Dynamic Decision Tasks

- A series of decisions required
- The next decision depends on the outcome of the previous one(s)
- Environments change
  - as a function of the decision(s)
  - autonomously
- Clock-driven (real-time) v.s. event-driven tasks
- Interaction between players

What is dynamic decision behavior?
- Task performance
  - Single / aggregate, consistent / conflicting
- Learning (task knowledge)
  - Verbalizable / non-verbal, declarative / procedural
- Decision efforts
  - Time
  - Information use
- Decision quality
  - Decision scope
  - Reliability
- Decision making architecture
  - Networked / hierarchical

What can explain / predict dynamic decision behavior?
- Decision makers
- Task complexity
- Decision-making interfaces and environments

Four predictors related to decision makers:
- Computing skills
- Cognitive / learning style
- Task expertise
- Task experience / practice

Computing skills - Not found to be directly relevant
Cognitive / learning style
- Almost without relevance, except Abstract in Gregorc Style Delineator -- learning concepts first, then examples
- Test intelligence in the European literature
Task expertise
- Task performance affected by academic background / long-term expertise or by pre-task training on task domain knowledge?
- Task domain knowledge helps learning decision heuristics?

Task experience / practice
- Improves task performance, reduces decision time
- Task knowledge acquired? = video game effect, dissociation between performance and learning
- Types of task knowledge

What can explain / predict dynamic decision behavior?
- Decision makers
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Real-time / event-driven simulation tasks
- No effect on task performance and decision time found
- Have to be replicated in simple tasks

Total number of variables: degrading task performance
Random variation: degrading task performance
Interaction between subsystems
- Supposedly a negative effect on task performance, but a positive effect found
- Types of subsystems (positive and negative loops)
- Dominance of loops

Positive feedback gains
- Enlarging trivial error, side effect
- Task performance degraded
- Decision time unchanged
- Reduce decision scope (decision rules attempted)
- Task knowledge?
- Lagged effects (delays), decision effectiveness, and oscillation
  - Time lag ignored → over-aggressive action?
  - Task performance degraded
  - Information use and decision-architecture unchanged
  - Verbal knowledge impaired
  - Decision time unchanged?
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Predictors related to decision-making interfaces and environments (continued)

Information Feedback
- Contents of information feedback
- Forms of information feedback

The Role of Task Complexity for Indirect Decision Aids
- Learning modes induced by lagged effects
- Learning induction
- Increasing task salience

Decision-making architecture (networked / hierarchical)
- The effect on task performance supported
- Decision time unaffected

Heuristics "hard-wired" in task systems
- Assumptions of the Monte-Carlo simulation: heuristics implemented with perfect consistency
- Heuristics demanding more information and more computation complexity do not always result in better task performance

Direct Prescriptions
- Heuristics-induced goal setting
  - Task performance improved
  - Decision time saved and information use affected
  - Task knowledge acquired

Verbal instructions on heuristics or task property
- Instructions on heuristics improves task performance, but task knowledge?
- Instructions on task property → task performance?
- Instructions on task property do not improve declarative knowledge → direct / indirect relationships
- Which is more helpful?

Task structure knowledge (declarative, feedback loops, variables’ relationships: direct / indirect)

Heuristics knowledge (procedural)
**Indirect Decision Aids**
- Concurrent verbalization (thinking-aloud)
  - Verbalization after pre-task instructions on performance and learning
  - Verbalization alone? Sufficient practice required? Redundancy with graphical representation?
- Require higher degree of decision precision - 1st decimal place
  - Force subjects to reason out the workings of variables' relationships
  - The positive effect on performance and learning mixed supported
  - Task complexity as the “invisible hand” again?

**Information Feedback**
- Contents of information feedback
  - Available throughout task operations
  - Bayesian probability helps performance, but more time needed
  - Previous decisions and outcomes (outcome feedback) hinder performance and decision reliability
  - Completeness not relevant here
  - Cognitive feedback (task property) and feedforward (heuristics)?

**The Role of Task Complexity for Indirect Decision Aids**
- Learning modes induced by lagged effects
  - Selective mode: explicit search for task structure
  - Unselective mode: decision-outcome contingencies
  - Adopting s-mode improves performance and declarative procedural knowledge
  - So what is good for u-mode learners? Transferring knowledge between tasks
- Increasing task salience
  - Informing subjects with lagged effects does not help
  - Providing task structure information improves performance and knowledge acquisition

**Decision-making environments**
- Decision-making interfaces
- Decision-making task systems
- Decision-making environments (politics, banking, etc.)
- What can explain / predict dynamic decision behavior?
  - Decision makers
  - Task complexity
  - Decision-making interfaces and environments
Task Complexity as the Invisible Hand

- Lurking behind all empirical evidences
  - Providing task property information may be useful in a "simple" task, but not in a "difficult" task
- Are people dynamically deficient?
  - Appears "yes" from the literature
  - Task complexity as a ceiling for human performance on dynamic decision making
- An unified complexity metric?
  - Delay and positive feedback gains as individual indicators

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Ceiling Score = 800 - Delay * 99

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Components of Cognitive Feedback (Balzer et al., 1989)
- Task information: Re, inter-cue correlation, and cue-criterion relation
- Cognitive information: Rs and cue-judgment relation
- Functional validity information: \( r_a \), G, and C

Design of Information Feedback as an Effective Decision Aid

**Research questions Worth Exploring**

**Task Complexity as the Invisible Hand**

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  - Providing task property information may be useful in a "simple" task, but not in a "difficult" task
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\[ r_a = G R_s + C \sqrt{(1 - R_e^2)(1 - R_s^2)} \]

- The lens model equation above depicts the relationship between human performance \( r_a \) and task predictability \( R_e \)
  - If the nonlinear part can be ignored, i.e., \( R_s \) and \( R_e \) large enough, \( r_a \) is always less than \( R_e \) since \( R_s \) (judgmental reliability) is always less than 1 even when we have a perfect knowledge (G = 1). That is, \( r_a \leq R_e \)
- Dynamic version of the lens model?
  - Independence of judgments (decisions in DDM)
  - A complex task model captured by a regression model
  - Human decisions in dynamic situations captured

**Research questions Worth Exploring**

**Are People Dynamically Deficient?**

**Research questions Worth Exploring**

**Design of Information Feedback as an Effective Decision Aid**

**Design of Information Feedback as an Effective Decision Aid**

**Outcome Feedback**

- For a judgment, such as weather prediction, the outcome of the judgment is the true status. For a dynamic decision task, we have a series of decisions leading to "outcomes."
- Outcome feedback in dynamic decision environments
  - In some DDM studies reviewed, outcomes of subjects’ decisions are regarded as outcome feedback
  - How about benchmark decisions and outcomes?
  - Plots over time as outcome feedback

**Research questions Worth Exploring**

**Design of Information Feedback as an Effective Decision Aid**

**Research questions Worth Exploring**
**Task Expertise**
- What is task expertise?
  - Task domain knowledge, e.g., social welfare, economics
  - Between domain knowledge and task property and heuristics → capability to identify certain patterns, e.g., delays and fixes that fail, “systems architectures”
  - Systems thinking experts?

- How task expertise can be developed and helpful in DDM tasks
  - Formal academic training and/or long term experience
  - Pre-task training sessions
  - Group model building exposure?

**Methodological Issues**
- The current review collects the dynamic decision making research conducted by laboratory experiments with two possible limitations.

- Single case studies as theory construction and testing

- Dynamic feedback models as a theory of dynamic decision behavior