Decision Making

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- How many psychologists to change a light bulb ?

•First, the light bulb has to want to be changed

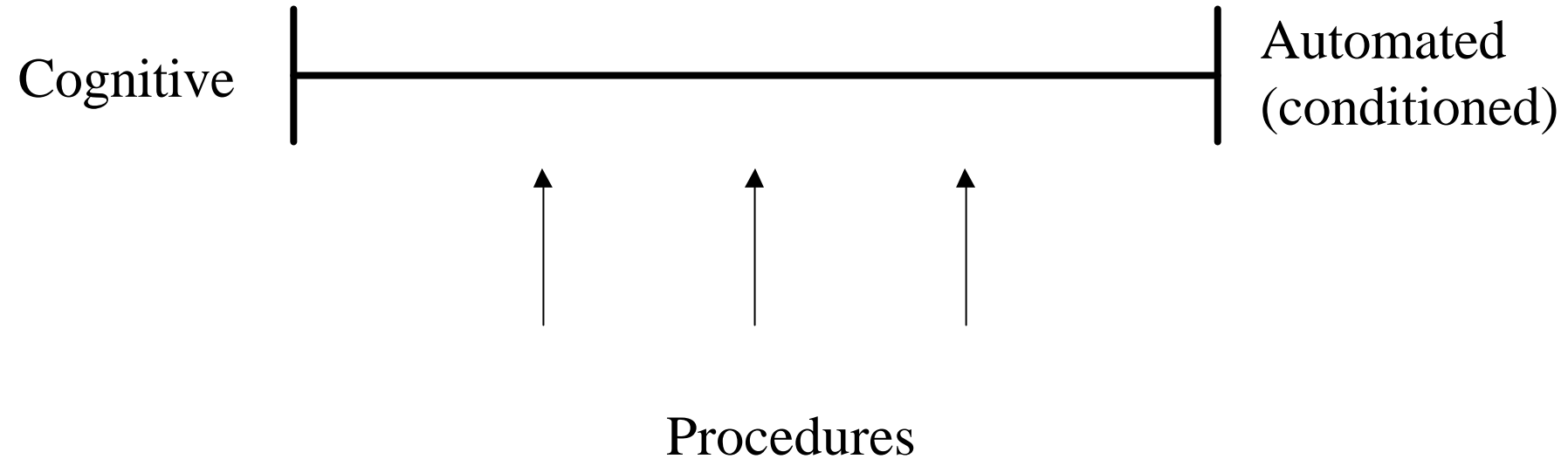# Land or Go Around ?

1000ft

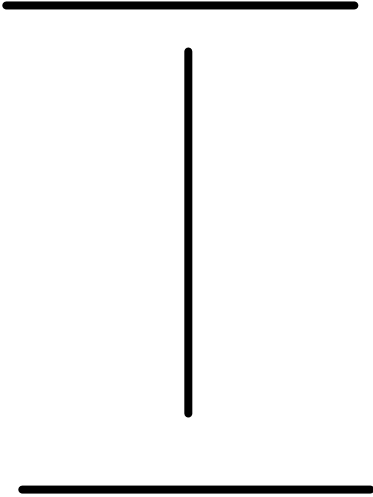500ft

100ft

50ft

10ft

Levels of Decision Making

	Cognitive Skill	Procedural Skill	Motor Skill	Perceptual Skill	Vision
				Confirmatory Bias	
Judgement	Y	Y	Y	Y	N
Training	Y	Y	Y	Y	N

Decision Making Continuum

Cognitive |————————————————————————————| Automated
                                           (conditioned)

Procedures
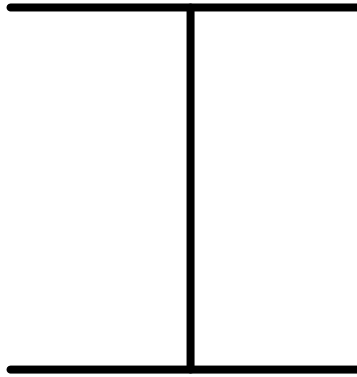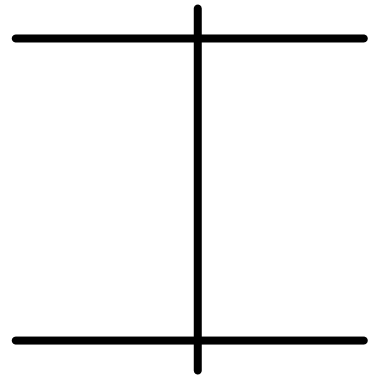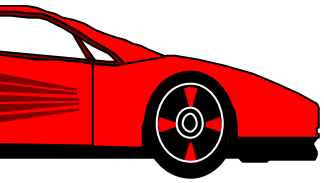
Judgement

Strategy ?

Judgement

New Car

- Price range
- Size/seating capacity
- Fuel type & economy
- Safety
- Reliability
- Manufacturer's reputation
- Style

- 10
- 9
- 4
- 8
- 7
- 5
- 6

1st prioritise
2nd assign weights
3rd 'calculate' attribute
4th total scores
Choose !

Classical Decision Making

- Rational
- Systematic
- Comparison of multiple options
- Objective (i.e. without bias)
- Assign values to options
- Choose best value option

Cognitive

- Decision making is distinct from an action
- An action can be completely autonomous
  - No thought until after the action
  - and sometimes not even then
- To decide, one has to first be aware
- To decide, there must be alternatives
  - Even if the alternatives are
    - Do nothing
    - Do something
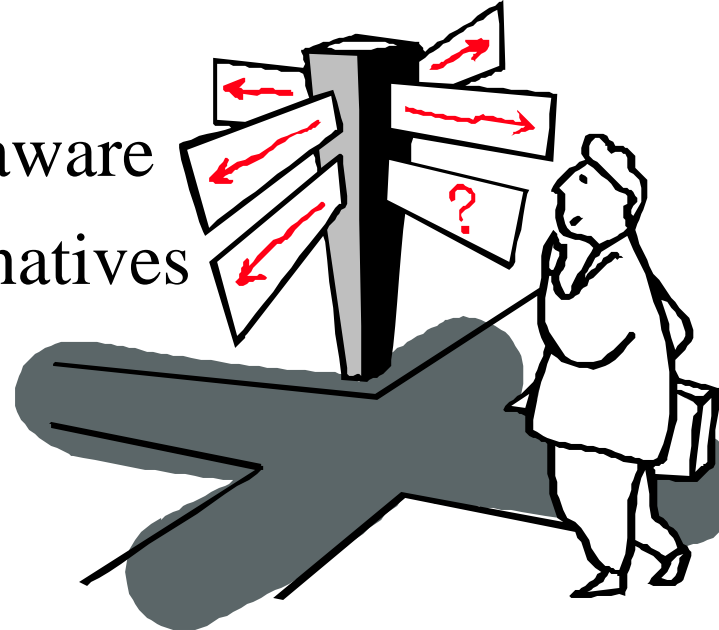
Decision Making

- Decision making occurs in Working Memory, but relies on information in long term store.

- Heuristics - short cuts formed from experience (saves time and effort searching and retrieving information) but…

- Can cause fast, but poor, decisions due to

  – poor quality information gathered from a narrow source
  – Information available is limited by memory accuracy and state of the organism e.g. high arousal results in either very narrow or very scattered (interference) attention (Nideffer). (Tversky & Kahneman 1974)

Every day decisions

- Probabilities are less certain

- Surgery or no surgery ?

- Buy or not to buy ?

- Drive or drop shot ?

- Swerve or Brake ?

- Land or Go-Around ?

    Time factor – or lack of it: changes process.
    Despite drawbacks - Short cuts are required

Heuristics

- We generally are not aware of the exact odds/ratios of loss vs gain

- Even when we are aware, we tend not to assess them accurately

- We use short cuts: 'heuristics', which 'fit'
  - (most of the time)

- Stereotyping is a heuristic

Representative heuristic

- Jack is a 45 year old man. He is married with four children. He is generally conservative, careful and ambitious. He shows no interest in political or social issues and spends most of his time on his many hobbies which include carpentry, modelling, aviation and mathematical puzzles.

- Group 1: This description was drawn from a population of seventy engineers and thirty lawyers.

- Is Jack an Engineer or a Lawyer ?

- Group 2: This description was drawn from a population of thirty engineers and seventy lawyers.

- Is Jack an Engineer or a Lawyer ?

Both groups estimated that the odds that Jack was an engineer were more than 90%
Jack's activities fitted the stereotype of an engineer. Real odds were ignored

Availability heuristic

- Population sample was asked: Does the letter R appear in the first position in words more often or in the third position more often ?

More than 2/3 stated that R appeared first more than 3rd. In fact the opposite is true.

Explanation is that our memory (and dictionaries) are organised according to the first letters. We can retrieve words with R as the first letter more often. More words beginning with R are available to our memory, so we base our decision on availability.

Thus, decisions are biased toward availability of favourable solutions

Risk and perception

- Are we rational ?
- You are given £10
- You can keep it or risk it
- Toss of coin (50:50), determines if win or lose
- Do you risk £10 for possible £100 gain ?

Yes. Logical decision. Gain is worthwhile. Loss is small.

Change the risks and gains….

- You are given £50. Do you risk it for possible £100 ?

- You are given £500. Do you risk it for possible £1000 ?

- You are given £800. Do you risk it for a possible £1000 ?

Law of diminishing returns.

We are unwilling to take risks with our gains.

The greater the perceived value risk and the smaller the potential gain, the less likely we are to take a risk.

BUT - The greater the perceived possible gain, the increased likelihood of taking a risk !

Losses

- You have £1000
- You lose £100
  - You can accept the loss or risk (50:50) no loss if you win or £200 loss if you lose.
- You have lost £500.
  - You can accept the loss or risk (50:50) no loss if you win or £200 loss if you lose.

Law of diminishing returns. You should cut your losses and run. But, most will risk further loss for the possibility of no loss. Casinos make their money based on this assumption.

Applied theory

- Pilot flies into IMC.
- They should turn around and fly out of IMC.
- But, they are prepared to risk more by continuing on track in IMC to 're-coup their losses'.
- The longer they continue in IMC, the greater the loss (time, distance of diversion to re-trace track etc)
- The longer they continue, the less likely they are to accept the (increasing) loss by turning back.
- Also called 'sunk cost theory'

Decision Making Research

- VFR flight into IMC
  - GA Pilots
    - Mix of PPLs, student commercial, commercial, All non IR
    - Simulator
    - Flight into deteriorating Wx
      - Lowering cloudbase and viz (100ft &500m)

VFR Flight into IMC

- Pilots briefed on VFR exercise
- Pilots completed a questionnaire stating their own minima for VFR flight
- Results
  - Over 50% continued the flight into IMC !
  - Despite stating prior to the exercise that they would never 'press on' under such conditions !

Other ongoing work

– PhD programme

– Decision Making in R.O.C. Air Force

– Classification of errors on HFACS system

– I.D. Decision Making errors
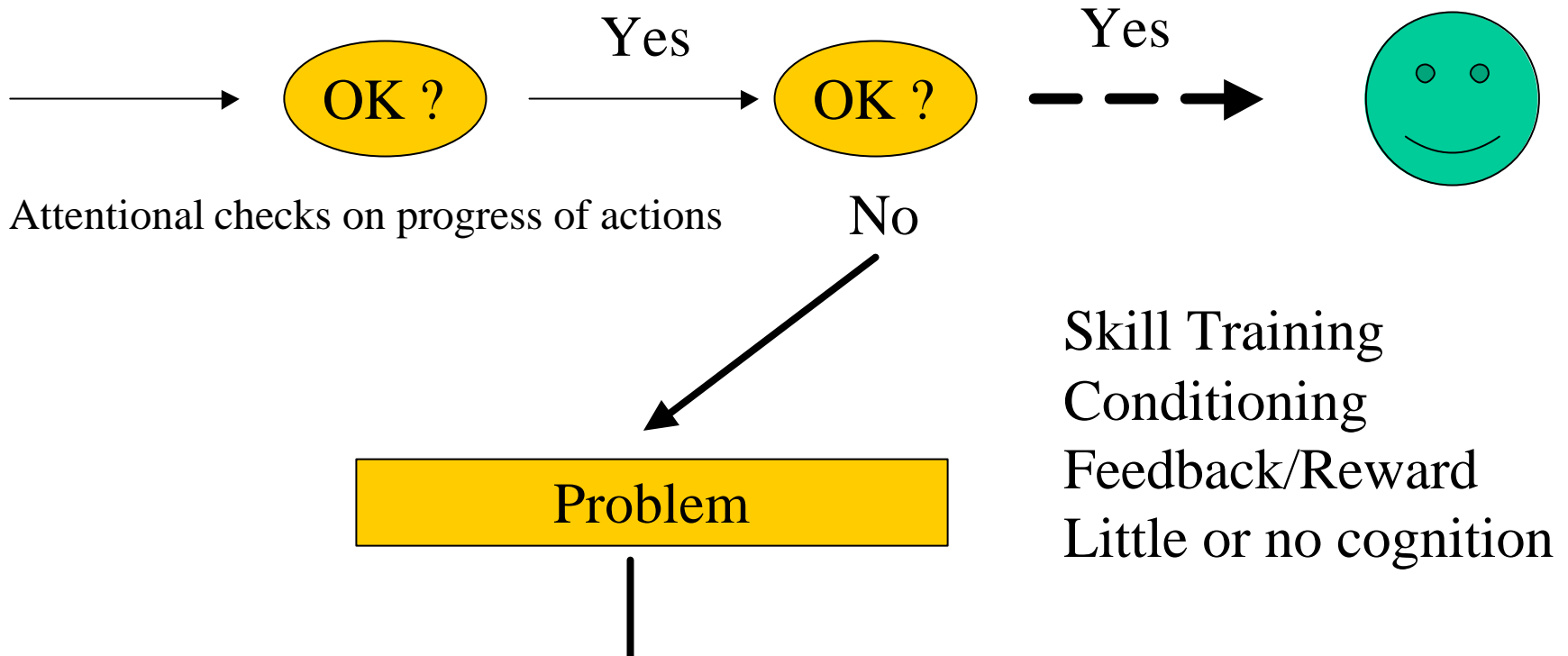
– Train DM skills in military pilots

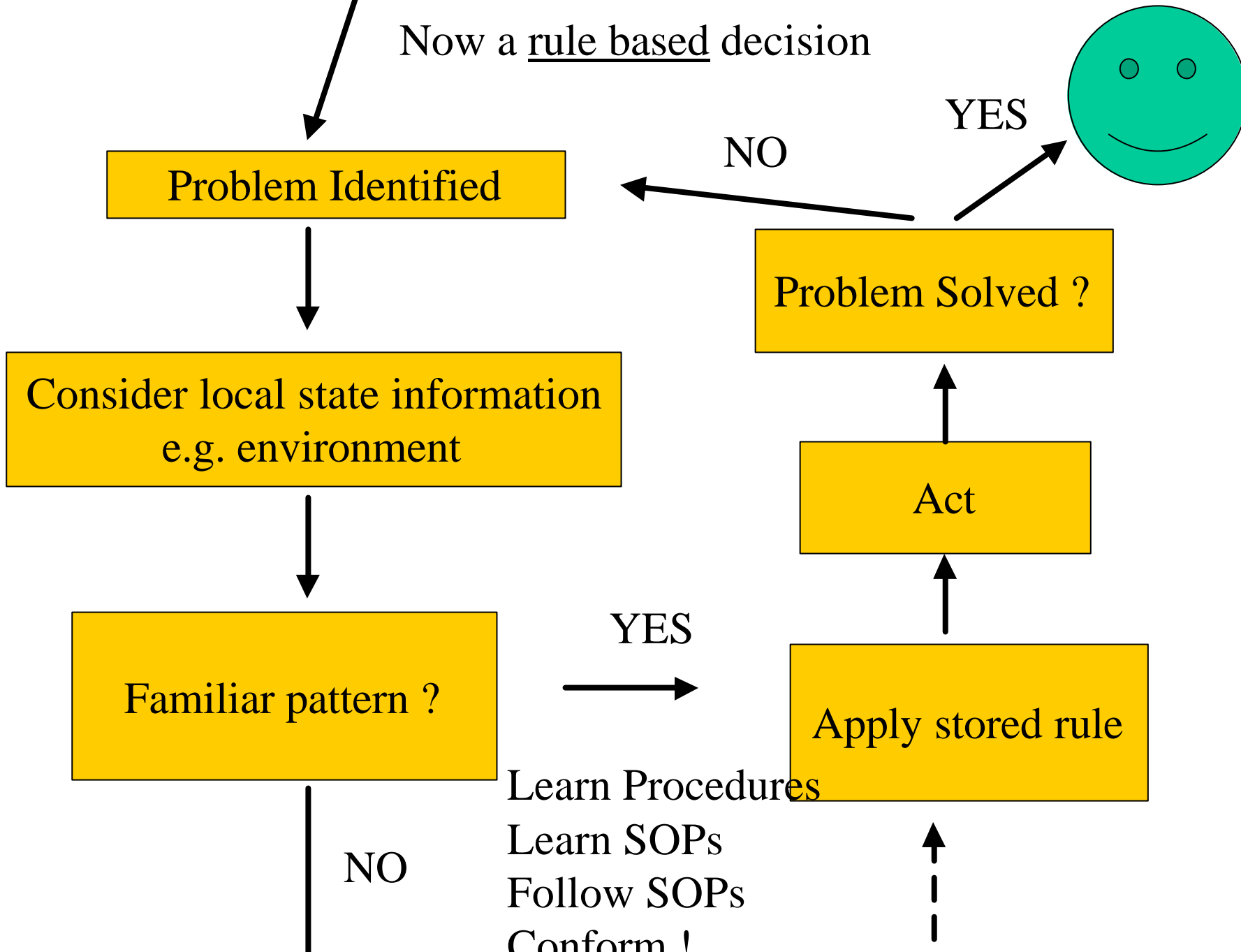# Decision Making at Skill, Rule and Knowledge based levels

GEMS Model: Generic Error Modelling System

Routine actions in familiar environment = <u>Skill Based</u>

Goal state

Yes   Yes

OK ?   →   OK ?   - - →

Attentional checks on progress of actions   No

Skill Training
Conditioning
Feedback/Reward
Little or no cognition

Problem

Now a <u>rule based</u> decision

Problem Identified

Consider local state information
e.g. environment

Familiar pattern ?

YES

NO

Problem Solved ?

YES

NO

Act

Apply stored rule

Learn Procedures
Learn SOPs
Follow SOPs
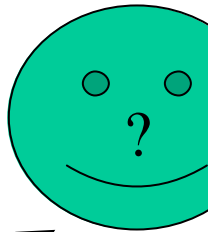Conform !

Now a <u>knowledge based</u> problem

Find Higher Level Analogy → Apply Similar Rule

Not found ?

Create/revert to mental model of situation. Analyse situation Create Hypotheses → Apply actions Test Hypotheses Monitor Outcome

Non Standard situations - Cognitive training required
Deep understanding of systems now required
Novel solutions may be required

Biases in Decision Making

- Decision making is not necessarily rational. It is open to :-

  - Availability bias - what options do we have at our disposal ?
  - Frequency bias - how often have we encountered this problem ?
  - Recency bias - when did we last encounter this problem ?
  - Simplicity of explanation - take the easiest path

- It is not always logical or rational!
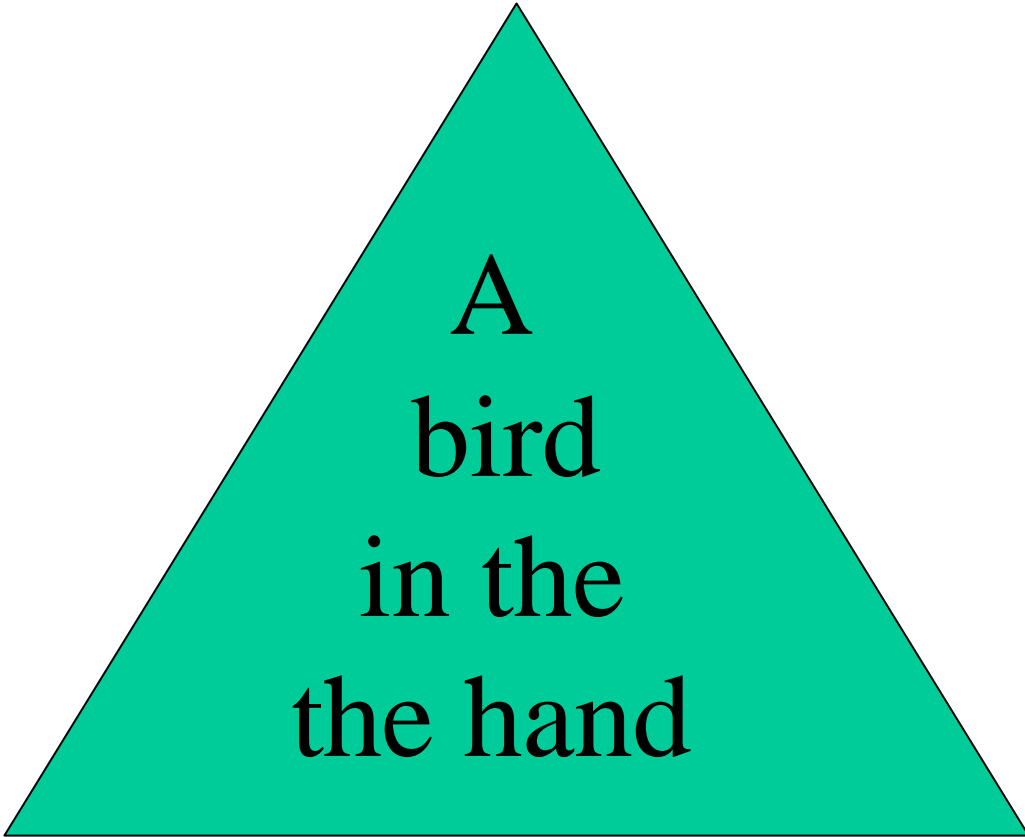
•A bird…

A
bird
in the
the hand

Recognition Primed Decisions (RPD)

- recognition of a situation is based upon:-

  - Interpretation of the meaning of the situation (SA)
    - influenced by perception (& experience)
  - Inference about the underlying causes
    - could be correct or incorrect
  - Assessment of risks and opportunities
  - Identification of the required actions
- **Expertise** influences final decision

RPD: Klein et al (1986)

Decision making under stress

- Effects of stress
  - More mistakes
  - Narrowed attentional focus (= reduced SA)
  - Scanning patterns break down (= reduced SA)
  - Working memory capacity reduced
  - Trade offs – speed vs accuracy
    - (false perception of time pressure BAA night runway inspection)

Training/Experience/Expertise

- Training and Experience and Expertise all influence
  - the perception of the situation (SA)
  - the range of options available (knowledge)
  - The predicted outcome of each
  - And therefore….. the final choice
- So, training can influence decision making !

CLEAR

- **C**larify the problem
- **L**ook for ideas, share info
- **E**valuate options
- **A**ct on decision
- **R**eview actions and situation

GRADE

- **G**ather
- **R**eview & collate
- **A**nalyse
- **D**ecide & do
- **E**valuate

RAAF

DECIDE

- **D**etect

- **E**stimate

- **C**hoose

- **I**dentify

- **D**o

- **E**valuate

FAA PPL Syllabus (Private Pilot Test Prep 2000)

Detect
Organise
Decide
Act
Review

The most important cause of human error is confirmatory bias or hypothesis locking……the tendency to be reluctant to change one's mind even when (in hindsight) it was obvious that the decision was incorrect (Roger Green).

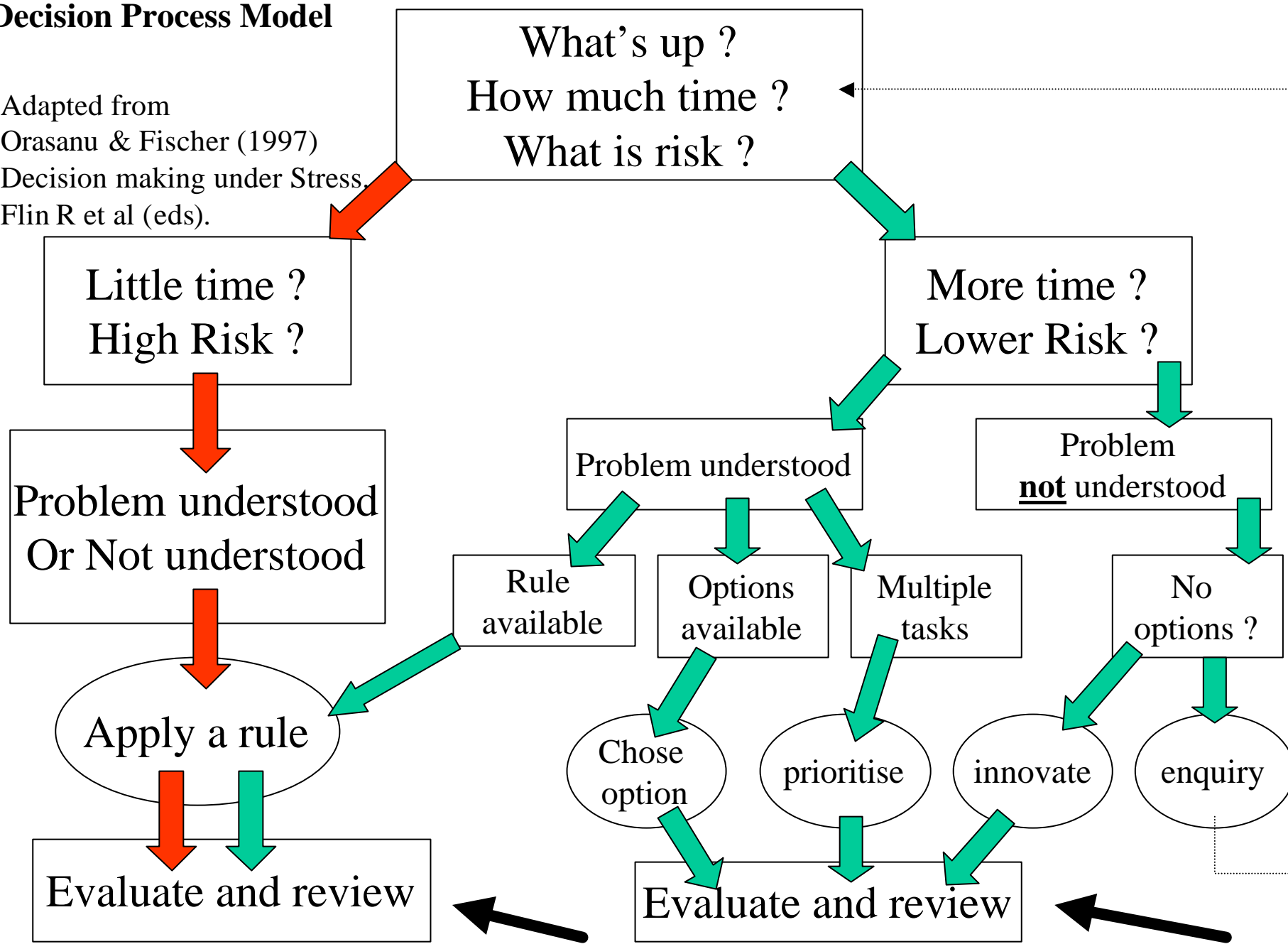BA 747 Nairobi approach cleared down to 'seven five zero zero'. 'seven' not heard by crew. Readback was 'cleared five thousand'… unchallenged by ATC. Glide slope pointer disappeared off top of indicator as a/c descended ! This vital information was dismissed as instrument failure or visual illusion. Once model had been generated, there was a reluctance to change. Aircraft (just) missed ground as it broke cloud.

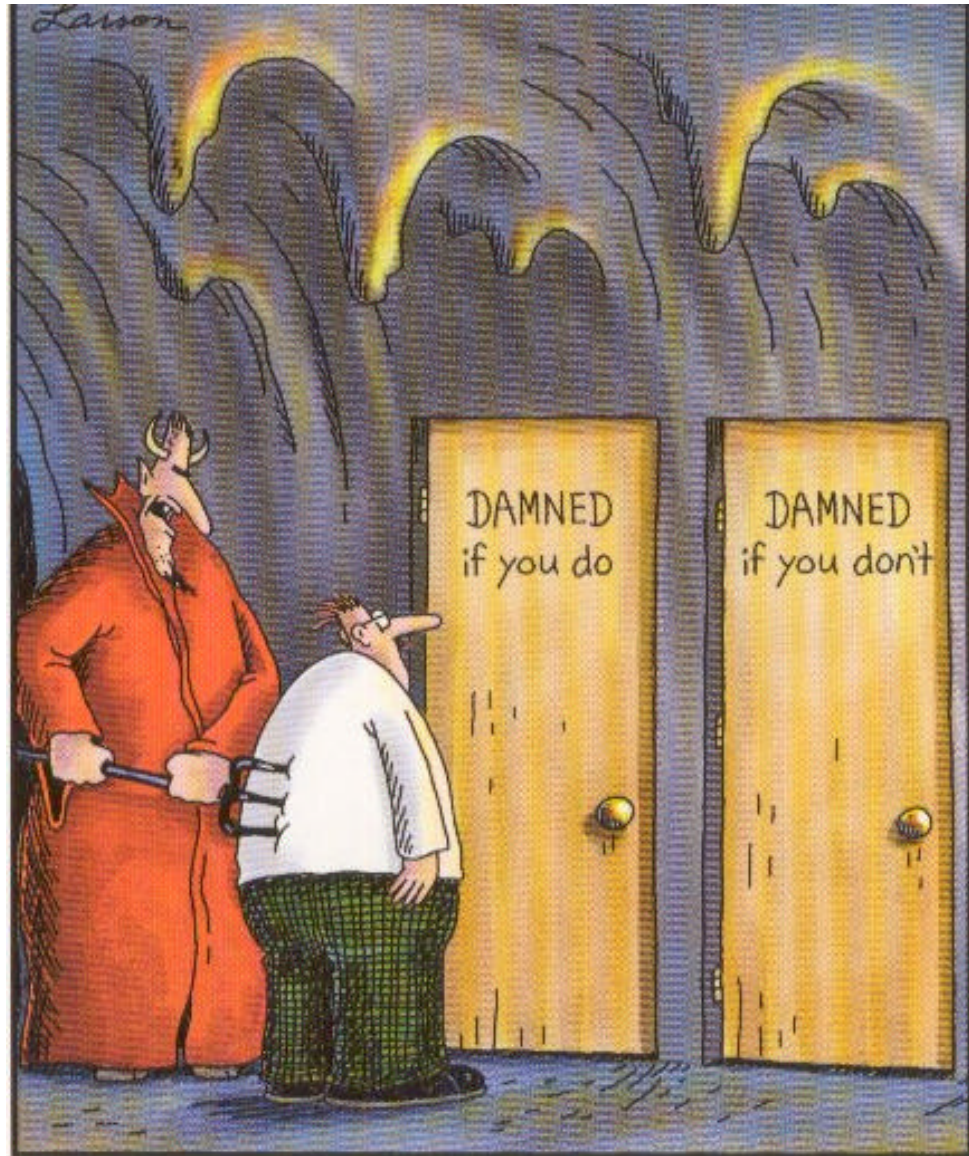Another example of confirmatory bias:
Photo of Moon from an Airplane…….

Decision Process Model

Adapted from
Orasanu & Fischer (1997)
Decision making under Stress,
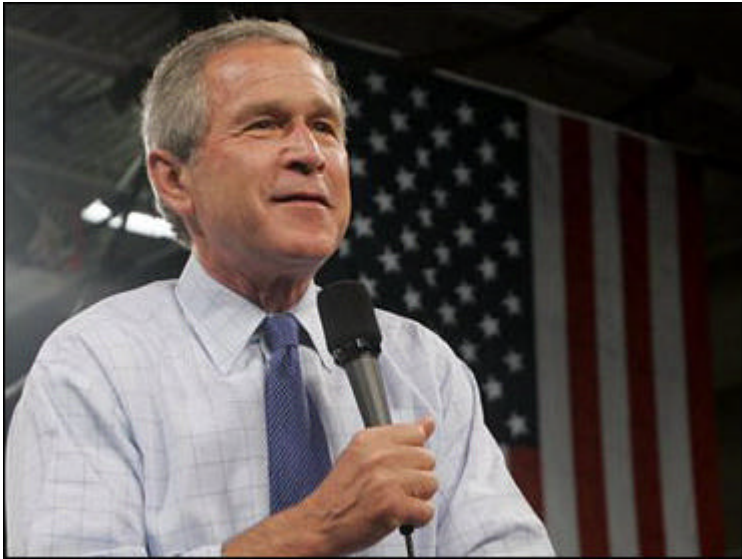Flin R et al (eds).

What's up ?
How much time ?
What is risk ?

Little time ?
High Risk ?

More time ?
Lower Risk ?

Problem understood
Or Not understood

Problem understood

Problem
not understood

Rule
available

Options
available

Multiple
tasks

No
options ?

Apply a rule

Chose
option

prioritise

innovate

enquiry

Evaluate and review

Evaluate and review

Sometimes, you just can't win….

"C'mon, c'mon – it's either one or the other"

A more difficult decision….

or

Refs

- Zsambok C & Klein G (1997) (Eds) *Naturalistic Decision Making*. Mahwah, NJ: LEA.

- Tversky A & Kahneman D (1974) Judgement under uncertainty; heuristics and biases. *Science*, 185, 1124-1131.

- Minsky M (1986) The Society of Mind. New York, NY:Simon & Schuster

- Klein GA, Calderwood R, Clinto-Cirocco A (1986). Rapid decision making on the fireground. Proceedings of the 30th Annual Human Factors Society Conference,!,576-580. Dayton, OH:Human Factor Society.

- Orasanu J & Connolly T (1993). The reinvention of decision making. In GA Klein , J Orasanu, R Calderwood & CE Zsambok (Eds), Decision making in action: models and methods. Norwood NJ: LEA.

- Orasanu J & Fischer U (1997). Finding Decisions in Natural Environments: The view from the cockpit. In Zsambok & Klein (Eds), Naturalistic Decision Making. Hillsdale NJ: LEA.

Further reading: Decision making under stress.Flin R, Salas E, Strub M, Martin L (Eds) Ashgate. (some practical research examples and approaches)