

# Three Roads to Commitment: An Integrative Framework for Decision Making

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# Plan of the Paper

**Problem:** Lack of a comprehensive framework of decision making to support research and cognitive engineering

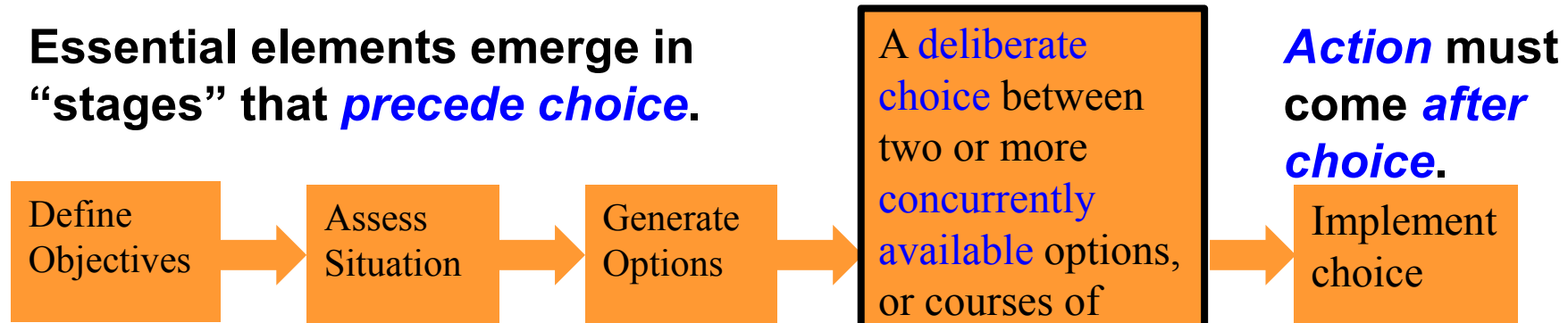
**Goal:** Introduce a **Trimodal Theory of Decision Making (TDM)**

**Approach:**

- ❑ A more accurate and productive definition of decision making in terms of **commitment**
- ❑ Three different **paths to commitment** with different *normative* rationales
- ❑ Uncertainty explained in terms of **obstacles to commitment**, or different levels of **affordance**
- ❑ *Descriptive* research classified within a *modes x uncertainty* matrix
- ❑ High-level *prescriptive* implications for decision support

# What is a Decision? The Rational Choice Story

Essential elements emerge in “stages” that *precede choice*.



The quality of decisions depends *at least as much* on “stages” other than choice!

Naturalistic DM research suggests objectives, expectations, cues, and options may be activated in parallel. (Klein) There may be no choice at all!

Normative benchmark (Decision Theory) applies *only* to *choice*!

# Problems

Neither rational choice nor NDM has provided

- A ***comprehensive framework*** that tells us *what a decision is*
- An ***account of key processes*** that the standard story places before (Simon) or after choice (Schon, March))
- ***Normative criteria*** other than coherence, outcomes, and expertise

## First Step: A More Fruitful Definition

- **Decisions are *graded commitments of mental, affective or material resources to courses of action.***
  - **Decision making includes *any cognitive processes that can create, sustain, or modify such commitments.***
    - Invariant function of decision making, regardless of how it is done.
  - **Intentions are commitments to future actions, of any *specificity* and *scope*.**
    - Include values, goals, plans, tactics, rules
    - May be unconditional or conditional, tacit or explicit

# What is Commitment?

The **intention** or commitment to do A is a set of correlated **dispositions**:

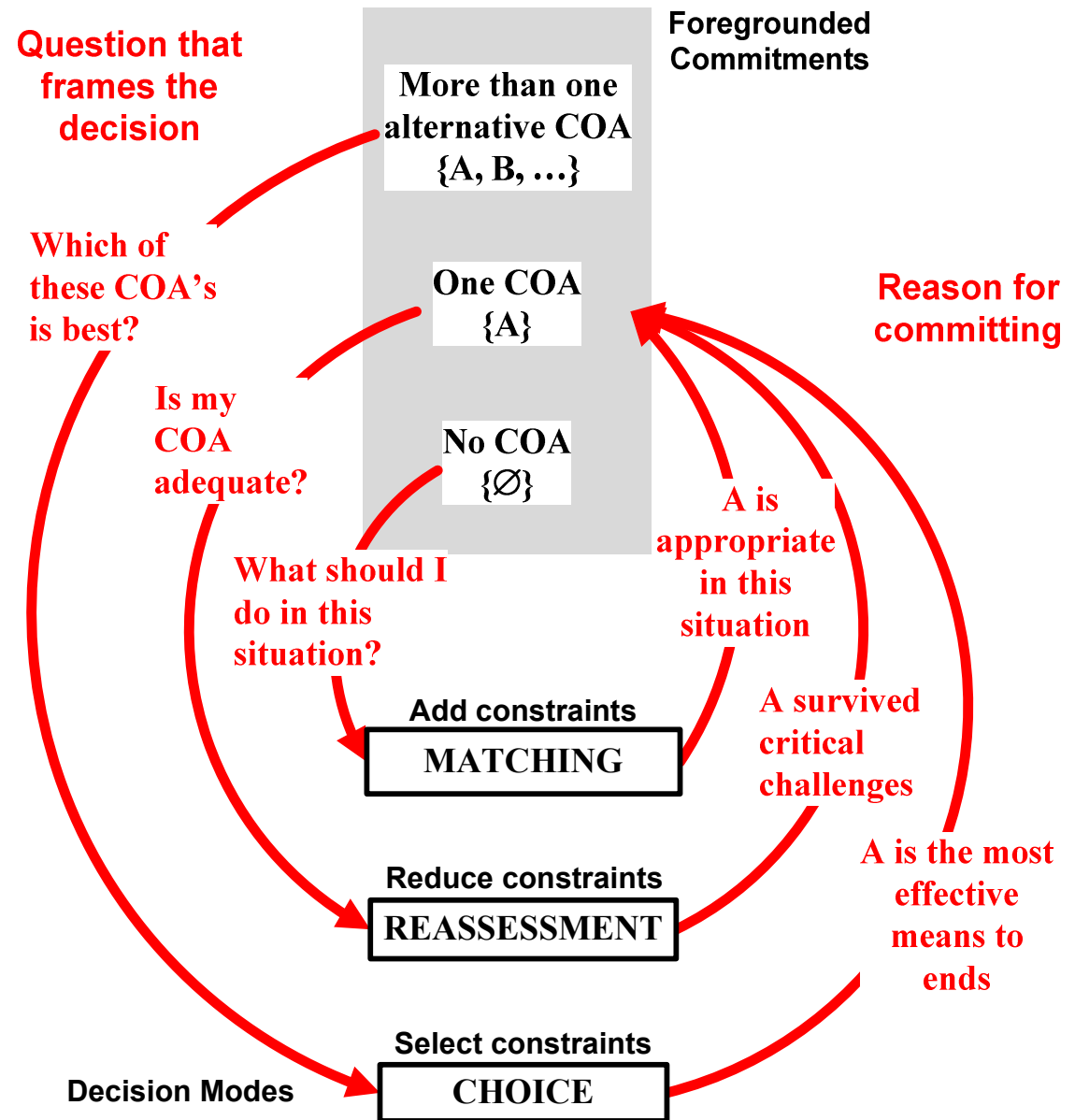
- ❑ (a) to stop looking for or thinking seriously about **alternatives** to A (unless there is specific reason for reassessing A);
- ❑ (b) to attend to **information** that is relevant for A's implementation or success;
- ❑ (c) to **specify and plan** A;
- ❑ (d) to take **preparatory steps** for A (e.g., allocating resources, creating opportunities, or enlisting cooperation);
- ❑ (e) to experience **negative affect** if A is blocked; and
- ❑ (f) to **do A** at suitable time(s) or place(s).

## Second Step: Modes of Decision Making

- Three possible starting points for a given decision cycle

A rich normative and descriptive phenomenology is associated with each prototype.

- Three ways to transform initial commitments



*Seeks actions that are obligatory, appropriate, or permissible for a particular person in a particular situation.*

- Associated with *social identities or roles of the agent in situations of the relevant kind*
- Related to kin, work, profession, voluntary association, religion, nationality, region, political ideology, etc.
- Include norms, routines, patterns / schemas / scripts, precedents, personal policies, emotional dispositions





# Reassessment

*Tests current commitments in light of new information, and explores improvements*

Target may be any commitment:

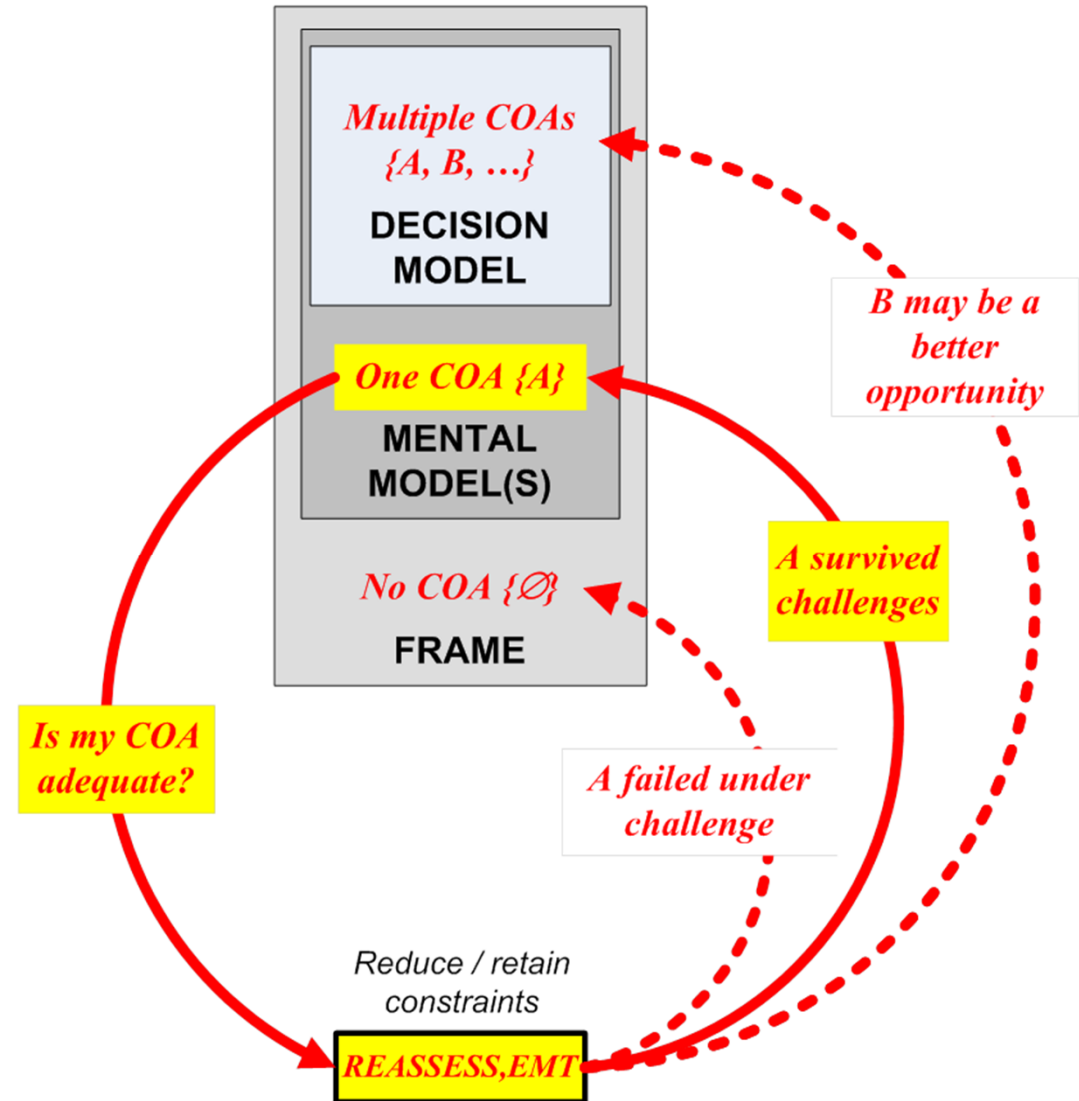
- Values, objectives, plans:
- General rules
- Ongoing activity

Possible both to be committed and to be aware of possibility, in novel situations, that plan will fail to:

- Achieve goals
- Match situation.

New information may be:

- Direct (sample of previous outcomes, trial & error) or
- Indirect (e.g., critical thinking, mental simulation, warnings or dissent, creative insight).



# Choice

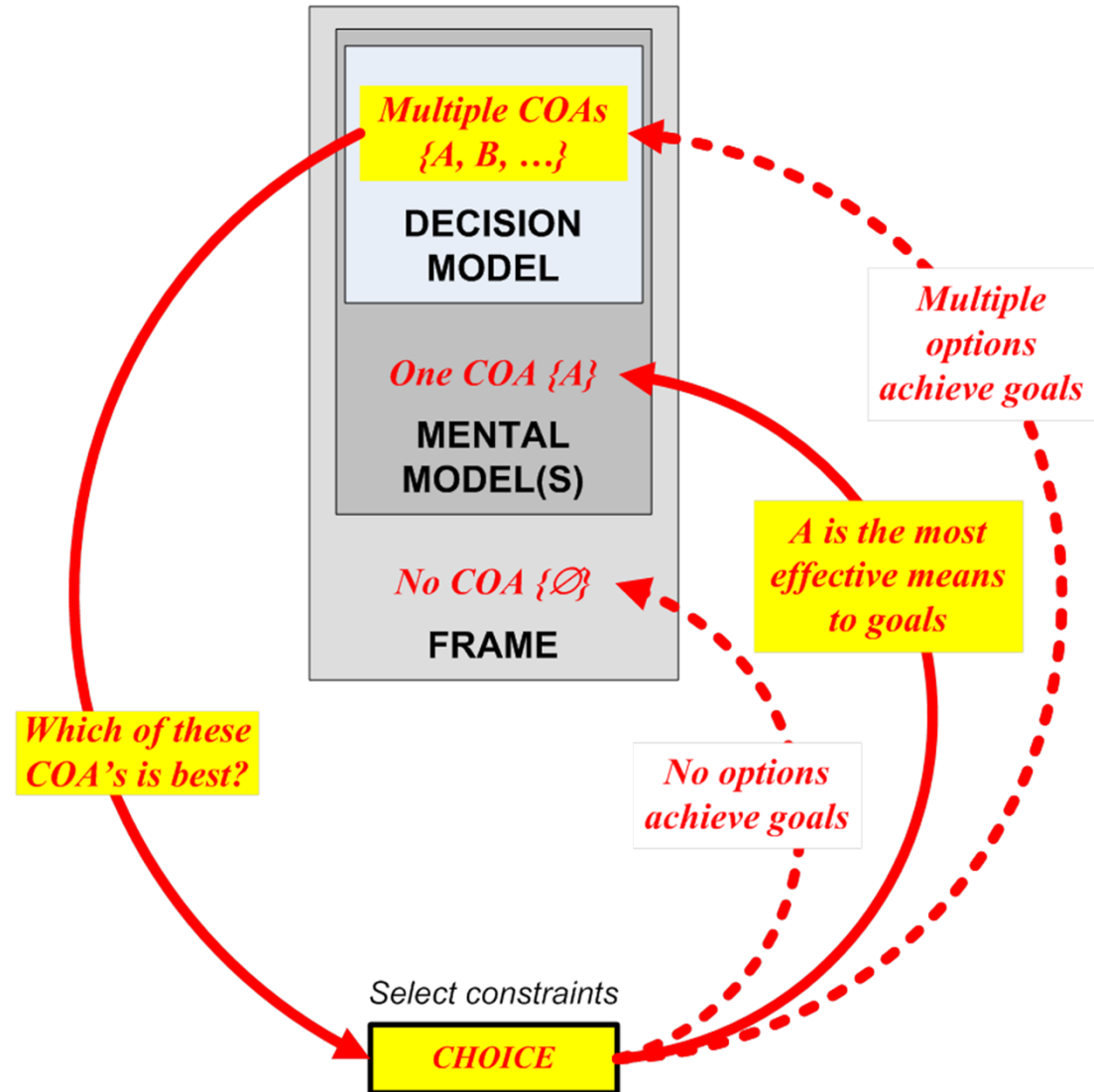
*Seeks most efficient means to desired ends*

## Consequentialist:

- There are no constraints on a person's ultimate goals, which are not means to further ends.

Normative criteria may be:

- **Objective** optimization.
- **Subjective** coherence.
- **Bounded rationality**: Conform to limitations, exploit specific environments.



# Some Implications of Complementarity

**Each mode can generate initial conditions for each of the others**

- Decision making **never starts from scratch**
  - New cycles are always recruited and framed by *pre-existing commitments*
  - Each mode shapes content for the background frame or foreground commitments of subsequent decision making in each *other* mode
- **Plans** are dynamic products of *multiple cycles distributed over time*
- **External actions** occur *opportunistically* – as needed to collect information, prepare, plan, persuade, test the waters, take care of other matters, buy time, or implement

# Implications

- Matching is normatively and cognitively **basic**
  - Necessary to make **commitments** stick
  - **Source** of intentions that are vetted by reassessment and of options selected by concurrent choice
  - **Determines when** other modes are appropriate
- Each mode is “**irrational**” from the perspective of the others!
  - **Matching**
    - Superstitious rule-following (Choice)
    - Does not adapt to change (Reassessment)
  - **Choice**
    - Favors cheating over cooperation and self-control (Matching)
    - Depends on assumptions about model structure, parameters, options, statistics of environment, etc. (Reassessment)
  - **Reassessment**
    - Disrupts coordination and knowledge exploitation (Matching)
    - Biased in favor of the current commitment (Choice)



## Third Step: Cognitive Strategies for Achieving Commitment

- **“Uncertainty”** is cited frequently but vaguely as a cause of problems in real-world decision making.
- **Probabilities** do not capture the reliability of knowledge used in:
  - Option generation
  - Framing (identification of relevant factors and relationships)
  - Assessment of probabilities and values themselves
- **Taxonomies** of uncertainty are often *ad hoc* lists that lack theoretical organization.
  - Most don't say *what uncertainty is*.

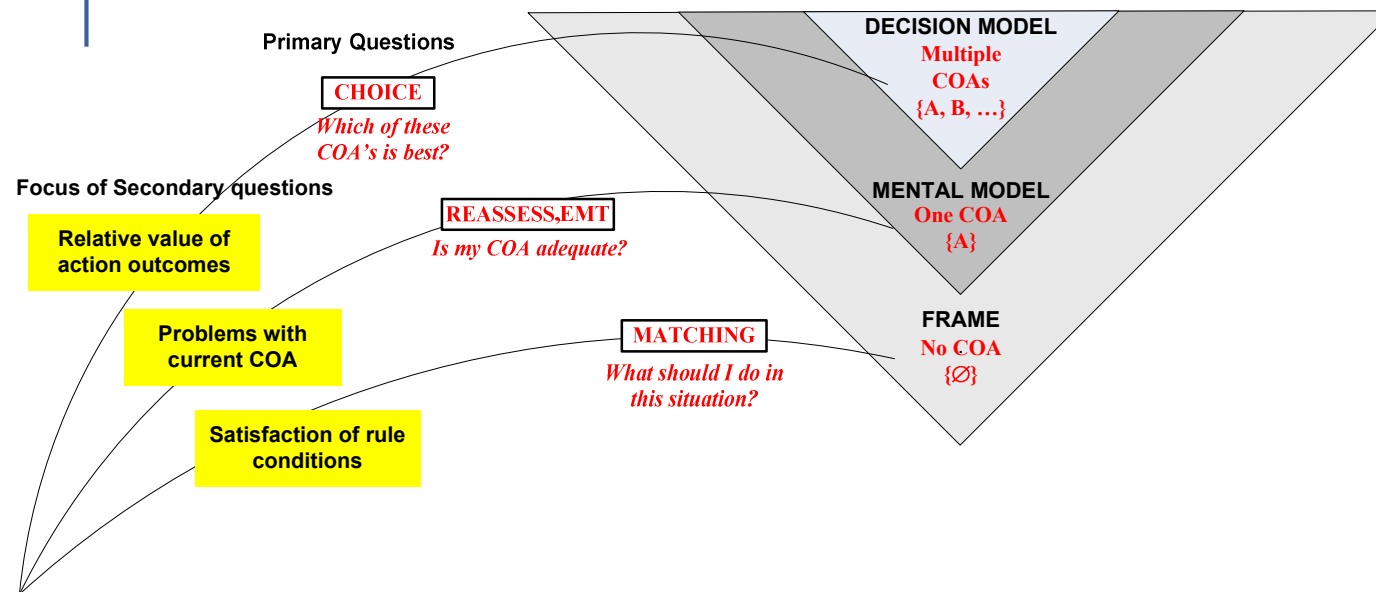
# Uncertainty as an Obstacle to Commitment

- Define uncertainty functionally as *a doubt that tends to block or postpone commitment* (Lipshitz & Straus, 1987) – or equivalently:

High uncertainty = *Low affordance for commitment.*

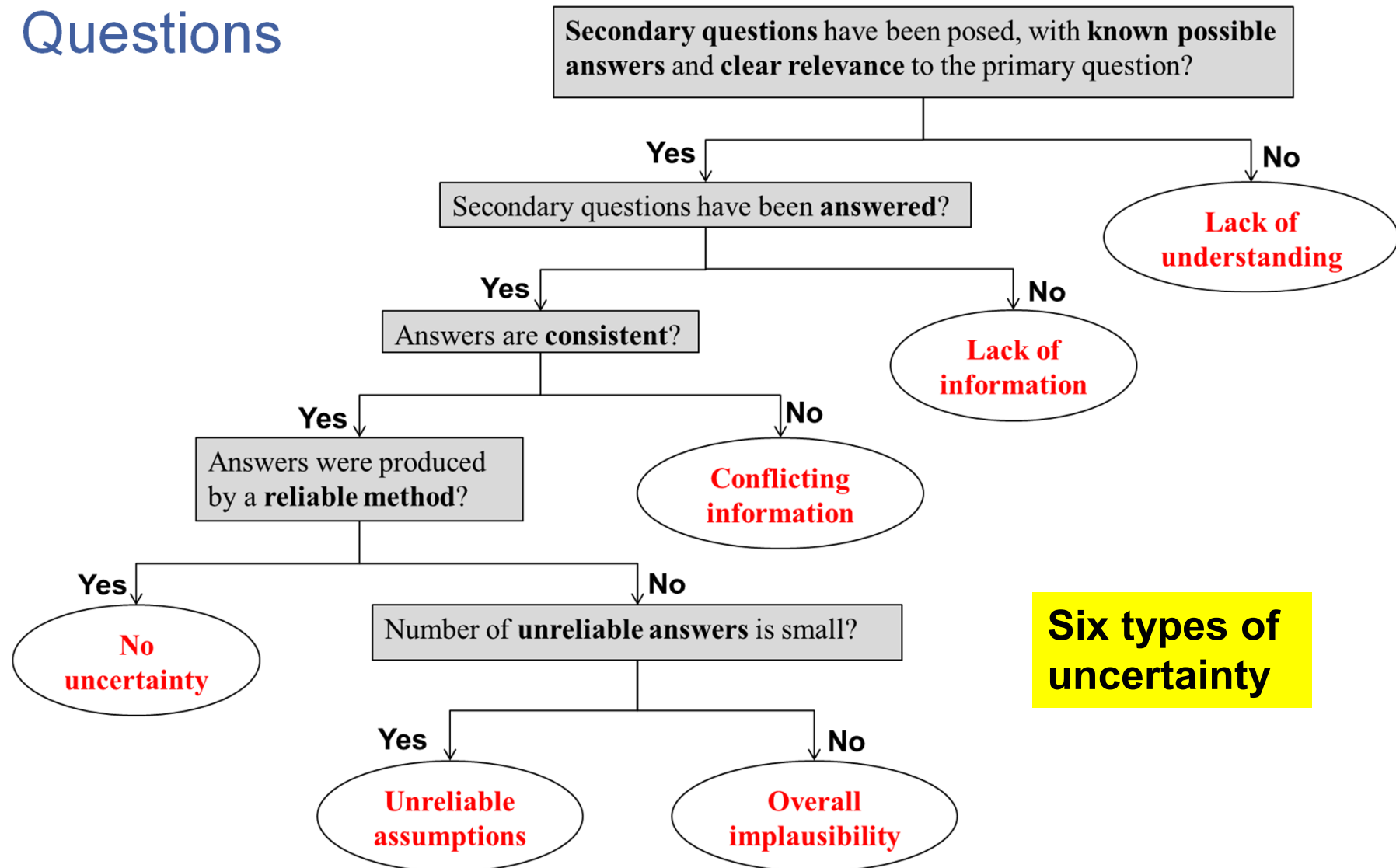
- Uncertainty is difficulty *answering the question posed by a decision mode*
- Uncertainty is greater the more *time or cognitive effort* is required to commit to an answer at levels of specificity and scope needed for performance in the relevant mode.
- **TDM** framework integrates empirical research captured by **RAWF (Lipshitz)** and **R/M (Cohen)**

# Cognitive Framework



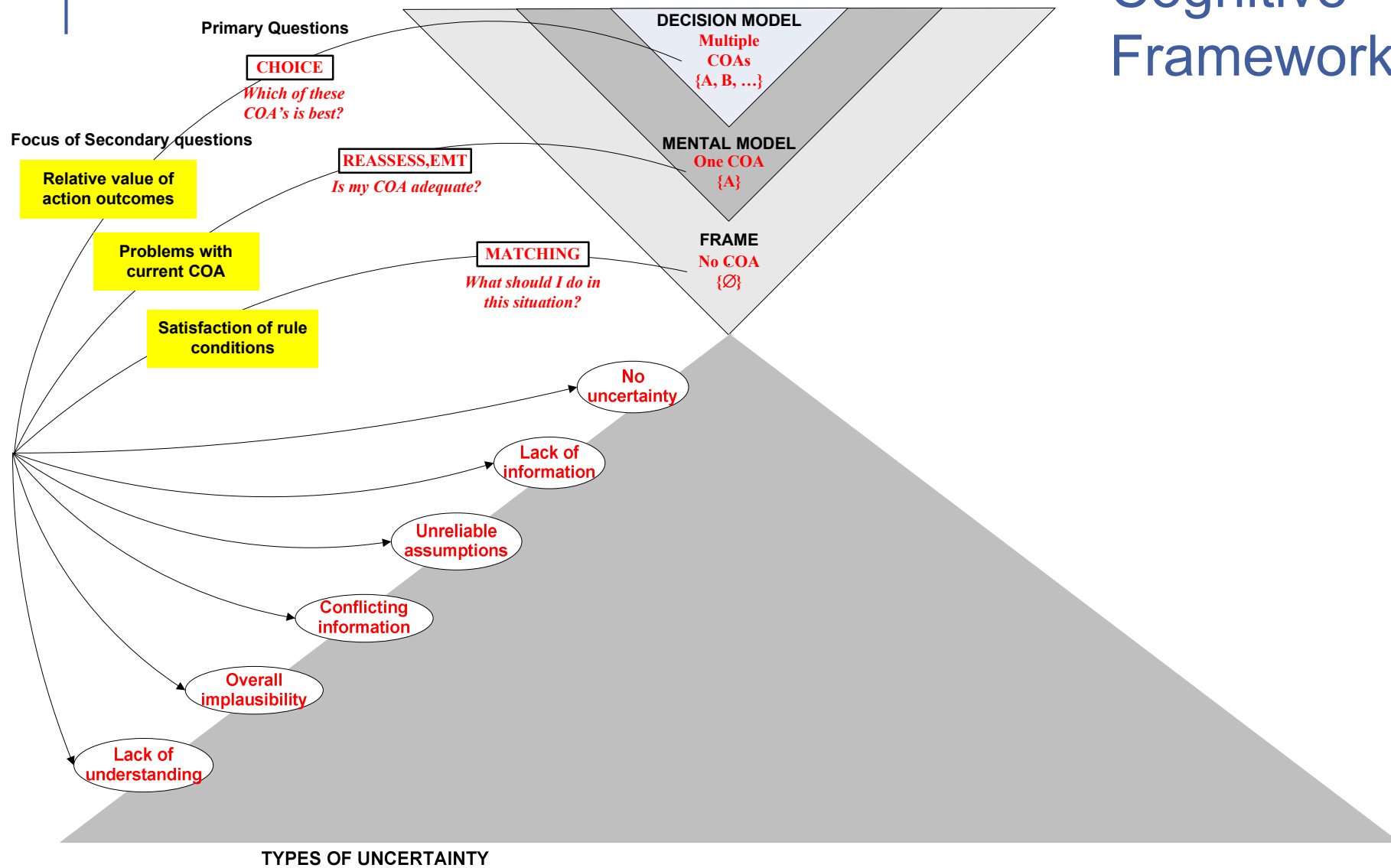
Answering primary question in each mode requires answering *secondary questions* that point to relevant information

# Affordance Depends in part on Current Status of Questions



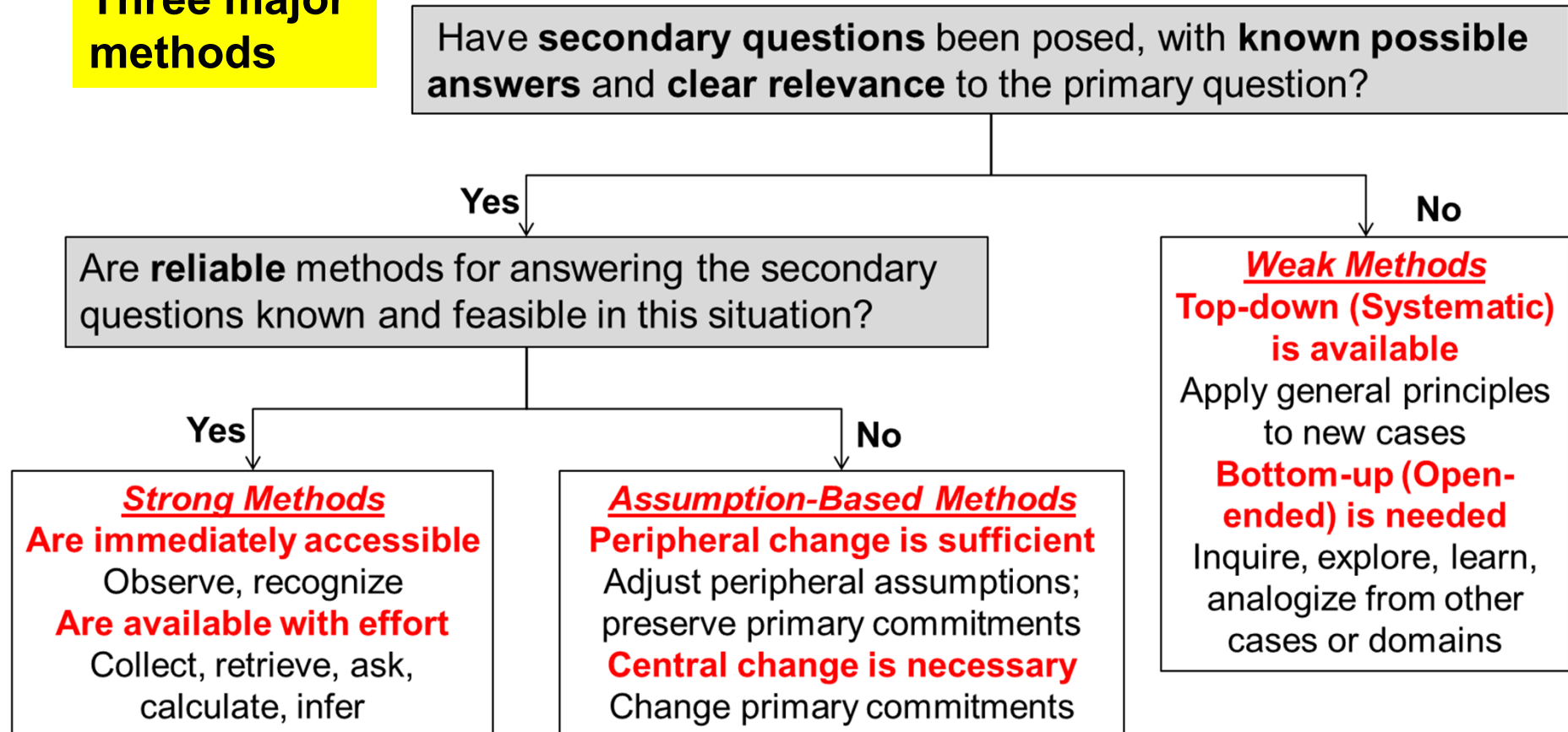


# Cognitive Framework

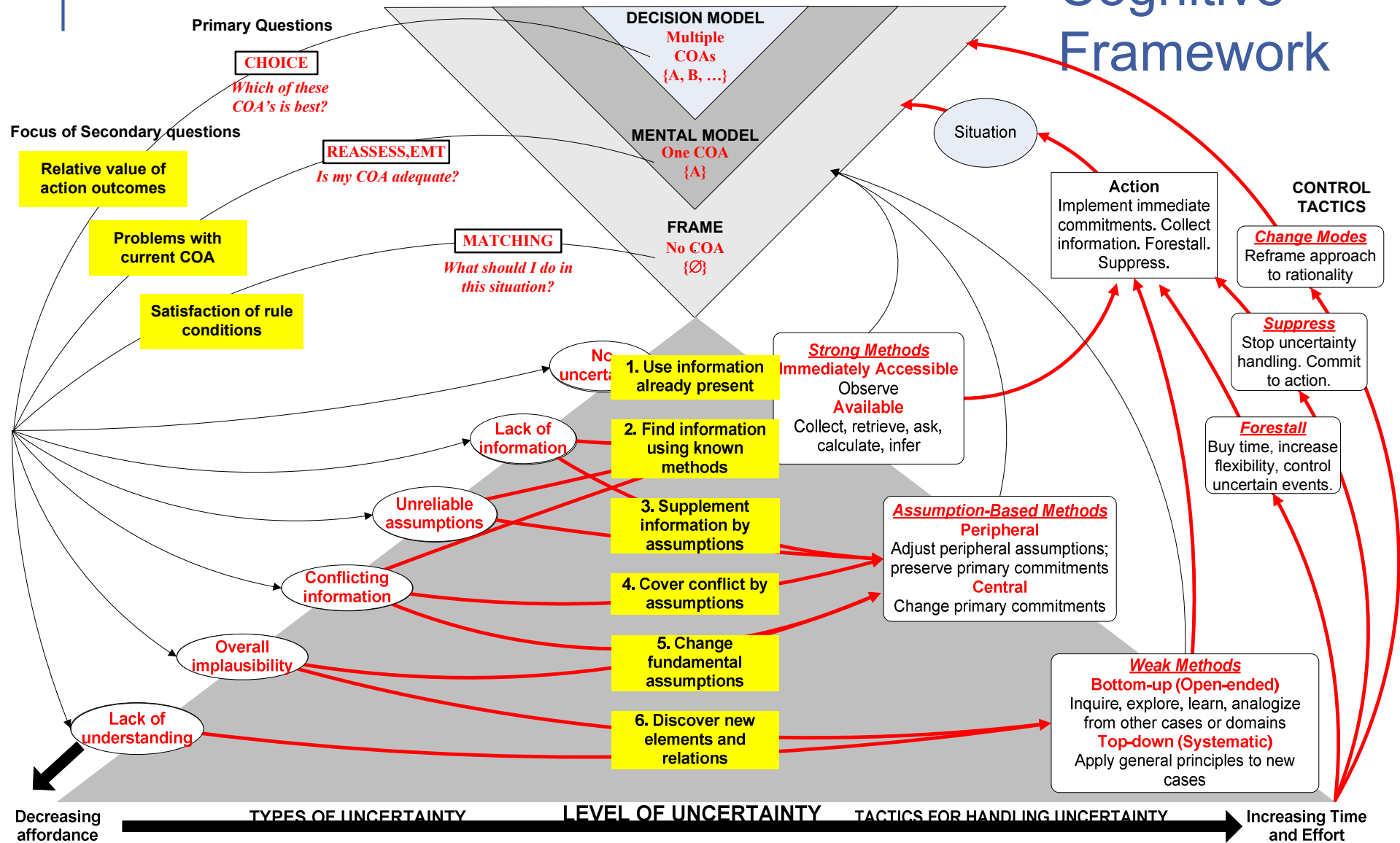


# Affordance Depends in part on Availability of Efficient, Effective *Methods* for Producing Answers

## Three major methods



# Cognitive Framework



## Fourth Step: A Taxonomy of Decision Strategies:

Intuitive levels within each mode

UNCERTAINTY		DECISION MODE		
	LEVEL	Matching	Reassessment	Choice
1	<b>Use immediately available information</b>	<b>Recognize that a rule fits the situation.</b> Expert pattern recognition (Chase and Simon, 1972), Rapid Recognition Primed Decision Making (Klein, 1998), socially conditioned scripts (Schank & Abelson, 1977, 1995).	<b>Natural feedback shapes on-going action.</b> Implicit learning (Berry & Dienes, 1993), reinforcement learning (Herrnstein & Prelec, 1992).	<b>Allocate time proportional to reinforcement rates.</b> Choice behavior (Herrnstein, 1997).
2	<b>Find information to handle gaps, assumptions, and conflict</b>	<b>Actively scan for information to determine fit of rules.</b> Situation awareness (Endsley, 1995, 2000), Data Frame theory (Klein et al., 2007), judgment policies, lens model (Shanteau, Hammond)	<b>Actively monitor for problems with current course of action</b> Reflection in action (Schön, 1983), Recognition / Metacognition (Cohen, et al. 1996).	<b>Predict outcomes and compare to cutoff criteria.</b> Elimination-by-aspects (Tversky, 1972), satisficing (Simon, 1955, 1987).

# A Taxonomy of Decision Strategies:

## Deliberative levels within each mode

	UNCERTAINTY		DECISION MODE	
	LEVEL	Matching	Reassessment	Choice
3	<b>Supplement information by assumptions</b>	<b>Fill gaps in situation awareness by assumptions based on normal / default values.</b> Schemas (Mandler, 1984).	<b>Use models to interpret outcomes and choose remedial actions</b> Action theories (Argyris & Schon, 1996).	<b>Employ heuristics that depend on assumptions about options and criteria</b> One-reason decision making (Gigerenzer & Goldstein, 1996, 1999), satisficing (Simon, 1955, 1987).
4	<b>Cover problems with assumptions</b>	<b>Explain or ignore conflicts between rule conditions and situation.</b> Explanation based reasoning (Pennington & Hastie, 1992); legal, moral, and political reasoning (Gunther, 1993; March, Schultz, & Zhou, 2000); normal science (Kuhn, 1996).	<b>Modify peripheral assumptions to explain anomalies</b> Recognition / Metacognition (Cohen, et al. 1996, 1998), sunk costs (Arkes & Ayton, 1999), escalation of commitment (Staw, 1976), confirmation bias (Poletiek, 2001)	<b>Revise aspiration levels or reorganize evaluation criteria.</b> Dynamic satisficing (Simon, 1955, 1987), dominance structuring (Montgomery, 1993).
5	<b>Change fundamental assumptions</b>	<b>Shift assumptions regarding nature of situation, self, or rules.</b> Gradual or rapid change in group identities, ethical, legal, or political values; paradigm shift in science (Kuhn, 1996).	<b>When ad hoc explanations cause strain, consider changes in central assumptions.</b> Recognition / Metacognition (Cohen et al., 1998, 2001, 2006); theory change (Popper, 1995; Quine & Ullian, 1970 ).	<b>Generate new options or new evaluation criteria.</b> Value-focused thinking (Keeney, 1992).

# A Taxonomy of Decision Strategies:

Systematic levels within each mode

	UNCERTAINTY		DECISION MODE	
	LEVEL	Matching	Reassessment	Choice
6	Discover new elements and relations	<p><b>Explore existing knowledge, or systematic principles.</b></p> <p>Case-based reasoning, analogical reasoning, creativity (Weinreb, 2005, Holyoke &amp; Thagard, 1995; Gentner, Holyoak, &amp; Kokinov, 2001); formalized theories.</p>	<p><b>Institutionalize practices of reassessment and innovation.</b></p> <p>Incremental planning (Braybrooke &amp; Lindblom, 1963), mixed scanning (Etzioni, 1988), skunk works (March, 1994), scenario-based planning (Shoemaker, 2007).</p>	<p><b>Decompose unfamiliar problems into simpler choices.</b></p> <p>Decision analysis (von Winterfeldt &amp; Edwards, 1986; Keeney &amp; Raiffa, 1976; Raiffa, 1968).</p>

## Fifth Step: High level Principles for Cognitive Engineering of Decision Support

- **Compatibility.** The most important task of cognitive engineers is to support modes of decision making that *match* the decision maker and situation.
- **Focus.** Depending on mode, maintain awareness of:
  - Satisfaction of rule conditions
  - Problems with the present course of action
  - Value of expected action outcomes
- **Uncertainty:** Identify obstacles by comparing the current state of commitment with the targeted state:
  - **Matching:** Compare actual situation with relevant rule conditions
  - **Reassessment:** Compare actual events with expected.
  - **Choice:** Evaluate projected action outcomes on desired features, or compare outcomes of one course of action with outcomes of another.

# High Level Principles for Decision Support

- **Transitions.** Support seamless transitions between decision modes and uncertainty levels :
  - **Modes:** E.g., displays for generating goals and actions, for comparing actions in term of goals, and for monitoring goal achievement during action implementation should relate transparently to one another.
  - **Uncertainty:** Support appropriate levels of intuitive vs deliberative vs systematic processing. Displays should seamlessly track uncertainty levels as they change in response to uncertainty handling tactics.
- **Control.** Balance time and effort against benefit in reducing uncertainty.
  - **Suppress:** Adapt decision processes to the available time. Stop and act on the current best solution when benefits of further processing are outweighed by risks.
  - **Forestall:** Adapt the available time to the decision making processes.
  - **Change modes:** Identify opportunities afforded by changing decision modes.



# Conclusion

Distinctive features of the *Trimodal Decision Making* framework:

- **Conceptually unified.**
  - A single concept, *commitment*, is rich enough to distinguish different modes of decision making, with normative, descriptive, and prescriptive implications.
- **Organizes research paradigms and findings and facilitates more integrative research.**
- **Expands the normative basis** for decision making beyond conventional decision theory, bounded rationality, or expertise.
- Sheds light on patterns underlying **cognitive strategies** used to handle uncertainty.
- Expands the function of **cognitive engineering** – to include identifying decision modes in particular domains, critical obstacles to those commitments, and ways of overcoming them.