Human Decision Making – Theory and Practice

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Today's lecture

- Decision-making and the IP-model
  - Cognitive processes
  - Heuristics & Biases
- Two alternative models
  - Recognition Primed Decision-making (RPD)
  - Skills-Rules-Knowledge Framework (SRK)
- Experiences from field studies

Decisions? What do we mean?

- The formulation of the problem will determine our interpretations and descriptions of the decision-makers actions
  - Is the decision an event or a process?
  - Are the goals and purposes important or not?
  - What kind of problem do we focus on?
  - What is the role of the situation, the context and the domain-specific knowledge?
Uncertainty

- The degree of uncertainty varies
- How do we model uncertainty?
  - Classical decision-making solves this with risk calculations, probabilities and assumptions
  - Are humans "intuitive statisticians" or "intuitive engineers"?

Domain knowledge/expertise

- The decision-makers domain knowledge varies
- What conclusions can be made -
  - When you ask students to answer general knowledge questions?
  - When you study experts abilities to answer domain-specific questions?

Is the time important?

- Shall judgments and decisions be looked upon as a series of independent or interdependent events?
- How do time pressure affect the decision-makers performances and behaviors?
**What is a good decision?**

- An optimal decision is =
  - Maximum outcome compared to an in advance subjective expected value?
  - In hindsight state of fact, the best imaginable outcome in terms of result?
  - When the most knowledgeable and suited expert has decided what to do?

**The Gottröra-crash**

**Decision Theory I**

- Normative decision-making
  - A prescriptive perspective
    - Prescribes how a decision must be made, for example in order to maximize profit or minimize losses
    - Several studies show that people deviate from such optimal decision strategies, both in terms of outcome and behavior
    - Humans are "bad intuitive statisticians"
    - Motives for development of decision aids and decision support systems
Decision Theory II

- Decision-making and cognitive processes
  - A cognitive perspective
    - Explains human decision-making in terms of "heuristics & biases"
    - Underlying principles such as frequency gambling and similarity matching lead to a number of phenomena ("Representativeness-, availability- & anchoring heuristics, overconfidence-, confirmation- & hindsight biases")

Decision Theory III

- Naturalistic decision-making
  - A holistic perspective
    - Aiming for descriptions of decisions in close relation to context- and situation-specific demands
    - Study decision-makers in representative contexts
    - Allow domain-specific expertise to be a precondition for the decision-making

Decision Theory IV

- Skilled and opportunistic decisions
  - An engineering perspective
    - Acknowledge the fact that humans learn, and as a consequence, act differently when they develop expertise
    - Explains decisions in terms of cognitive and contextual hierarchies
Three models

- **IP-model**
  - From the cognitive perspective
  - Method: Laboratories + Experiments
- **Kleins RPD-model**
  - Naturalistic and dynamic contexts
  - Method: Field studies + Analyses
- **Rasmussens SRK-model**
  - An engineers perspective
  - Method: Case studies + Trouble shooting

Perception

- Humans have difficulties to
  - Judge relative frequencies of extreme values
  - Extrapolate non-linear trends
  - Judge the size of co-variations when correlations are very high or very low
- Hypotheses testing with cues
  - The product of a diagnostic value of a cue and its reliability is used to estimate the information value of that cue
  - The physical characteristics of a cue decide its importance in a decision task
Attention

- Problems when integrating cues
  - Very often information is missing
    - "A distinguished decision maker knows what's missing in terms of information"
  - Abundance of information sometimes lead to cognitive overload
  - Information that is easy to understand and obvious is used at the expense of information that is non-transparent and difficult to access
  - People tend to not consider the relative value of cues

Long-term memory

- Two basic cognitive heuristics
  - Representativity: similarity-matching
    - "I know this situation from........"
    - When we have a lot of relevant cues
  - Availability: frequency-gambling
    - "This situation happens when........"
    - When cues are ambiguous and domain-specific expertise is low

Faulty decisions

- In situations of underspecification, the cognitive system tends to react with operations, heuristics, that have previously shown to be useful
- As a consequence, a number of different kind of errors and mistakes will arise on all levels of cognitive activity
Long-term memory cont.

- Long-term memory and systematic errors
  - Overconfidence phenomenon
    - We think we know more, and perform better, than what is actually the case
    - Scientists argue about the value of the phenomenon
  - Confirmation phenomenon
    - We tend to search for evidence in order to maintain existing comprehensions, rather than critically examine our assumptions

Working memory

- How do we choose between different alternatives?

Practise for learning

- Problems to get feedback on actions
  - Feedback is often ambiguous, the causal relations between choice and outcome is often uncertain
  - Feedback is often processed selectively, and unsystematic
  - Feedback is often delayed
    - Dead-time
    - Time-constants
    - Action information feedback
RPD: Point of departure

- Decision contexts are characterized by
  1. Unstructured problems
  2. Uncertain, dynamic contexts
  3. Shifting, ill-defined and conflicting goals
  4. Decision processes in terms of action-feedback loops
  5. Time pressure, real-time, different time-scales
  6. Strong interest och large responsibility
  7. Several stakeholders
  8. Organizational objectives and norms

Unstructured problems
Uncertain dynamic contexts

M/S Sleipner before....

....and after

Action-feedback loops

Time pressure, real-time and different time-scales
Strong interest and large responsibility

Several stake-holders cooperating

Organizational objectives and norms
Kleins RPD-model

- Important differences compared to the IP-model
  1. Focus on situation awareness
  2. Utilizes experience and competence
  3. Immediate identification of reasonable solution
  4. “Satisficing”, good enough is enough
  5. Judging alternatives one by one
  6. Evaluation in terms of mental simulation
  7. Preparation for action continuously

Rasmussens SRK-model

- Decision-making at two levels
- General human characteristics in terms of abilities and limitations
  - Example: Working memory limitations affect almost all office work negatively
- Domain-specific competence in terms of expertise within a certain domain
  - Example: Train-drivers must have route-knowledge in order to stop at the platform
SRK cont.

- General human knowledge
  - Models from cognitive psychology

- Domain-specific knowledge
  - Three-level taxonomy model
    - “Skills”
    - “Rules”
    - “Knowledge”

SRK: Knowledge

- Problem space = mental models
  - Whole-parts relations
  - Means-end relations
  - Causal relations

- Process-rules in terms of:
  - Rules of thumb
  - Model development
  - Transformation of models
  - Matching between abstraction levels
  - Cognitive walk-throughs

SRK: Rules

- Problem space = implicit rules
  - Rules in terms of matching between impressions and actions
  - Action-response models (implicit)

- Process-rules in terms of:
  - Situation-based rules (if-then)
  - Actions directed toward physical or symbolic objects in the work context
SRK: Skills

- Problem space = internal dynamic models about closest surrounding
  - Closest surrounding and the own body
- Process-rules in terms of:
  - Not relevant here, behavior is controlled by fluctuations in the nervous system

SRK: Levels of signals

- Knowledge level – Symbols are the units on which knowledge-based behavior is based
- Rule level – Signs lead to rule-based behavior, if-then situations
- Skill-level – Signals lead to automated actions, pattern-matching

SRK: Supports expertise

- The advantage with the SRK-model is that it gives possibilities to design dialogues and process pictures with the level of expertise in mind
- This is especially important in contexts where domain-specific knowledge is a precondition for a decision adapted to the context and situation
Our theoretical model

Requirements in order to control a system:
• goals (G)
• models (M)
• actions (A)
• observations (O)

Rapid decisions I

Rapid decisions II
Generations of decision support systems

[Images of various decision support systems]

[Another set of images related to decision support systems]