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Unique NAVIS-based Approach for Framing Dialog Regarding Nuclear Power Expansion

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Overview

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   Overarching Goal, Specific Objective, Approach
2. **Description of Work**
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   Current Status
4. **Summary**
   Review, Future Objective-Specific efforts, Other Applications

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Introduction

- **The overarching goal**: Sustain / Grow public support for Nuclear Power expansion based upon economic & environmental benefits; minimize NPP project delays or cancellations due to interventions
  - Not just among the general public, but various special interest groups
- **The specific objective**: Promote understanding of decision bias traps that may ensnare the unwary regarding public perception of nuclear power & provide specific communication strategies to pro-nuclear entities (e.g., utilities, government orgs., etc.)
- **The approach**: Leverage recently developed NAVIS-based decision making approach to explore public perceptions of potential approaches. The NAVIS-based approach includes:

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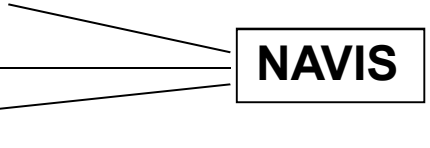
Approach

- **Simplified overview of general decision making approach:**
  - Explicit reflection upon knowledge limitations
  - Application of 10 specific, well-defined critical thinking skills
  - Understanding of relevant demographics and formation of diverse decision making team
  - Build & maintain trust among those impacted by decision outcomes
  - Identify bias processes using the NAVIS framework then select and apply strategies known to be effective in mitigating those identified biases
- **The Unique NAVIS taxonomy of decision making biases:**
  - 26 decision making **biases** grouped into 3 categories:
    - **N**ormative Knowledge
    - **Av**ailability
    - **I**ndividual **S**pecific



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A Unique Framework for Understanding Risk Perception & Decision Making

The NAVIS Framework

Normative – **Availability** – **Individual Specific**

- combinatorics
- probability theory
- statistics
- related critical thinking skills

Result from structure of human cognitive machinery

An individual's:
- Values
- Personality
- Interests
- Group identity
- Substantive knowledge

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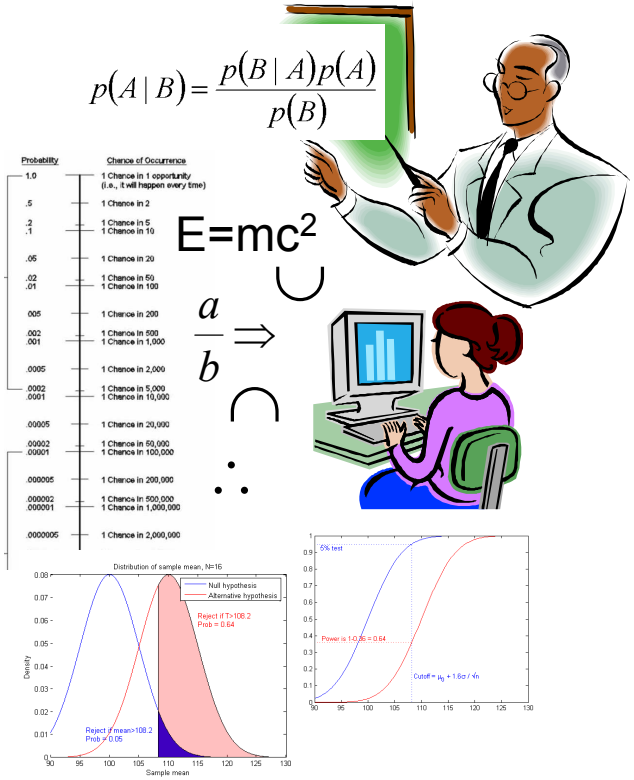
Combinatorics, probability, statistics and related *critical thinking skills*

Structure of human cognitive abilities

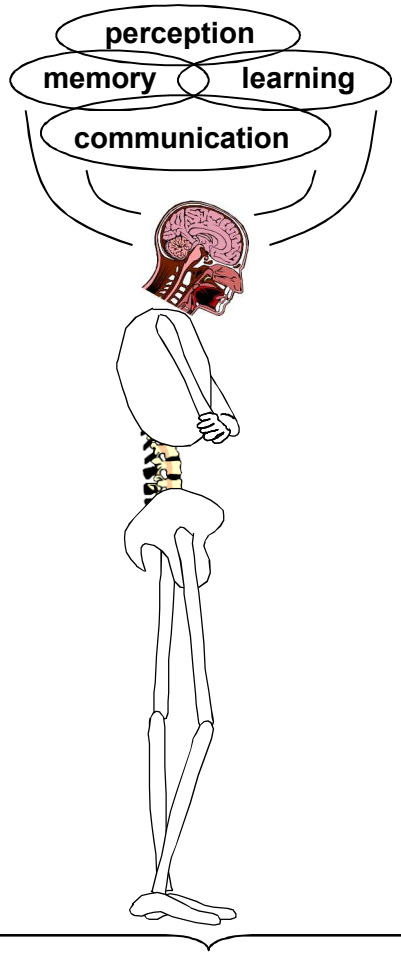
Values, personality, interests, group identity, substantive knowledge, and overarching *critical thinking skills*

Normative Knowledge



Number sense & analytical skill

Availability



The human 'machinery'

Individual Specific

A specific person

Normative Knowledge

- insensitivity to sample size
- means and medians estimated well
- coefficient of variation is noticed
- variance largely ignored
- gambler's fallacy
- small probabilities overestimated
- large probabilities underestimated
- as number of options change; probability assignments change dramatically
- overestimate the probability of conjunctive events (series combinations)
- underestimate the probability of disjunctive events (parallel combinations)

Availability

- anchoring effect
- illusory correlation
- recency
- imaginability
- salience
- retrievability
- representativeness
- explicitness
- framing effect

Individual Specific

- loss aversion
- law of effect
- constantly requiring more
- locus of control
- ambiguity aversion
- confirmation bias
- hindsight bias

Biases/tendencies that are related to each of the 3 main categories

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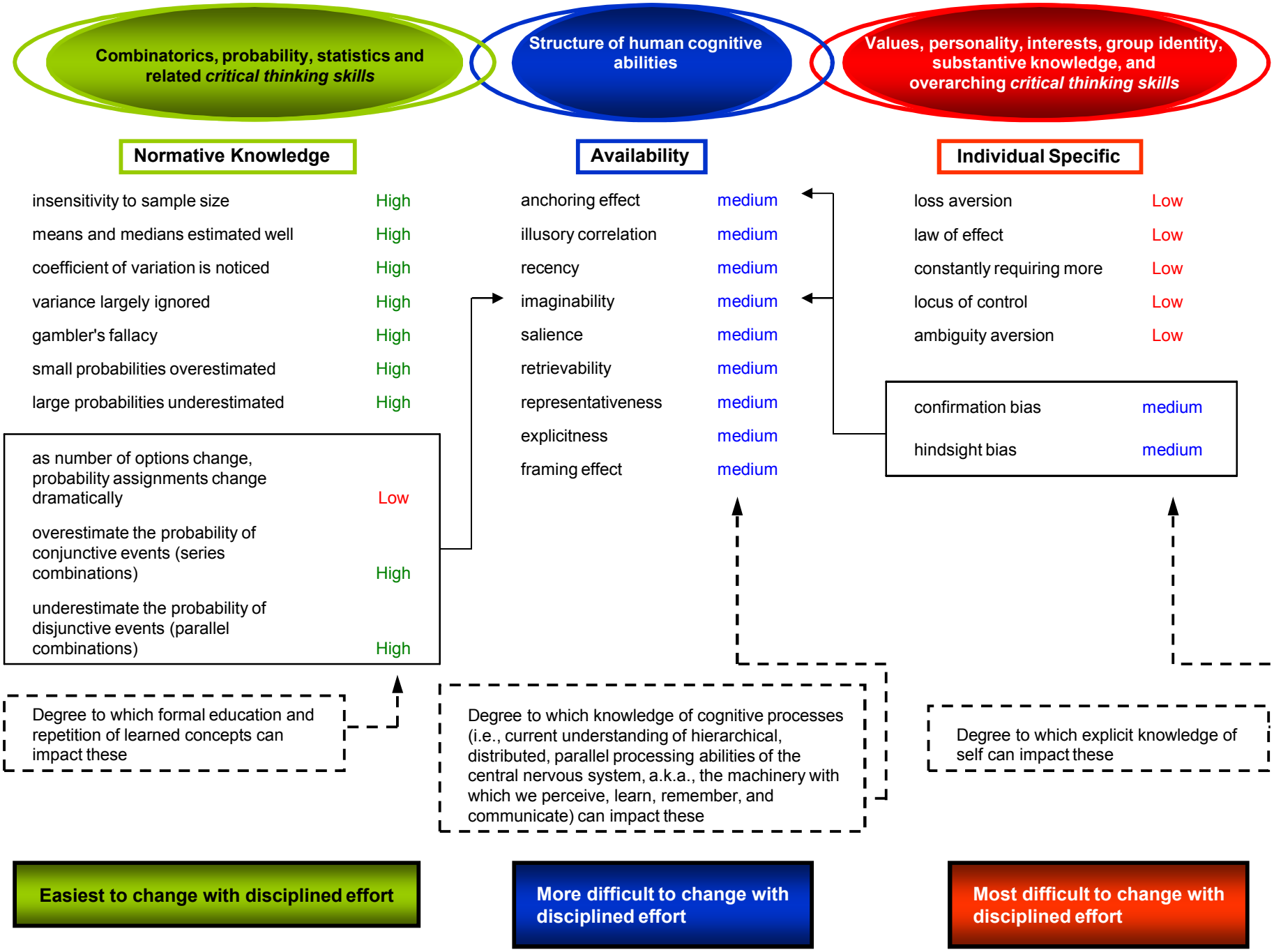

Combinatorics, probability, statistics and related *critical thinking skills*
Structure of human cognitive abilities
Values, personality, interests, group identity, substantive knowledge, and overarching *critical thinking skills*
Normative Knowledge
Availability
Individual Specific
insensitivity to sample size High
means and medians estimated well High
coefficient of variation is noticed High
variance largely ignored High
gambler's fallacy High
small probabilities overestimated High
large probabilities underestimated High
as number of options change, probability assignments change dramatically Low
overestimate the probability of conjunctive events (series combinations) High
underestimate the probability of disjunctive events (parallel combinations) High
anchoring effect medium
illusory correlation medium
recency medium
imaginability medium
salience medium
retrievability medium
representativeness medium
explicitness medium
framing effect medium
loss aversion Low
law of effect Low
constantly requiring more Low
locus of control Low
ambiguity aversion Low
confirmation bias medium
hindsight bias medium
Degree to which formal education and repetition of learned concepts can impact these
Degree to which knowledge of cognitive processes (i.e., current understanding of hierarchical, distributed, parallel processing abilities of the central nervous system, a.k.a., the machinery with which we perceive, learn, remember, and communicate) can impact these
Degree to which explicit knowledge of self can impact these
Easiest to change with disciplined effort
More difficult to change with disciplined effort
Most difficult to change with disciplined effort

Evaluation of critical thinking process?

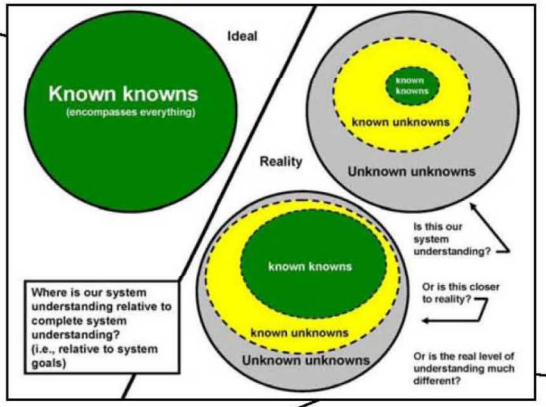
Realistic global view of system?

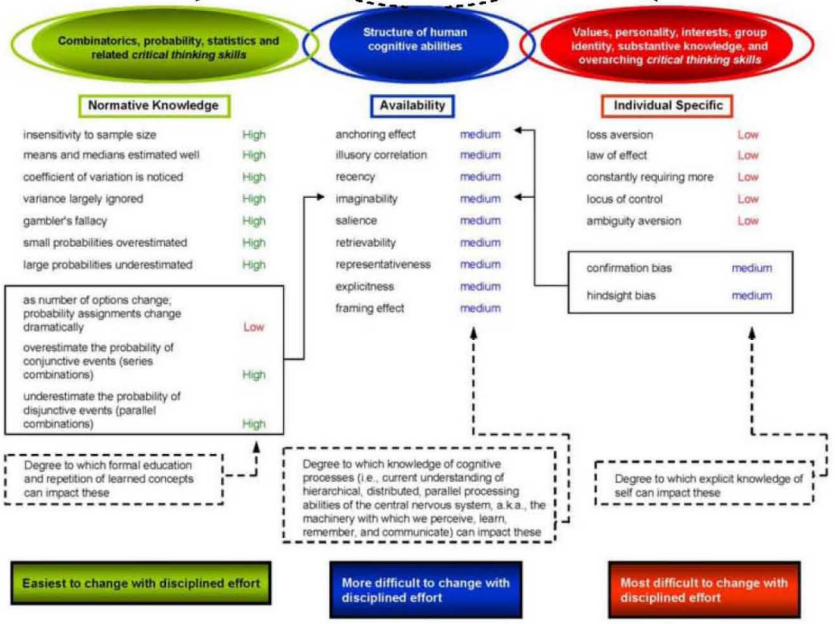
Structured search for & mitigation of biases?

Appropriate decision making team?

Critical thinking processes

1. Raising the **questions**: "What do we know…? How do we know…? Why do we accept or believe…? What is the evidence for…?
2. Clear and explicit awareness of **information gaps** (i.e., recognizing when one is taking something on faith).
3. Discriminating between **observation and inference**, between established fact and subsequent conjecture.
4. Recognizing that **words are symbols for ideas** and not the ideas themselves. Recognizing the necessity of using only words of prior definition, rooted in shared experience, in forming a new definition and in avoiding being misled by technical jargon.
5. **Probing for assumptions** behind a line of reasoning.
6. **Drawing inferences** from data, observations, or other evidence and recognizing when firm inferences cannot be drawn (i.e., **inference adequacy check**).
7. **Hypothetico-deductive reasoning**: apply relevant knowledge of principles and constraints, and abstract visualization of plausible outcomes from imagined changes imposed on the system.
8. Discriminating between **inductive and deductive reasoning**, that is being aware of when an argument is made from the particular to the general or from the general to the particular.
9. Test one's own line of reasoning and conclusions for **internal consistency**.
10. Develop **self-consciousness** concerning one's own thinking and reasoning processes.





Key elements of the decision	Key participants
Facts	Experts
Values	Experts & Non-experts (**Engenders TRUST**)
Blind spots	Experts & Non-experts (**Engenders TRUST**)

Expert = …someone who can solve a question much more quickly and efficiently than most, but who runs a higher risk than do other citizens of asking the wrong question altogether.
Perrow (1984)

Description of Work

- Application of approach to frame communication with members of the public who vary widely in their current knowledge and acceptance of nuclear power
  - ❖ Understand public priorities, values, attitudes, analytical skills, & knowledge bases
  - ❖ Strategic tailoring of communication approaches to achieve specific goals

Surveys (to gather information)

- Initial idea based on NAVIS approach:

  Maximally practicable failsafe design (MPFD)
  - ❖ "Risk comparability" or "first do no harm"
  - ❖ Begin debate with most failsafe practicable design (i.e., 5–10 times cost of currently accepted designs)

Strive for optimal engagement of wide audience – esp. those with entrenched* opposition attitudes toward nuclear power – in **Cost** vs. **Benefit** risk analysis process

* Not those who are "die hard" anti-nuclear; unwilling to engage in any type of rational debate.

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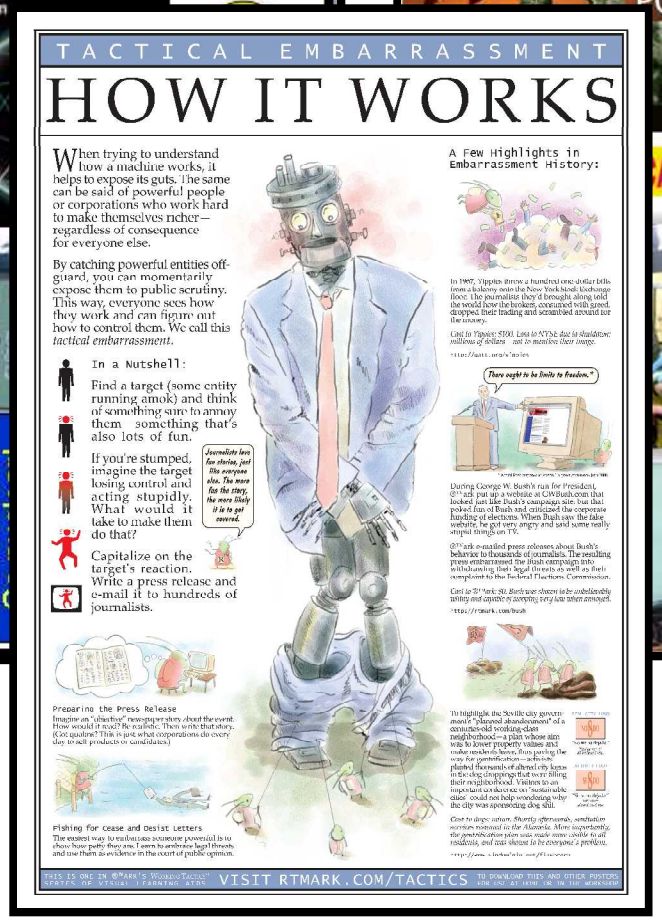
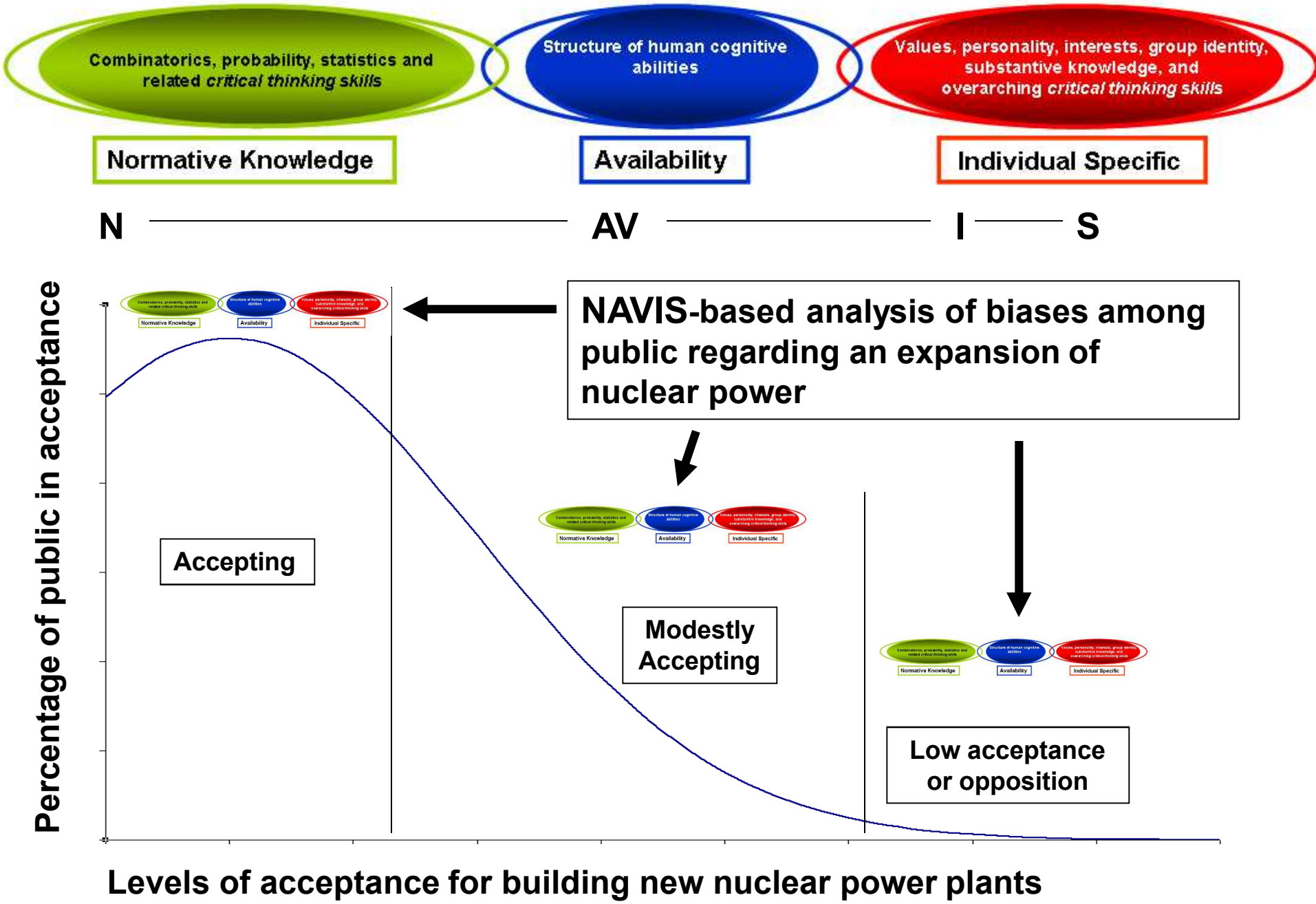
“Pro” versus “No”



Polarized debate:
“Us” versus “Them”

Strategy:
Viciously attack & discredit

Spiral of stereotypes ensues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Structure of human cognitive abilities
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Normative Knowledge
Availability
Individual Specific
N
AV
I
S
Percentage of public in acceptance
NAVIS-based analysis of biases among public regarding an expansion of nuclear power
Accepting
Modestly Accepting
Low acceptance or opposition
Levels of acceptance for building new nuclear power plants

Multiple of 'cost' → 1x 2–3x 10x

D-I-D Protection 'safety' → Extensive Very Extensive Maximally practicable failsafe design

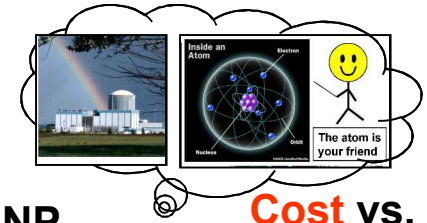
'reasonable cost & safety' per NPP industry

Start Here

Move this direction

% of people willing to live at specified distance

4.5
4
3.5
3
2.5
2
1.5
1
0.5
0



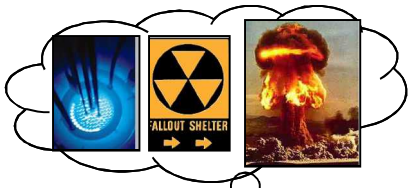
NP Best!

Cost vs. Benefit!

Highly supportive

Cost vs. Benefit?

Accepting to Modestly Accepting



Cost! vs. Benefit!

NP Evil!

Strongly oppose

0 10 20 30 40 50 60 70 80 90 100

Distance in miles from power plant

Results – Current Status

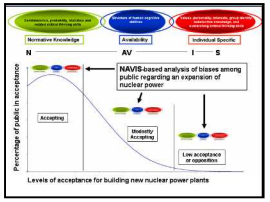
- Two data collection efforts were initially considered
- One data collection effort will begin soon

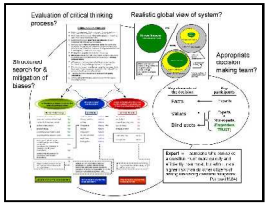
The results of this initial investigation promise to increase the prospective strategic power and transparency of communication techniques in order to reduce “message misinterpretation risk” and increase public acceptance of the expansion of nuclear power

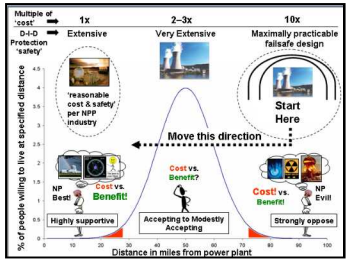
Summary

For more information:
Google: SAND2005-5730

- Goal: Increase public support for nuclear power expansion; minimize delays or cancellations
- Objective: Develop specific communication strategies; identify potential communication traps
- Approach: NAVIS-based
  - Survey to be conducted
  - Initial idea: Maximally Practicable Failsafe Design (MPFD)







- **PRA / PSA**
- **Nuclear Energy Policy**
- **Various "Mega-projects"**
- **Improved life-cycle system engineering for various complex, high-consequence systems**
- **Emergency Response Ops.**
- **Management Leadership Training**
- **Strategic & Tactical Decision Making – Military Applications**

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Back-Up Material

Critical thinking processes

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Decision Making Strategy

Six Basic Steps:

1. Explore individual specific attributes, knowledge of cognitive capabilities, & normative knowledge.
2. Make an initial attempt at articulating the decision domain.
3. After one or more iterations, review composition of decision team.
4. Create baseline with new team members.
5. Repeat step # 2.
6. Conduct time portal to failure technique (TPTF). Iterate.

Much more specific guidance & specific bias mitigation techniques in the full report: SAND2005-5730

Bias mitigation techniques – short list

- To combat confirmation bias – reiterate what it is, with examples (review suspects with **10 critical thinking skills**)
- Tolerate **opposing** points of view (helpful until contrary is proven – probe with 10 critical thinking skills) – don't fall into **'spiral of stereotypes'**
- Be mindful that the '**availability**' category of biases is an artifact of human cognitive 'machinery' – use this insight to depersonalize and diffuse conflicts
- Separate **factual** or **technical** questions from **value** judgments (e.g., 'how likely is a particular accident sequence?', versus 'how safe is safe enough?')
- Where might **blind spots** lie? Unknown Unknowns? Where do we think the borders of the known unknowns are?
- If scenarios are restricted to ≤ 6 steps, ≤ 6 decision metrics; **stop** & **reflect**, are **working memory** limitations restricting the process?

Bias mitigation techniques – short list

- Increase the **substantive knowledge** of team members (especially new team members) on the specific decision topic; be prepared to teach new team members the 10 critical thinking skills & biases/tendencies with decision domain specific examples
- People are **loss averse** and seek to gain, often the concept of loss is not associated with (or normalized by) total changes in wealth, safety, or anything else. **What do people really consider as gaining and losing?** How are the **mental accounts** structured?
- Create ways to describe the probability distributions to the populations of interest. Numerous well-developed likelihood comparisons & be clear on underlying assumptions
- Be wary of the **Hind Sight Bias**, “I knew that wouldn’t work...”

References (just a handful)

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