

Lessons From Space Shuttle Disasters For Avoiding IT Project Disasters

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A previous version of this talk was presented at Agile2013, Nashville, TN, 5-9 August 2013



At least 45 years of IT Project Hell

- Significant improvements stubbornly elusive
 - *Software Engineering: A Report on a conference sponsored by the NATO Science Committee*. Garmisch, Germany. 07-11 Oct 1968. Peter Naur and Brian Randell, Eds.
- Risk Adjusted Performance shows
 - Junk bonds often better investments
 - See: “Junk Bonds Versus IT Projects”*

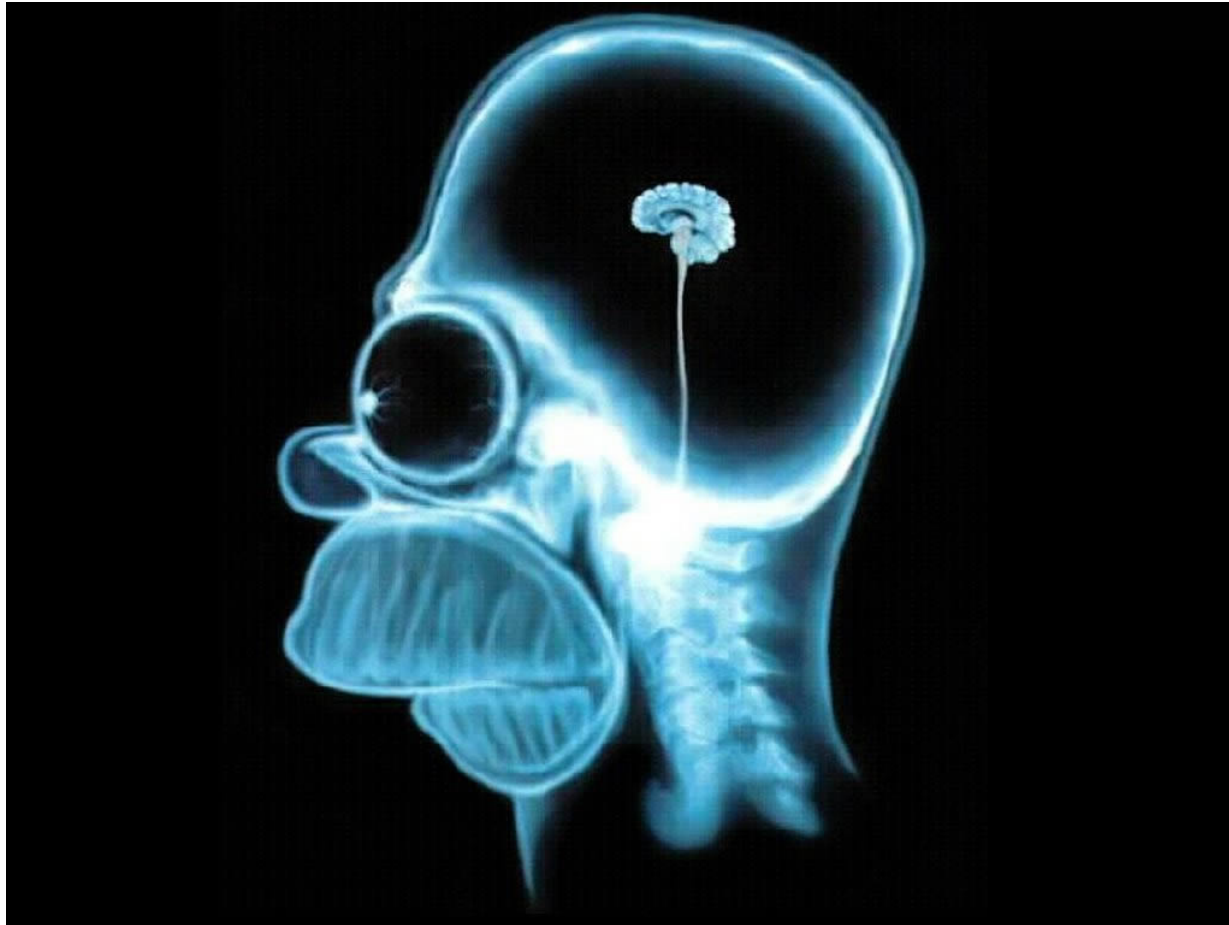
* <http://jhelmassociates.com/resources.html?item=junkProj>

Four User Stories

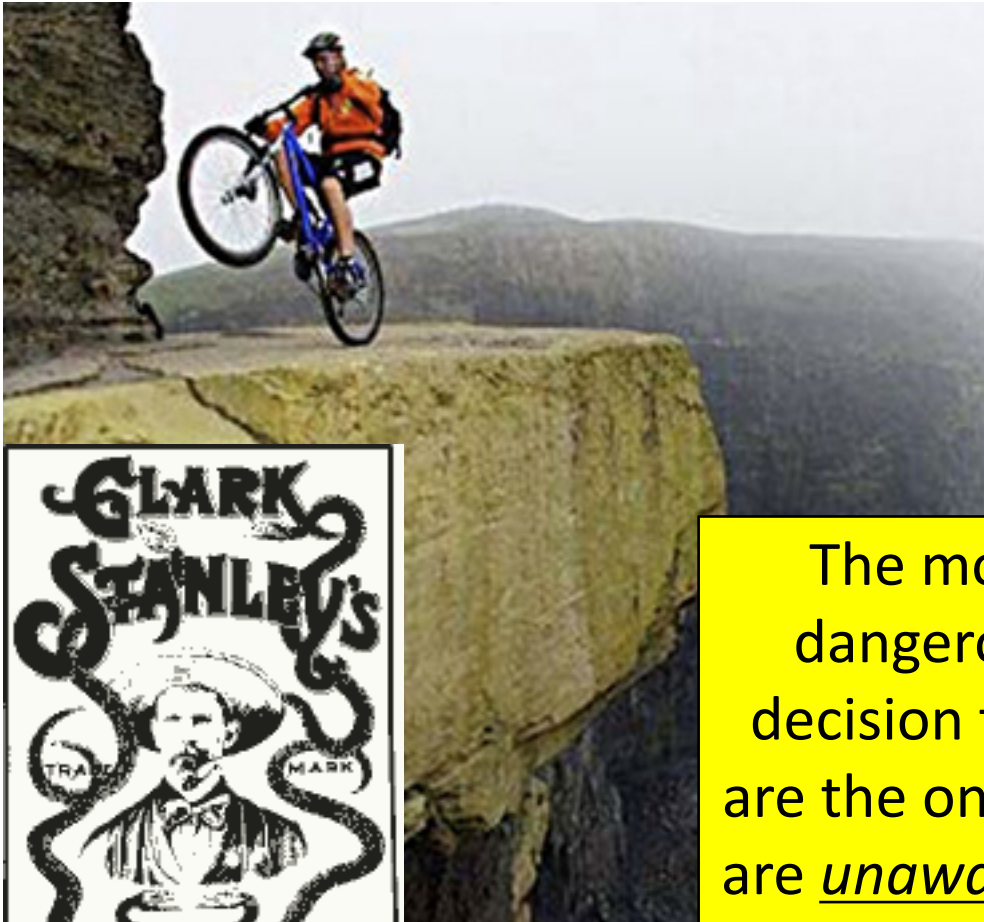
(3 Stories And One Small Epic, really :^)

- As an Agile Professional, I want to
 1. Apply findings from Decision Science to my work so I can be more effective
 - Note: Present Holistic Critical Decision Making Framework
 2. Avoid a death of 10,000 smells because dying that way sucks
 - Note: Do Challenger case study
 - Note: Set stage for thinking tools
 3. Learn about new tools to make better execution decisions and have better fact-based conversations with my stakeholders
 - Note: Introduce unpredictability measurement and thinking tools
 4. See Agile be deployed more successfully
 - Note: Do Columbia case study

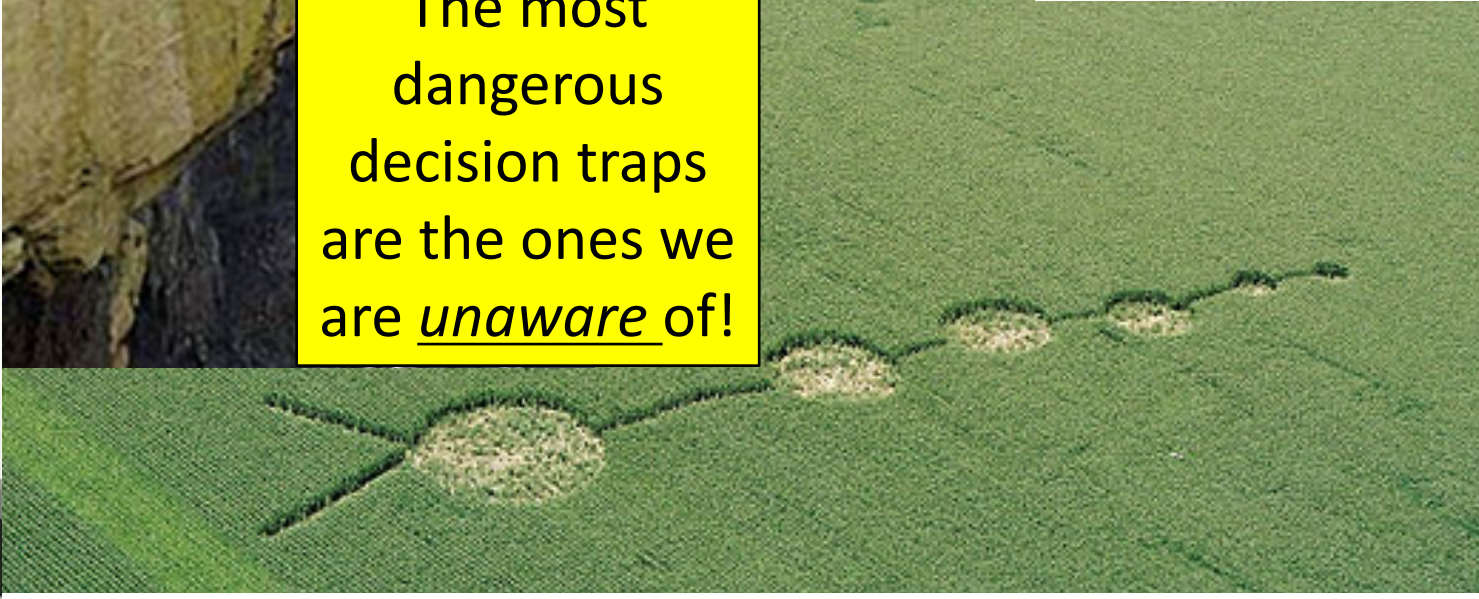
Why Think About Thinking?



Why Think About Thinking?

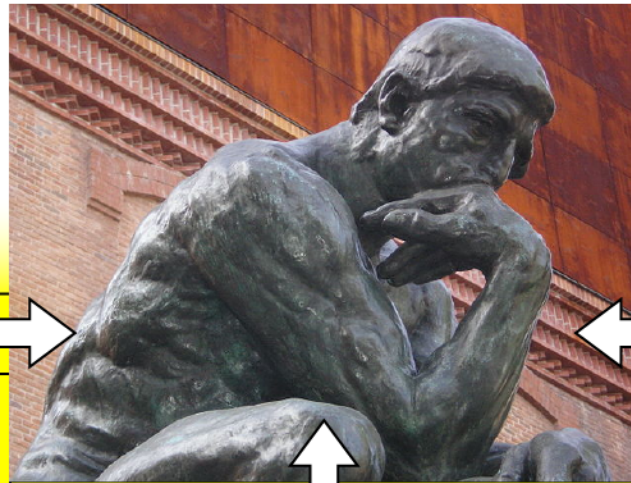


The most dangerous decision traps are the ones we are unaware of!



Art and Science of Decision Making

Individual Decision Making



Heuristics

Cognitive Biases

Thinking Traps

Cognitive rules of thumb
used subconsciously

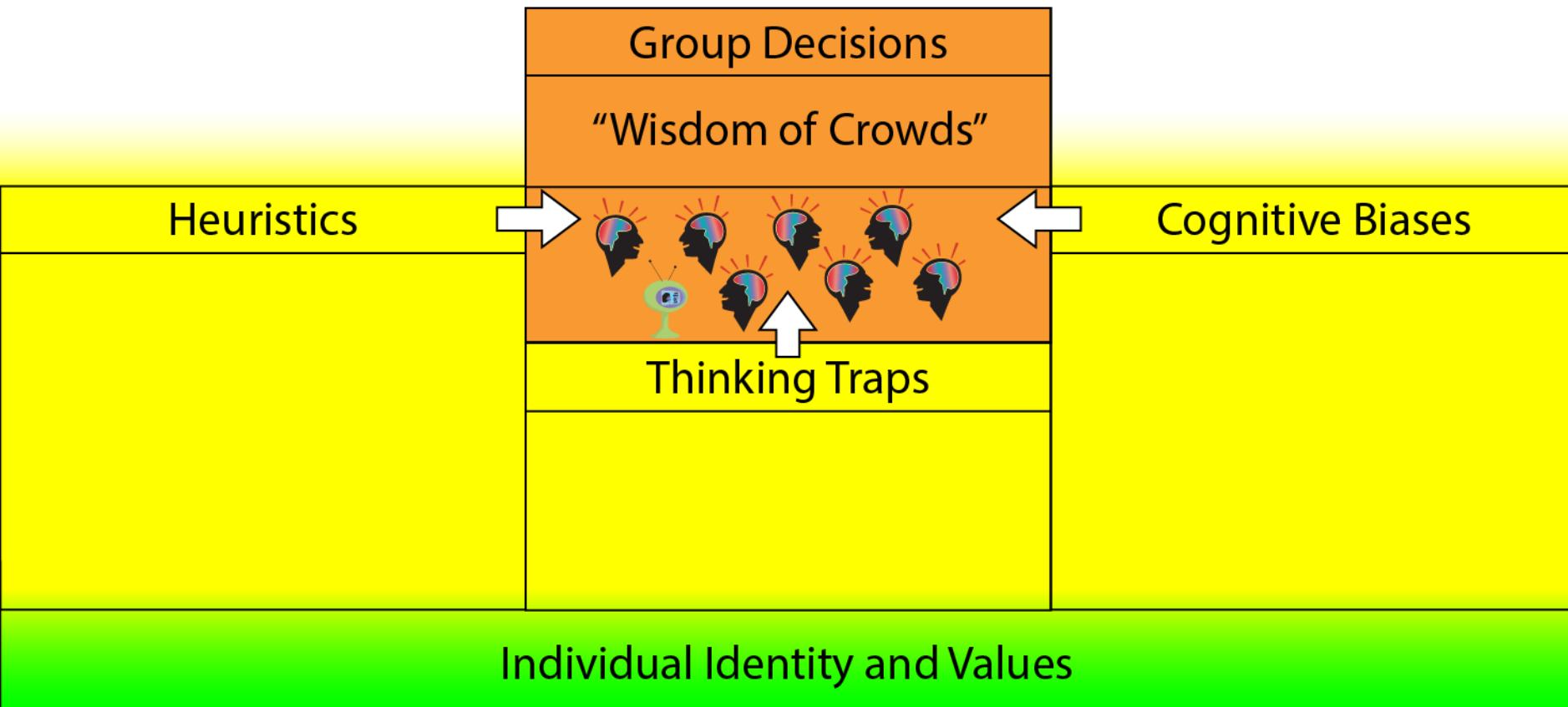
Mental processes
that make
things worse

Subconscious tendency
to think in a certain way

Individual Identity and Values

Art and Science of Decision Making

Group Decision Making



Art and Science of Decision Making

Organizational Modulation

Corporate Identity



Corporate Culture



Corporate Values



Group Decisions

"Wisdom of Crowds"

Heuristics



Cognitive Biases

Thinking Traps



Individual Identity and Values

Art and Science of Decision Making

Heuristics

Feed a Fever, Starve a Cold?
Feed a Cold, Starve a Fever?



Heuristics

Patterns and Agency
Analogies
Availability/Recency
Representativeness
Many more

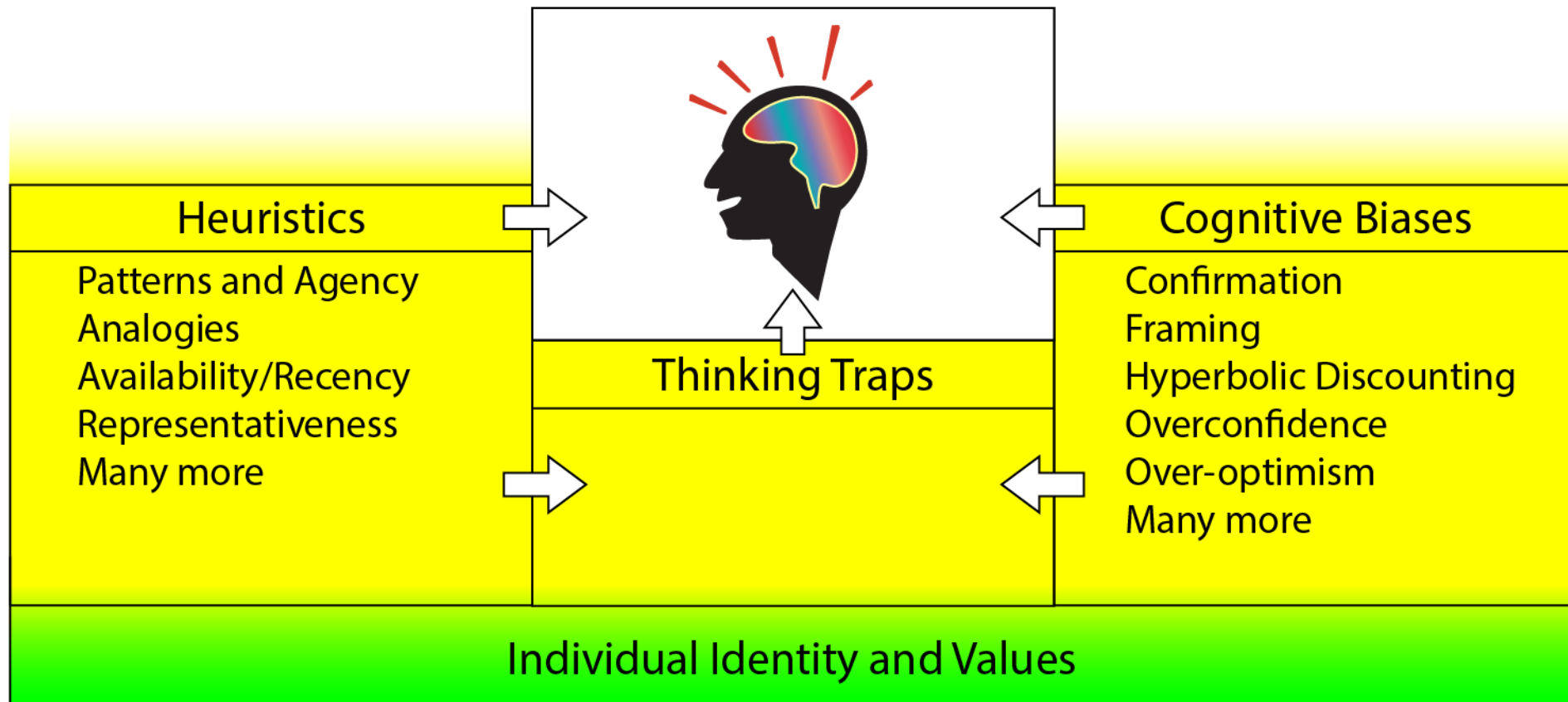
Cognitive Biases

Thinking Traps

Individual Identity and Values

Art and Science of Decision Making

Cognitive Biases



Art and Science of Decision Making

Cognitive Biases: Confirmation Bias

The TRUTH Is Out There...



Photo: Bill Cunningham, Capricorn Control

All Swedes Are Blond...



Noomi Rapace, Swedish Actress

Art and Science of Decision Making

Cognitive Biases: Confirmation Bias

- Confirmation Bias is built into us
- Quantitative studies are no protection
- Example: inference of a causal relationship from correlated data

Read: Why Most Published Research Findings Are False

By John Ioannidis

<http://www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.0020124>

Art and Science of Decision Making

Cognitive Biases: Framing and Prospect Theory

Your surgery has a 25%
chance it will kill you

Your surgery has an 75%
chance to save your life



Frame in terms of LOSS

- Easier to motivate
- Choices constrained to familiar

Frame in terms of OPPORTUNITY

- Harder to motivate
- More flexibility & innovation

Art and Science of Decision Making

Hyperbolic Discounting

- Preference for small pleasures today that are detrimental to our future
 - \$50 today v. \$100 tomorrow?
 - \$50 today v. \$100 6 months?
 - \$50 today v. \$100 1 year?
- Our brains are wired to respond to future uncertainty by discounting the future
 - Coke & fries today, bypass surgery in 10 yrs?
 - 500,000 bypass surgeries/year
 - Only 10% undo their unhealthy lifestyle
- Coding while behind schedule for release...
 - Cut and paste today, spaghetti code next year?
 - Skip full coverage testing today, 2 day outage next year?



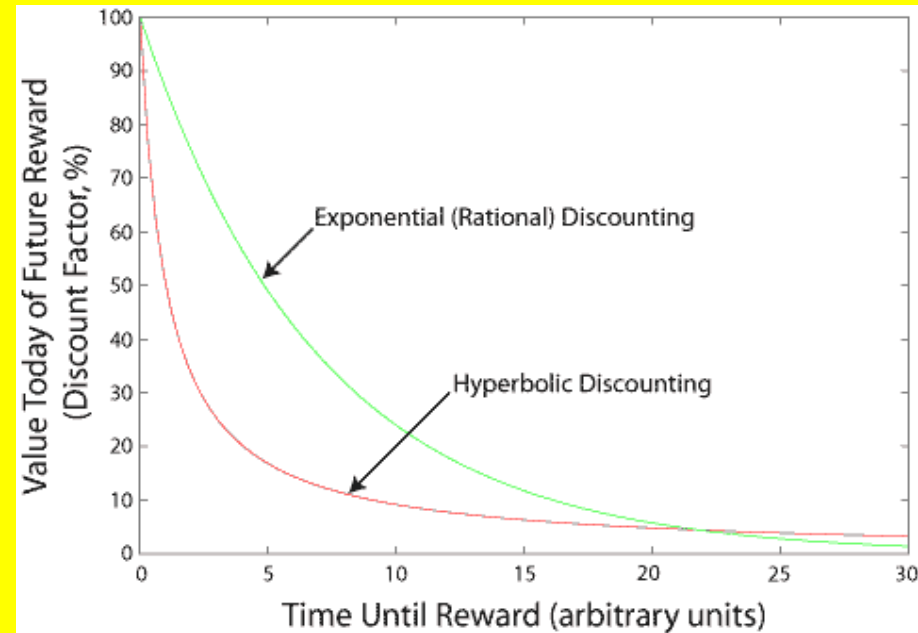
Art and Science of Decision Making

Hyperbolic Discounting

- Discounting is the assessment of present value of a future gain
 - At 4% inflation, \$100 in 10 years *should be* worth \$67.55 today
 - The 4% is called the discount rate; 0.6755 is the discount factor
 - According to the rational approach

Each period is discounted the same

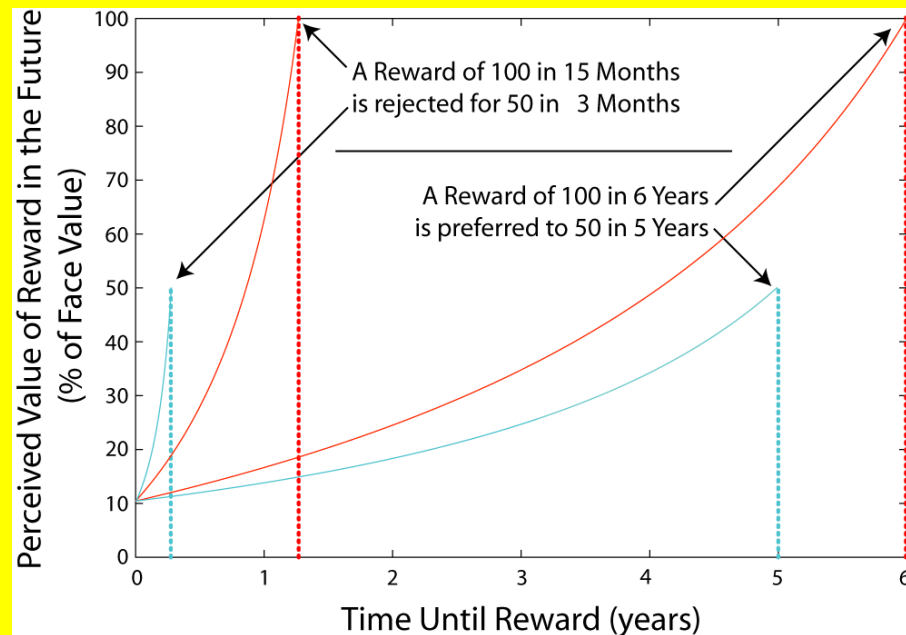
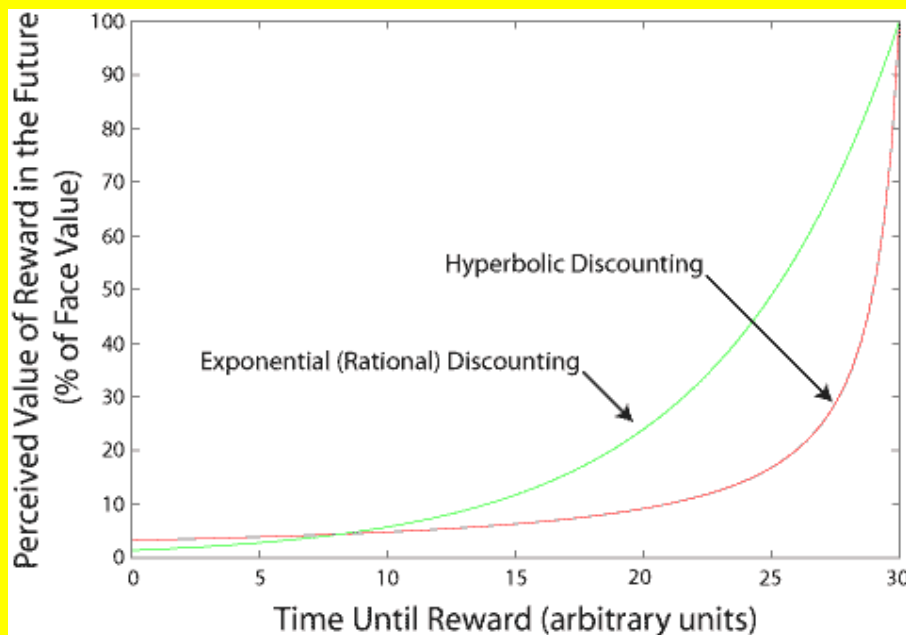
- The result is an exponential discount function
- But people DON'T discount each period the same!
 - The near future is valued much more relative to “far” future
 - The resulting discount function is called HYPERBOLIC (more correctly, it's quasi-hyperbolic)



Art and Science of Decision Making

Hyperbolic Discounting

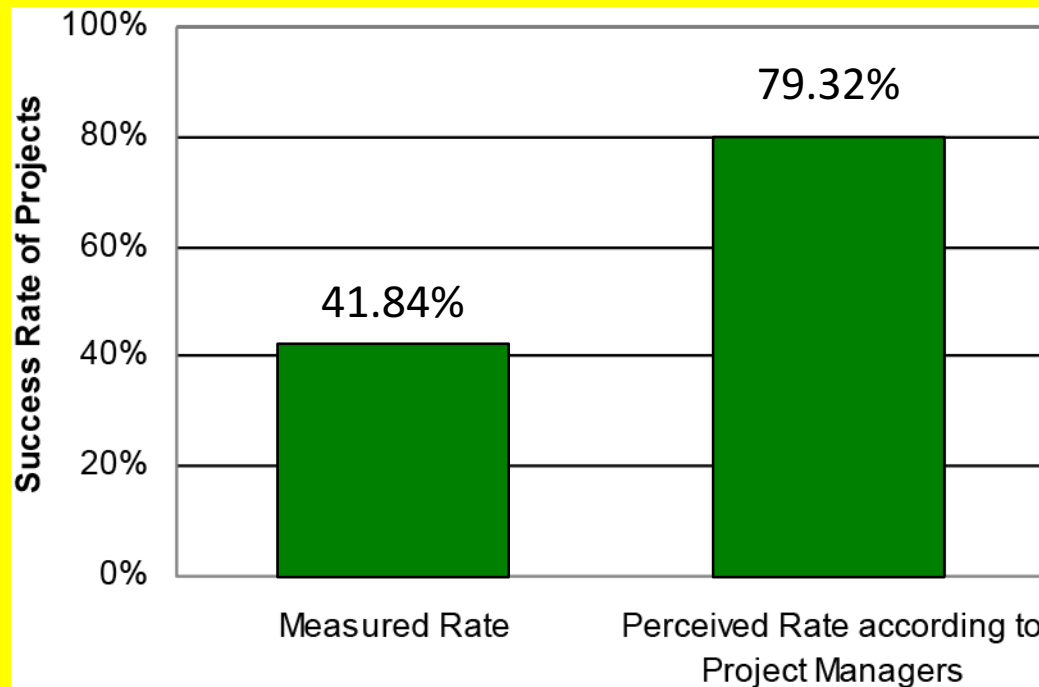
- Discount function graphs are unhelpfully abstract
- What matters for people is the anticipation of satisfaction!
- More interesting is the trade-off between a small reward soon vs. a larger reward farther in the future



Delay dependent preference reversal!

Art and Science of Decision Making

Overconfidence/Attribution Bias

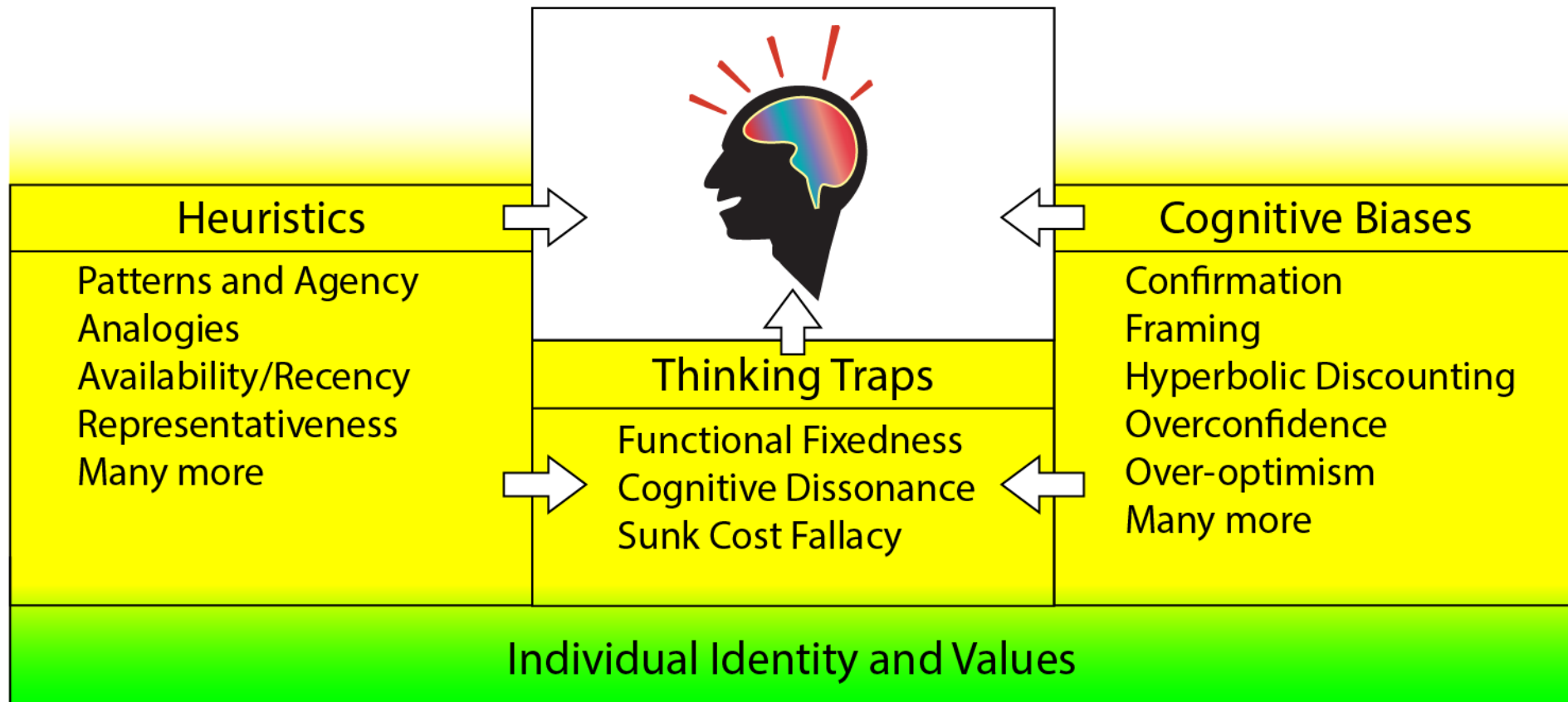


The measured success rate (10% allowances) compared to how the project managers perceived their projects

Matthew G. Miller, Ray J. Dawson, Kieran B. Miller, Malcolm Bradley (2008). *New Insights into IT Project Failure & How to Avoid It*. Presented at 22nd IPMA World Congress - Rome (Italy) November 9-11, 2008, in Stream 6. As of May 2013, self published at <http://www.mgmiller.co.uk/files/paper.pdf>

Art and Science of Decision Making

Thinking Traps



Art and Science of Decision Making

Functional Fixedness

The Candle Problem

Karl Duncker, 1945

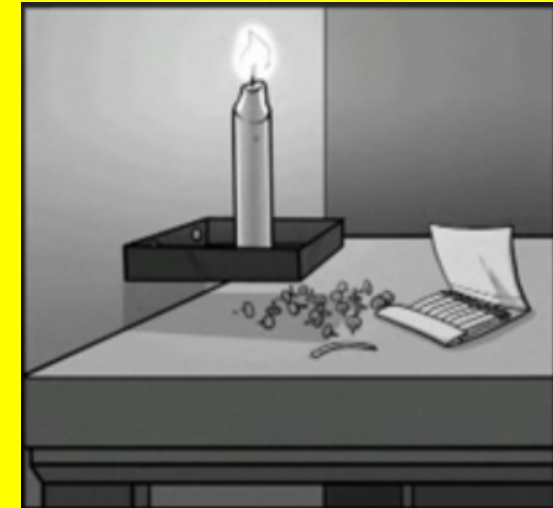
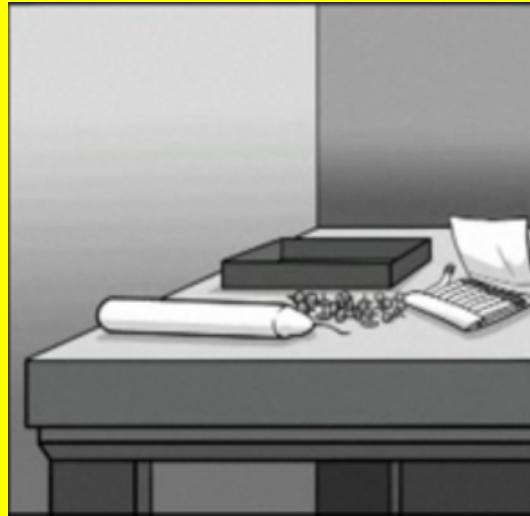
Sam Glucksberg, 1962

The task:

- Fix a lit candle to the wall such that no wax hits the table using only
 - Book of matches
 - A box of thumbtacks
 - A candle (of course)

How long to do?

- Box empty
- Tacks in box
- No Pressure
- Under Pressure

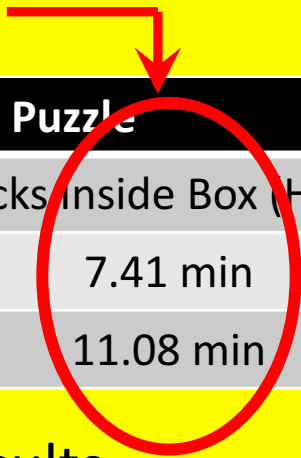


Art and Science of Decision Making

Functional Fixedness

- Financial incentives
 - Improved performance of simple doing task
 - HURT performance of creative thinking task

	Mean Time To Solve Puzzle	
	Tacks Out of Box (Easy)	Tacks Inside Box (Hard)
Low Performance Pressure	4.99 min	7.41 min
High Performance Pressure	3.67 min	11.08 min



- More incentive → worse creative thinking results

Art and Science of Decision Making

Cognitive Dissonance

- Cognitive dissonance:
 - Unpleasant emotions arising from simultaneous mutually exclusive beliefs
 - Rationalizations developed to defend belief we wish to hold
 - Aronson model: Role of Ego is to protect identity, whatever it takes
- Can motivate many irrational decisions and behaviors
 - Denial
 - Illogical Rationalization (special pleading)
 - Escalation of Commitment

Art and Science of Decision Making

Cognitive Dissonance

Great Flood Scheduled
Dec 21, 1954

**DOCTOR WARNS
OF DISASTERS IN
WORLD TUESDAY**

**Worst to Come in 1955,
He Declares**

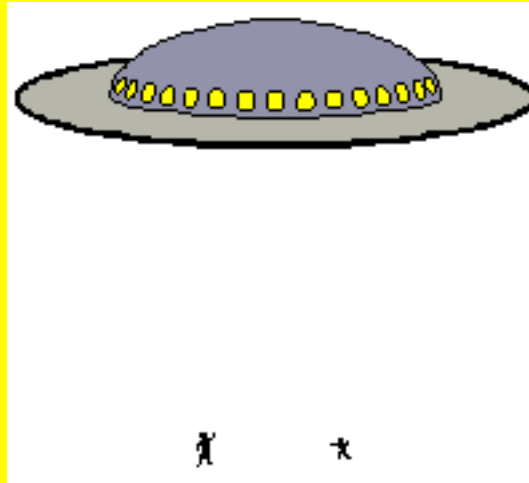
Art and Science of Decision Making

Cognitive Dissonance

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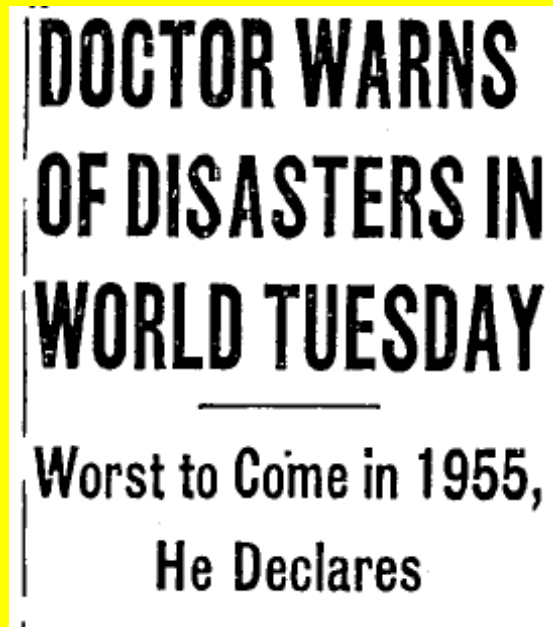


Believers, give it all away!
You will be saved by UFO

Art and Science of Decision Making

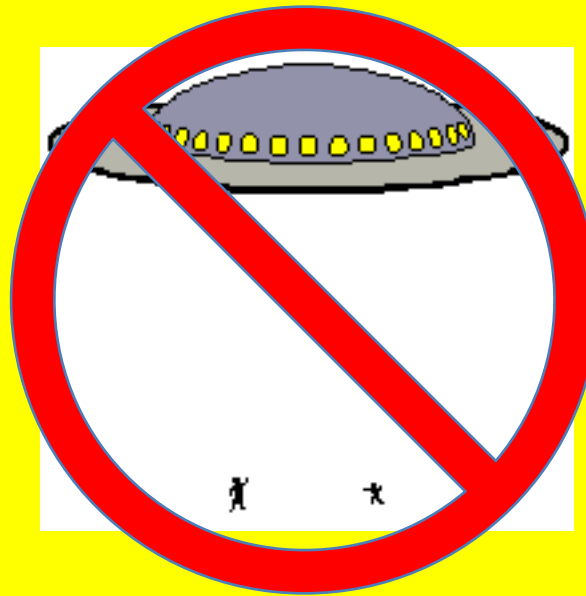
Cognitive Dissonance

Great Flood Scheduled
Dec 21, 1954



Believers: give it all away!
You will be saved by a UFO

4:00 am
Cataclysm Day



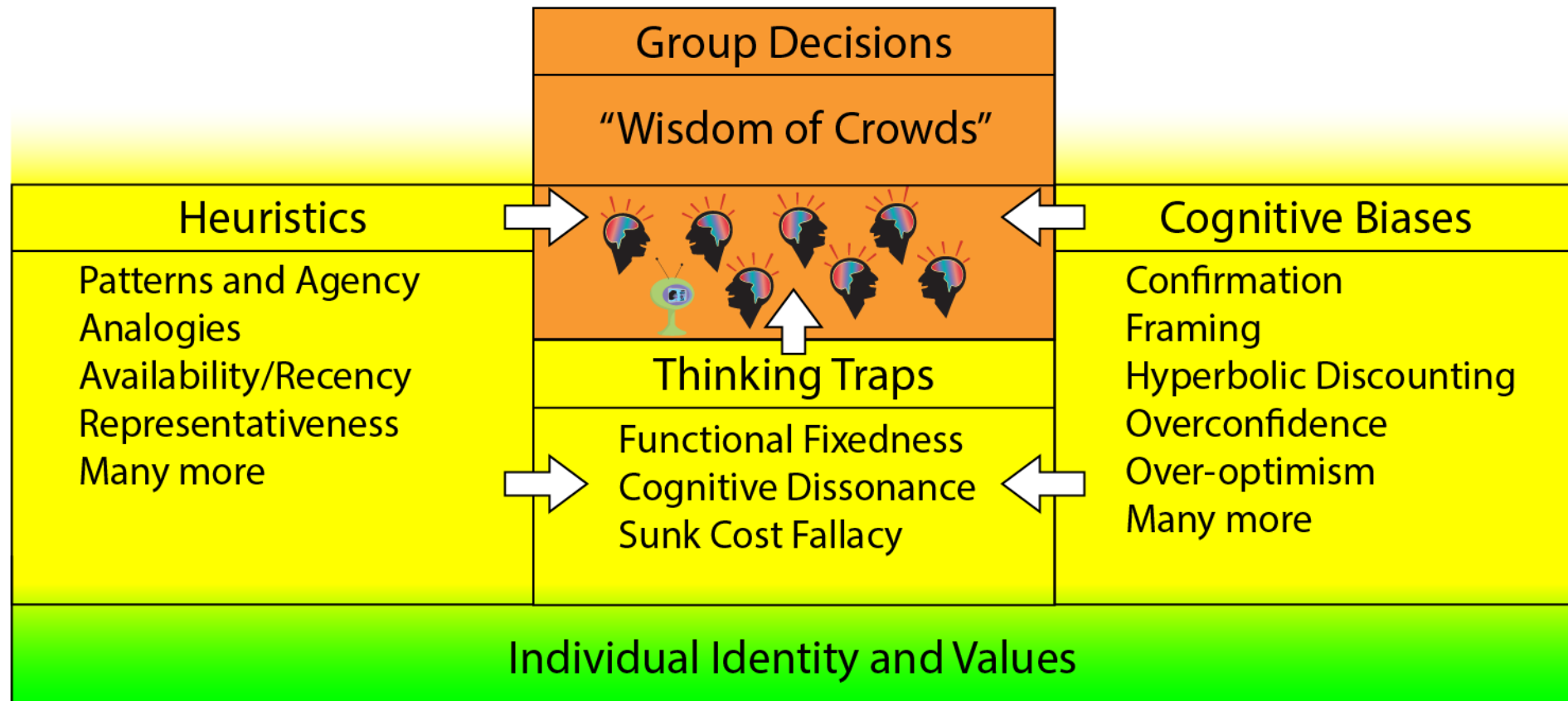
The inconsiderate buggers
failed to show up!!!

4:45 am
“Press Release”

“The little group,
sitting all night long,
had spread so much
light that God had
saved the world from
destruction.”

Art and Science of Decision Making

Group Decision Making



Art and Science of Decision Making

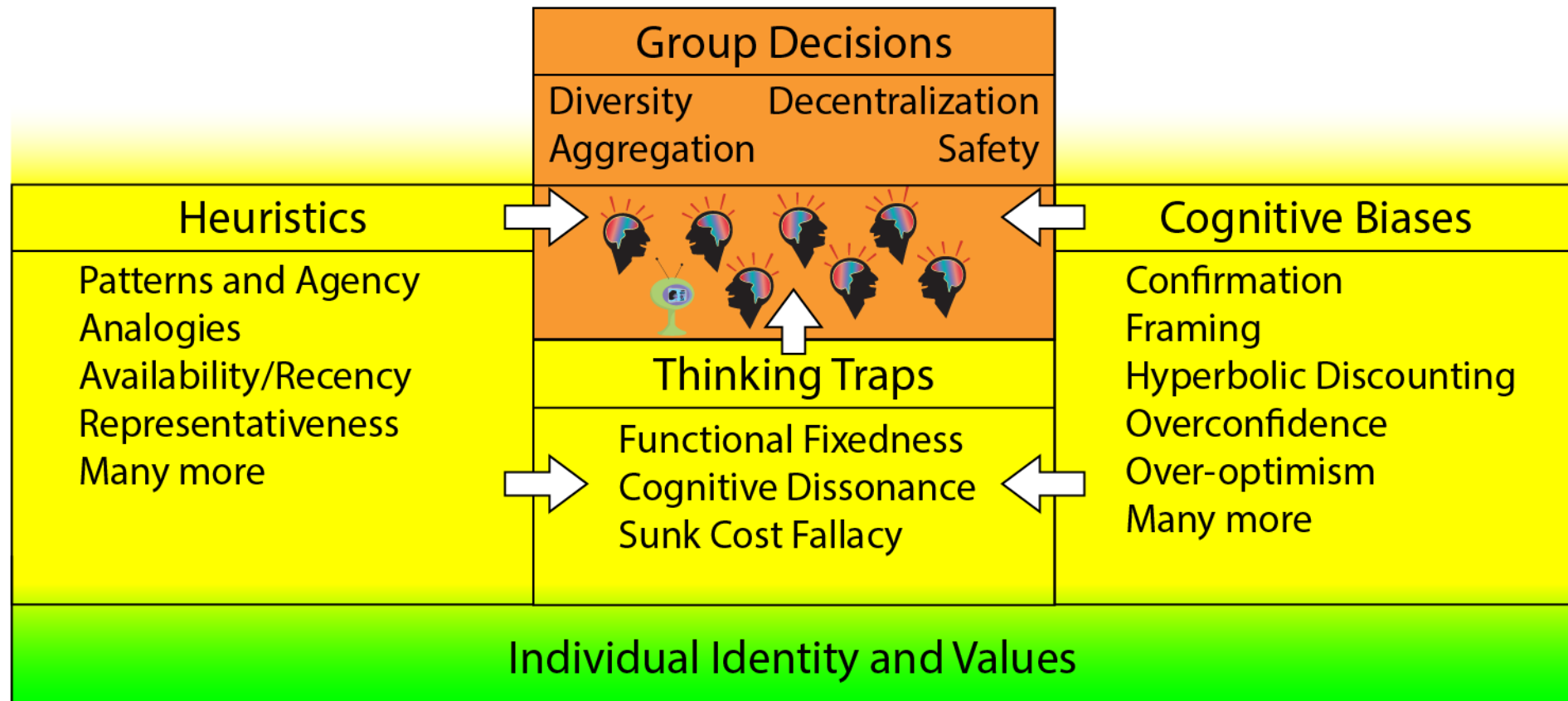
Group Decision Making

- Often many heads *ARE* much better than one
 - Groups pool and tap diverse talents
 - Surface and correct imperfect individual decisions
- “Who Wants To Be a Millionaire?” audience correct 91%
- BUT, often “Process Losses” trash the magic

Desired Condition	Process Loss
Diversity of skills and views	Everybody like minded or same background
Decentralization/Delegation	Centrally directed decision making
Aggregation	Can't integrate individual contributions
Safety/Independence	Might get fired for ideas or speaking up

Art and Science of Decision Making

Group Decision Making



Art and Science of Decision Making

Organizational Modulation

Group decisions *DO NOT* occur in a vacuum

- Two dimensions of organization examination
 - Structural Perspective (e.g. Normal Accident Theory)
 - Behavioral Perspective (Many)
- Decision making issues can arise from BOTH
 - Structural features
 - Clumsy organizational relationships
 - Too many time zones....
 - Behavioral tendencies
 - Corporate identity
 - Culture
 - Values

Art and Science of Decision Making

Organizational Modulation

- Structural properties of organizations include
 - Component Coupling (Loose or Tight)
 - Interactive Complexity (Linear or Non-linear)
- Organizational context shapes behavior
 - Identity: who we are
 - Constrains or biases solution sets
 - Values and Culture: unspoken “rules” everyone must know
 - Constrains and directs behavior

Art and Science of Decision Making

Organizational Modulation

Corporate Identity → Corporate Culture ← Corporate Values

Group Decisions

Diversity Decentralization
Aggregation Safety

Heuristics

Patterns and Agency
Analogies
Availability/Recency
Representativeness
Many more

Cognitive Biases

Confirmation
Framing
Hyperbolic Discounting
Overconfidence
Over-optimism
Many more

Thinking Traps

Functional Fixedness
Cognitive Dissonance
Sunk Cost Fallacy

Individual Identity and Values

Art and Science of Decision Making

Decisions and Projects

Corporate Culture

Product Vision



Product Backlog
(prioritized, coarse est.)

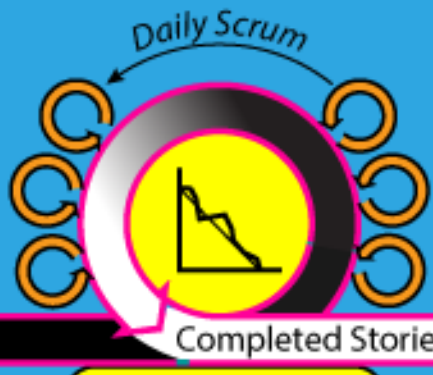
Release Planning
(features expanded to prioritized user stories, story size estimated)

Release Plan Scope

User Stories

Sprint Planning
(task lists, task estimates)

Sprint Backlog



Completed Stories

Sprint (2-4 weeks)



Working Production Software

Delivery
(Integration Packaging, System Testing, ..., Release)

Story Acceptance
(demonstration of each story as potentially shippable product increment)

Individual Identity and Values

Four User Stories

- As an Agile Professional, I want to
 - ✓ Apply findings from Decision Science to my work so I can be more effective
 - 2. Avoid a death of 10,000 smells because dying that way sucks
 - 3. Learn new tools to make better execution decisions and have better fact-based conversations with my stakeholders
 - 4. See Agile be deployed more successfully

Decisions And The Challenger Disaster 27 Years Ago



Decisions And The Challenger Disaster

The "L-1 Meeting" Decision To Launch

The Rogers Commission:
Communication failures
enabled flawed group
decision:

“If the decision makers had known all of the facts, it is highly unlikely that they would have decided to launch 51-L on Jan 28, 1986.”

(Pg. 82, Rogers Commission Report)

Strong evidence suggests
matters not this simple



Decisions And The Challenger Disaster

Process Losses in the L-1 Meeting?

Groupthink Unlikely

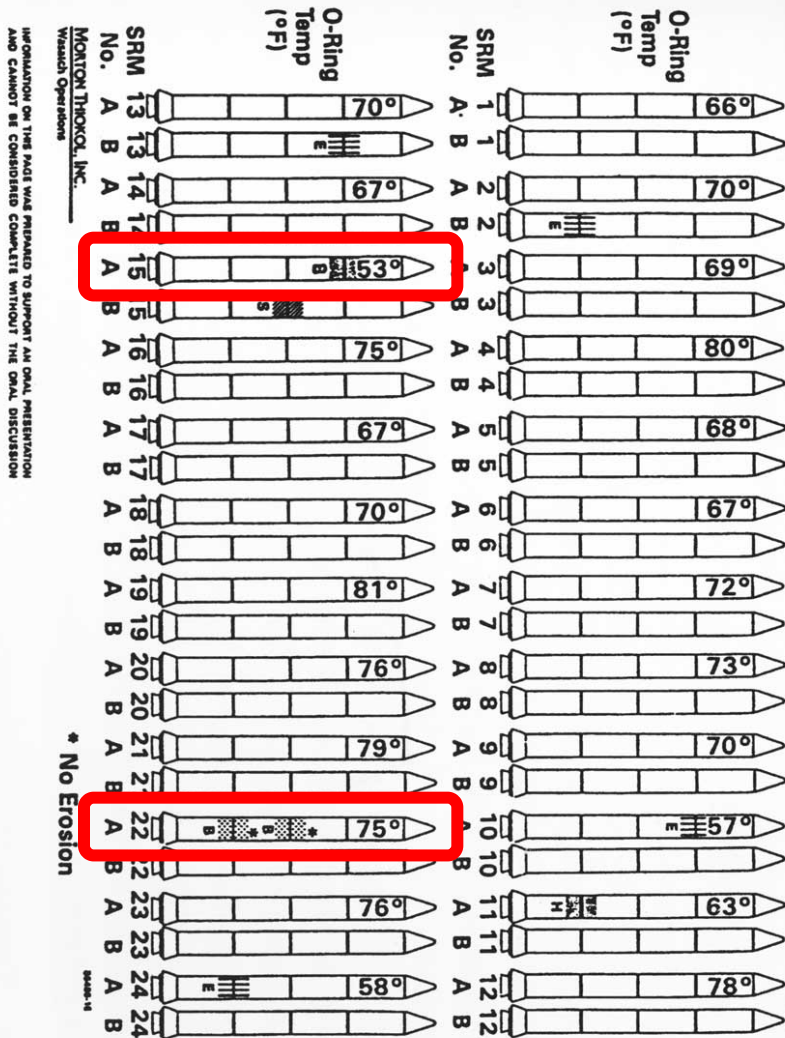
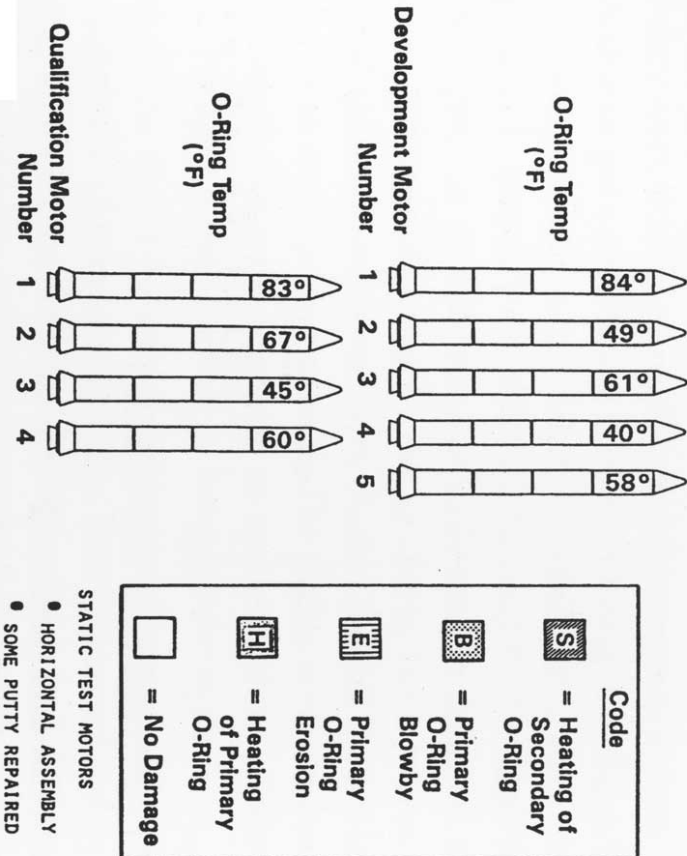
Desired Condition	Process Loss?	Why?
Diversity of views	No	Various internal and external experts
Decentralization	No	NASA staff and many independent contractors
Aggregation	No	Vigorous and open debate of differing views
Safety/Independence	No	Managers did not “pull rank” Decision was “rule-based”

Decisions And The Challenger Disaster

Did Stress/Functional Fixedness play a role?

Discussion focused on two key launches, circled in red

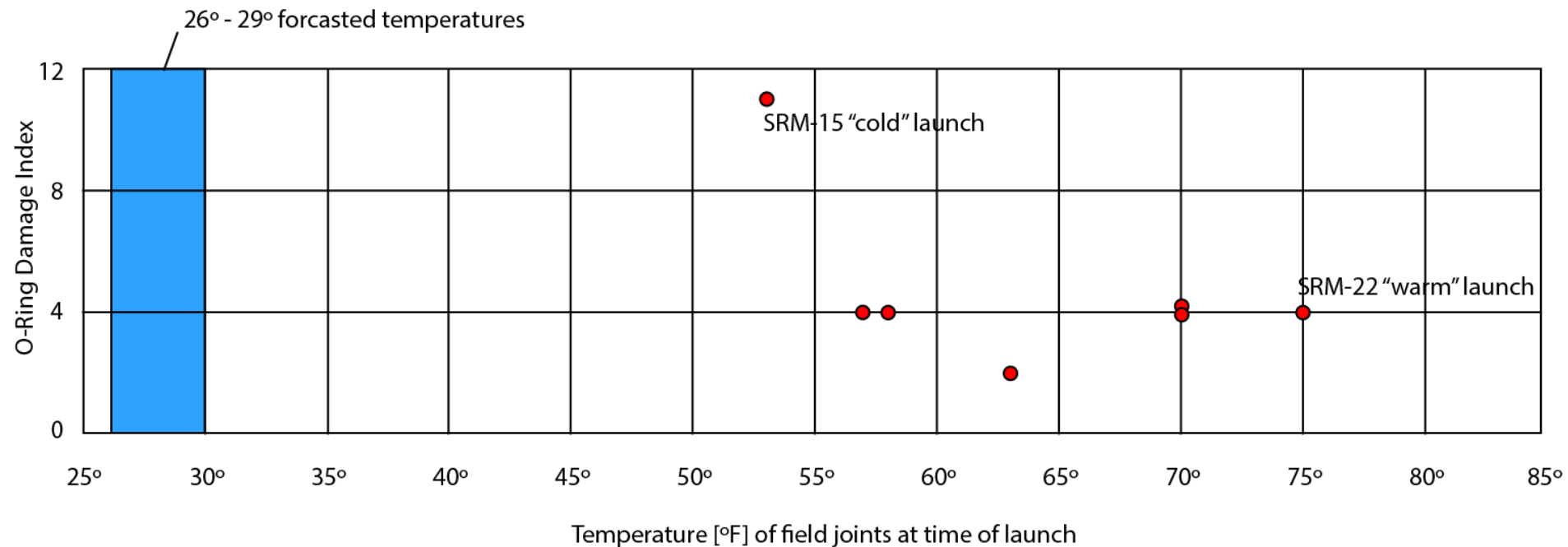
History of O-Ring Damage in Field Joints



Decisions And The Challenger Disaster

Did Stress/Functional Fixedness play a role?

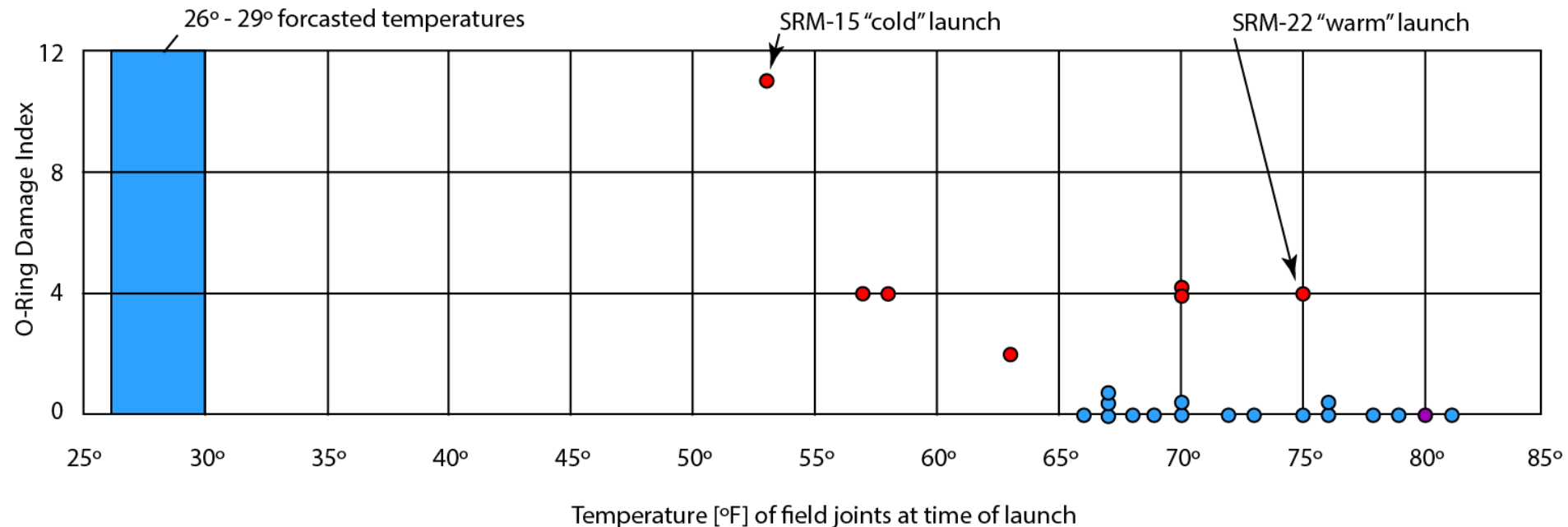
- Data of problems only
- Discussion focused on
 - SRM-15
 - SRM-22



Decisions And The Challenger Disaster

Did Stress/Functional Fixedness play a role?

- Data all 24 Launches
 - Damage launches in red



Decisions And The Challenger Disaster

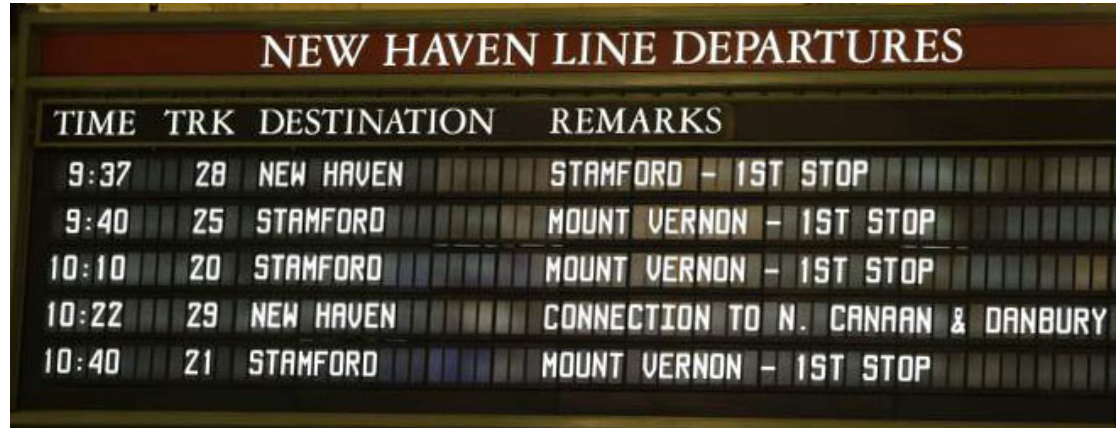
NASA: Structural Considerations

- Structural Observations
 - Complex matrix org (NASA-contractor ecosystem)
 - Geographically dispersed
 - Established hierarchical bureaucracy
- Little evidence that structure was issue
 - Long and impressive history of superb execution
 - Effective management of complex ecosystem and supply chain
 - Impressive safety record for “two million parts – all built by the lowest bidder on a government contract”

Decisions And The Challenger Disaster

NASA's Organizational Identity, Values and Culture

They called it a
SHUTTLE



TIME	TRK	DESTINATION	REMARKS
9:37	28	NEW HAVEN	STAMFORD - 1ST STOP
9:40	25	STAMFORD	MOUNT VERNON - 1ST STOP
10:10	20	STAMFORD	MOUNT VERNON - 1ST STOP
10:22	29	NEW HAVEN	CONNECTION TO N. CANAAN & DANBURY
10:40	21	STAMFORD	MOUNT VERNON - 1ST STOP

“It will revolutionize transportation
into near space by routinizing it”

– Nixon, 1972

“Beginning with the next flight, the Columbia and its sister
ships will be fully operational” – Reagan, after 4th flight

Decisions And The Challenger Disaster

NASA's Organizational Identity, Values and Culture

- Politics and Funding
 - Wrong Frame ➡ Structure and culture of routine operations
- Behavioral Observations
 - Rigid rules and protocols (no level hopping)
 - Poor information flow
 - Obsession with schedule and deadlines
 - Stark distinction between engineers and managers
 - “Take off your engineer's hat and put on your manager's hat”
 - Penchant for extensive supporting data
 - Insufficient acknowledgement of the unknowns

Critical Thinking and Decision Making

Normalization of Deviance

- Diane Vaughn studied NASA's organizational context and history
 - Observed O-Ring problems were not new
 - Issues cropped up over the years
 - History and context *must* have influenced the launch decision
- Vaughn argued the launch decision is best understood in historical context
 - O-ring erosion unexpected
 - Happened once, no disaster
 - O-ring erosion began to occur regularly
 - Rationalized redundancy was sufficient
 - Gradually the *unexpected became, expected, then accepted*

Critical Thinking and Decision Making

Normalization of Deviance

Vaughn proposed a slow holistic process at work

1. Small deviations from standards or norms are rationalized, often under (perceived) coercive pressure
2. Nothing bad happens, supporting the correctness of the rationalization
3. With repetitions the “deviation” eventually becomes the new norm

NORMALIZATION OF DEVIANCE

Not incompetence, just humanity!

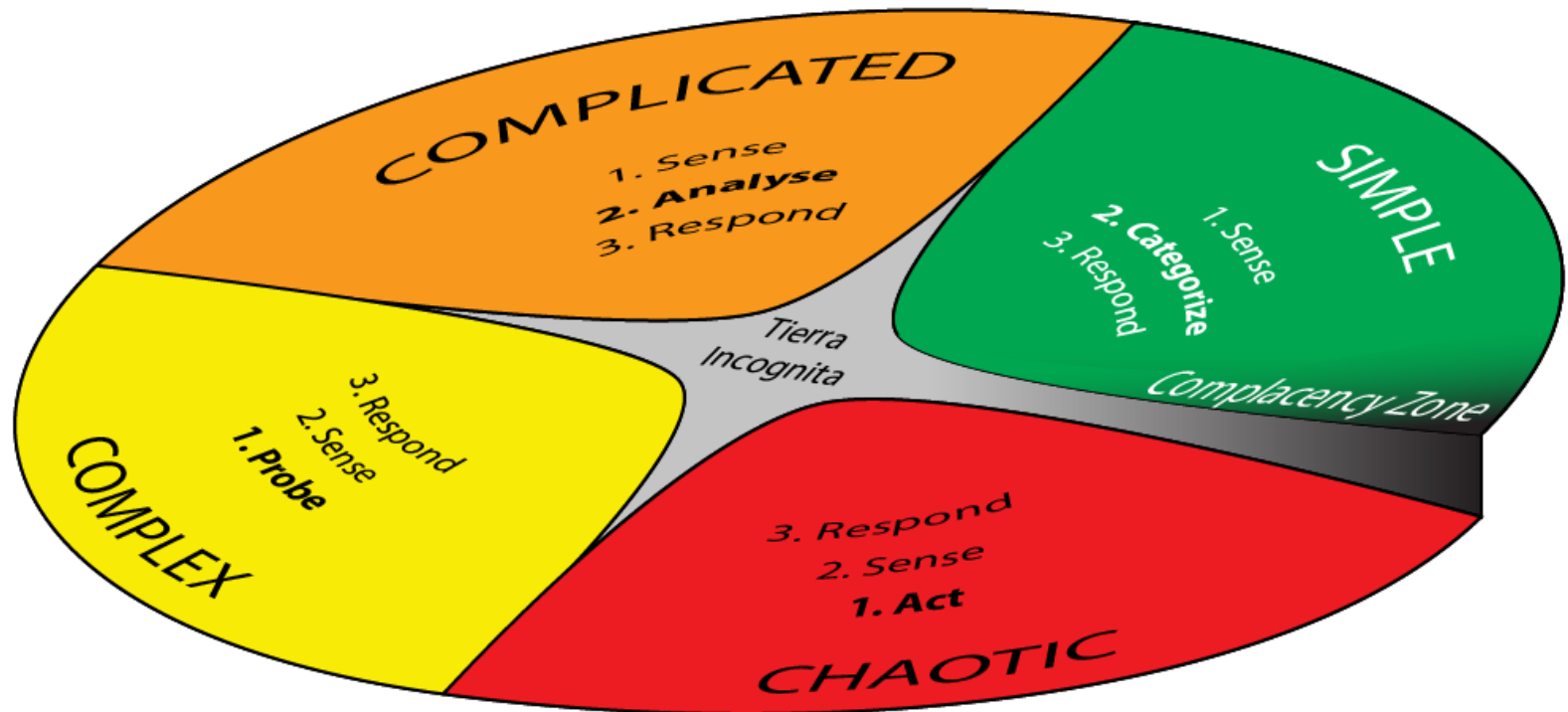
See Also: Practical Drift; read “Friendly Fire”, Snook

Four User Stories

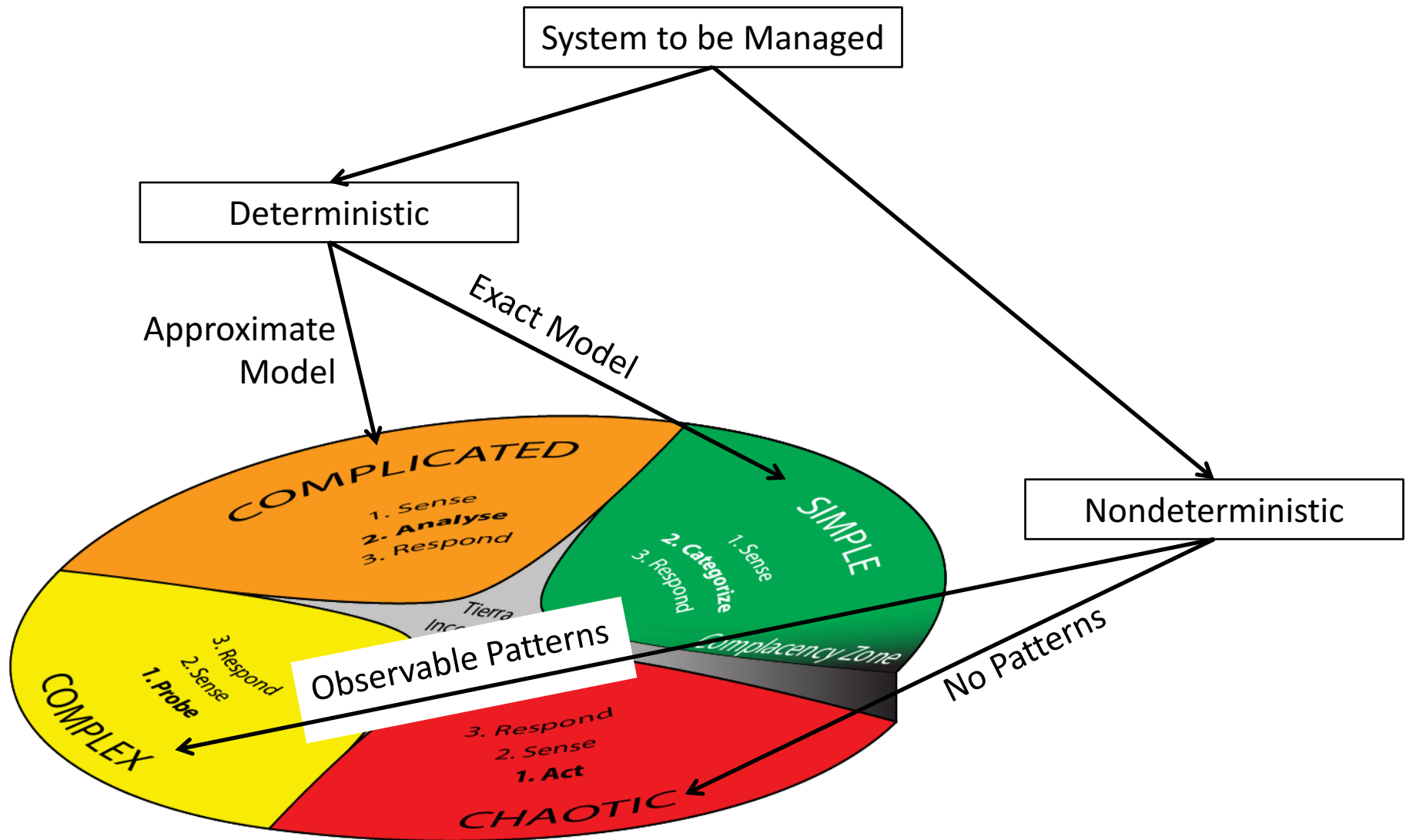
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 - 3. Learn new tools to make better execution decisions and have better fact-based conversations with my stakeholders
 - 4. See Agile be deployed more successfully

Quantitative Unpredictability Management

Am I doomed if I can't pronounce Cynefin?



Quantitative Unpredictability Management

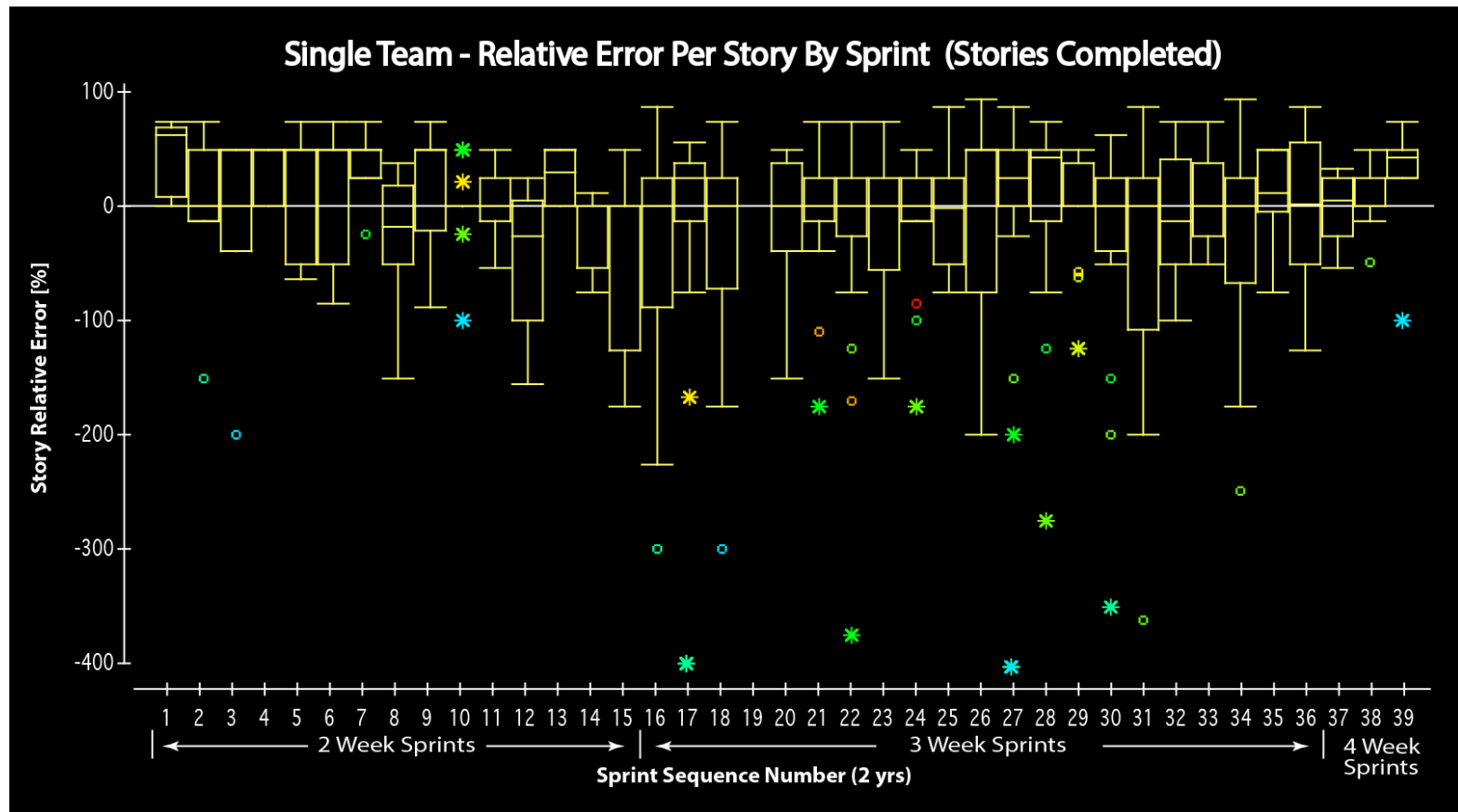


Quantitative Unpredictability Management

- Normalization of Deviance ➡ 10,000 smells
 - Every riskier behavior
 - Increasingly poor judgment
 - Escalating vulnerability to “Black Swans”
- Like O-ring leaks, can see them developing
- Use Estimation Error Distributions
- Look for long tails

Quantitative Unpredictability Management

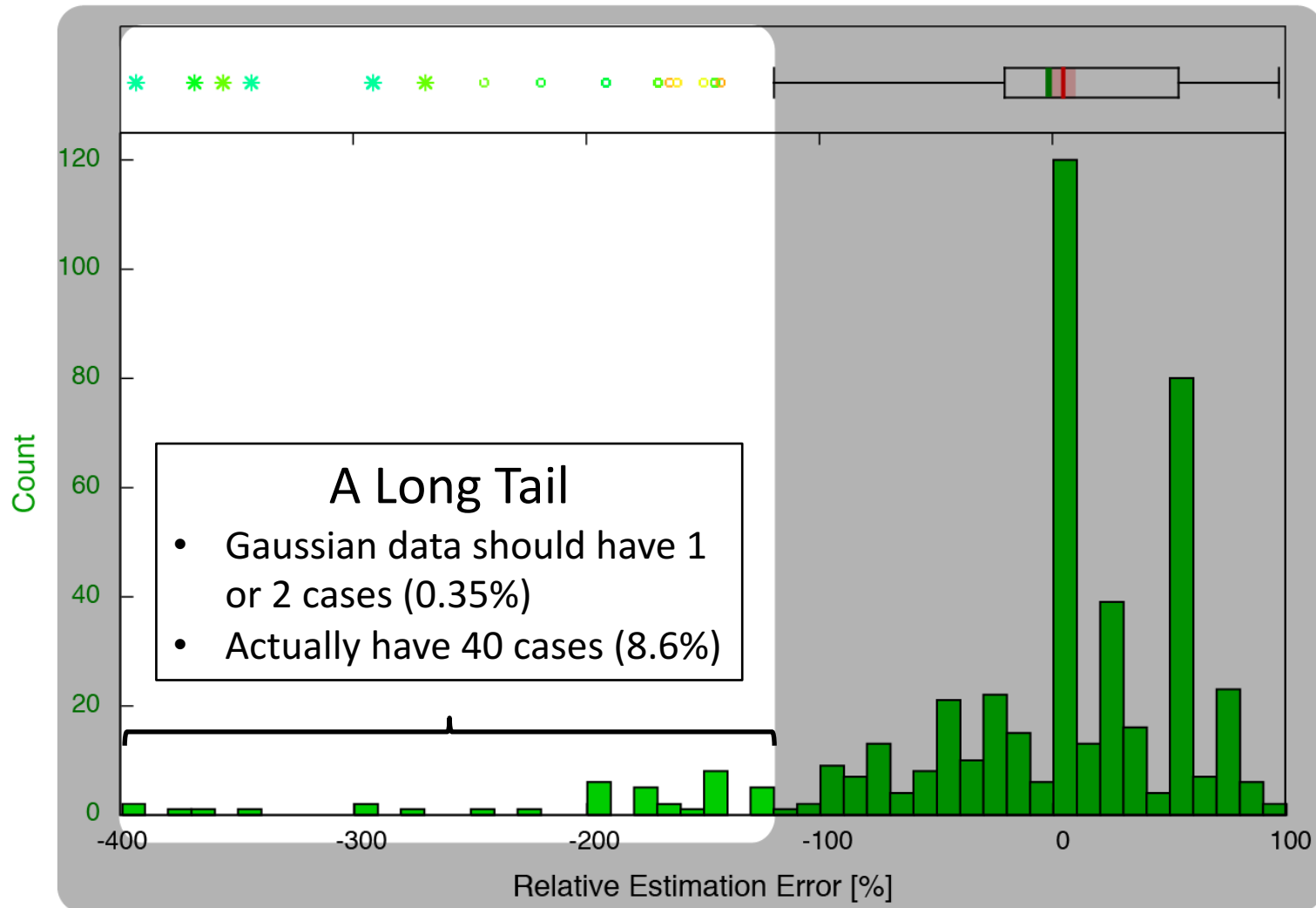
- You can't manage what you don't measure
- Track $Relative\ Estimation\ Error = \frac{Est - Actual}{Est}$



Decisions and Projects

Measure Unpredictability

Example Estimation Accuracy “Distribution”

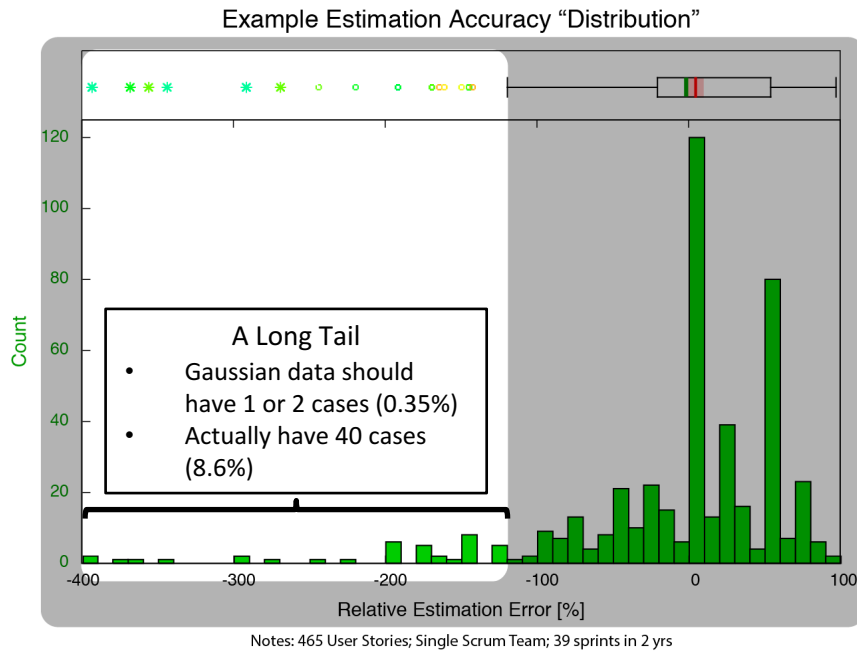


Notes: 465 User Stories; Single Scrum Team; 39 sprints in 2 yrs

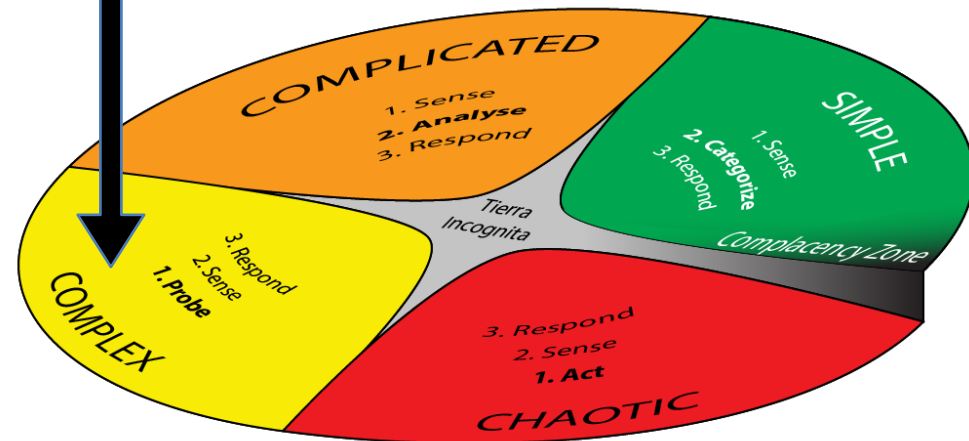
Decisions and Projects

Measure Unpredictability

Uses: Sense making with Cynefin



You are here!

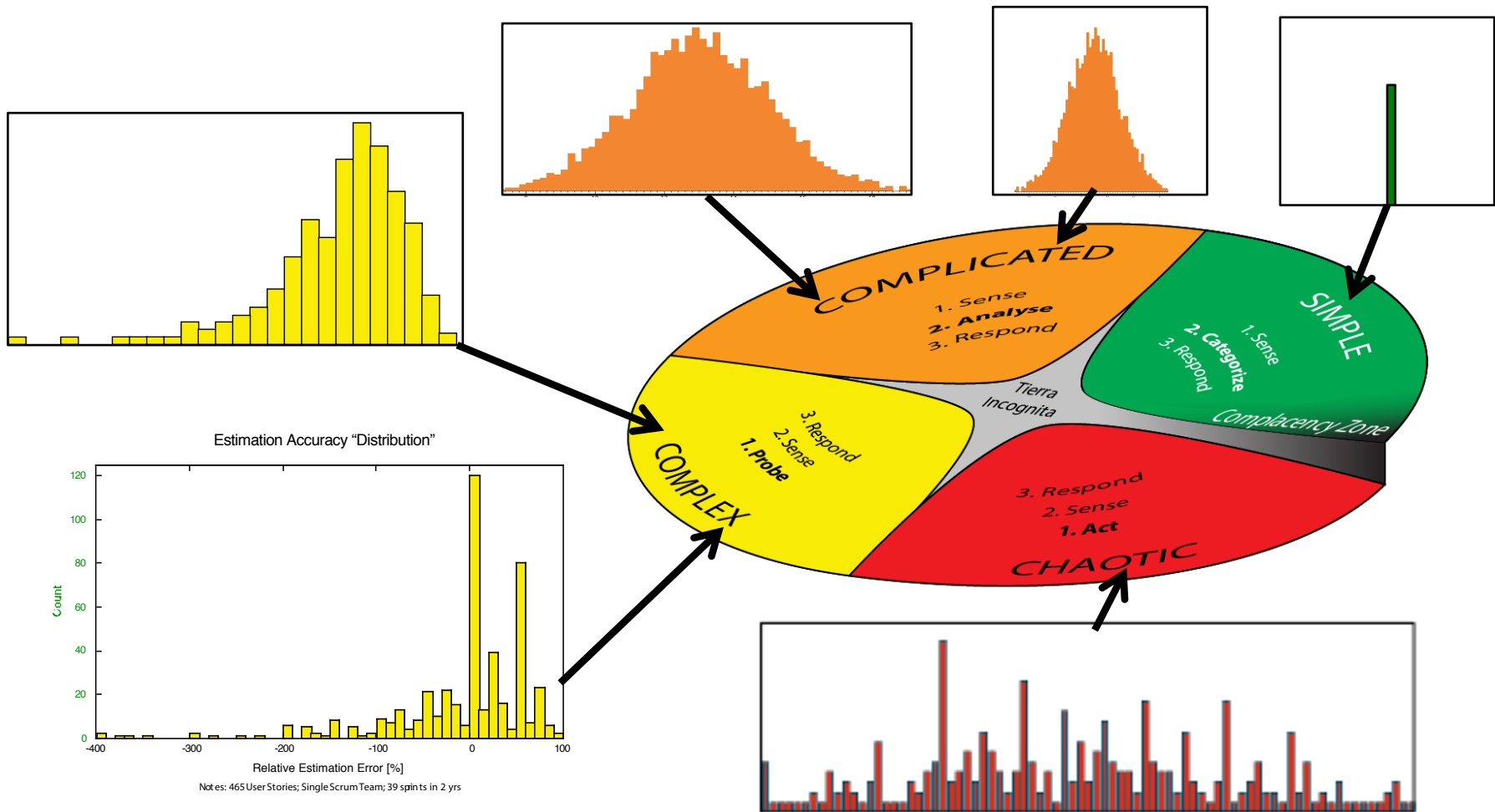


Decisions and Projects

Measure Unpredictability

Long tails deprive systems of *consistent* predictability

Waterfall requires LOTS predictability

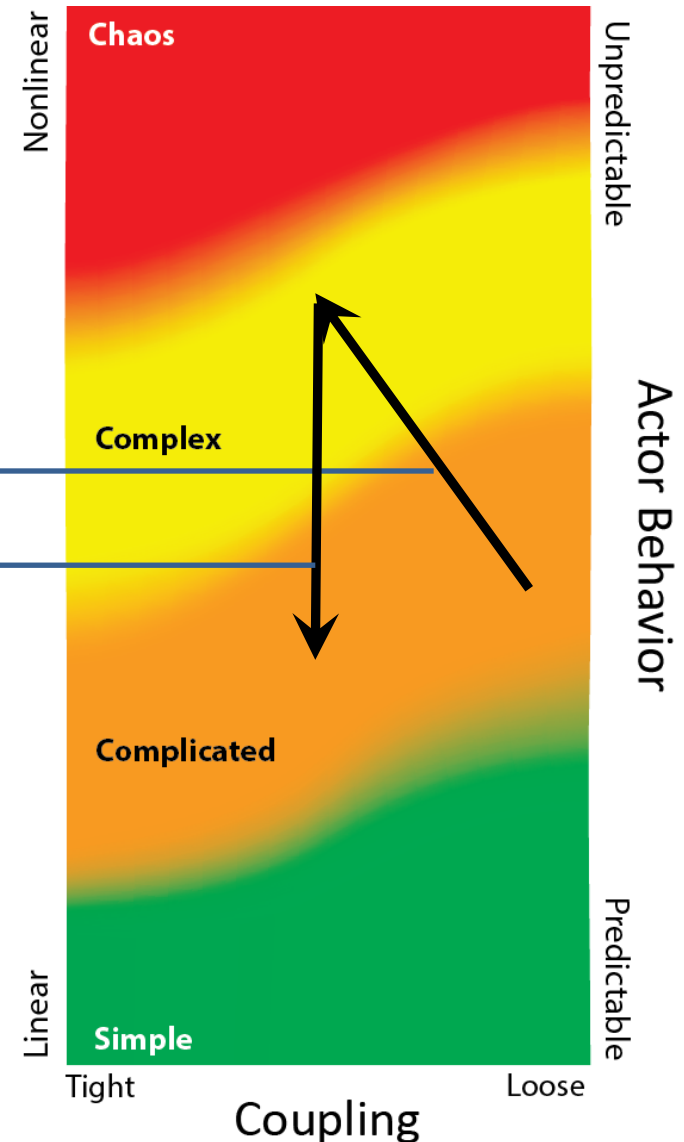


Decisions and Projects

Measure Unpredictability

Uses

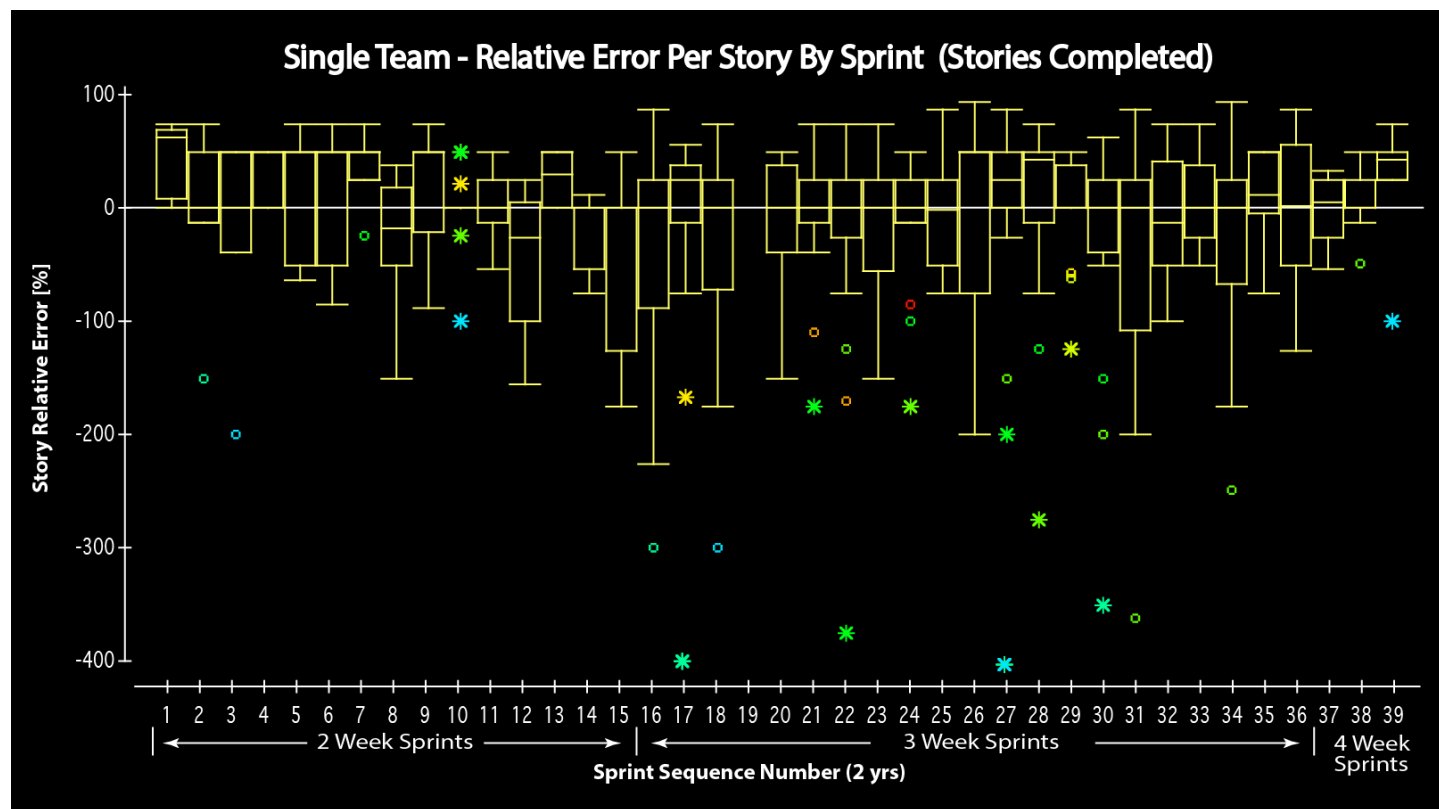
1. Sense making with Cynefin
2. Conversations with business
3. Seeing
 - Deterioration in code base/system
 - Effect of changes



Decisions and Projects

Source of Muri and Mura?

- Black Swan underestimation
 - Creates Muri and Mura
 - Undermines trust building
- Escalating stress and fatigue define negative feedback



Decisions and Projects

Protective Tools And Techniques

- Bias Guards
 - Become aware and understand biases exist
 - **Try to learn yours**
 - SWOT-style decision analysis
 - Manage stress
- Group Effectiveness
 - Understand and apply framing
 - Leaders must frame especially carefully
 - Use multiple frames
 - Monitor group dynamics for process losses
 - Watch for groupthink
 - Stimulate constructive debate (scenarios/pre-postmortems)
 - Include decision reviews in retrospectives
 - ***Fix membership problems promptly!***

Decisions and Projects

Protective Tools And Techniques

- Normalization of Deviance

Use THE FORCE

- Cognitive Dissonance
 - Engage a Truthsayer
 - Focus on (attach identity to) process, not outcome
 - Keep written records
 - Use honest metrics
- Understand the Culture Code
 - See the organization that is
 - If actions \neq words, ignore words



Decisions and Projects

Decision Accounting/Checks and Balances

- Set up checks and balances
 - Don't only self assess
 - Invite an outside auditor
- Use separate groups to
 - Approve projects
 - Monitor or cancel projects

Four User Stories

- **As an Agile Professional, I want to**
 - ✓ Apply findings from Decision Science to my work so I can be more effective
 - ✓ Avoid a death of 10,000 smells because dying that way sucks
 - ✓ Learn new tools to make better execution decisions and have better fact-based conversations with my stakeholders
- 4. **See Agile be deployed more successfully**

Take-Aways and Opportunities

The Columbia Disaster



Take-Aways and Opportunities

The Columbia Disaster

- Observations

- NASA *never* interviewed Vaughn
- Evidence of
 - Confirmation bias
 - Process losses in debris meetings

- The Columbia disaster investigation board:

The Foam Did It, But The Organization Let It Happen

- NASA

- Failed to learn from the Challenger experience
- Failed to meaningfully change its behavior

Take-Aways and Opportunities

Beware the Hypecycle!

- Project Management remains unsatisfactory
 - Stubbornly so since 1968 NATO Conference
- Agile is helping!
- Have we “Crossed the Chasm”?
- With increasing adoption comes increasing risk
- Failed adoption damages “the brand”
- Embrace critical thinking and critical decisioning

Take-Aways and Opportunities

Let's Use Gandhi's Formula

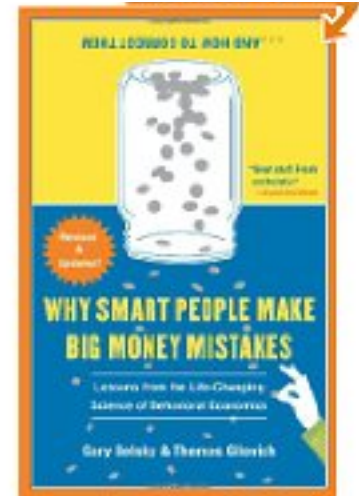
“Be the change you wish to see in the world”

Gandhi

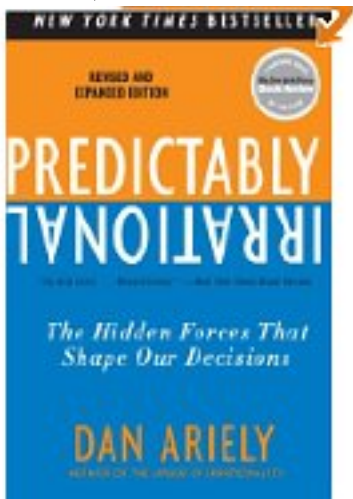
Let that change be enriched by critical decision making

Let's Get Started

- Why Smart People Make Big Money Mistakes and How to Correct Them, Belsky and Gilovich



- Predictably Irrational, Dan Ariely

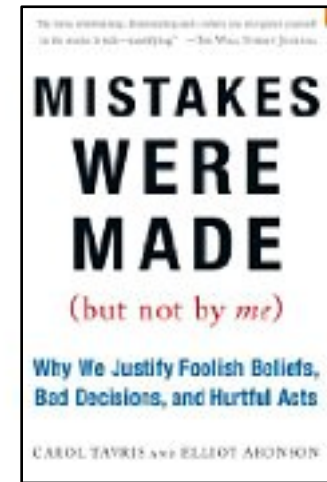


- Friendly Fire: The Accidental Shootdown of U.S. Black Hawks over Northern Iraq, Scott Snook

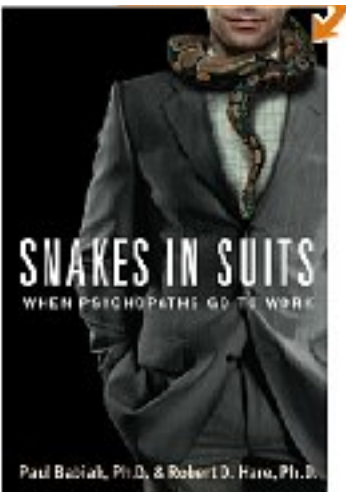


Let's Get Started

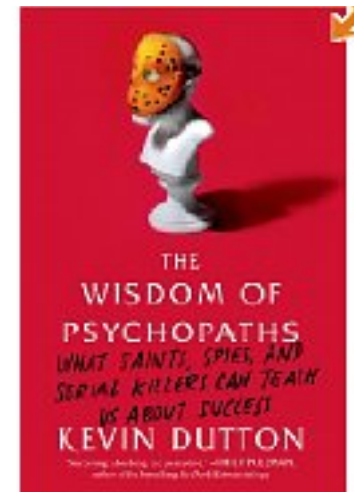
- Mistakes Were Made (But Not by Me), Tavris and Aronson



- Snakes in Suits: When Psychopaths Go to Work, Babiak and Hare



- The Wisdom of Psychopaths: What Saints, Spies, and Serial Killers Can Teach Us About Success, Dutton



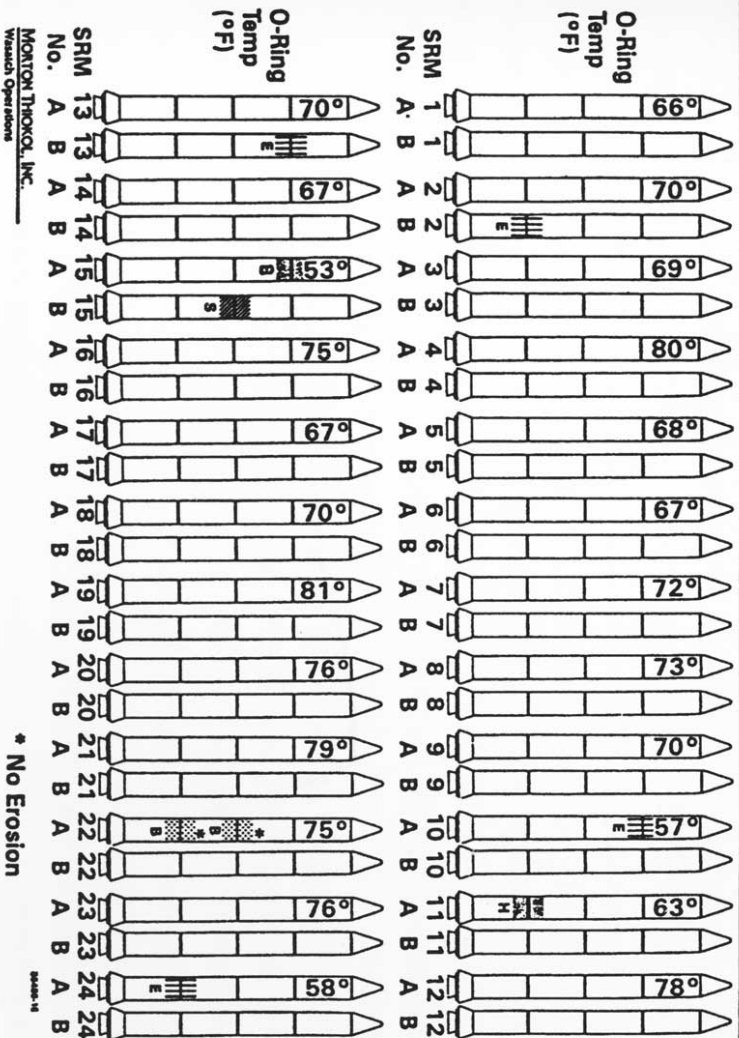
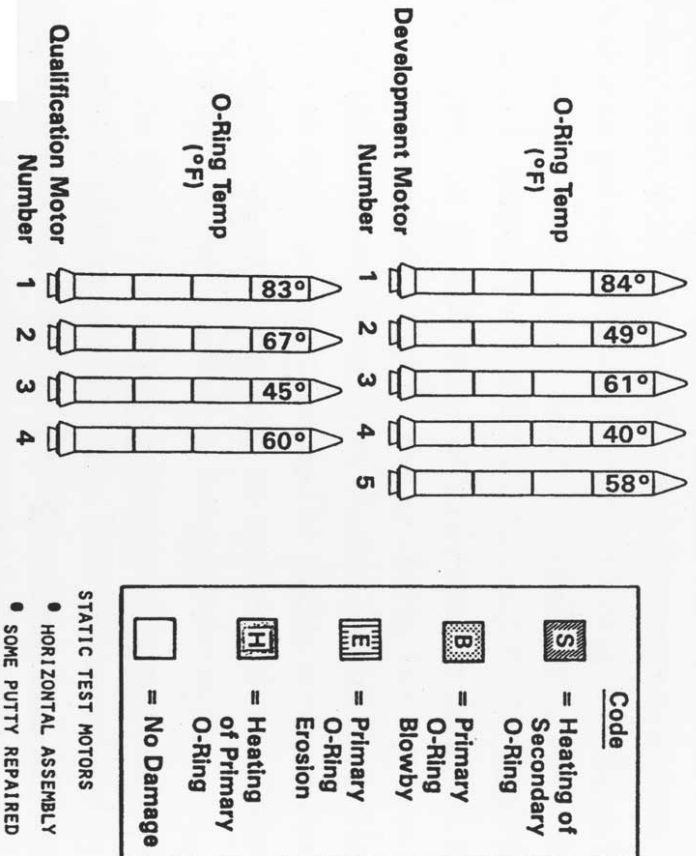
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Questions and Discussion

Appendix and Extras

Thiokol Record of O-Ring Erosion and Blowby

History of O-Ring Damage in Field Joints



* No Erosion

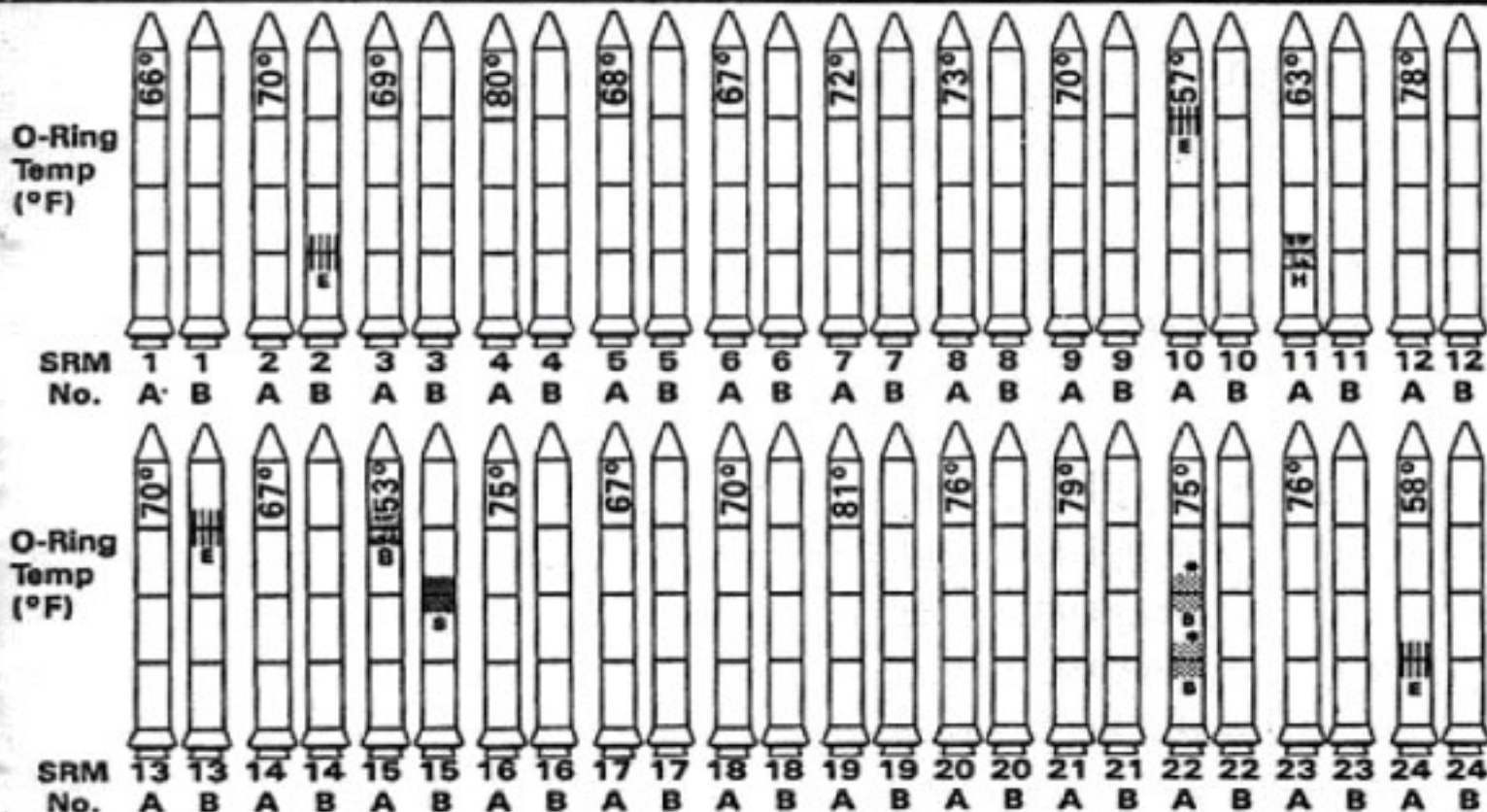
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Appendix and Extras

Thiokol Record of O-Ring Erosion and Blowby

History of O-Ring Damage in Field Joints (Cont)



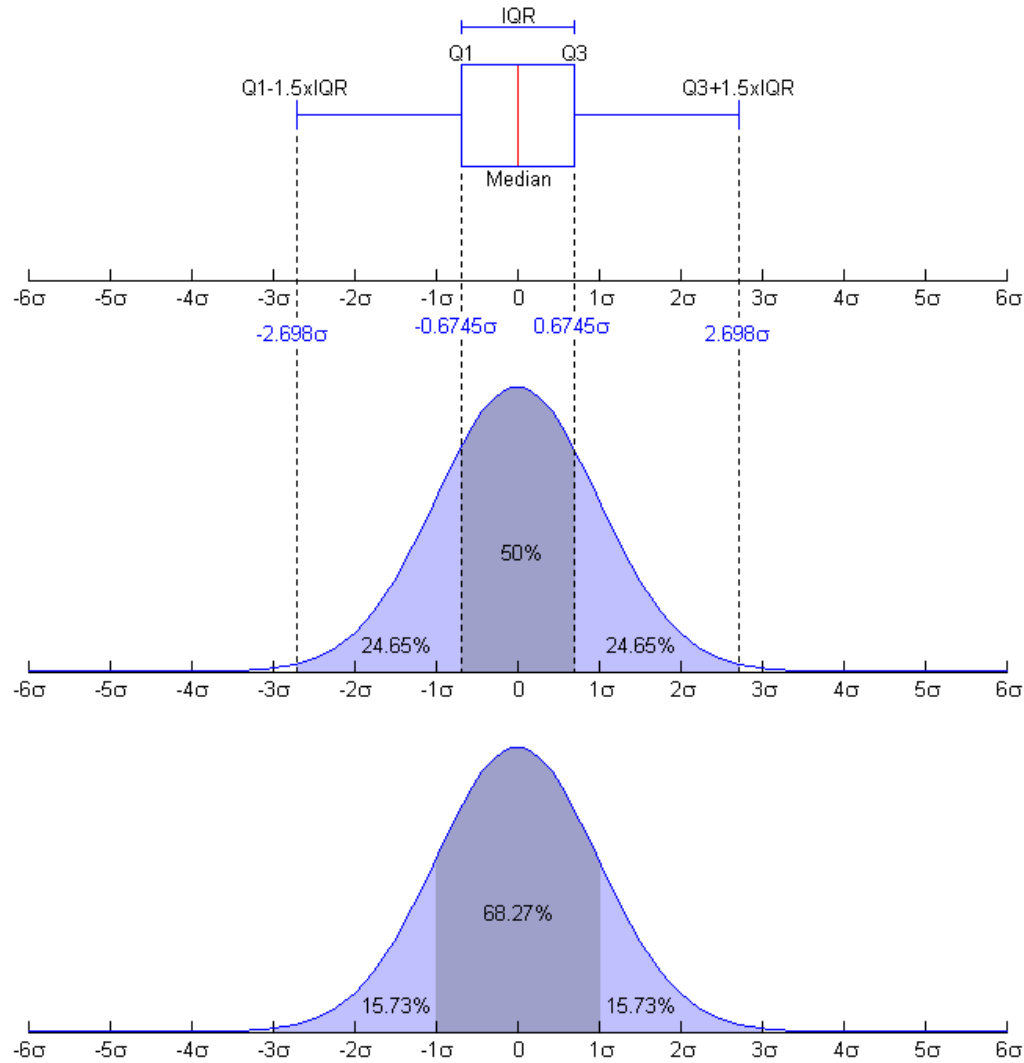
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* No Erosion

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Appendix and Extras

Boxplot Ranges Over The Gaussian Distribution



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