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Human Supervisory Control

# Naturalistic Decision Making



Massachusetts Institute of Technology

# Naturalistic Decision Making

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- How experts make decisions in the real world
  - Descriptive method
  - Stress, time-pressure, dynamic conditions, ambiguous information, and ill-defined goals
- Heuristics may introduce bias but can be very powerful.
- Other related research areas:
  - Behavioral decision theory
  - Judgment decision making
  - Organizational decision making

Group of behavioral scientists who shared common theme of “the importance of (1) time pressure, (2) uncertainty, (3) ill-defined goals, (4) high personal stakes, and (5) other complexities that characterize decision making in real-world settings.”

2nd theme was to study people with expertise during the decision making process

3rd theme was that people appeared to size up situations with more importance than they would select between courses of action

# NDM vs. Classic Decision Theory

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- People are not always “rational” decision makers
  - But people are proficient
- Situation-action matching decision rules
  - As opposed to choosing an alternate
- Context-bound informal modeling as opposed to context-free formal modeling
- Process orientation as opposed to prediction of outcomes
- Empirical-based prescriptions

# Forms of NDM

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- **Recognition primed decision making**
- Related theories/methods
  - Critical decision method
  - Explanation based theory
  - Image theory

# Recognition Primed Decision Making (RPD)

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- Intuitive form of diagnosis and prediction
  - Pattern matching
- Multiple cues, highly correlated
  - Key observations
- Requires learning and expertise
  - Experts choose feasible course of action without analyzing all or even many options
- Decision making under uncertainty, time-pressure, & stress
  - Military commanders & firefighters
- What biases might we see in RPD?

# RPD Process

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- Boundary conditions: expertise, time-pressure, uncertainty/ill-defined goals
- Recognition
- Situation Understanding
  - plausible goals
  - critical cues
  - expectancies
  - typical actions
- Serial Evaluation
- Mental Simulation

# Coping With Uncertainty

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- Inadequate understanding, lack of information, conflicted alternatives
- RAWFS heuristic
  - Reducing uncertainty
    - Gathering more information
  - Assumption-based reasoning
    - Filling in gaps
  - Weighing pros and cons
  - Forestalling
    - Anticipate undesirable consequences
  - Suppressing uncertainty
    - Rationalization

# Recognition/Meta-cognition Model

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- Another model (framework?) for how decision makers cope with uncertainty
- Pattern matching critical
- What happens when recognition fails?
  - Decision makers revert to assumption-based reasoning and meta-cognitive processes
    - Attempt to find flaws & weaknesses in evaluation
- **STEP: Construct a story, test, evaluate, & plan**
  - A prescriptive approach

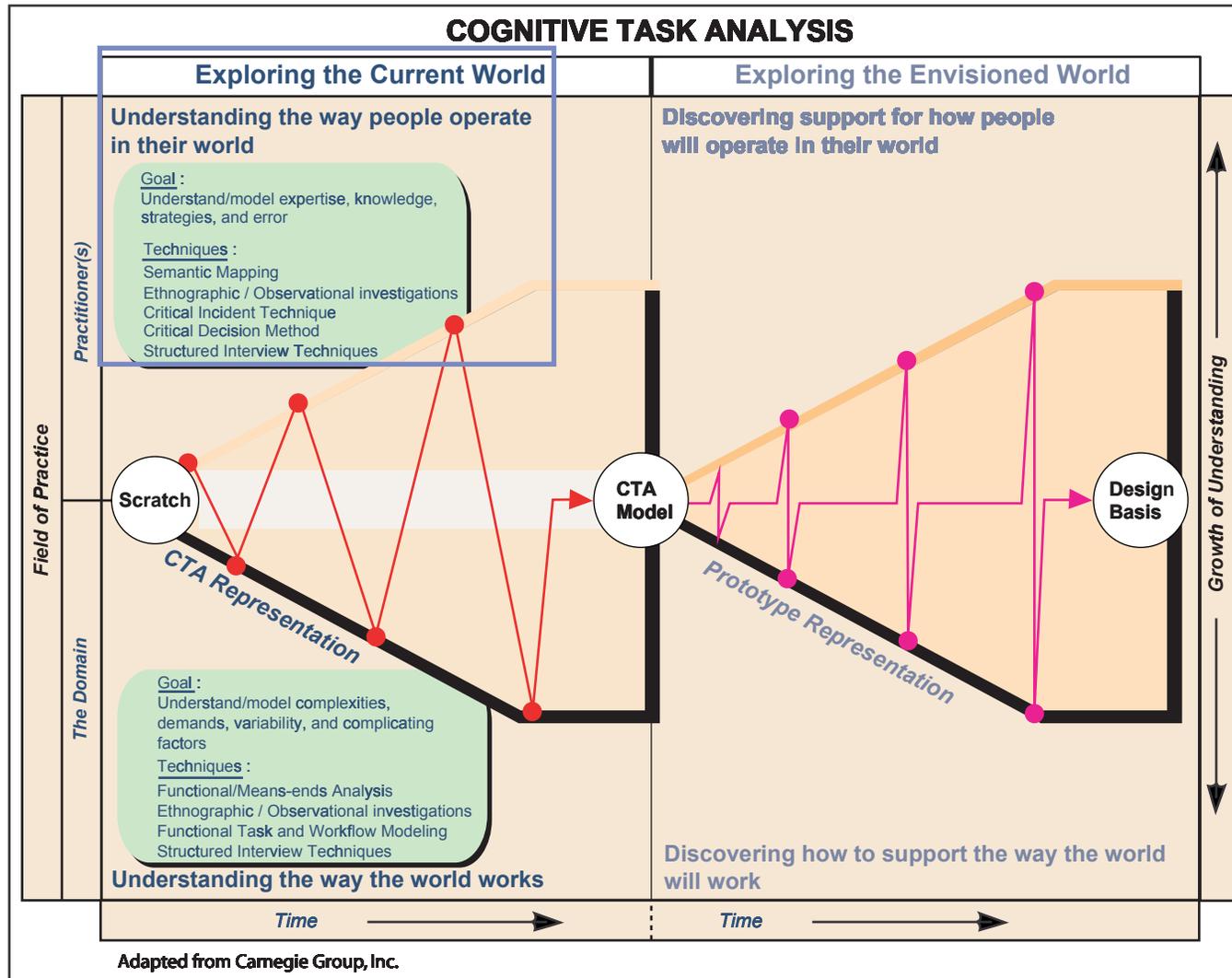
# NDM and Teams

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- How does team decision making differ from individual?
- Team SA and shared mental models
- Studying teams in their natural environment
  - Real teams performing real tasks in real settings
  - Contextual focus as opposed to more general and abstract
- Team research is not easy

# CTA Methods for NDM Research



- critical decision method in which participants are asked to describe a specific decision-making incident in detail and then to respond to probes seeking elaboration of **important aspects** of the decision sequences.
- Semantic mapping (a.k.a., mind-mapping, idea mapping, word webbing, etc.) is a term which describes a variety of strategies designed to show how key words or concepts are related to one another through graphic representations. Mapping is an *effective* technique for teaching vocabulary and textual patterns of organization; and it is also *effective* for improving note taking and creative thinking skills.

# Evaluating NDM Studies

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- Laboratory vs. real-world settings
- Credibility determined by:
  - Quality of research questions
  - Data collection methods
  - Suitability of methods for research questions
  - Plausibility of answers
  - Reasonableness of assumptions
- Transferability
- Cognition in the wild

# Forms of NDM

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# Critical Decision Method

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- Retrospective interview technique
  - Cognitive probes used to elicit knowledge and strategies used in expert decision-making
  - Non-routine events
- Based on critical incident technique (1954)
  - What led up to the situation?
  - What action was effective or ineffective?
  - What was the outcome or result of this action?
- CDM focuses on identifying critical cues, judgments, & decisions
  - What-if queries

John Flanagan is the originator of the CIT method. Read more at <http://www.air.org/overview/flanagan.htm>

More CIT: <http://www.apa.org/psycinfo/special/cit-intro.pdf>

<http://www.emmus.org/html/frames/guidelines/EmmusWP3/methods/cit.html>

# Explanation Based Model

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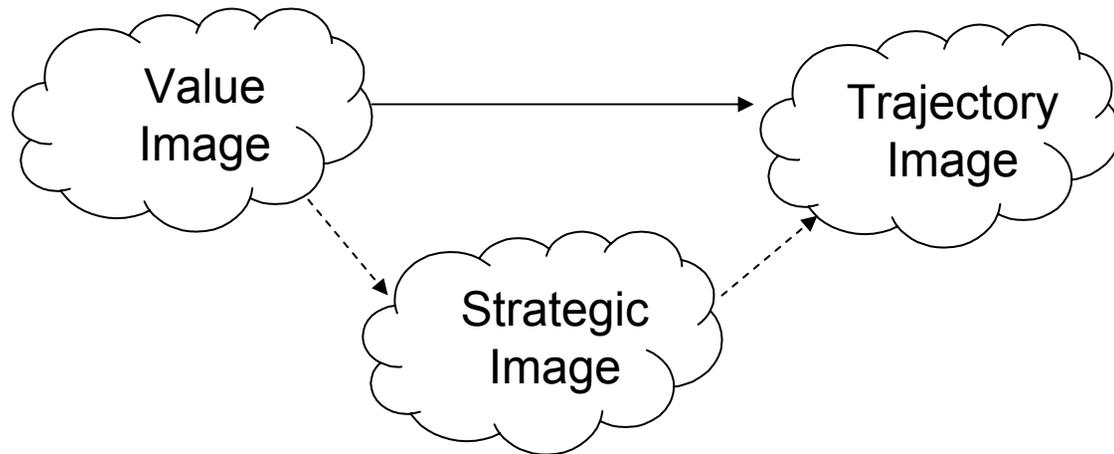
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- Need to generate a coherent story and match that story against possible choices
- Formulating a full story based on incomplete facts
  - Filling in the gaps
  - Expectancies
  - Recall long term memory discussion
- Match hypothesized story with possible outcomes
  - Modifying story to achieve a desired outcome is possible
- Where might we see this in aviation accidents?

# Image Theory

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- Decisions are not discrete events but a more complicated process
  - Progress Decisions: Are past decisions are being adequately carried out?
  - Adoption Decisions: Consideration of new goals, plans, principles or actions,
- Problems
  - Unclear underlying goals
  - Poor planning or implementation of strategy
  - Values insufficient or incorrectly defined



# Cognitive Continuum of Decision Making

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Social Judgment  
Theories (Lens Model)



## Analytic Decisions

- Analytic strategies
  - Example: SEU
- Concurrent options
- Unbounded rationality
- Optimization with constraints

## Intuitive Decisions

- Naturalistic Decision Making
  - Example: RPD
- Serial options
- Bounded rationality
- Fast & frugal heuristics

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