

Decision Rationalities and Decision Reference Points

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Three Kinds of Decisions

Decisions under certainty
Decisions under uncertainty
Decisions under risk

Fate = Uncertainty + Risk + certainty

Three Research Approaches

Normative approach:

What the optimal choice or decision would be

Prescriptive approach:

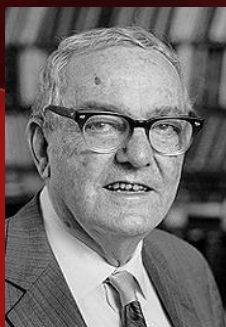
What people should do

Descriptive approach:

What people actually do

How do people make decisions under uncertainty?

Two Psychologists received the Nobel prize in Economics for their work on the above topic.



Psychology of Decision Making

Simon's contribution :

Bounded rationality
- cognitive limitation +
the structure of task environment

Kahneman's contribution

People's judgment and decision making
show consistent and systematic biases
Value functions and reference points

A pair of scissors with only one blade:

Lack of research attention on ecological and
social constraints on decision making

Why do we need to study cognitive aspects of decision making?

- ❖ **Human factors psychology and ergonomics**
 - ❖ Multiple resource theory in accounting for differences in dual task interference (e.g., Wickens (2002)
 - ❖ Situation awareness
 - ❖ Shared cognition (e.g., Richards, 2000)
- ❖ **Error taxonomy** (Reason, 1990)
- ❖ **Heuristics and Biases** (e.g., Tversky & Kahneman, 1986)

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Numerical Models of Risk-Based Decision Making

- ❖ **From Information theory** (Shannon, 1948) to
- ❖ **Expected utility theory** (von Neumann & Morgenstern 1944) to
- ❖ **Signal detection theory** (e.g., Green & Swets, 1966) to
- ❖ **Prospect theory** (Kahneman & Tversky, 1979)

Research Gaps

- ❖ (1) Focus on only logical consistency but not social consistency
- ❖ (2) Focus on only individual utility but not collective utility
- ❖ (3) Lack of consideration of how people search, use, and integrate cues of risks under cognitive, social and ecological constraints
- ❖ (4) Lack of consideration of task requirements as decision references
- ❖ (5) Use of a single number (expected value) to measure subjective utility at the cost of losing information about risk distribution
- ❖ (6) Problematic reliance on information hungry, complicated decision tools (e.g., computational intractability, data overfitting)

Divide and Conquer – Partition Rationality

- **Economic Rationality** – Expected utility maximization
- **Bounded Rationality** – Consider economic man's cognitive constraints and task related stochastic features
- **Evolutionary Rationality** – Identify evolutionarily typical risks, search for design features of the mental mechanisms that have evolved for coping with these risks; and examine psychological factors that activate or inhibit these mechanisms in present time
- **Ecological Rationality** - Make use of the regularities of the natural environment when making decisions
- **Social Rationality** – Understanding self and others, consider payoffs of social relations, dynamics of social capitals, and the constituencies of wellbeing
- **Non-rational Component** - Random and fateful variations beyond rational expectation

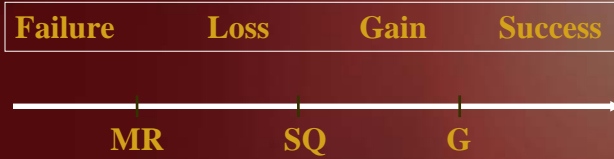
Combine Decision Rationalities

- ❖ Bounded Rationality and Satisficing (Simon, 1956, 1990)
- ❖ Adaptive Toolbox (e.g., Gigerenzer, 2008)
- ❖ Evolutionary, Ecological and Social Rationalities (e.g., risk communication – framing effects – group size effect and kith-and-kin effects. Wang, 1996, 2002, 2008)
- ❖ Decision Making at risk are bounded by reference points.
- ❖ The settings of decision reference points are regulated by prioritized cues of risks.

Under task constraints people strike to maximize the likelihood of reaching a goal and minimize the likelihood of falling below a minimum requirement the same time.

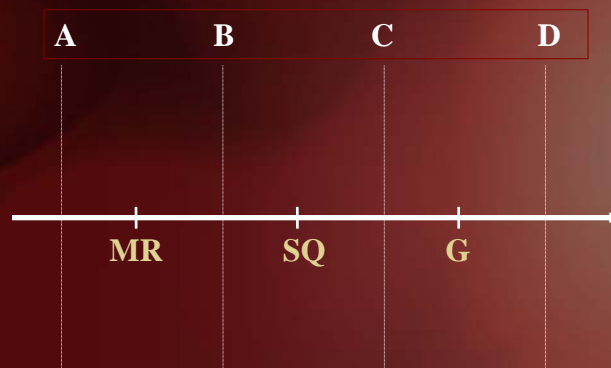


Four outcome regions demarcated by three reference points



(Wang, 2002, Wang, 2008, Wang & Johnson, in prep.)

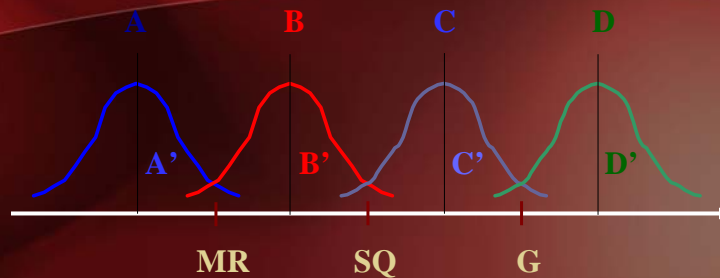
Communicating Values using a TRP Display



Expected values: $AB = BC = CD$

Utilities: $AB > CD > BC$

Communicating Risks Using A TRP Display



Predicted Risky Choices between a **Sure Thing** (A, B, C, or D) and its **Gamble Equivalent** (A', B', C', or D'):

A-A'	A' (Risk Seeking +++)
B-B'	B (Risk Averse ++)
C-C'	C' (Risk Seeking +)
D-D'	D (Risk Averse +)

General TRP Choice Rules

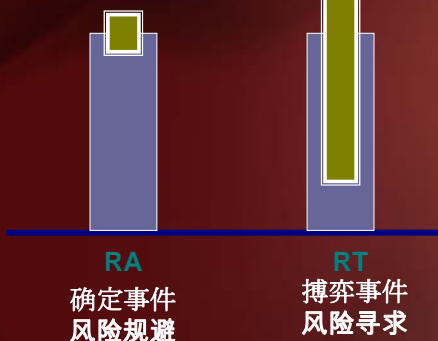
A decision maker is expected to minimize $VF(x)$ and $V-(x)$ and maximize $VS(x)$ and $V+(x)$. SQ or above MR.

(1) Mean-Variance Principle

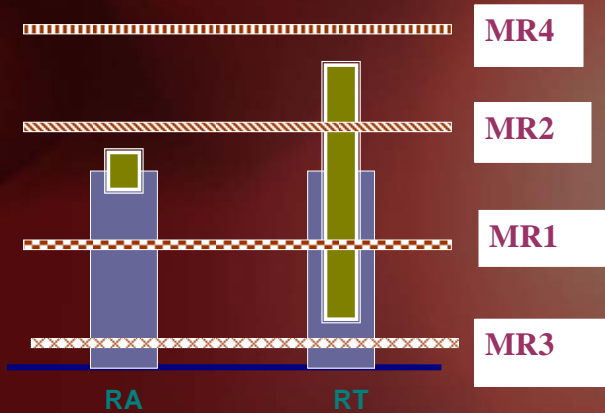
- Be risk/variance seeking (**RS**) when the expected mean value of choice outcomes is below a reference point ($MEV < MR$ or G); but be risk/variance averse (**RA**) when the expected mean value is above a reference point ($MEV > MR$ or G).

TRP Theory: An MR Example

Expected Value
Variance



TRP Theory: An MR Example



General TRP Choice Rules

- (2) A special condition.
When $MEV \gg (MR \text{ or } G)$ so that the variance in the expected outcomes fails to reach MR or a G, the model predicts a risk-averse preference to maintain the SQ (e.g., lottery, medical insurance)
 - **Collective Risk Taking**
 - **Partition the G (divide and conquer)**
 - **Disengagement**

Reference Points and Decision Heuristics

- ❖ How would different decision heuristics predict actual choice preferences?
 - ❖ Six Cognitive Heuristics Tested in the Context of Presidential Election
 - ❖ Likelihood of Success Assessment (Baseline)
 - ❖ Franklin's Rule (Normative Benchmark)
 - ❖ Take-the-Best Heuristic (Likelihood-based)
 - ❖ Partisan Identification Heuristic
 - ❖ Net Pros-and-Cons Heuristic (Frequency-based)
 - ❖ Minimum Requirements (MR) Heuristic (Frequency and reference points based)

Reference Points and Decision Heuristics

Self-Generated Voting Cues (Issues), Pros-and-Cons, and Their Weights, Values, Minimum Requirements and Likelihood Assessments

Issues	How strong you Feel (1-7)	Agree with Bush's Policy (-5 to 5)	Agree with Kerry's Policy (-5 to 5)	MR Bush - or +	MR Kerry - or +	Likelihood of Success for Bush (1-9)	Likelihood of Success for Kerry (1-9)
1 ...	5	3	1	+	-	9	2
2 ...	3	-2	3	-	+	8	7
3 ...	7	5	4	-	+	3	6
.							

Reference Points and Decision Heuristics

Performance of Cognitive Heuristics

	Descriptive Fit	Predictive Accuracy (deviation)
Likelihood of Success alone	67.0%	Incorrect (10.7%)
Franklin' Rule	72.6%	Incorrect (9.3%)
Take-the-Best Heuristic	72.6%	Incorrect (14.8%)
Partisan Identification	76.7%	Correct (1.9%)
MR Heuristic*	83.6%	Correct (3.8.3%)
Net Pros-and-Cons*	87.7%	Correct (2.4%)

Decision support tools in real time and decision heuristics

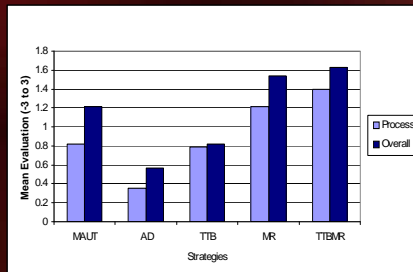
- ❖ Examine decision strategies in terms of user preference in the contexts of public and consumer choice
- ❖ Strategies tested
 - ❖ Multi-Attribute Utility Theory (MAUT) model,
 - ❖ Additive Difference (AD) principle,
 - ❖ Take-the-Best (TTB) heuristic,
 - ❖ Minimum Requirement (MR) heuristic,
 - ❖ Take-the-Best on your MR (TTB-MR) heuristic.
- ❖ The MR heuristic can be viewed as an extension of Herb Simon's satisficing heuristic from information search to risky choice and from satisfying and surfacing to minimally acceptable.

Decision support tools in real time and decision heuristics

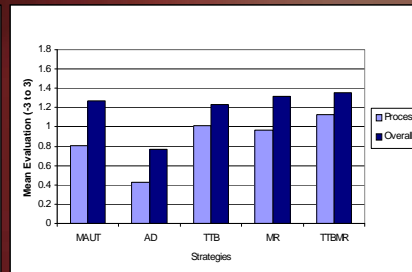
- ❖ These decision strategies differed in their normality, complexity, and reference dependency.
- ❖ A two (domains) by five (strategies) within-subject design

Decision support tools in real time and decision heuristics

Mean Scores of Strategy Evaluation



Social Domain



Consumer Domain

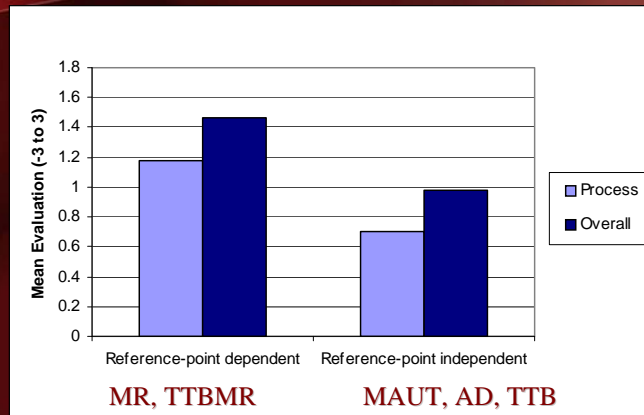
Decision support tools in real time and decision heuristics

Strategies' Goodness of Fit with the Actual Choices

Strategy	MAUT	AD	TTB	MR	TTBMR
Social Choice					
Initial Choice (IC)	32%	25%	29%	38%	43%
Final Choice (FC)	57%	41%	41%	50%	59%
Change IC - FC	25%	16%	12%	12%	16%
Consumer Choice					
Initial Choice (IC)	50%	38%	39%	27%	30%
Final Choice (FC)	64%	48%	50%	27%	30%
Change IC - FC	14%	10%	11%	0%	0%

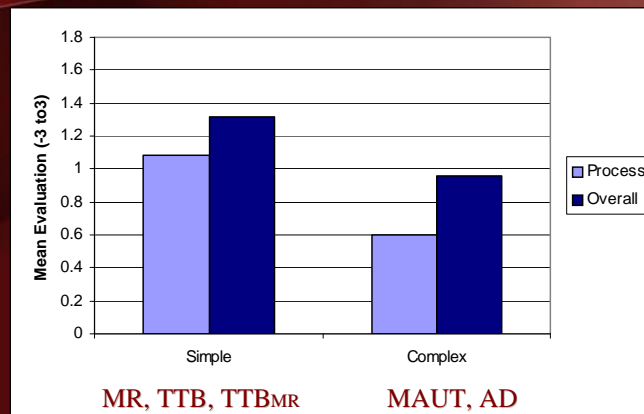
In the social domain, the reference-point dependent heuristics had the best fit, while in the consumer domain MAUT exhibited the best fit.

Decision support tools in real time and decision heuristics



Reference-point dependent heuristics were overall preferred.
Wilk's Lambda =.810, $F(2, 54)=6.327$, $p=.003$, *partial eta squared* =.190
(Separate analyses for each domain: significant only in the social domain)

Decision support tools in real time and decision heuristics



Simple heuristics were overall preferred.
Wilk's Lambda =.856, $F(2, 54)=4.552$, $p=.015$, *partial eta squared* =.144
(Separate analyses for each domain: significant only in the social domain)

Decision support tools in real time and decision heuristics

- ❖ The Mean-Variance Heuristic
(Wang, 2008, Wang & Johnson, in prep)
- ❖ The MR-Heuristics
(Wang, 2008b, Wang & Ziebarth, in press)
- ❖ Spatial vs. Temporal Discounting
- ❖ Simulation and Modeling of Team Performance Data (e.g., NFL, NBA)
- ❖ Life-History Framework of Risky Choice (Kruger, Wilke, & Wang, 2007; Wang, Kruger & Wilke, in press)

