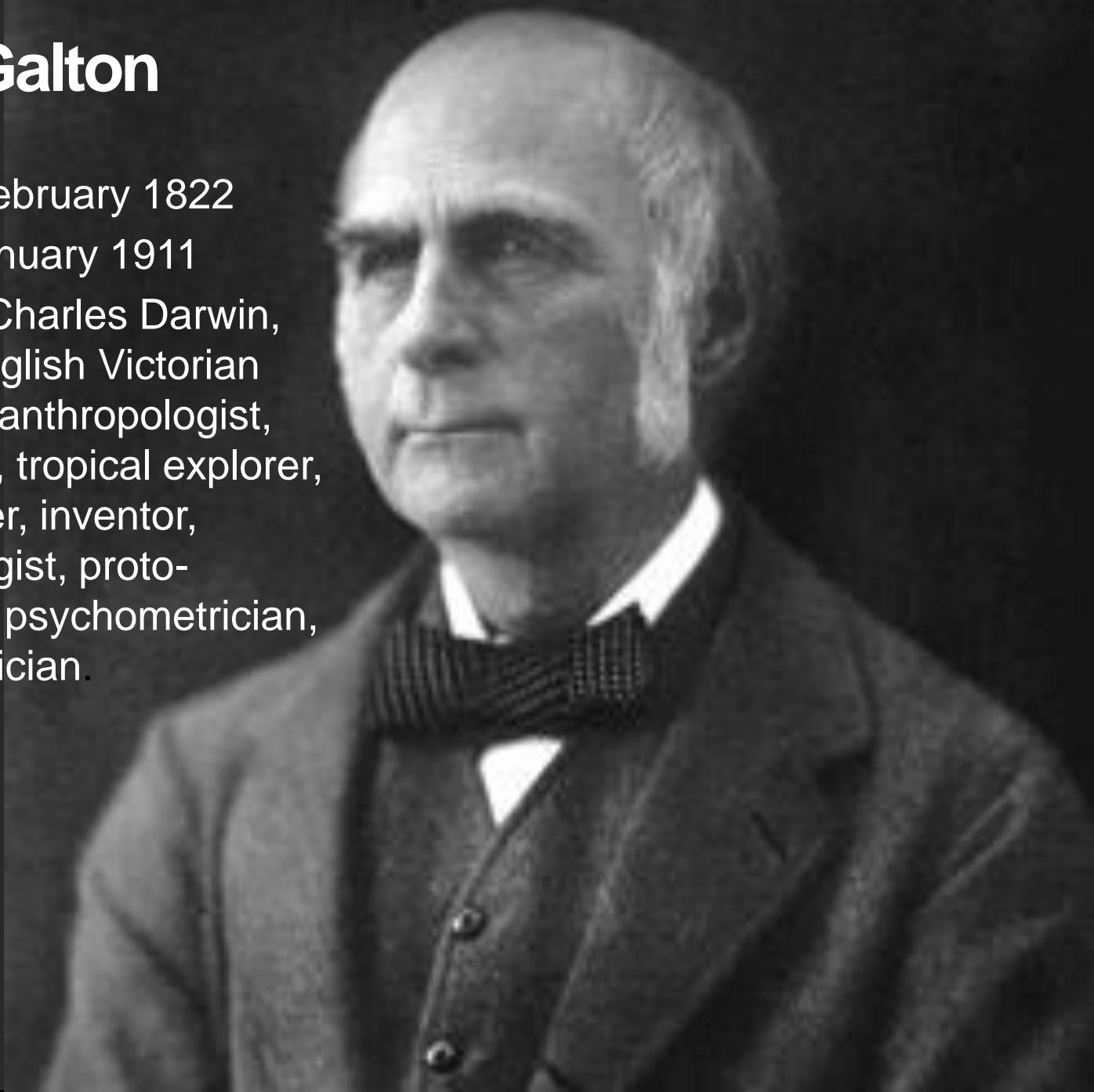
- Everyone write down what they think my age is individually.
- Now get the average of the answers.
- How close are you to correct?

Traditional Problem Solving

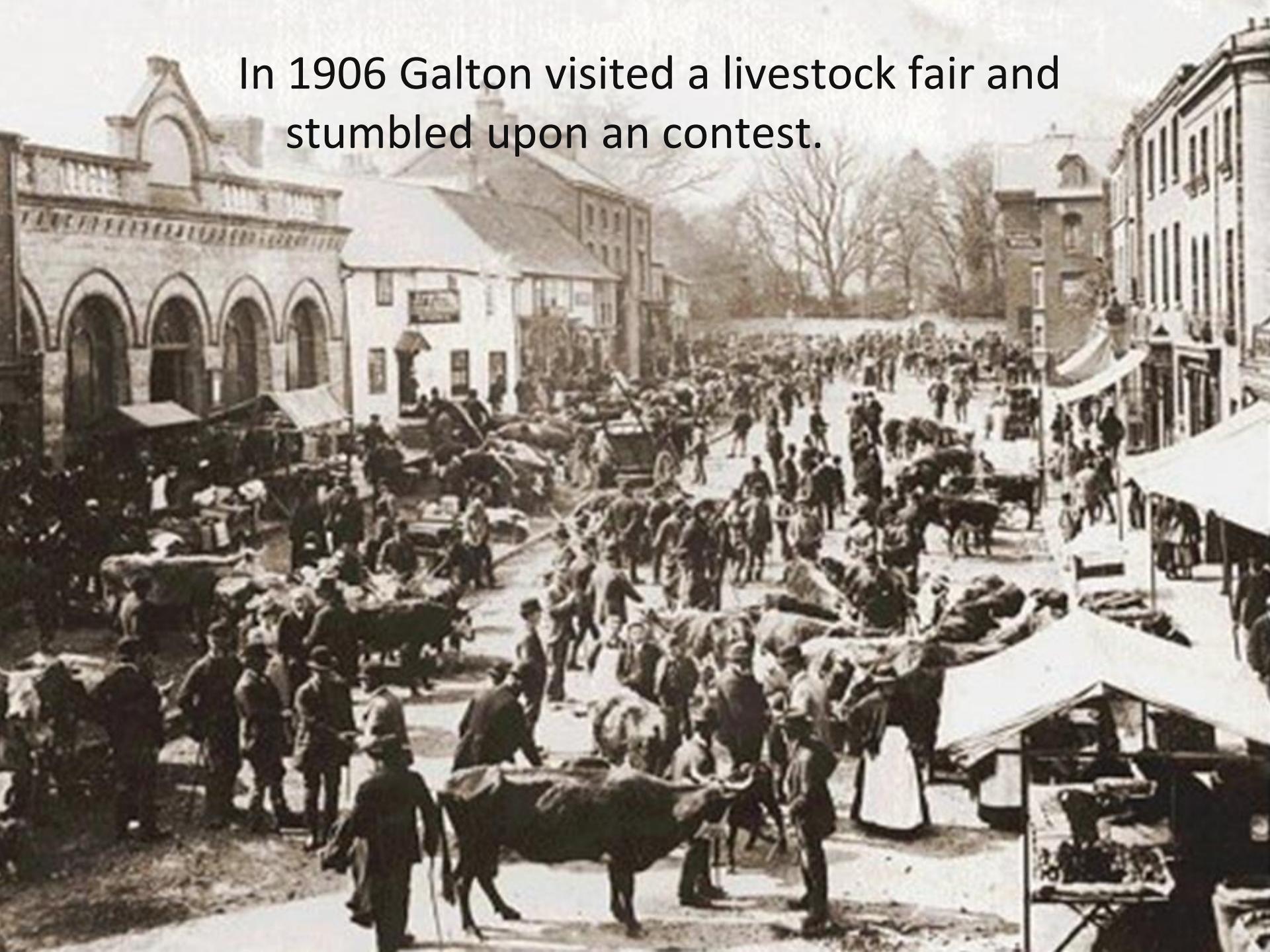
- Use our Instinct/Guess
- Use our own Experience
- Ask an Expert
- Research books by Experts
- Ask a Friend
- Follow the Leader
- Follow the Trend
- Work with colleague/co-worker/boss

Francis Galton

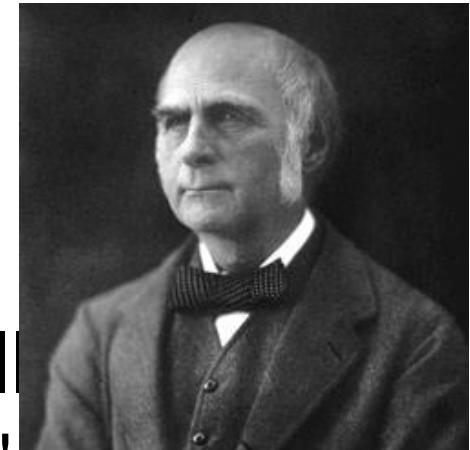
- Born 16 February 1822
- Died 17 January 1911
- cousin of Charles Darwin, was an English Victorian polymath, anthropologist, eugenicist, tropical explorer, geographer, inventor, meteorologist, proto-geneticist, psychometrician, and statistician.



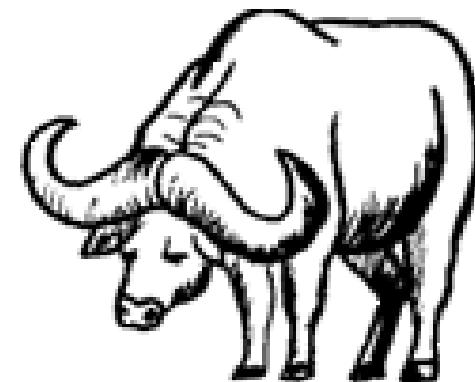
In 1906 Galton visited a livestock fair and stumbled upon an contest.



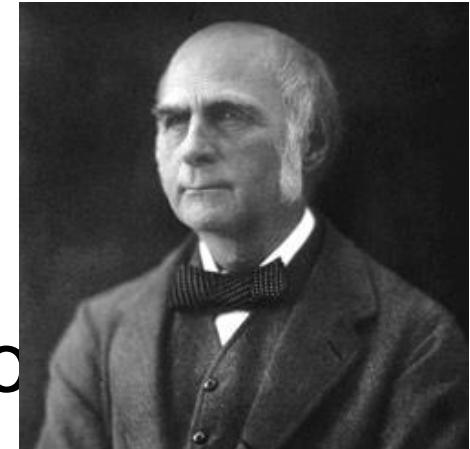
Francis Galton



- An ox was on display, and the villagers were invited to guess the animal's weight after it was slaughtered and dressed.
- Galton disliked the idea of democracy and wanted to use the competition to show the problems of allowing large groups of people to vote on a topic.



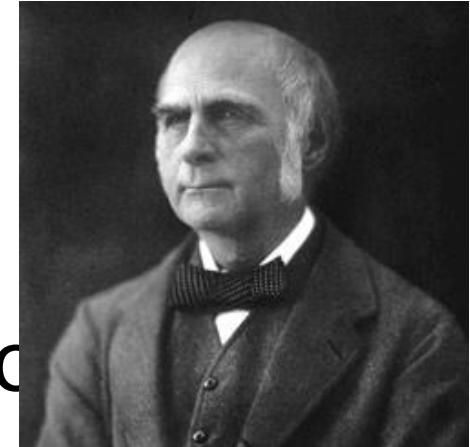
Francis Galton



- 787 people guessed the weight of a ox. Some were experts, farmers and butchers, others knew little about livestock. Some guessed very high, others very low, many guessed fairly sensibly.
- Galton collected the guesses after the competition was over

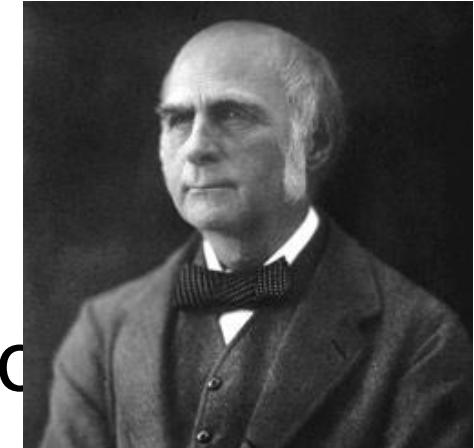
Francis Galton

- The average guess was 1,197 pounds.



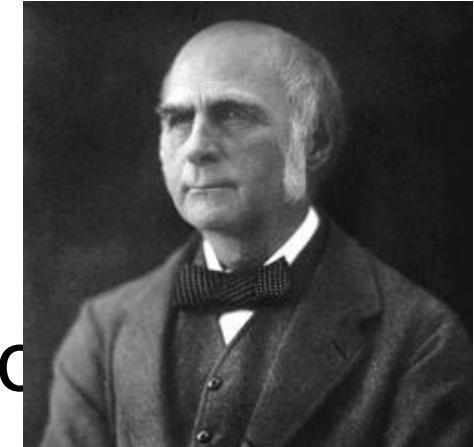
Francis Galton

- The average guess was 1,197 pounds
- The correct weight was 1,198 pounds

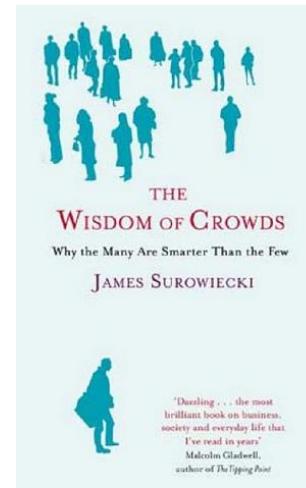


Francis Galton

- The average guess was 1,197 pounds
- The correct weight was 1,198 pounds
- AMAZING



Wisdom of Crowds



- What Dalton discovered was that in actuality crowds of people can make surprisingly good decisions **IN THE AGGREGATE**, even if they have imperfect information.



THE
WISDOM OF CROWDS

Why the Many Are Smarter Than the Few

JAMES SUROWIECKI

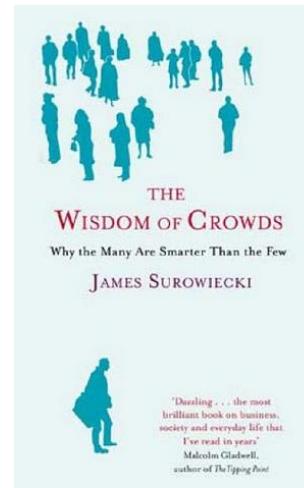


'Dazzling . . . the most brilliant book on business, society and everyday life that I've read in years'
Malcolm Gladwell,
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Other examples



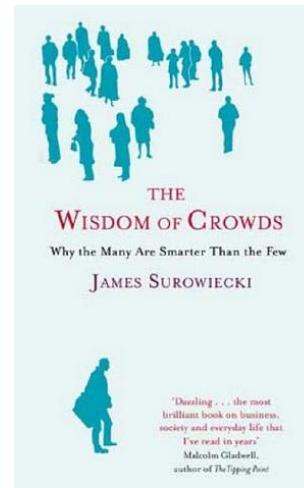
Who wants to be a millionaire?



- Compare the lifelines;
 - Phone a friend
 - Ask the Audience



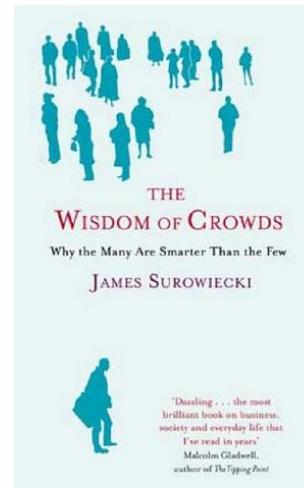
Who wants to be a millionaire?



- The correct answer is given;
 - Phone a friend
 - Ask the Audience

65%

Who wants to be a millionaire?



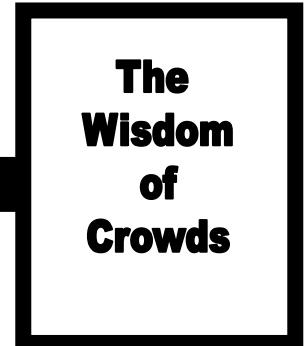
- The correct answer is given;
 - Phone a friend
 - Ask the Audience

65%
91%

Who wants to be a millionaire?

- The correct answer is given;
 - Phone a friend
 - Ask the Audience

65%
91%



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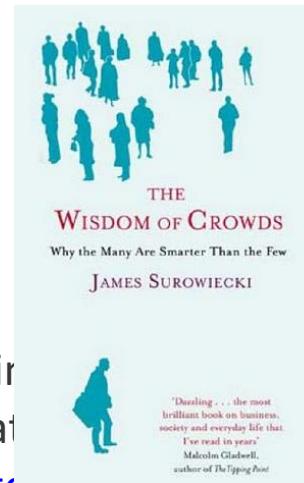
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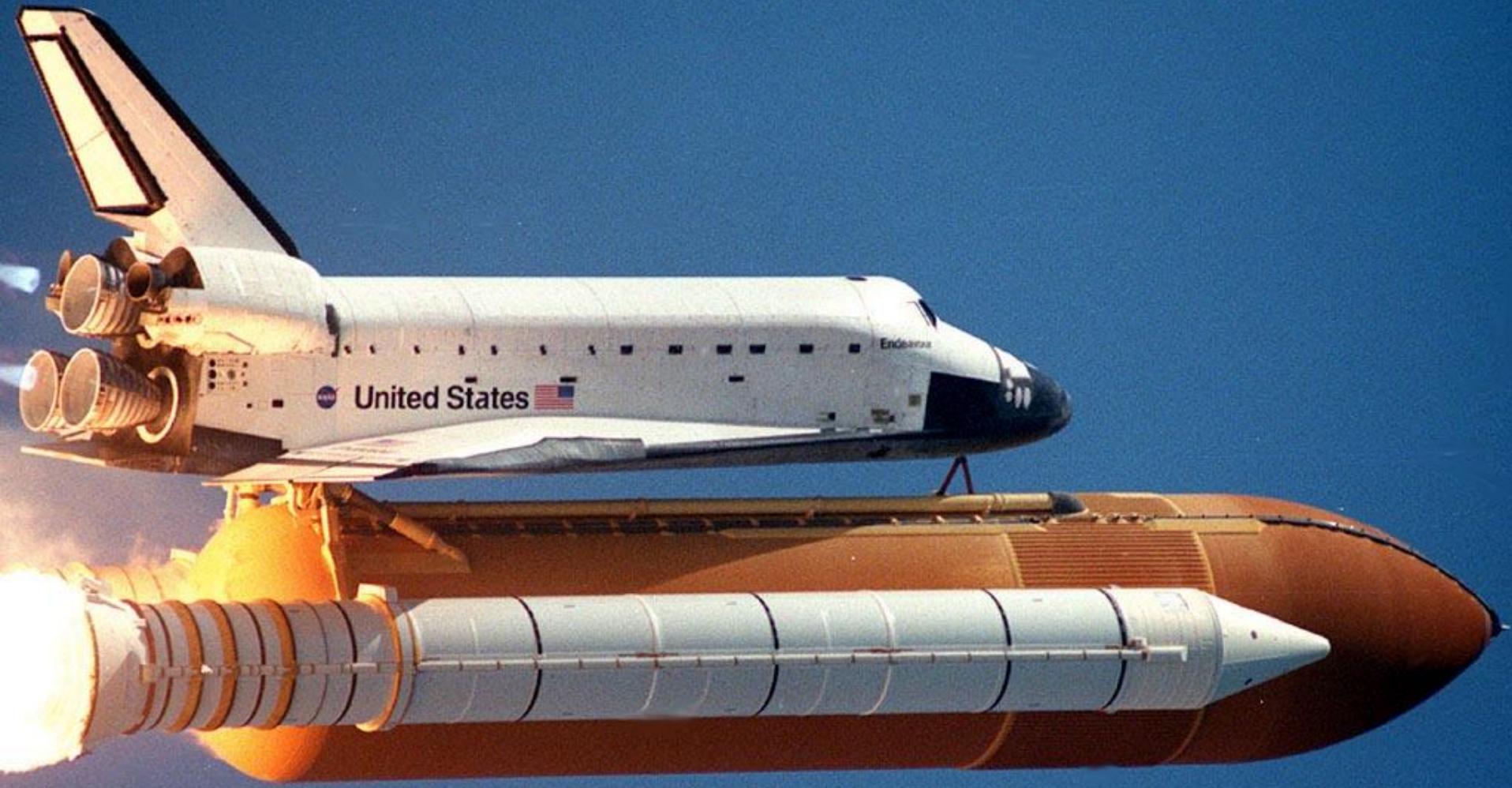
Other examples

The Lost Submarine Scorpion



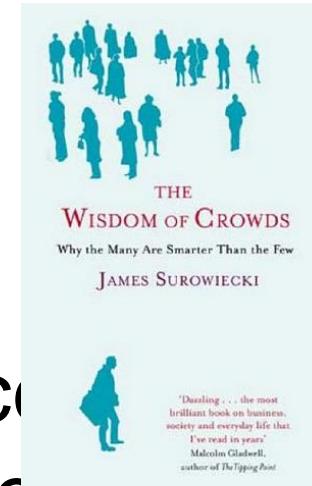
- On May 22 1968 the US navy lost one of its submarines and wanted to find the wreckage, but the intelligence it had was not able to provide an area that was small enough to effectively search. John Craven a naval officer, decided to harness the wisdom of crowds.
- He asked a wide group of individuals, drawn from diverse backgrounds ranging from mathematicians to salvage experts to guess the submarine's location. The group's average guess was just 220 yards from the location where the Scorpion was eventually found.

<https://youtu.be/NJWHiPSvzh8>



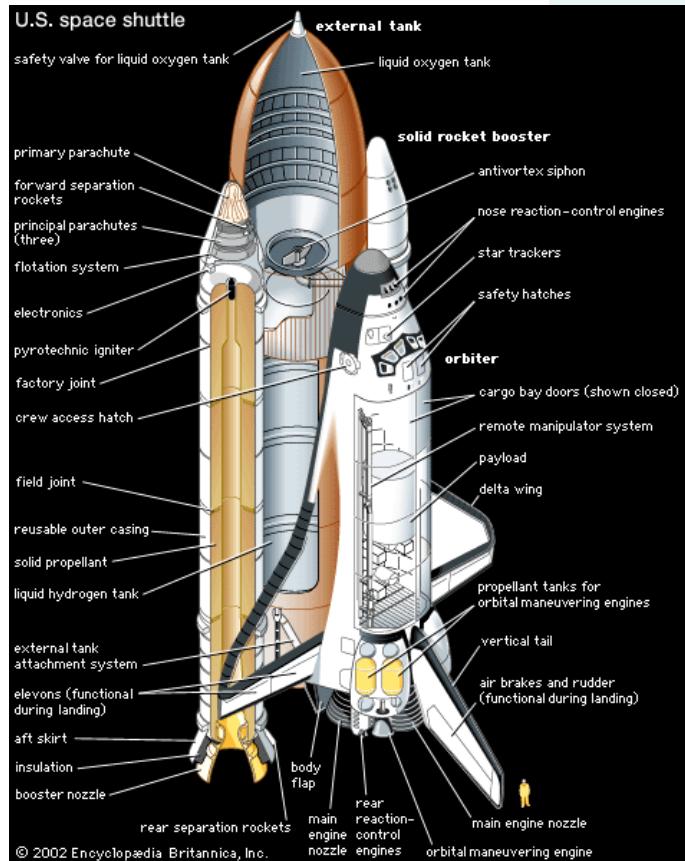
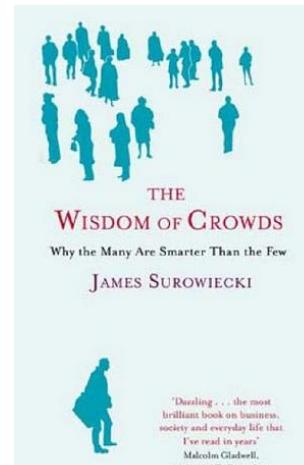
The Spaceshuttle Challenger

- On January 28, 1986, when the Space Shuttle Challenger broke apart 73 seconds into its flight, leading to the deaths of its seven crew members. The spacecraft disintegrated over the Atlantic Ocean, off the coast of central Florida



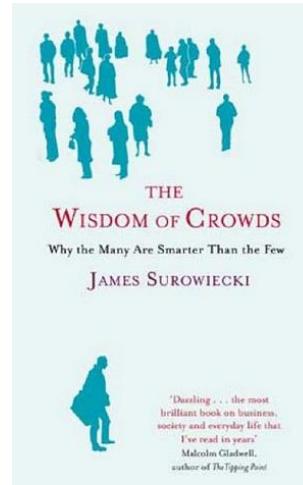
The Spaceshuttle Challenger

- The stock market did not pause to mourn. Within minutes, investors started dumping the stocks of the four major contractors who had participated in the Challenger launch



The Spaceshuttle Challenger

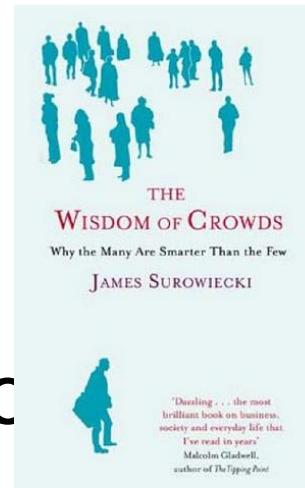
- **Rockwell International**, which built the shuttle and its main engines;
- **Lockheed**, which managed ground support;
- **Martin Marietta**, which manufactured the ship's external fuel tank; and
- **Morton Thiokol**, which built the solid-fuel booster rocket.



Rockwell International

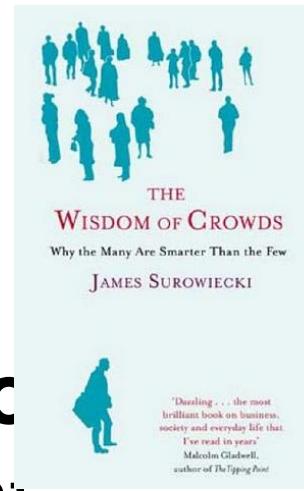


The Spaceshuttle Challenger



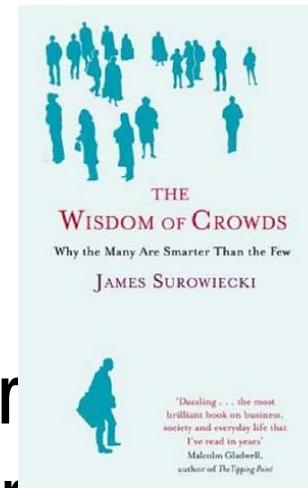
- Twenty-one minutes after the explosion:
 - **Rockwell**'s stock was down 6%,
 - **Lockheed**'s was down 5%,
 - **Martin Marietta**'s was down 3%,
 - **Morton Thiokol**'s stock was hit hardest of all, so many investors were trying to sell Thiokol stock and so few people were interested in buying it that a trading halt was called almost immediately. When the stock started trading again, almost an hour after the explosion, it was down 6%.

The Spaceshuttle Challenger

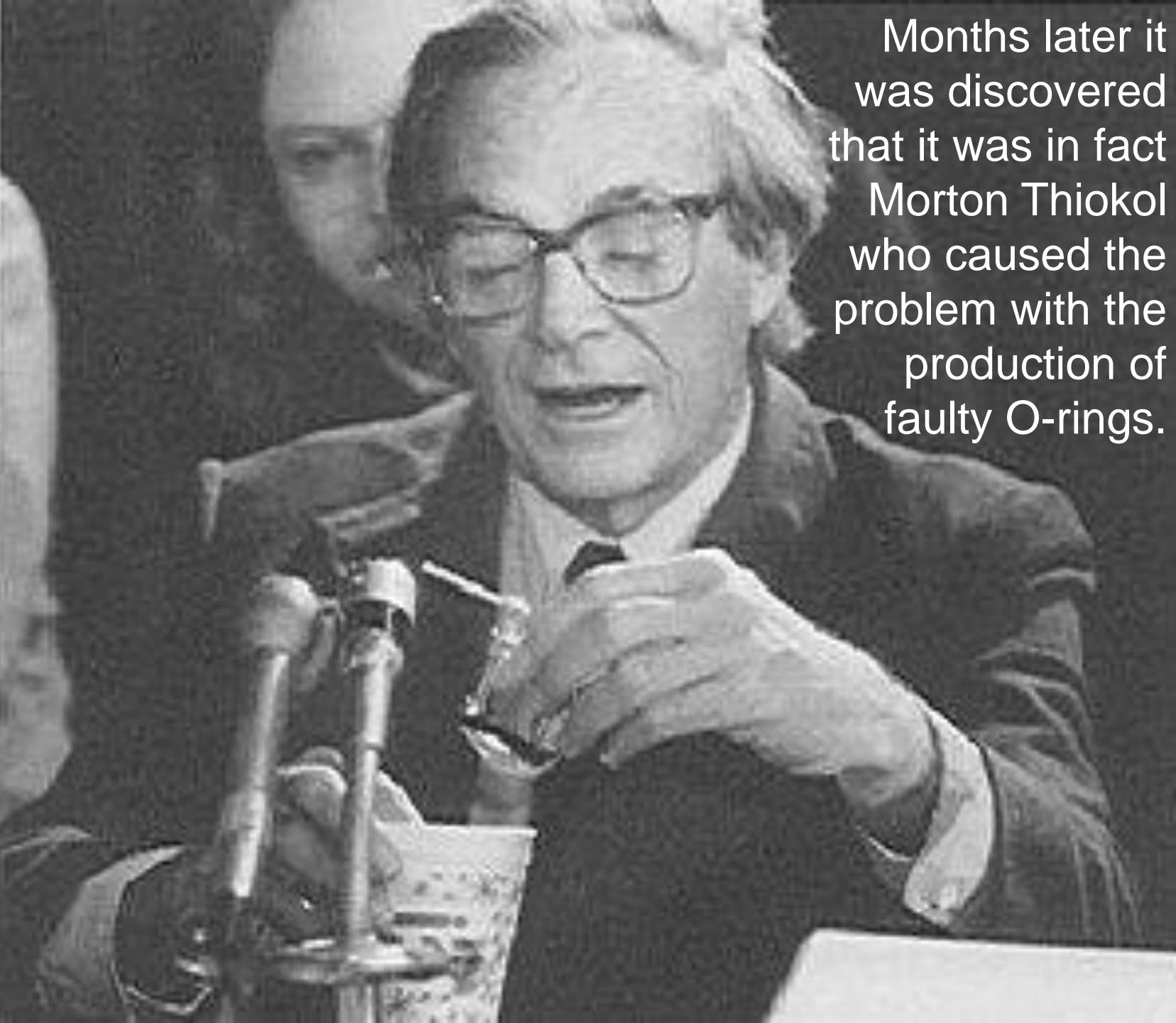


- By the end of the day, **Morton Thiokol**'s stock price decline had almost doubled, so that at market close, Thiokol's stock was down nearly 12%.
- By contrast, the stocks of the three other firms started to creep back up, and by the end of the day their value had fallen only around 3%.

The Spaceshuttle Challenger

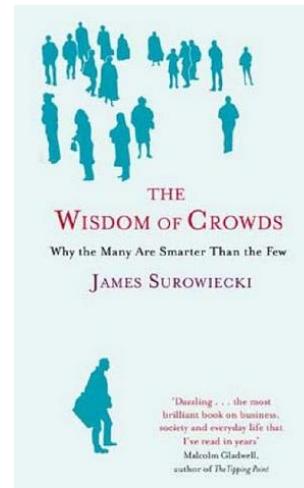


- What this means is that the stock market had, almost immediately, labelled Morton Thiokol as the company that was responsible for the *Challenger* disaster.
- Months later it was discovered that it was in fact Morton Thiokol who caused the problem with the production of faulty O-rings.



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The Spaceshuttle Challenger

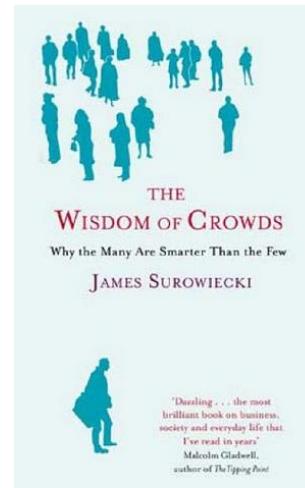


- How did the stock investors know ?



'Dazzling . . . the most brilliant book on business, society and everyday life that I've read in years'
Malcolm Gladwell,
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The Spaceshuttle Challenger



- How did the stock investors know ?
- There is no satisfactory explanation, other than the wisdom of crowds.



THE
WISDOM OF CROWDS

Why the Many Are Smarter Than the Few

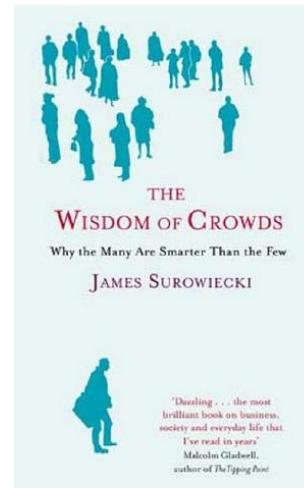
JAMES SUROWIECKI



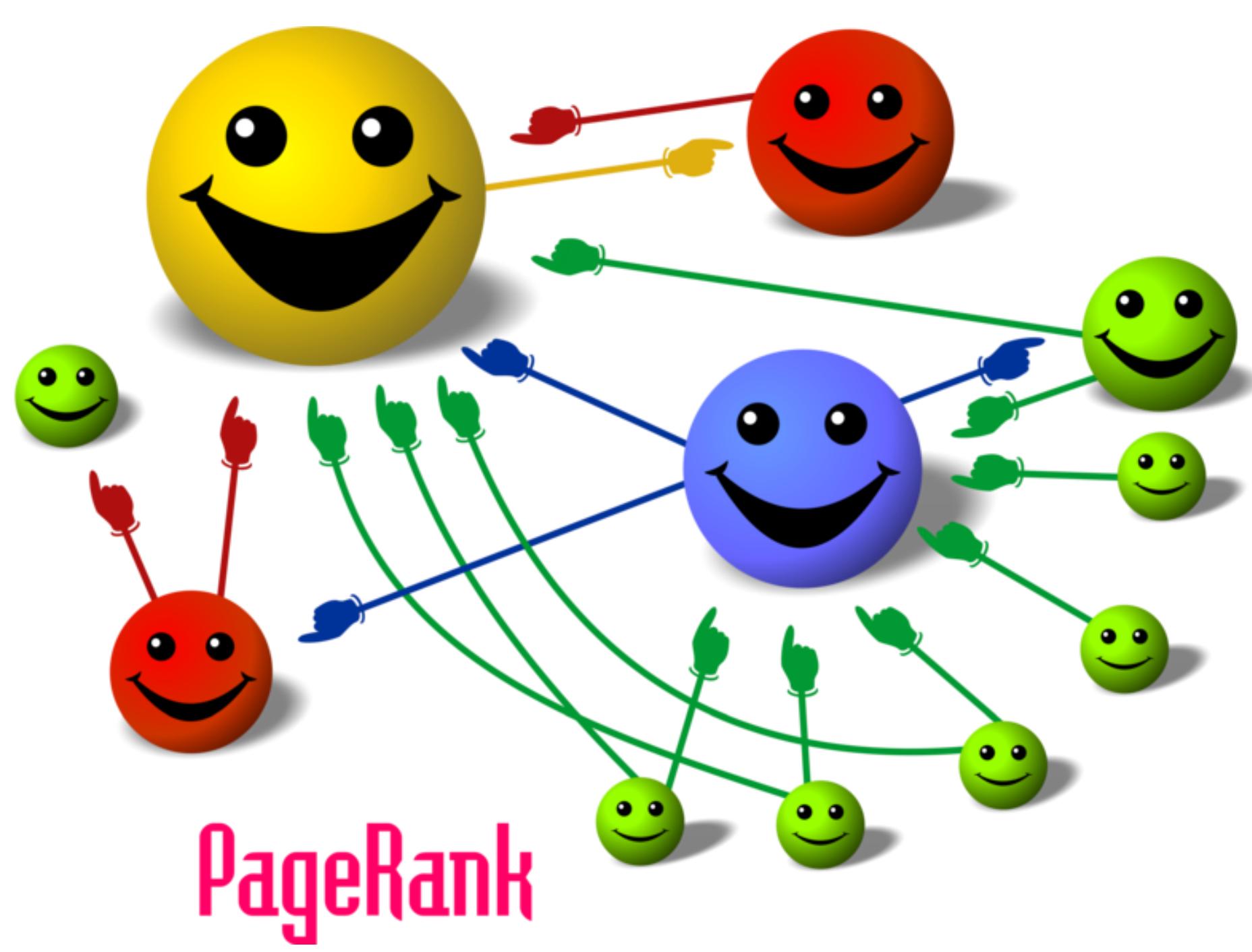
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Other examples

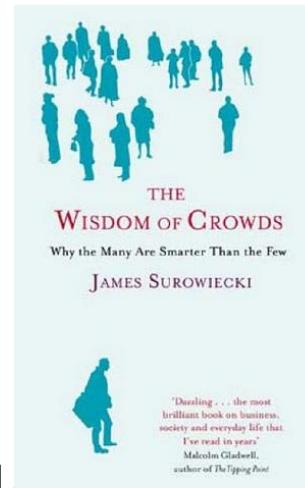
Google PageRank Algorithm



- How does Google work ?
- How does it classify pages so that typically the page you are looking for is the in first ten links it returns?

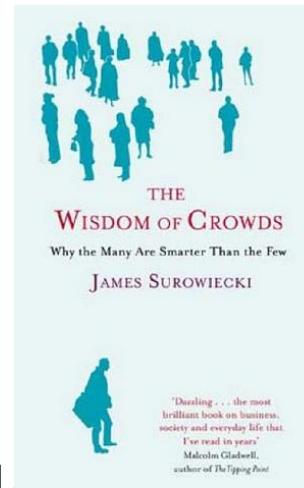


Google PageRank Algorithm



- It uses the PageRank algorithm, the specifics of which are a closely guarded secret, but the main idea is easy to grasp:
 - the more sites that link to a certain URL with a certain phrase, the higher the rating.
 - This works because each link is a vote for the connection between the phrase and the site.

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The Wisdom of Crowds

Exercise

- A friend of yours said they will be in Dublin on Saturday and want to meet you, but you didn't hear where they said, if you had you guess where would you go ?

Exercise

- A friend of yours said they will be in Dublin on Saturday and want to meet you, but you didn't hear where they said, if you had you guess where would you go ?
- Most people would tend to say the Spire or Cleary's clock.

Exercise

- You also missed the time at which you are supposed to meet them at, if the meeting is for a Saturday, what time will you head into town for?

Exercise

- You also missed the time at which you are supposed to meet them at, if the meeting is for a Saturday, what time will you head into town for?
- Most people say Noon or 1 o'clock.

Exercise

- Thus in general the majority of pairs of two people who don't know when or where they are meeting could hook up without prearrangement.



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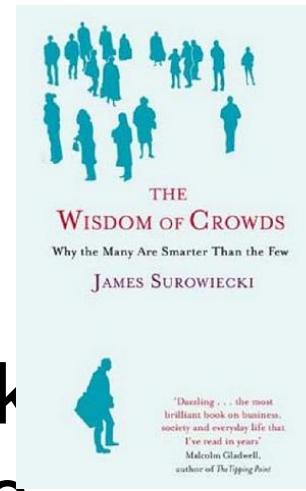


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So what does this tell us?



Wisdom of Crowds



- It shows us that groups of people make excellent decisions and can select the correct alternative out of a number of options without any specific expertise.
- How could this be?



THE
WISDOM OF CROWDS

Why the Many Are Smarter Than the Few

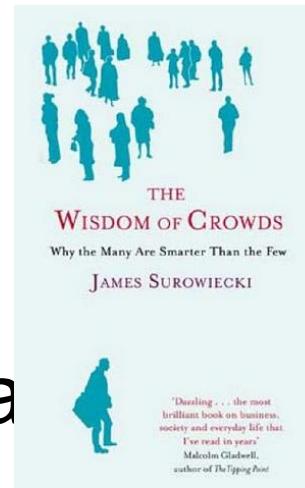
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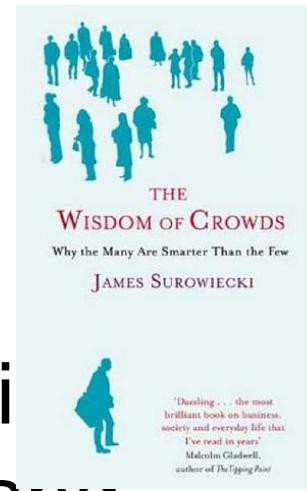
It is important to remember...

Experts are not know-it-alls



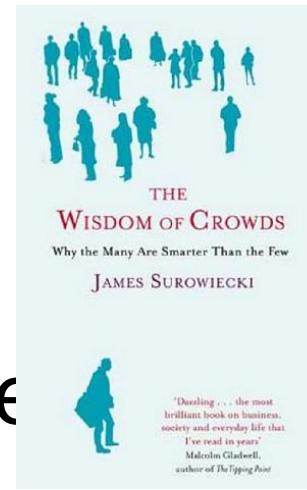
- Individual experts really aren't as smart as we think.
- Herbert Simon and W.G. Chase (1973) explored the nature of expertise in the domain of chess.

Experts are not know-it-alls



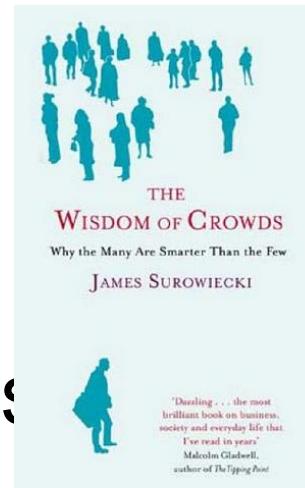
- They showed a chess-board in the middle of a game to an expert chess player and an amateur.
- They asked both to recreate the locations of all of the pieces on another boards, consistency the experts were easily able to reproduce the boards, whereas the amateur rarely could.

Experts are not know-it-alls



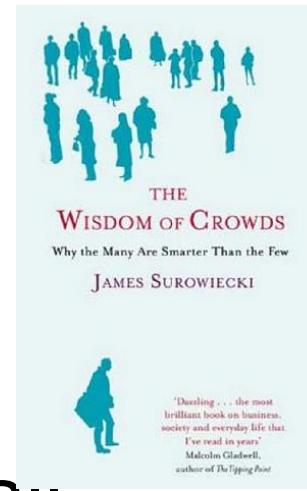
- So does this mean experts are smarter
???

Experts are not know-it-alls



- No, because when they put the pieces on the board randomly, the expert and amateur both did equally as well.
- This shows the very, very limited scope of expertise.

Experts are not know-it-alls



- We normally assume people who are intelligent at one pursuit are good at all, but in actuality this is not at all the case.
- Chase said the intelligence and expertise is, in fact, “*spectacularly narrow*”



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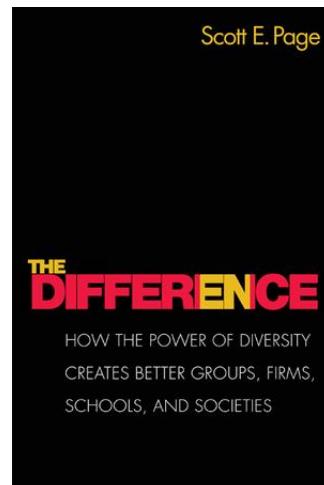
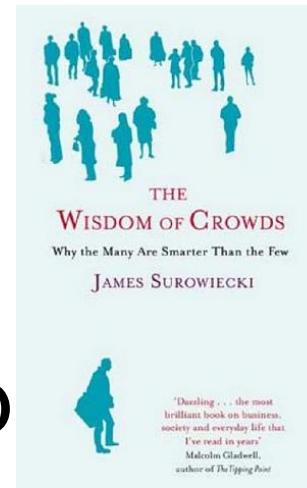


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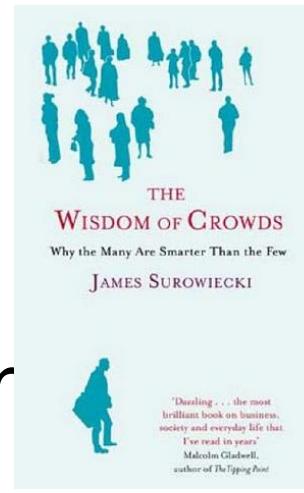
A key point is...

Diversity

- Scott Page has shown that groups who display a range of perspectives outperform groups of like-minded experts.



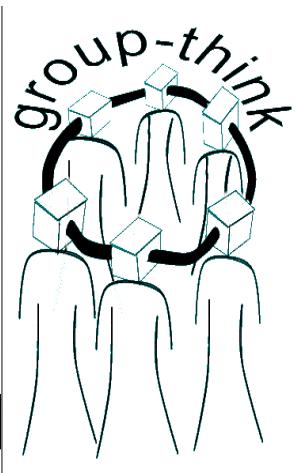
Diversity

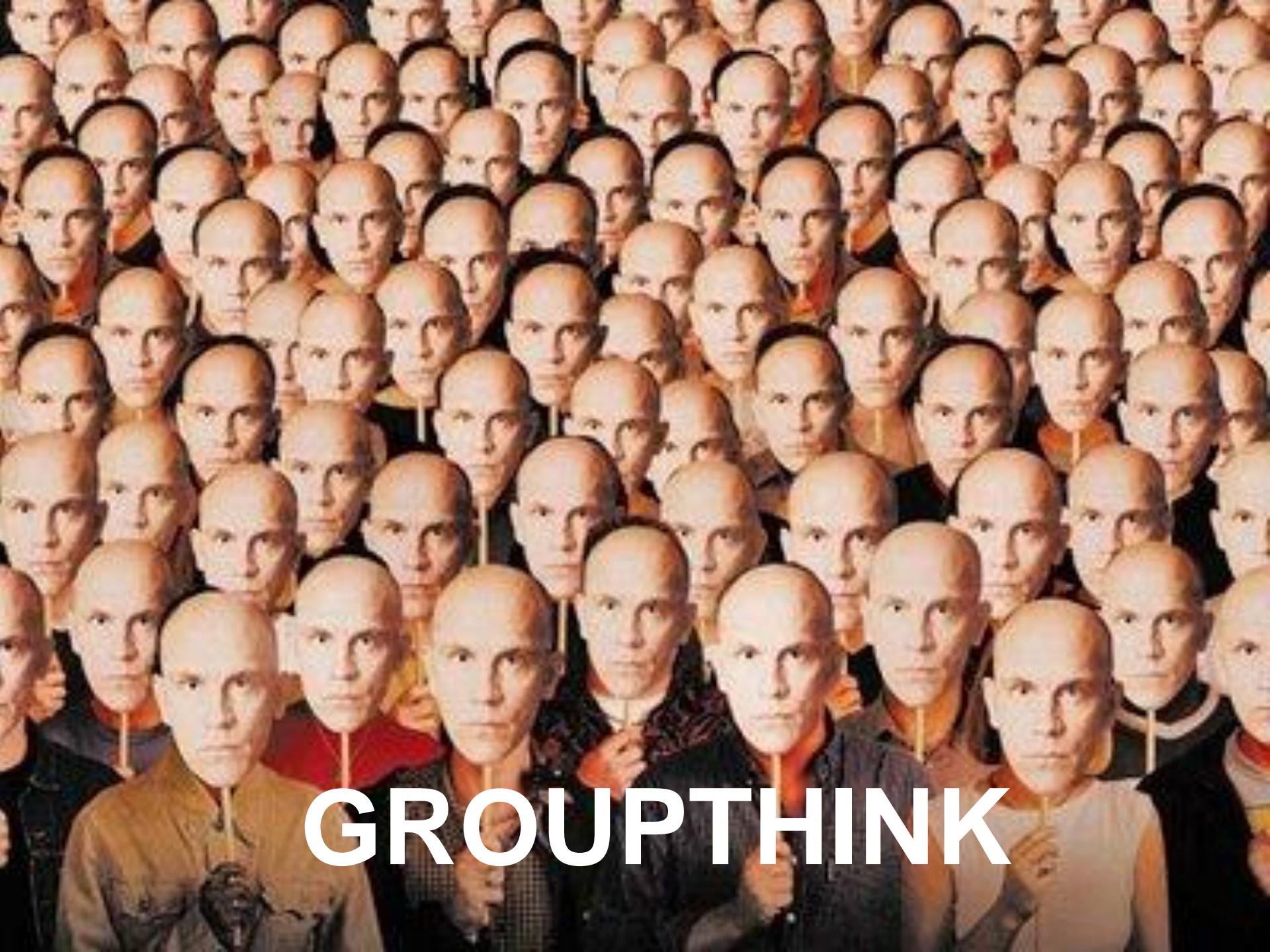


- Diversity yields superior outcomes, as Page demonstrates this in a range of ways.
- Page suggests that difference beats out homogeneity, whether you're talking about citizens in a democracy or scientists in the laboratory.
- Diversity gives you a larger range of opinions to select from.

Diversity

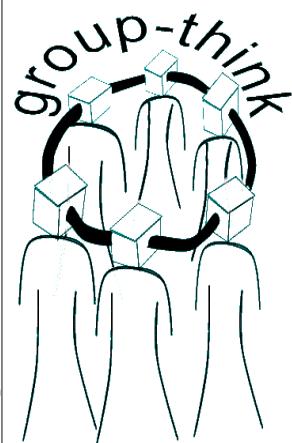
- If we don't have diversity in our groups we end up with **GROUPTHINK**.



A dense, repeating pattern of numerous identical, featureless faces, each mounted on a thin stick. The faces are arranged in a grid-like fashion, filling the entire frame. The lighting is uniform, highlighting the texture of the faces and the sticks.

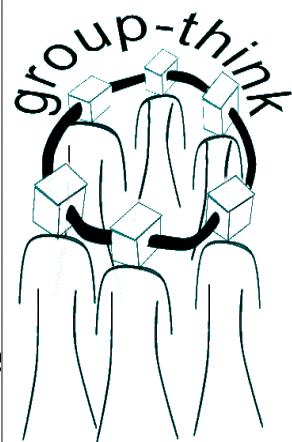
GROUPTHINK

GroupThink



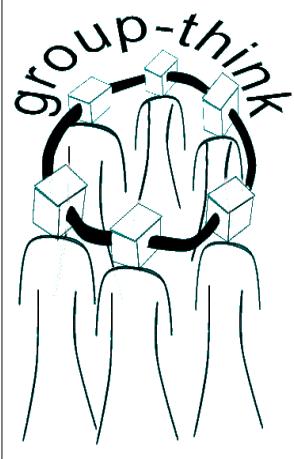
- Groupthink occurs when a group makes faulty decisions because group pressures lead to a deterioration of "*mental efficiency, reality testing, and moral judgment*" (Irving Janis, 1972, p. 9).

GroupThink



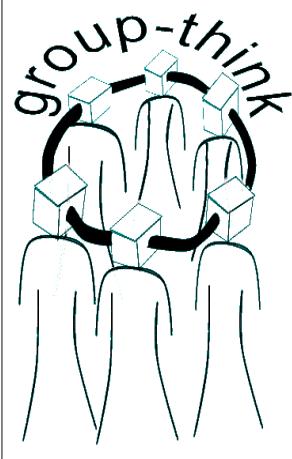
- The key factor that causes Groupthink is when the group is homogeneous.
- If all members think and act the same this can lead to groupthink, as can be seen in highly regulated organisations like the army.
- To harness the power of the wisdom of crowds you really need diversity, the nay-sayers, the moaners and complainers, and the crazy optimists, the fools, the happy-go-luckies – you need the whole mix.

Consequences of GroupThink



- Pearl Harbour
- The Bay of Pigs
- Failed Rescue Attempt of Hostages at US Embassy in Iran
- US Invasion of Iraq

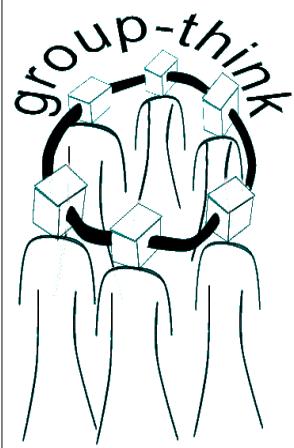
Symptoms of GroupThink



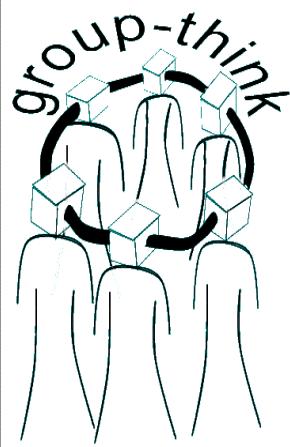
- Illusion of invulnerability: Creates excessive optimism that encourages taking extreme risks.
- Collective rationalization: Members discount warnings and do not reconsider their assumptions.
- Belief in inherent morality: Members believe in the rightness of their cause and therefore ignore the ethical or moral consequences of their decisions.
- Stereotyped views of out-groups: Negative views of “enemy” make effective responses to conflict seem unnecessary

Continued ->

Symptoms of GroupThink



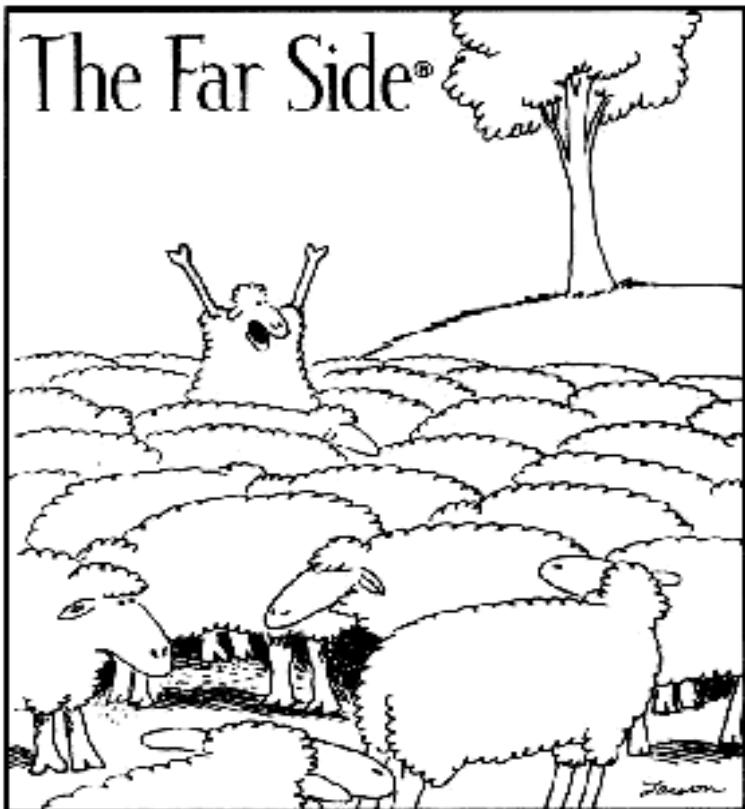
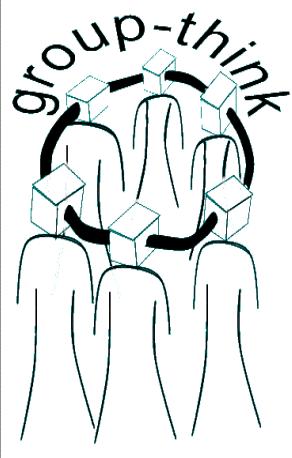
- Direct pressure on dissenters: Members are under pressure to express arguments against any of the group's views.
- Self-censorship: Doubts and deviations from the perceived group consensus are not expressed
- Illusion of unanimity: The majority view and judgments are assumed to be unanimous.
- Self-appointed 'mindguards': Members protect the group and the leader from information that is problematic or contradictory to the group's cohesiveness, view, and/or decisions



Signs of GroupThink

- Incomplete survey of alternatives
- Failure to examine risks of preferred choices.
- Poor information search.
- Selective bias in processing information at hand.
- Failure to work out contingency plans.

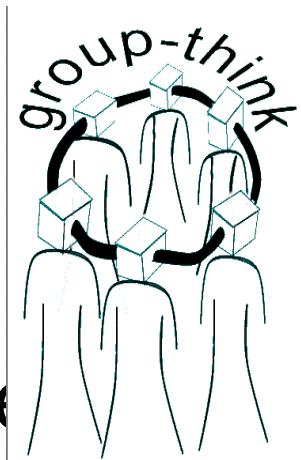
What can we do ?



"Wait! Wait! Listen to me! ...
We don't *have* to be just sheep!"

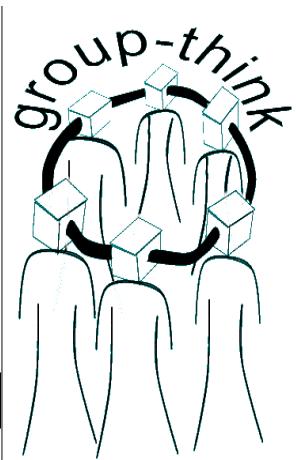
What can we do ?

- The manager/leader should assign the role of critical evaluator to each member of the crowd



What can we do ?

- The manager/leader should avoid stating preferences and expectations at the outset



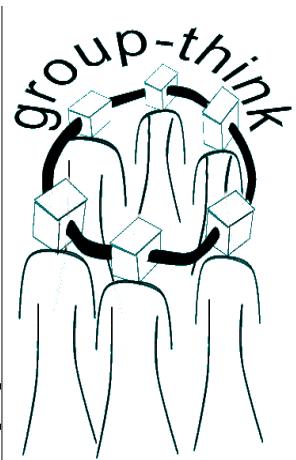
What can we do ?

- Each member of the group should routinely discuss the groups' deliberations with a trusted associate and report back to the group on the associate's reactions



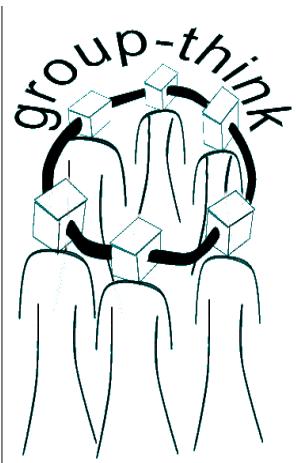
What can we do ?

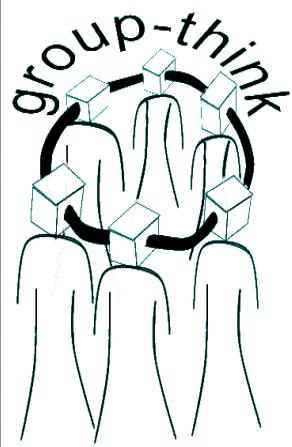
- One or more experts should be invited each meeting on a staggered basis and encouraged to challenge views of the members



What can we do ?

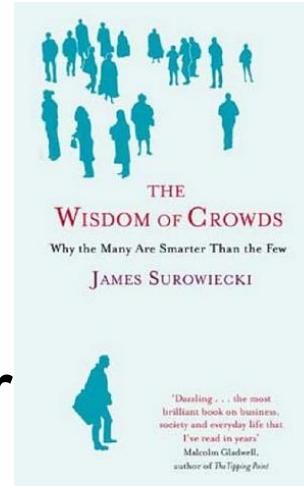
- At least one member should be given role of devil's advocate (to question assumptions and plans)





What can we do ?

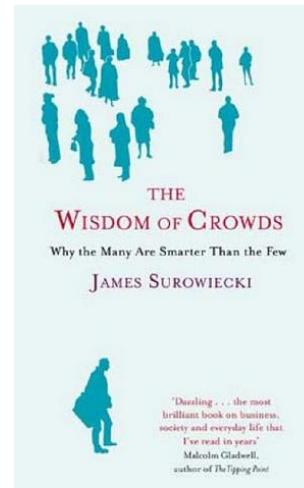
- The manager/leader should make sure that a sizeable block of time is set aside to survey warning signals.



Diversity (recap)

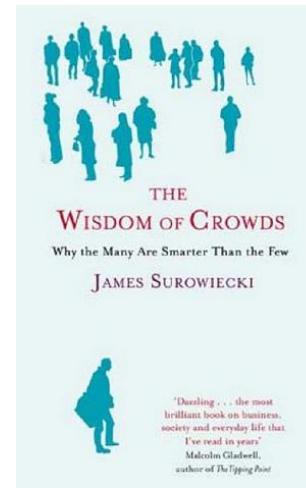
- It not only contributes by adding different perspectives to the group but also by making it easier for individuals to say what they really think.

Good Crowd For Wisdom



- Diversity of Participants
- Independence of Opinion
- De-Centralised Organisation

Good Crowd For Wisdom



Independence: The various guesses have to be independent of one another. That is, each person must guess without the knowledge of what other people have guessed.

Diversity: It is important to have a diverse set of guesses. In the guess the weight of the ox example, the people making the guesses ranged from farmers, butchers, livestock experts, housewives etc. That is, some people would be considered experts, while others would be considered as people with just a passing interest.

Decentralisation: The people making the guesses should be able to draw on their private, local knowledge.

Aggregation: There must be some way of aggregating the guesses into a single collective guess. In the guess the weight of the ox example, this was done by taking the average guess. This is a common method, but others may also be used.





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Decision Analysis

Framing a Decision - Metadecision

PB Venkataraman
Mechanical Engineering Department

Decision Making Process

Where do you spend most of your time?



Foot Note of previous Slide

- Decision making involves the following processes, meta-decision, framing the problem, identification of alternatives, data collection, reasoning and deciding. A good decision maker will spend most of her time in the first three processes, which will reduce the efforts in the rest of the processes. Where do you and your team spend most of the time?

Meta-Decision



Don't judge too quickly :P

What is the issue about?

What is its gravity?

Should we decide NOW?

Should I decide?

Is it 'Risk' or 'Uncertainty'?

Which process challenges?

Do we need external help?

How will a leader decide?

Foot Note

- ‘Plunging-in’ is the most common practice we have. As soon as a situation is posed to us, we get into judging or jumping into conclusions. We have solutions seeking problems. Meta-decision, is an essential part even before we get into the decision making process. It is about asking certain basic questions on the decision making itself. What is the crux of the problem? What is the gravity of the situation? Is there a necessity to take decision? Should I decide, or should I just be an enabler? When should the decision be taken? Is it an ‘uncertainty scenario’ or a ‘risk scenario’? Which process in the decision making going to be a challenge? Should we seek an external help? How will an expert decide in the given situation? These are all the questions that need to be answered even before entertaining the decision making process. It is a good idea to use the checklist either physically or mentally at this stage. A young executive was performing well in his role hence was promoted to the Team-Leader position. Whenever an issue was reported to him, he would propose a solution instantly. Initially the team felt supported but as the days progressed people started leaving the organization. The exit interviews revealed that the members found the job less challenging and hence uninteresting. The strong tendency of the team leader to jump into the role of decision making deprived the members, the challenge of handling problems. When you hire a driver, allow him to drive. Don’t be a back-seat driver.

Answer the Questions

- Why organic food is expensive?
- You are in a flight which has landed in HAL airport because the BIAL is crowded. Airhostess announces that you can't alight here and need to wait for further information. What is your decision?
- You are in your seat and the phone on the next desk rings. As a courtesy you attend the call because your colleague is not in seat. The caller asks for some information about your company, which you can answer. What is your choice?
- Your friend seeks your advice on her higher studies. How will you decide?
- Purchasing an automobile is a decision or meta-decision?
- Identify the nature of these as 'risk' or 'uncertainty':
 - Gambling
 - Stock market
 - Mutual fund
 - Fixed deposit

END OF SLIDE



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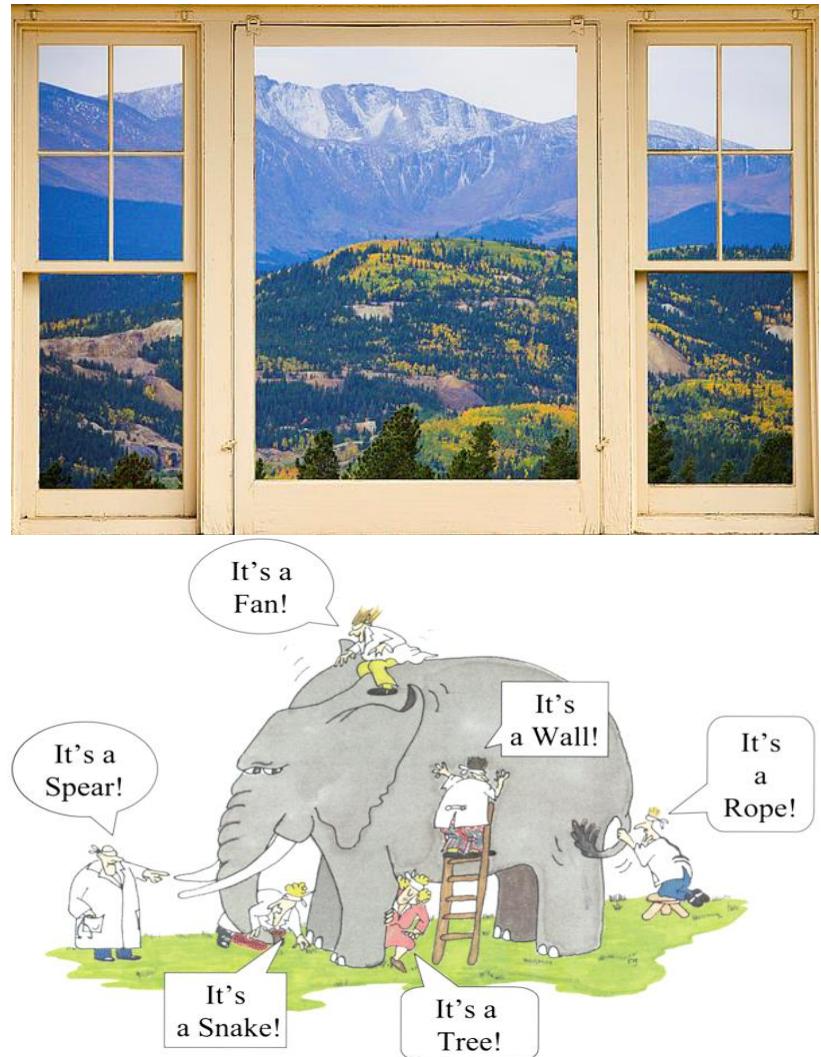
Decision Analysis

Framing a Decision – Creating a Winning Frame

PB Venkataraman
Mechanical Engineering Department

Framing

- Framing is the process of structuring a problem.
- Framing simplifies a complex issue.
- It sets boundaries to the view.
- Some things are seen and some obscured.
- No single frame can capture all.
- To gain a perspective view the issue from more than one frame.
- Team can enable ‘framing’ substantially.



- **Framing** is the process of structuring a problem. The analogy of window frame explains decision frame well. Architects choose where to put windows to give a desired view. But no single window can reveal the entire panorama. Framing of the decision essentially simplifies a complex problem by setting boundaries; it controls what is in and what is out. Our frames tend to focus us on certain things while leaving others obscured. No single frame can capture the entire problem. This is one reason why it is essential to create multiple frames to address one complex problem. In a more common language we call this as ‘gaining perspective’. It is easier to gain this perspective when attempted as a team. Remember the famous blind men figuring out an elephant?

Why Frame?

- Framing enables shared understanding.
- Well framed problem is almost solved.
- Data and analysis cannot compensate for ill-frame.
- A manager's most demanding job is to select and manage the process of framing.

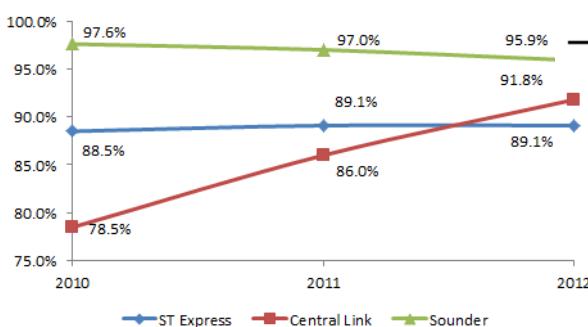
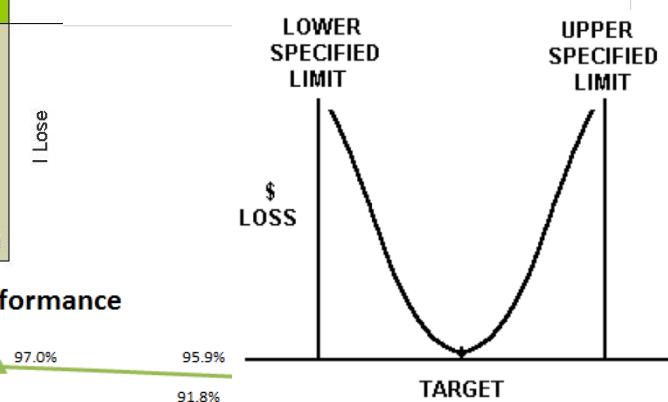
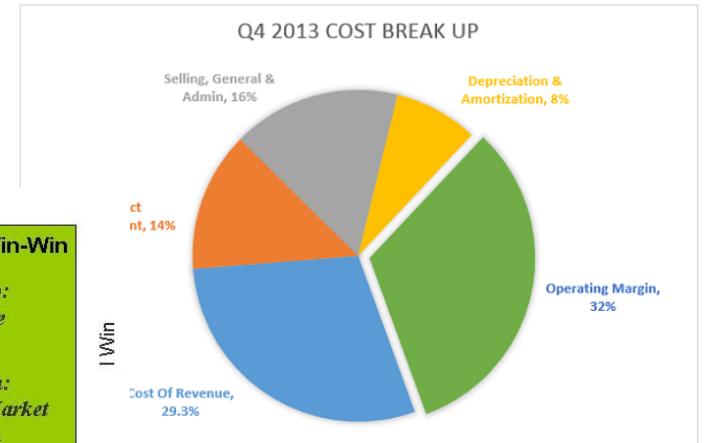


The valve we shipped two days back to France for ASME testing was not as per the current drawing. Our QA noticed it last evening while compiling inspection pack. It cannot proceed to lab test as it is. How do we meet the test date without reschedule? It is a mission critical project for France.

- A well framed problem statement enables shared understanding and automates the decision making process. No amount of data and reasoning can better an ill-conceived frame. It is like, looking for a lost ring in a bright spot because it is well illuminated. A successful leader's most demanding job is to create, select, and manage the process by which the company selects 'winning frames'.

A Winning Frame

- Is defined by **Boundaries, Reference points & Yardstick.**
- Boundaries:
 - What is included?
 - What is excluded?
 - Why is it excluded?
- Reference Points:
 - Vantage points
 - Comparisons
- Yardstick:
 - Measure of performance
 - Aim for a target value
 - Avoid ratio / percentages



Foot Note of previous Slide

- A winning frame is defined by its boundaries, reference points and yardsticks. The **boundaries** of a frame are limited by the authority of the decision maker. For example, a project on cost reduction handled by the operations team is limited to controlling ‘operating expenses’. The boundaries cannot extend to financial cost reduction. **Reference points** are vantage points from which we frame the problem. Cost reduction from a buyer’s reference point is a saving, whereas from the supplier’s reference, it is profit erosion. Win-win solutions are obtained when problems are framed with multiple reference points. A compromising reference is not a win-win solution. Alternatively stated, a reference point can be a point of comparison. While deciding the fair price, you may choose to compare it against a known brand. A **yardstick** is the one with which we evaluate the success of our decision outcome. Many organizations intending to improve customer satisfaction use ‘on-time performance’ as their yardstick. They also create complex computations to express on-time performance. The fundamental compromise here is, creating a negative yardstick to measure a positive performance. Such a yardstick necessarily assumes a ‘not-on-time performance’, hence the problem stays unsolved. Selecting the yardstick using a relative measure such as percentage is a mistake. Every performance has an absolute target value. Any deviation from this is an error. Evaluating the performance using this absolute measure is the appropriate method. Quality loss function by Taguchi is built upon this principle.

Metaphor as a Frame



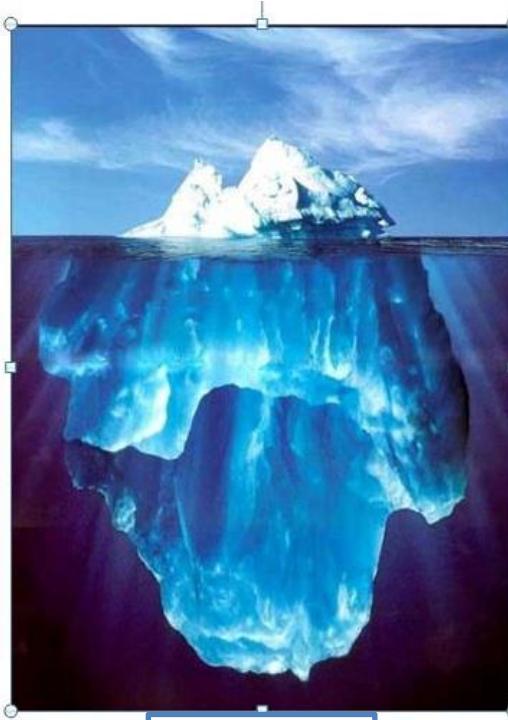
Theory of Automobile Evolution (Honda City)



Strategy

Genetic Algorithms

By Chhavi Kashyap



Inventory



Takt

Foot Note of Previous Slide

- In complex situations where it is difficult to objectively state the problem, metaphor is used. Here is a classic example of metaphorical problem definition by Honda when they decided to design a new car grounds-up. Honda top management charged the team with two—and only two—instructions: first, to come up with a product concept fundamentally different from anything the company had ever done before; and second, to make a car that was inexpensive but not cheap. Project team leader Hiroo Watanabe coined a slogan to express his sense of the team's ambitious challenge: Theory of Automobile Evolution. The phrase described an ideal. In effect, it posed the question, If the automobile were an organism, how should it evolve? As team members argued and discussed what Watanabe's slogan might possibly mean, they came up with an answer in the form of yet another slogan: "man-maximum, machine-minimum." This captured the team's belief that the ideal car should somehow transcend the traditional human-machine relationship. The other popular metaphoric frames are 'military metaphor' for strategy problems, 'family metaphor' for human resources problems, 'sports metaphor' for internal competition etc.

A Good Frame

1. States the issue objectively like a research paper.
 2. Describes how the issue came to be noticed.
 3. Pronounces how the issue impacts the business or individual.
-
- A good frame will directly or indirectly:
 - State the issue objectively like a research paper.
 - Describe how the issue came to be noticed.
 - Pronounce how the issue impacts the business or individual.

Nine Common Mistakes in Framing

1. Proposing solutions even before framing the problem.
Have to achieve...
2. Listing the causes as problems. *Because of the...*
3. Stating wishful intents as the frame. *I have to balance...*
4. Stating something that is not in our control. *Due to customer...*
5. Not being objective.
6. Stating objectives as the problem.
7. Lack of perspective.
8. Being emotional.
9. Influenced by bias.

Foot Note

- Some common mistakes while framing a problem are:
- Proposing solutions even before framing the problem. *Have to achieve...*
- Listing the causes as problems. *Because of the...*
- Stating wishful intents as the frame. *I have to balance...*
- Stating something that is not in our control. *Due to customer...*
- Not being objective.
- Stating objectives as the problem.
- Lack of perspective.
- Being emotional.
- Influenced by bias.
- Identify the mistakes in the following problem statement if any.

Identify the Mistakes (if any)

- I joined a new Organization as a “----” and I was not satisfied with the Job profile or with the Work environment either. I was under immense stress since I moved my base to a new city where the Organization was located along with my family.
- There is serious customer dissatisfaction on the deliverables made by the company. The situation is critical and the customer is threatening to withdraw from the company.
- Overshooting of Transport Budget. Actual cost of the Transport department is exceeding the allotted budget by 15 % for last 7 months. This is a overhead for the company and needs to be minimized.
- Compression test results shall meet average compressive strength results of y N/Sq.mm out of samples made in n sets. But, it was observed during last month that test results got failed in one of the n sets of casted cubes. The problem to note is that “How cubes were casted and why one set got failed?”.

Frame Analysis Worksheet

1. The issue the frame addresses. (Crux)
2. What aspects of the situation I leave out of consideration? (Scope)
3. What yardsticks I use to measure the success? (MoP)
4. What reference points I use to measure success? (Benchmark)
5. What metaphors I use while thinking about the issue?
6. Why do I think the way I do? (Assumptions)
7. What does the frame achieve? (Objective)
8. Can I summarize my frame as a slogan? (Problem statement)

Foot Note of Previous Slide

- Frame Analysis Worksheet, is a simple tool to create winning frames. Have a look at the updated sheet, which will help you creating a winning frame. While answering each of the questions in the worksheet challenge your assumptions. For example, if the framing is about getting an automobile and you have considered ‘leasing’ as out of boundary, challenge this assumption. Apart from you updating the sheet get it updated by the other team members and even adversaries to get a perspective. Try to think with an analogy. Nature, health, culinary, sports, army, cosmology are some of the analogies. Do you know, breakthrough improvements were achieved when the knowledge from a domain is applied to a completely different domain? Game theory is math in behavioural biology; genetic algorithm is evolutionary biology in software.

Frame Analysis Worksheet Updated

1. The issue the frame addresses. (Crux) – Personal vehicle.
2. What aspects of the situation I leave out of consideration? (Scope) – Leasing, pre-owned, loans, old models (before 2012), diesel.
3. What yardsticks I use to measure the success? (MoP) – Mileage, comfort, cost.
4. What reference points I use to measure success? (Benchmark) – Better than 17kmpl, driving comfort as Santro, rear seat space as Sunny, parking ease as Tata Nano.
5. What metaphors I use while thinking about the issue? Swimming
6. Why do I think the way I do? (Assumptions) – Leasing is expensive, pre-owned vehicle breaks-down, loans are a pain, old models don't resell.
7. What does the frame achieve? (Objective) – An independent and comfortable mode of transport.
8. Can I summarize my frame as a slogan? (Problem statement) – Comfortable, affordable car.

END OF LECTURE



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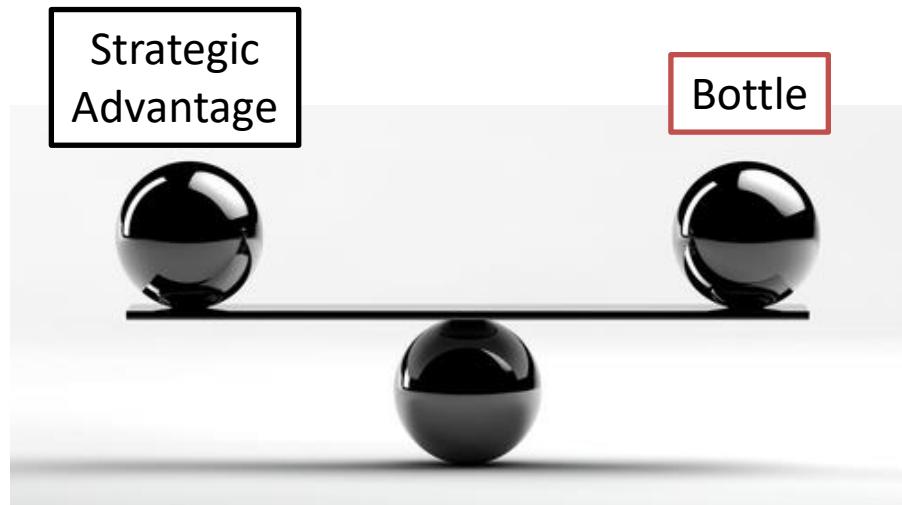
Decision Analysis

Alternatives

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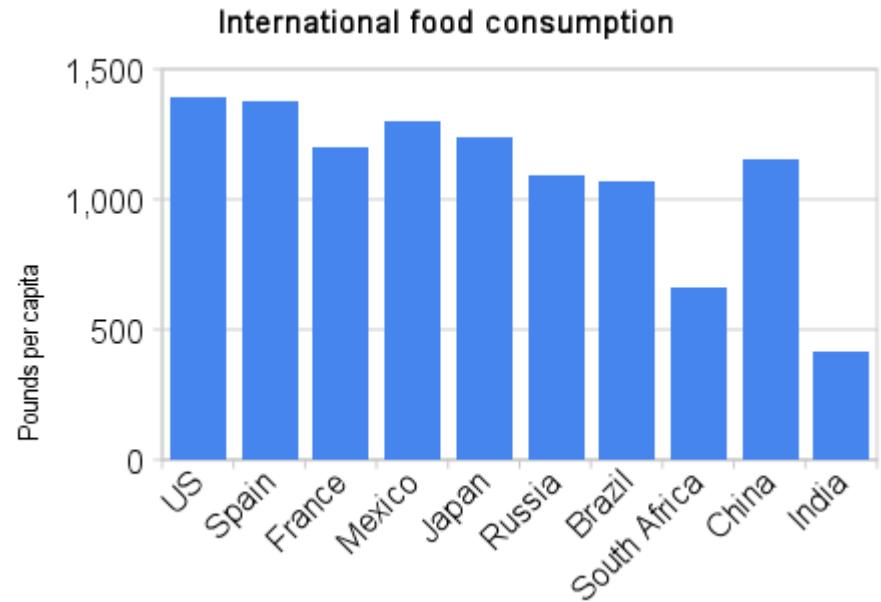
The Starting Point



Foot note of last slide

- PepsiCola executives believed for many years that Coca-Cola's distinctive, hourglass-shaped bottle was "Coke's most important competitive advantage." Pepsi-Cola executives had plunged into a series of efforts to compete with Coke's bottle. They approached packaging, within the competitor's framework. They spent millions of dollars and many years studying new bottle designs. John Sculley, the Vice President of PepsiCo asked the question differently. "What the customer really wanted?" Sculley realized that the company simply didn't know enough about consumers to determine what they really wanted.

The End



Less you order less your consumption

More you order more your consumption

Make customers order more

Make packages to contain more

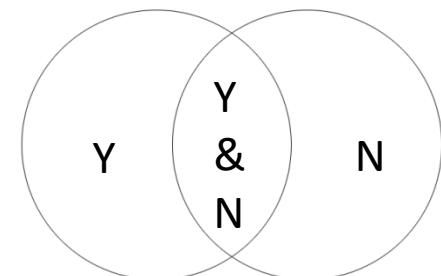
Foot Note of last slide

- So he created an opportunity to learn from a kind of feedback the company had never used before: He launched a careful test to study how families actually consumed Pepsi and other soft drinks in their homes. The company allowed 350 families to order soft drinks weekly in whatever quantity they wanted at discount prices. "To our astonishment," Sculley recalls, "we discovered that no matter how much Pepsi they ordered, they would always consume it." Sculley had discovered what all marketers now recognize as a key fact about snack foods – however much you can persuade people to buy, that's how much they'll eat. It dawned to PepsiCo that what they needed to do was design packages that made it easier for people to get more soft drinks into the home. The results were dramatic. Coca-Cola couldn't convert its famed hourglass silhouette bottle into a larger container. Pepsi's market share expanded dramatically. Indeed, Pepsi drove the long unassailable "Coke bottle" into extinction in the U.S. market. Today Pepsi-Cola is fiercely competitive in U.S. supermarkets with Coke. What went wrong in the beginning and what was corrected?

Alternatives

- Good decisions always emerge from a set of feasible alternatives.
- Alternatives are a range for feasible alternatives, not just ‘yes’ or ‘no’ choices.
- Decision makers should always seek alternatives.
- Creative and doable alternatives are preconditions for any decision.
- If there are no alternatives, there is no decision.

Y/N



Brainstorming

- Be neutral if you are leading the session.
- Don't qualify any idea as good or bad. Statements like, "That's not a feasible idea though I will add it in the list for now", are idea killers.
- Encourage all to participate, particularly the introverts.
- Manage session-hijackers.
- Include outsiders and novices.

Tips for Generating Alternatives

- Invite outsiders and novices to participate in brainstorming sessions.
- Create a diverse team.
- Break protocols. Adopt a ‘equals-seating’.
- Encourage playful behavior.
- Conduct external benchmarking.
- Think out of box.
- List all natural alternatives first – write them on a board – ask the team members to identify alternatives that are not listed in the board.

Tips for Generating Alternatives



- Role play as other functional heads.
- Learn to consider conflicting views.
- Revisit abandoned alternatives time to time. Remember the chained elephant.
- Actively consider hybrid alternatives.
- Ask each member to prepare their own list before sharing them.
- At the end of the session aggregate the ideas into common buckets.
- When discussing alternatives, ask each team / person to argue for the opponent.
- Conflicts are good, encourage them and turn them into positive energy.
- If the discussion is getting sensitive, consider adjourning the meeting.
- Enforce a group behavior and set some clear ground rules.

Group Norms

- Every group members should show respect for others.
- Everyone should make a commitment to active listening.
- Everyone has a right to disagree and an obligation to challenge others' assumptions.
- Everyone will have an opportunity to speak.
- Conflicting views are an important source of learning.
- Ideas and assumptions can be attacked but not the individuals.
- Calculated risk taking is good. Remember 3M style. The person opposing an idea has the obligation to prove he is right.
- Failures should be acknowledged and examined for their lessons.
- Playful attitudes are welcomed.
- Successes will be celebrated as a group.

Qualities of Good Alternatives

- They are broadly constructed and not simply minor variations of another concept.
- They are genuine alternatives that do not exist for making another alternative appear superior.
- They are feasible.
- They are sufficiently numerous however, not infinitely varied.

Review your recent decision based on the above learning. Did you generate alternatives that met these standards?

END OF LECTURE



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Decision Analysis

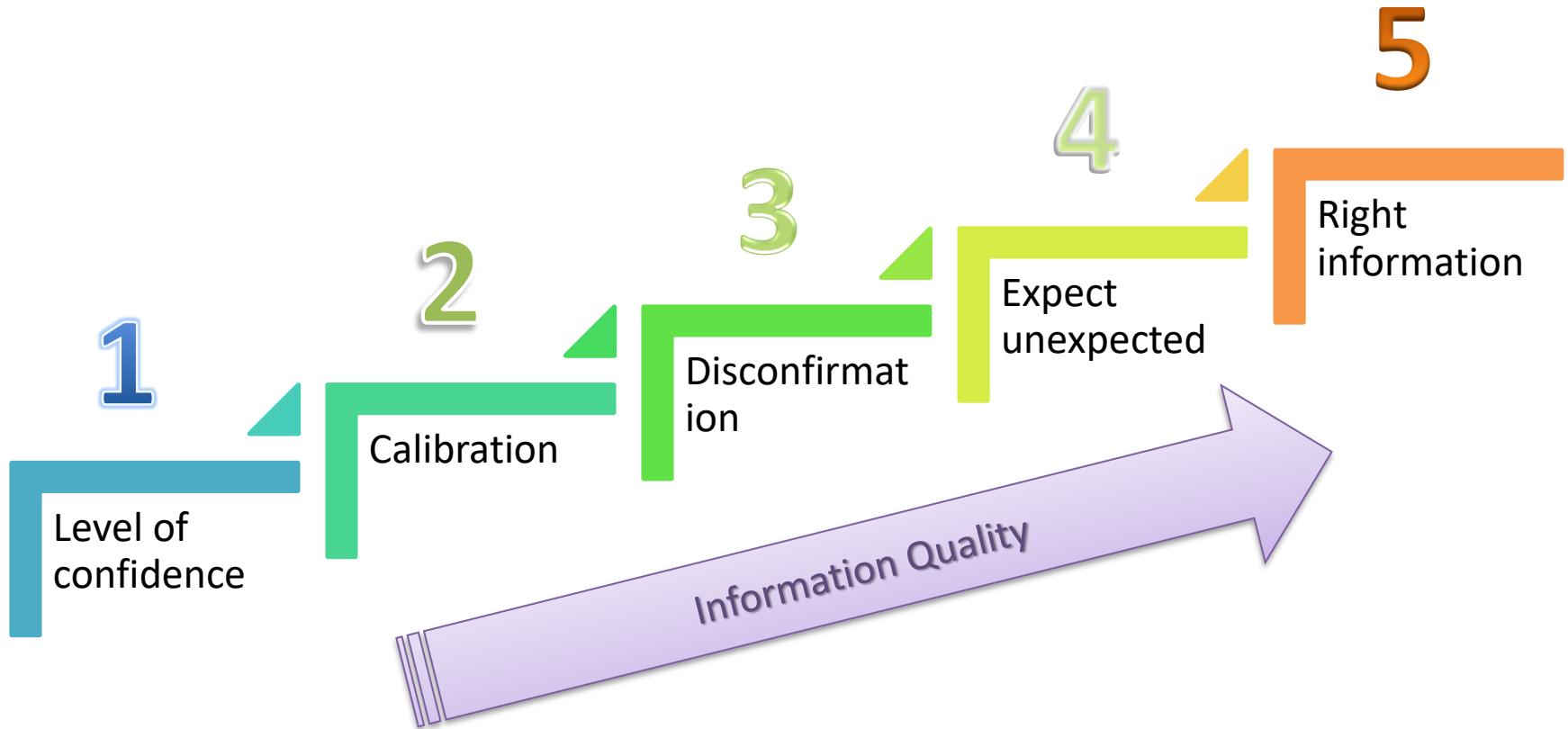
Gathering Information – Smart Information

PB Venkataraman
Mechanical Engineering Department

Traps in Information Gathering

Shortcuts – Relying inappropriately on ‘rules of thumb’ such as *‘implicitly trusting’* the most readily *‘available’* information or *‘anchoring’* too much on convenient facts.

Smart Information



Answer the following:

Give your best estimate. Do not Google

1. Mother Teresa's age at death	
2. Number of states in India	
3. Diameter of the moon in kilometres	
4. Weight of an empty Boeing 747 in kg	
5. Gestation period of an Asian elephant in days	
6. Year in which Abdul Kalam was born	
7. Number of chapters in Bhagavad Gita / Bible / Quran	
8. Will it snow tomorrow in Hawaii?	

Level of Confidence

- What is your estimate?
- What is the range?
- What is your level of confidence?
- How can we improve the level of confidence or narrow the range?
- What is the probabilistic distribution the metric follows?

Answer the questions again:

	Range	Confidence
1. Mother Teresa's age at death		
2. Number of states in India		
3. Diameter of the moon in kilometres		
4. Weight of an empty Boeing 747 in kg		
5. Gestation period of an Asian elephant in days		
6. Year in which Abdul Kalam was born		
7. Number of chapters in Bhagavad Gita / Bible / Quran		
8. Will it snow tomorrow in Hawaii?		

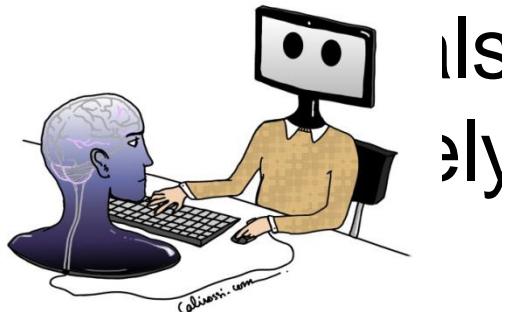
Answers:

1. Mother Teresa's age at death	87
2. Number of states in India	29
3. Diameter of the moon in kilometres	3,500
4. Weight of an empty Boeing 747 in kg	177
5. Gestation period of an Asian elephant in days	645
6. Year in which Abdul Kalam was born	1931
7. Number of chapters in Bhagavad Gita / Bible / Quran	18/1189 /114
8. Will it snow tomorrow in Hawaii?	No

Between your first set of answers and the second, which one you fared better?

Calibrate

- Provide feedback to the estimators.
- Data analytics using past data can be useful.
- This can be an effective way to calibrate against overc



Inventory Stock Taking



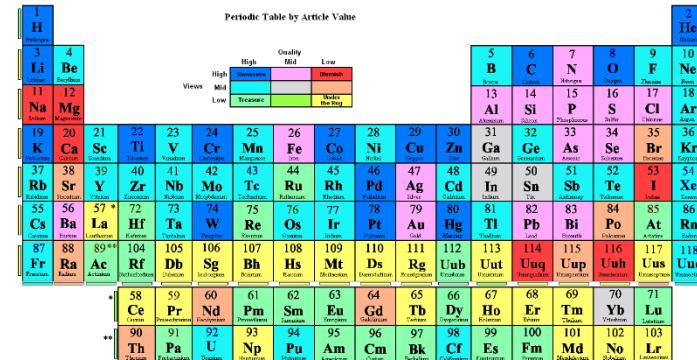
Disconfirmation

- “If I had an hour to solve a problem and my life depended on it, I would use the first 55 minutes determining the proper question to ask, for once I know the proper question, I could solve the problem in less than five minutes.”
Albert Einstein.
- Art of asking disconfirming questions that will show our initial judgement was wrong.
- Avoid asking leading / binary questions, they strengthen confirmation bias.
- ‘What’ questions are powerful to turn debate into dialogue.



Expect the Unexpected

- Availability bias prevents us from seeing the unexpected.
 - Suitable tools are:
 - Fault tree analysis, which considers all possibilities.
 - Scenario analysis that considers, best-case, worst-case and most-likely scenarios.
 - Prospective hindsight – pre-mortem* of failure. Try listing what mistakes you did in your mid-sem. Try listing what mistakes you might make in compre. List 2 will be more exhaustive than list 1

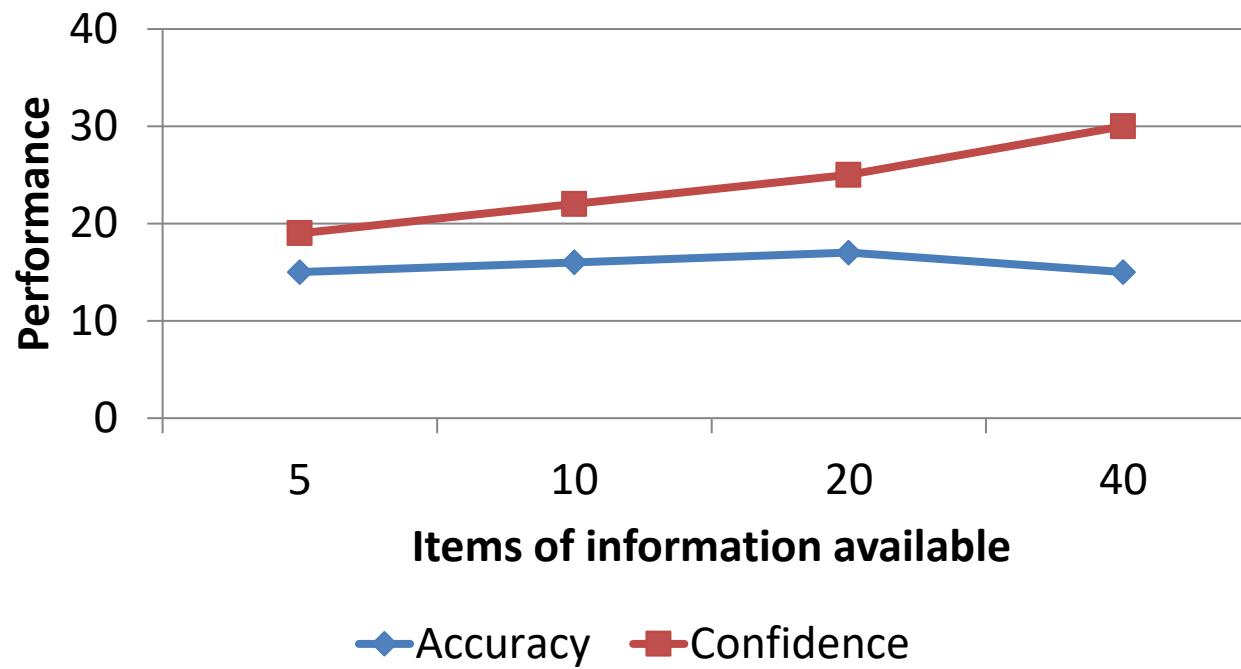


Foot Note of last Slide

- In 1888 Alfred's brother Ludvig died while visiting Cannes and a French newspaper erroneously published Alfred's obituary.^[4] It condemned him for his invention of dynamite and is said to have brought about his decision to leave a better legacy after his death.^{[4][17]} The obituary stated, *Le marchand de la mort est mort* ("The merchant of death is dead")^[4] and went on to say, "Dr. Alfred Nobel, who became rich by finding ways to kill more people faster than ever before, died yesterday."^[18] Alfred (who never had a wife or children) was disappointed with what he read and concerned with how he would be remembered.

Right Information

- Information is costly, data is not.
- More data is not more information.
- More data do not increase accuracy of estimate.



End of lecture



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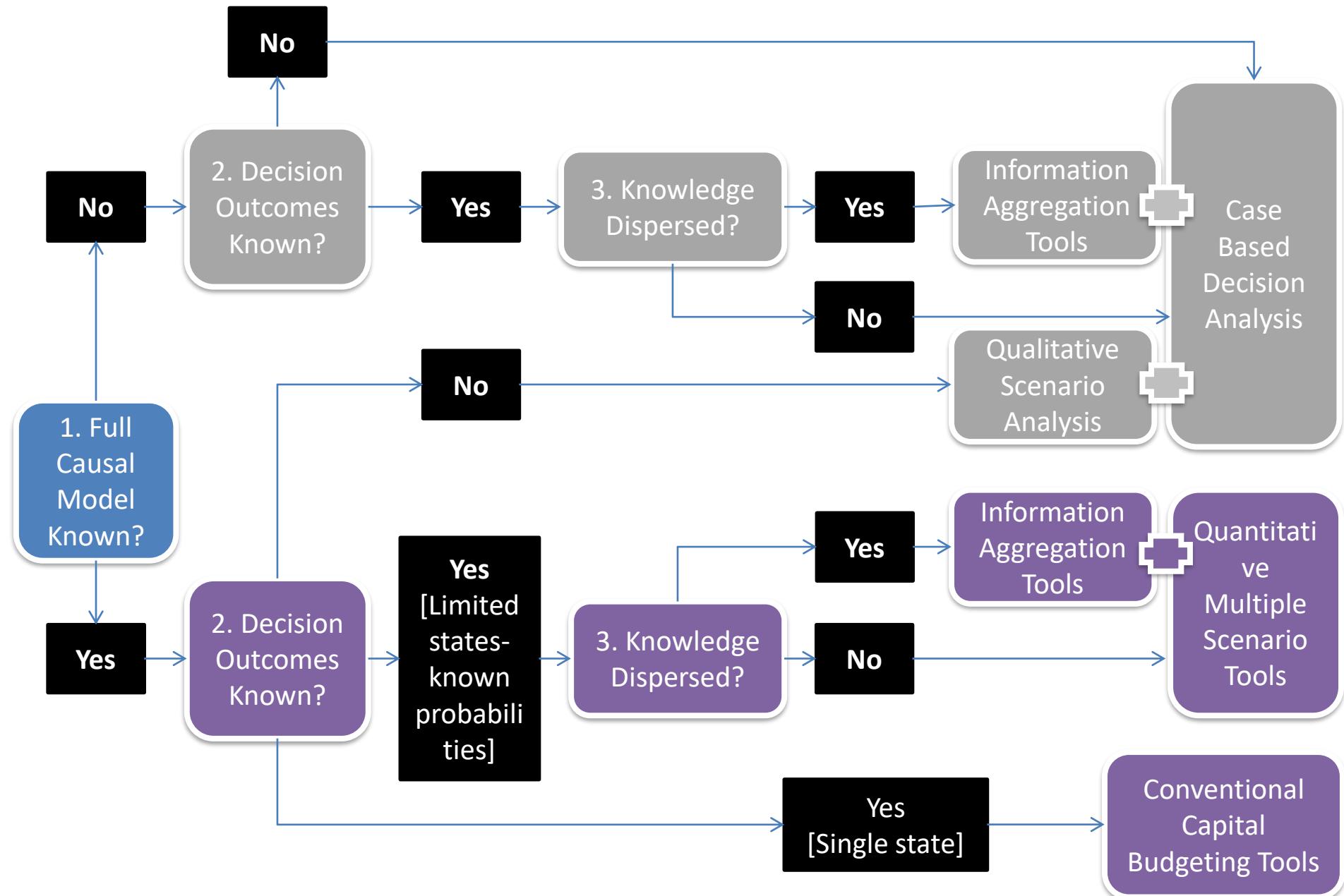
Decision Analysis

Deciding to Decide – Selecting the Right Tool

<https://hbr.org/video/2804400859001/diagnosing-your-decision>

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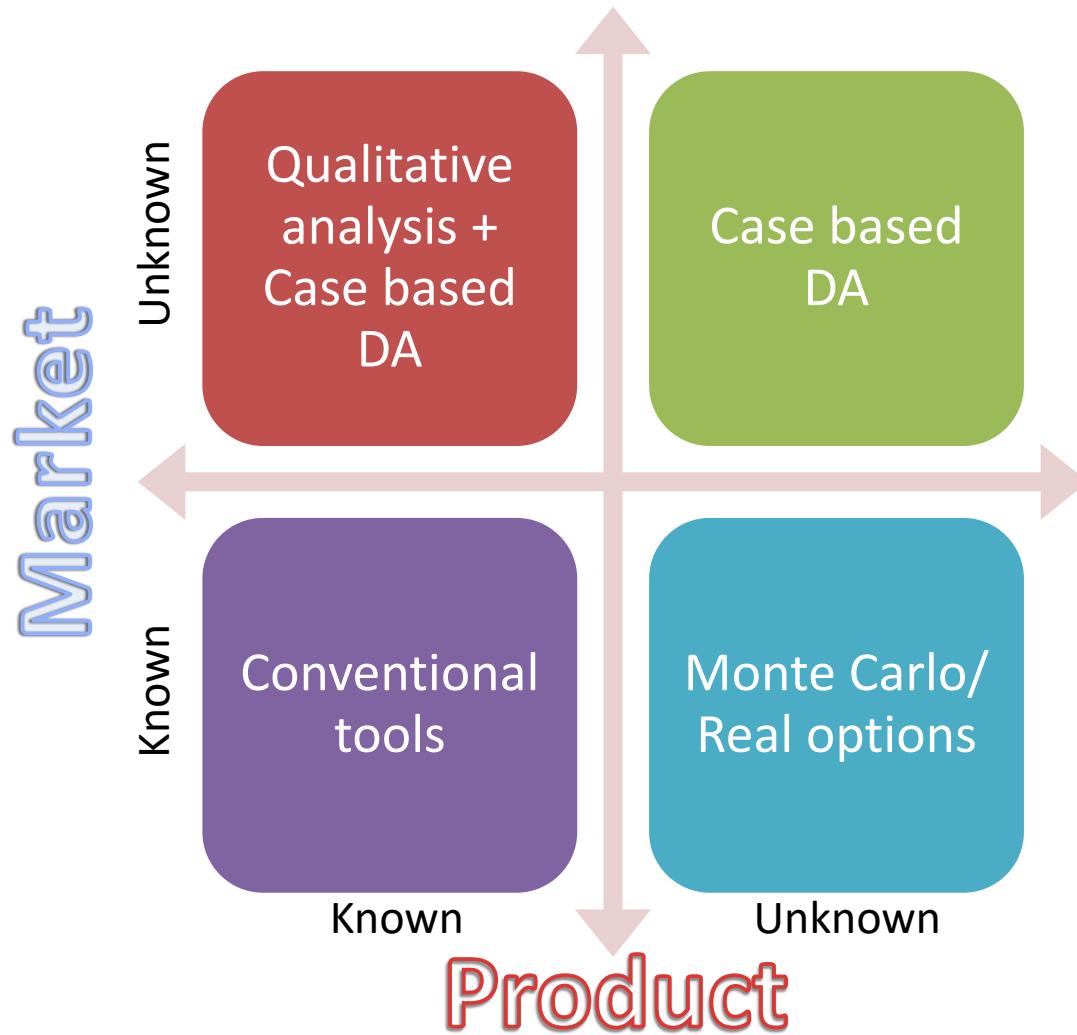
Diagnosing Your Decision



Foot Note of Previous Slide

- When choosing a decision support tool for a major investment, executives need to answer three questions: 1, Do I know what it will take to succeed? (or, Do I have a full causal model?). 2, Can I predict the range of possible outcomes? 3, Do I need to aggregate information? These answers will point to the best decision support tools. In some cases you will need just one tool; in others you will need a combination. To illustrate the point, let us look at five scenarios that executives at McDonald's might face.

Deciding to Decide Model



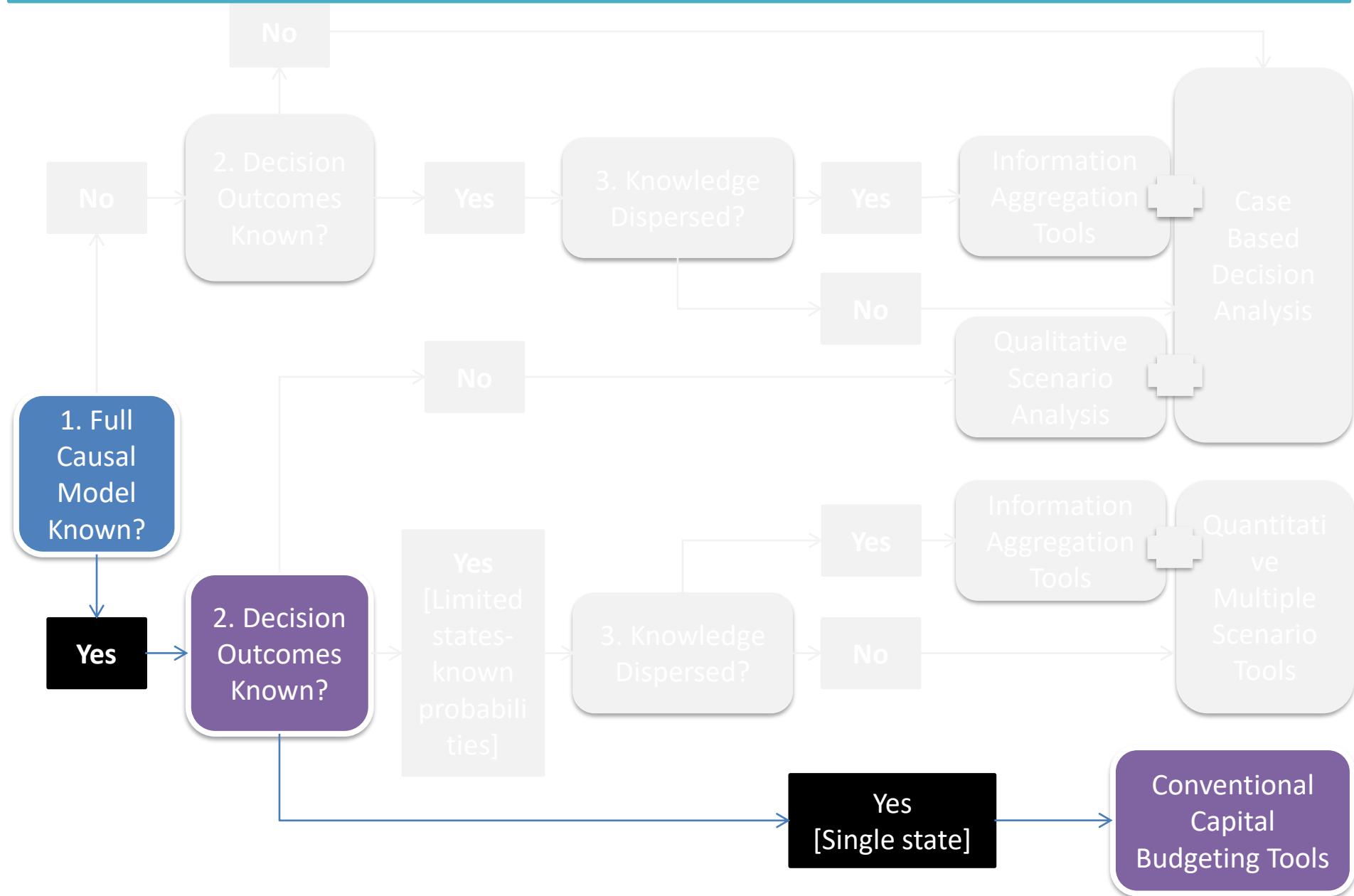
Scenario 1

- You understand your causal model and can predict the outcome of your decision with reasonable certainty
- Where to locate new U.S. restaurants? – Crux of problem.
- Cities in AL – Boundaries.
- Sales and profit – Yardsticks.
- Sales > \$Xm; Profit > \$Ym – Reference points.
- AL is a growing state – Assumptions.
- Achieving higher sales and profit through geographic expansion – Objective.
- Alternatives – All cities in AL
- Tools – Factor rating, Cost volume analysis, NPV, IRR, CoG

Foot Note

- Scenario 1: You understand your causal model and can predict the outcome of your decision with reasonable certainty
 - In our example, McDonald's executives must decide where to locate new U.S. restaurants. The company has or can get all the information it needs to be reasonably certain how a given location will perform. First, it knows the variables that matter for success: local demographics, traffic patters, real estate availability and prices, and locations of competitive outlets. Second, it has or can obtain rich data sources on those variables. And third, it has well-calibrated restaurant revenue and cost models. Together that information constitutes a causal model. Decision makers can feed the information about the traffic and other variables into standard discounted cash flow models to accurately predict (to a close-enough approximation) how the proposed location will perform and make a clear go/no-go decision.

Scenario 1: You understand your causal model and can predict the outcome of your decision with reasonable certainty – *Where to locate new U.S. restaurants?*



Foot Note

- What causes success in terms of sales and profit? Target population, spending pattern, complimenting businesses and cost of running business.
- Decision outcomes – Relationship between these variables and sales / profit.
- Tool – Conventional capital budgeting tools such as cost volume analysis, NPV, IRR etc.

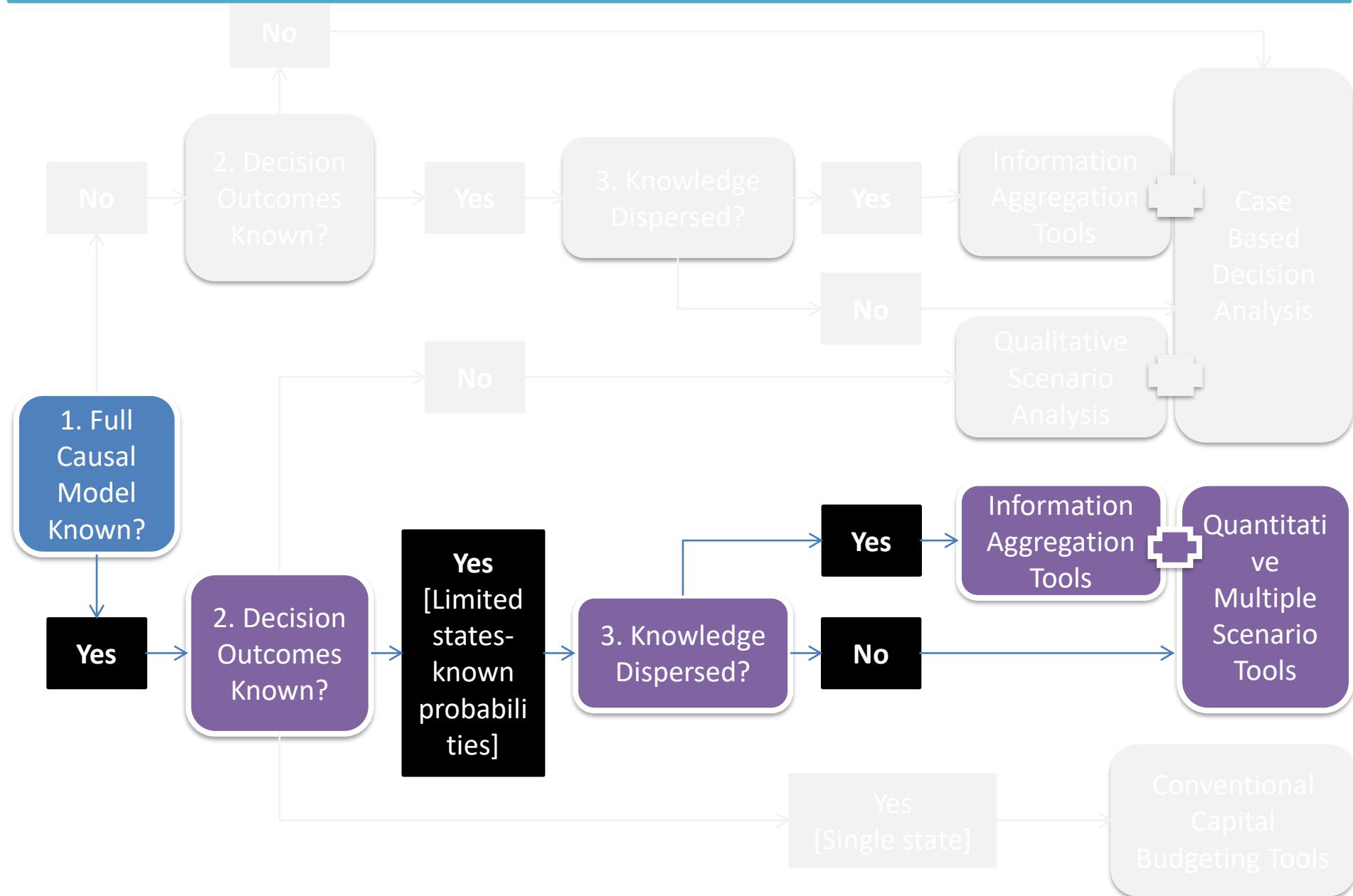
Scenario 2

- You understand your causal model and can predict a range of possible outcomes, along with probabilities for those outcomes.
- Whether to introduce a new sandwich in the U.S.
- Sandwich – Boundaries.
- Sales and profit – Yardsticks.
- Sales > \$Xm; Profit > \$Ym – Reference points.
- Sandwiches have high potential for sales and profit – Assumptions.
- Achieving higher sales and profit through new product introduction – Objective.
- Alternatives – Varieties of sandwiches.
- Tools – Monte Carlo simulation, real options valuation.

Foot Note

- You understand your causal model and can predict a range of possible outcomes, along with probabilities for those outcomes. Whether to introduce a new sandwich in the U.S. They still have a reliable way to model costs and revenues; they have relevant data about demographics, foot traffic, and so forth. In other words, they have a causal model. But there is significant uncertainty about what the outcome of introducing the sandwich will be: They don't know what the demand will be and nor do they know what impact the new product will have on sales of complementary products. However, they can predict a range of possible outcomes by using quantitative multiple scenario tools such as decision trees or a controlled launch. The trees or the actual market information could be used to calculate the expected value, variance and range of financial outcomes.

Scenario 2: You understand your causal model and can predict a range of possible outcomes, along with probabilities for those outcomes. *Introducing sandwich.*



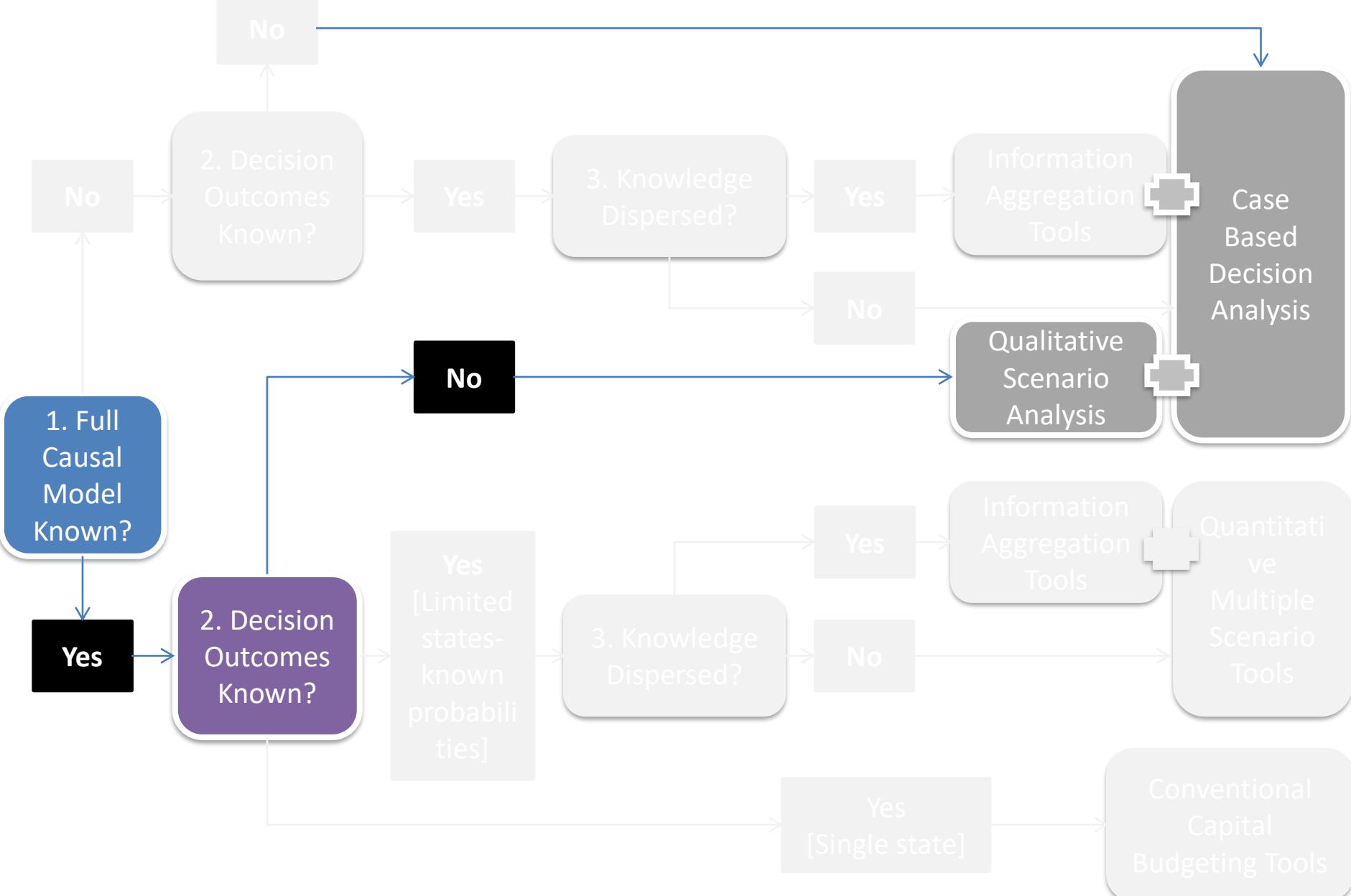
Foot Note

- What causes success in terms of sales and profit? Target population, spending pattern, complimenting businesses and cost of running business.
- Decision outcomes – Relationship between these variables and sales / profit. Outcomes are known over a range with probabilities.
- Tool – Quantitative multiple scenario tools such as Monte Carlo simulation and with information aggregation tools such as controlled launch.

Scenario 3

- You understand your causal model but cannot predict outcomes.
- Entering an emerging market – Crux of the problem.
- Emerging market say, India – Boundaries.
- Sales and profit – Yardsticks.
- Sales > \$Xm; Profit > \$Ym – Reference points.
- India has high potential for sales and profit – Assumptions.
- Achieving higher sales and profit by expanding into emerging markets – Objective.
- Alternatives – India, China, South Africa, Brazil.
- Tools – Qualitative scenario analysis supplemented with case-based decision analysis.

Scenario 3: You understand your causal model but cannot predict outcomes. Entering into emerging markets.



Qualitative Analysis Tools

<http://www.slideshare.net/tilahunigatu/qualitative-data-analysis-11895136>

- These tools inform decisions by developing a set of qualitative, representative scenarios of how the present may evolve into the future and identifying the likely consequences of the decision under consideration.
- These techniques don't assume a complete and fully specified set of possible outcomes, they are helpful to decision makers who face high level of uncertainty about outcomes.

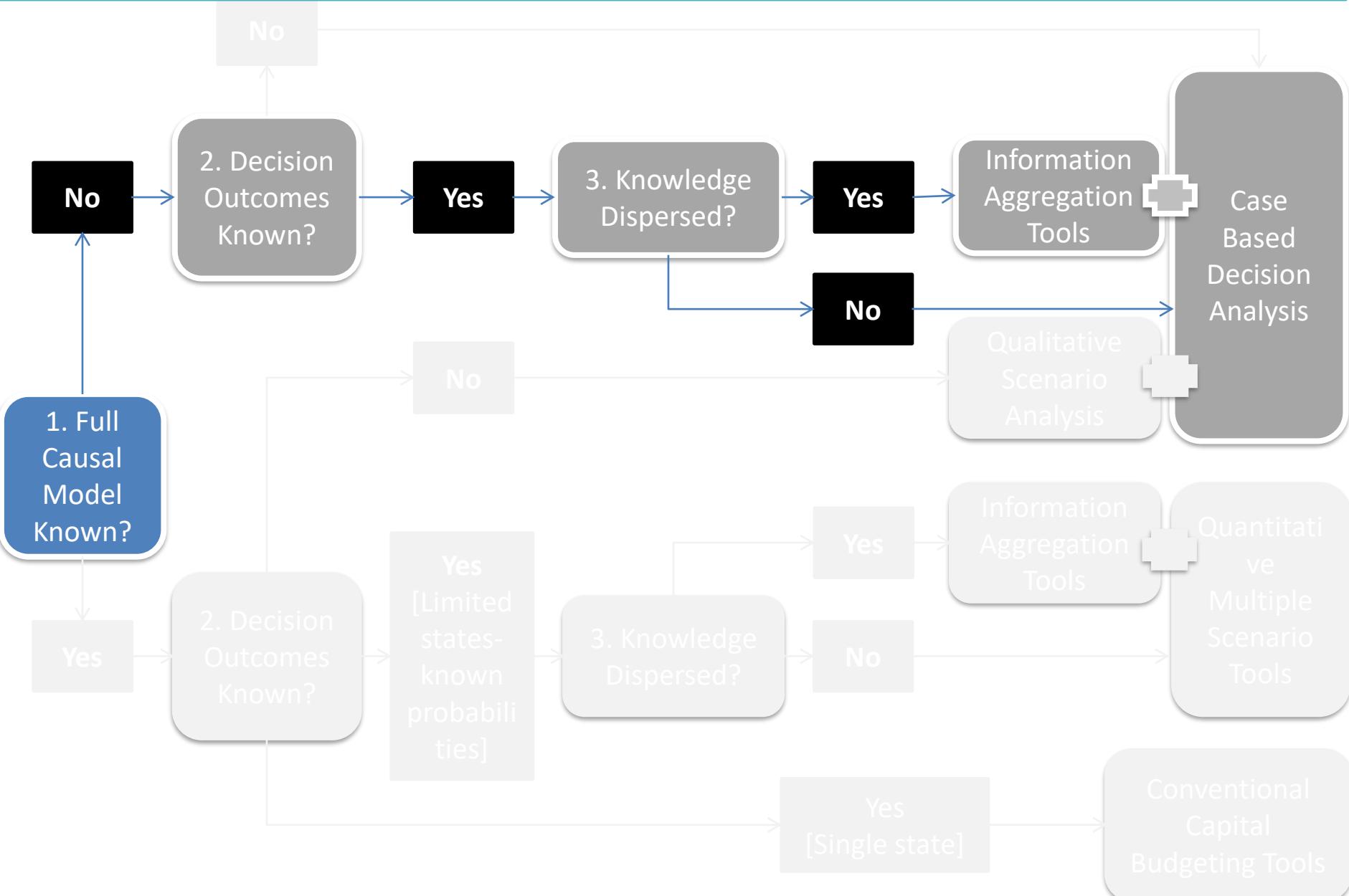
Foot Note

- Snowball Sampling - is a non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances. Thus the sample group appears to grow like a rolling snowball (similarly to breadth-first search (BFS) in computer science). As the sample builds up, enough data are gathered to be useful for research. This sampling technique is often used in hidden populations which are difficult for researchers to access; example populations would be drug users or sex workers. As sample members are not selected from a sampling frame, snowball samples, analogously to BFS samples,[4][5] are subject to numerous biases. For example, people who have many friends are more likely to be recruited into the sample.

Scenario 4

- You don't understand your causal model but you can still predict a range of outcomes.
- Entering into a new business of consulting – Crux of the problem.
- New business, say, consultancy – Boundaries.
- Sales and profit – Yardsticks.
- Sales > \$Xm; Profit > \$Ym – Reference points.
- Consultancy in food business has high potential for sales and profit and we have adequate expertise – Assumptions.
- Achieving higher sales and profit by entering into unexplored business – Objective.
- Alternatives – Consultancy, certification, training.
- Tools – Case-based decision analysis.

Scenario 4: You don't understand your causal model but you can still predict a range of outcomes. Entering into a new business of consulting.



Case-Based Decision Analysis (CBR)

- These tools provide a systematic approach to aggregating and synthesizing information from analogous past experiences and examples. In general, analogies that are most similar to the decision at hand are given more weight in determining the best choice.
- Collect a sample of analogous cases.
- Determine the results achieved in those cases.
- Assess how similar each case is to the decision at hand.
- The best decision is the one that maximizes the similarity-weighted average of results in the analogous cases.
- Examples, movie production decisions.

Foot Note

- Snowball Sampling - is a non-probability sampling technique where existing study subjects recruit future subjects from among their acquaintances. Thus the sample group appears to grow like a rolling snowball (similarly to breadth-first search (BFS) in computer science). As the sample builds up, enough data are gathered to be useful for research. This sampling technique is often used in hidden populations which are difficult for researchers to access; example populations would be drug users or sex workers. As sample members are not selected from a sampling frame, snowball samples, analogously to BFS samples,[4][5] are subject to numerous biases. For example, people who have many friends are more likely to be recruited into the sample.

Factors Impacting Quality of CBR

http://alumni.media.mit.edu/~jorkin/general/papers/Kolodner_case_based_reasoning.pdf

- The earlier experiences - Consider both successful attempts and failed attempts. *Remember overconfidence bias while considering successful attempts and prudent bias while considering failed attempts.*
- The ability to understand new situations in respect to old experiences - Includes recalling (indexing) and interpreting. Recalling is the core of CBR.
- Its adeptness at adaptation - The process of fixing the new problem with an old solution.
- Its adeptness at evaluation - Assessment of new results and course correction are the essential part of CBR.

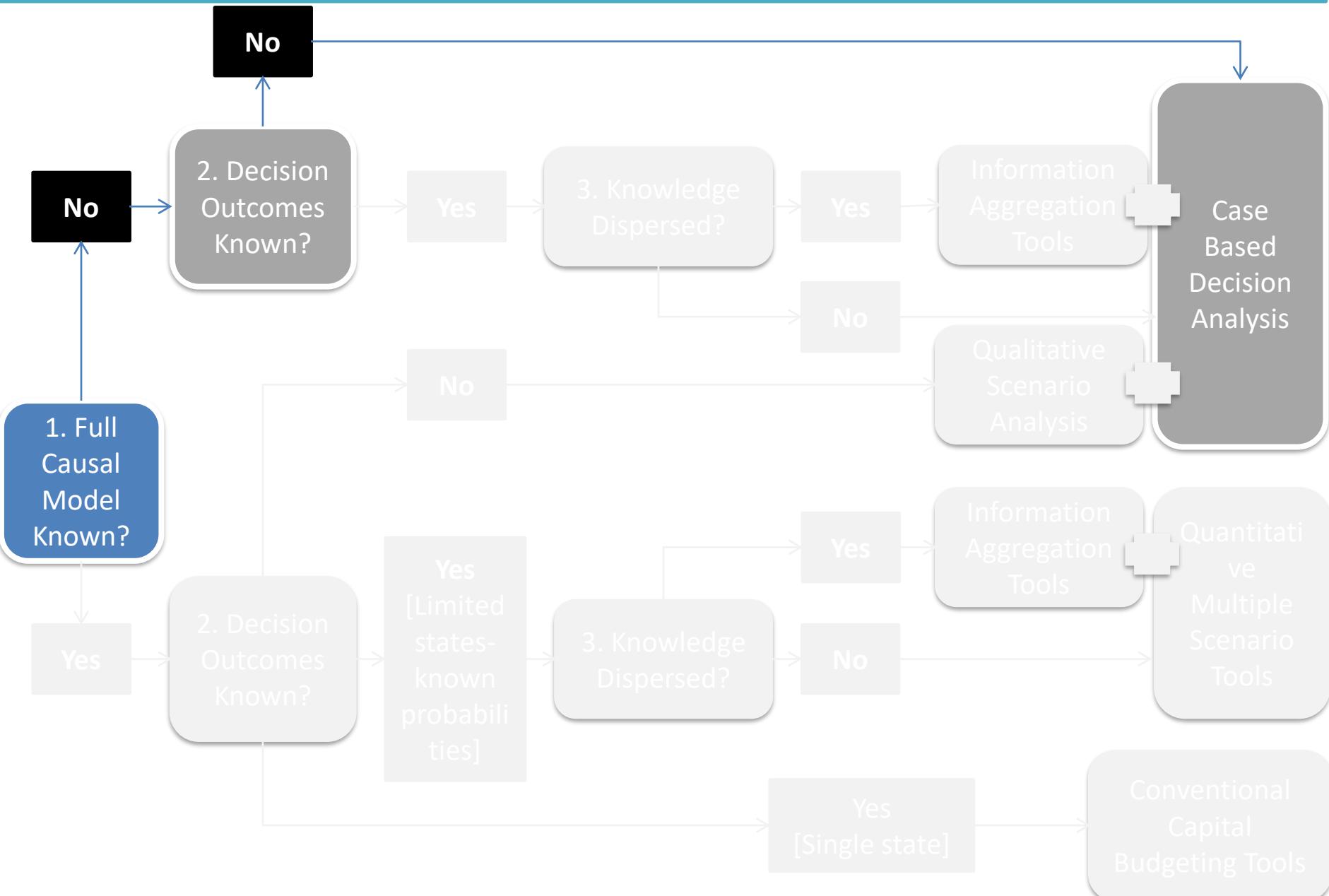
CBR Approaches

- CBR for Design Problems - When no solutions are possible for a given set of constraints, find the optimal one using past instances. *Remember the variables are unknown or fuzzy to solve using quant techniques.*
- CBR for Planning - When goals are moving or emerging wayside and they are networked, solving them independently is time consuming. CBR can consider all of this and unknown variables as well.
- CBR for diagnosis - When there are too many symptoms that can't be interpreted consistently.

Scenario 5

- You don't understand your causal model and you cannot predict a range of outcomes.
- How to respond to obesity – Crux of the problem.
- Responding to the problem of 'obesity' – Boundaries.
- Reduction of obesity related issues – Yardsticks.
- Number of obesity related issues faced by the consumers < n
- Reference points.
- Consumption of our high calorie food causes obesity related issues to consumers – Assumptions.
- Positively impacting obesity related issues faced by our consumers – Objective.
- Alternatives – Low calorie foods, awareness, health screening.
- Tools – Case-based decision analysis.

Scenario 5: You don't understand your causal model and you cannot predict a range of outcomes. *How to respond to obesity.*



END OF LECTURE
REFER TO ART OF CRITICAL DECISION MAKING
LECTURES 5, 6 & 7