The Dynamics of Experience: How the mind does work?

John M. Flach
john.flach@wright.edu

Overview

- Eco - Logic
  - Abduction
  - Triadic
  - Unified Ontology of What Matters
- Cognitive Systems Engineering
  - Abstraction Hierarchy
  - Decision Ladder
  - Ecological Interface
- Outside the boxes?

Which cards would you turn to test this rule?

A	D	4	3

*

RULE: If a card has a vowel on the letter side, it has an even number on the number side.

*All cards have a letter on one side and a number on the other.

Is this table legal?

beer	coke	25	15

*

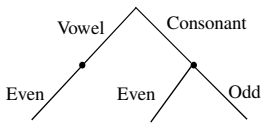
RULE: If a person is drinking beer, then they are over twenty-one years old.

*All cards have a drink on one side and an age on the other.

Problem Isomorphs

A	D	4	3
beer	coke	25	15

If vowel (beer), then even number (over 21).



6

NASA Mission

Hypothesis: Water is necessary condition for life.
If life, then water.

A	D	4	3
life	No life	water	No water

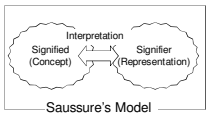
Logic

Deduction: All the beans from this bag are white. (General Rule)
These beans are from the bag. (Observation)
These beans are white. (Conclusion)

Induction: The beans are from this bag. (Observation)
These beans are white. (Observation)
All the beans from the bag are white. (Generalization)

Abduction: All the beans from this bag are white. (Known)
These beans are white. (Surprise)
These beans are from this bag. (Hypothesis)

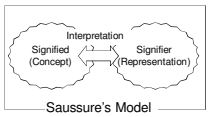
Semiotics



Dyadic System

Semiotics

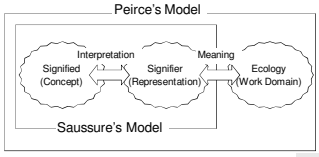
Mind



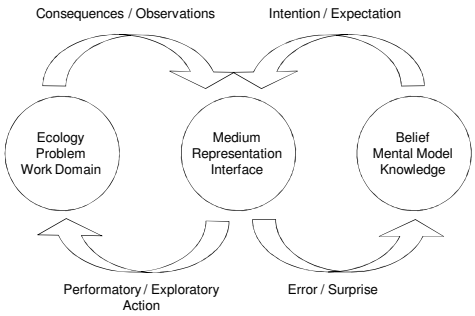
Matter

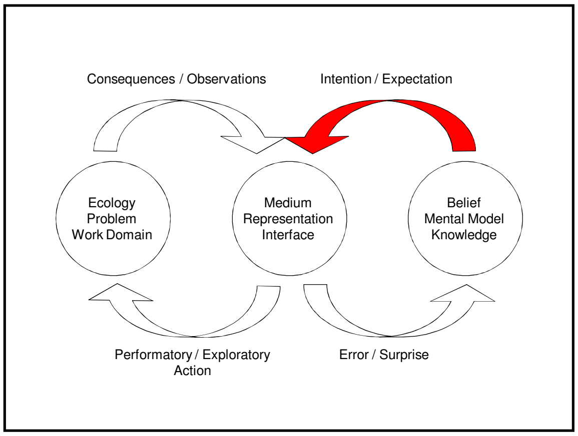
Dyadic System
Dualistic Ontology

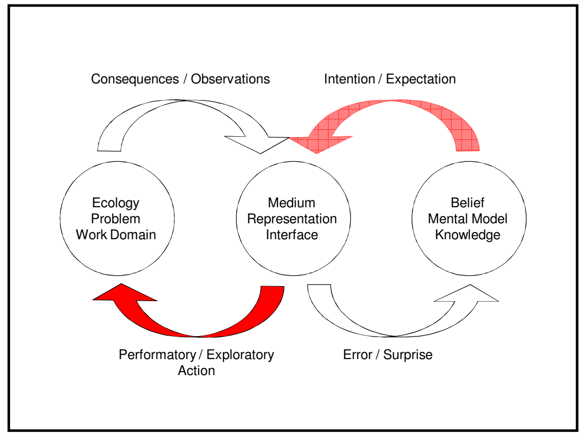
Semiotics

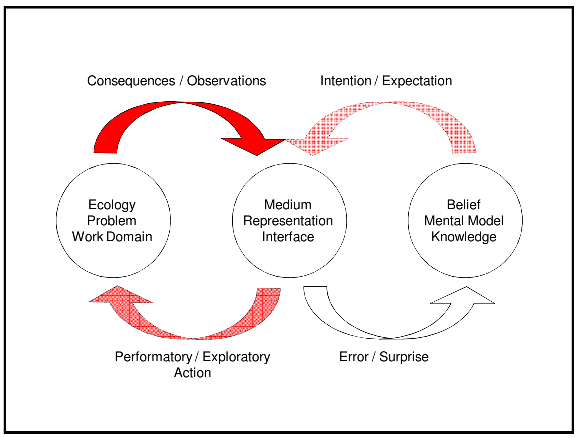


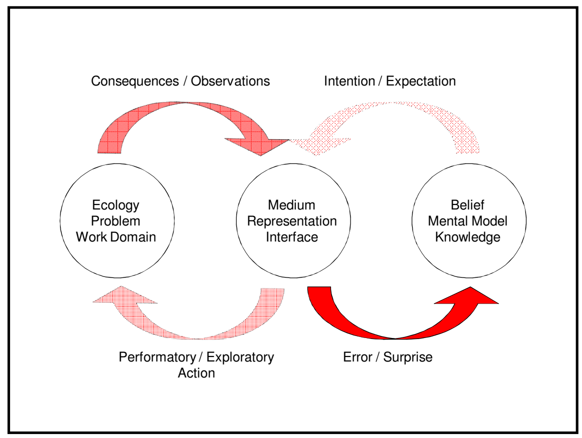
Triadic System
Unified Ontology

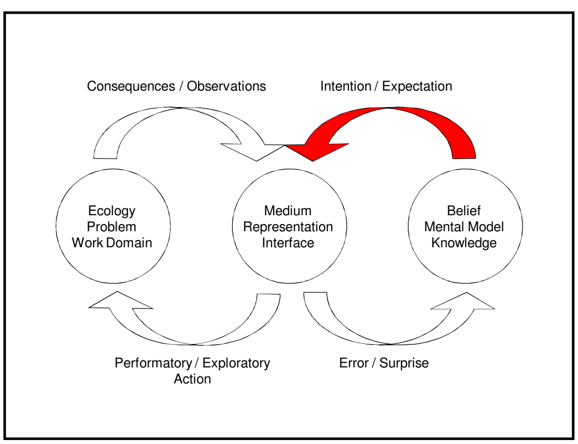


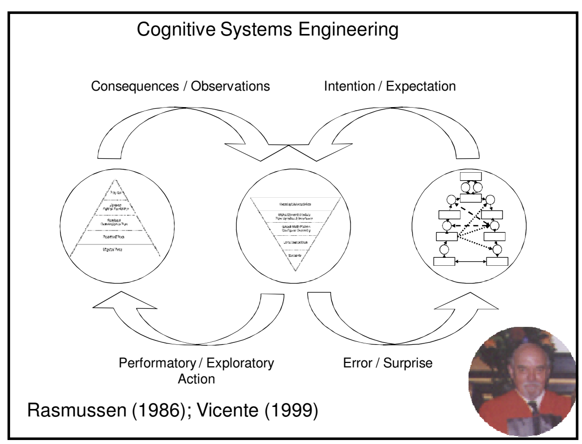

Consequences / Observations
Intention / Expectation
Ecology
Problem
Work Domain
Medium
Representation
Interface
Belief
Mental Model
Knowledge
Performatory / Exploratory
Action
Error / Surprise


Consequences / Observations
Intention / Expectation
Ecology
Problem
Work Domain
Medium
Representation
Interface
Belief
Mental Model
Knowledge
Performatory / Exploratory
Action
Error / Surprise


Consequences / Observations
Intention / Expectation
Ecology
Problem
Work Domain
Medium
Representation
Interface
Belief
Mental Model
Knowledge
Performatory / Exploratory
Action
Error / Surprise


Consequences / Observations
Intention / Expectation
Ecology
Problem
Work Domain
Medium
Representation
Interface
Belief
Mental Model
Knowledge
Performatory / Exploratory
Action
Error / Surprise


Consequences / Observations
Intention / Expectation
Ecology
Problem
Work Domain
Medium
Representation
Interface
Belief
Mental Model
Knowledge
Performatory / Exploratory
Action
Error / Surprise


Cognitive Systems Engineering
Consequences / Observations
Intention / Expectation
Performatory / Exploratory
Action
Error / Surprise
Rasmussen (1986); Vicente (1999)

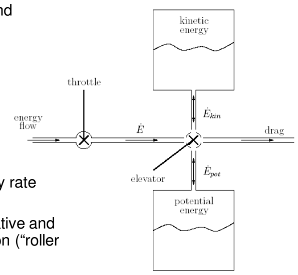
Work Domain Analysis: Means-Ends - Abstraction/Decomposition

Abstraction Level	Less Detail				More Detail
Functional Purpose	Soft Landing	RPMs Air Speed Glide Angle		Total Energy Kinetic Potential	Display Signals
Abstract Measurement			Energy Balance		
General Function	Manual Control	Stick to Speed ILS Beacon		Throttle = T.E. Stick = P.E./K.E.	
Physical Function	Pilot				
Physical Form	Classical Instruments				Tunnel + Energy

Reservoir analogy

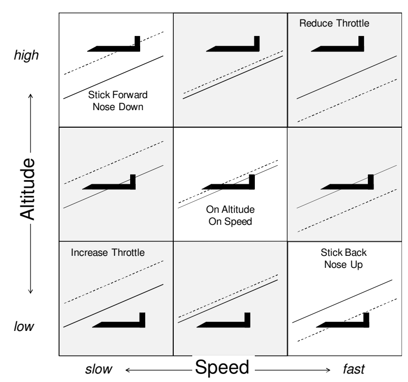
- By applying Newton's second law along the flight path:

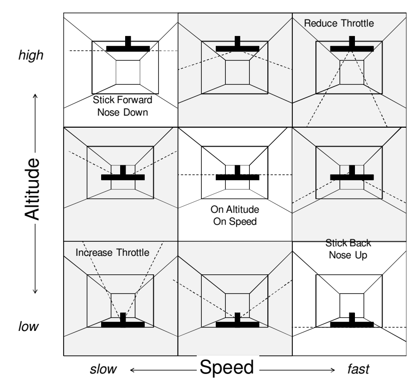
$$\frac{T-D}{W} = \dot{E}_{sn}$$



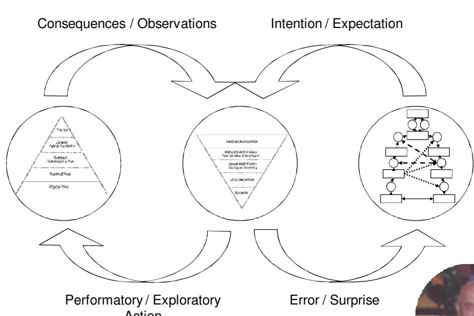
- Throttle controls total energy rate
- Elevator is energy conservative and controls the energy distribution ("roller coaster")

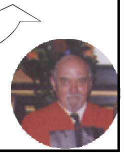
January 23, 2009 26



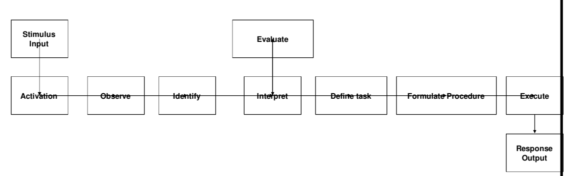


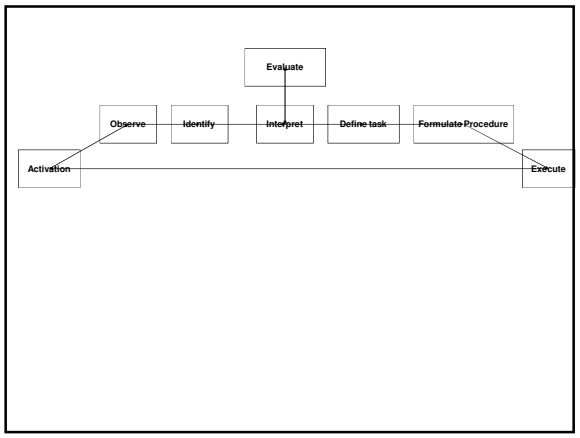
Cognitive Systems Engineering

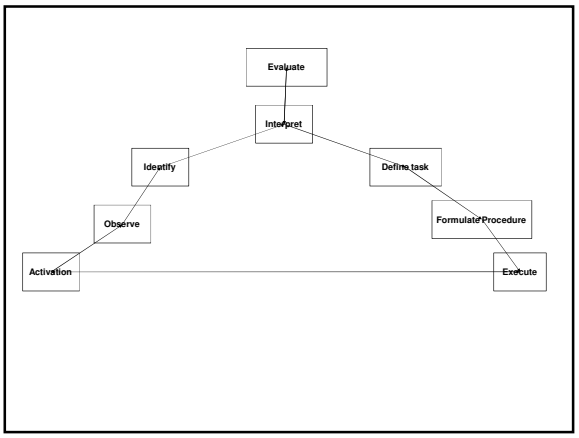


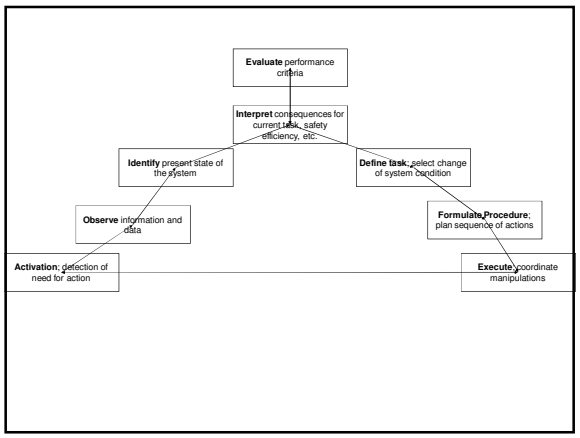


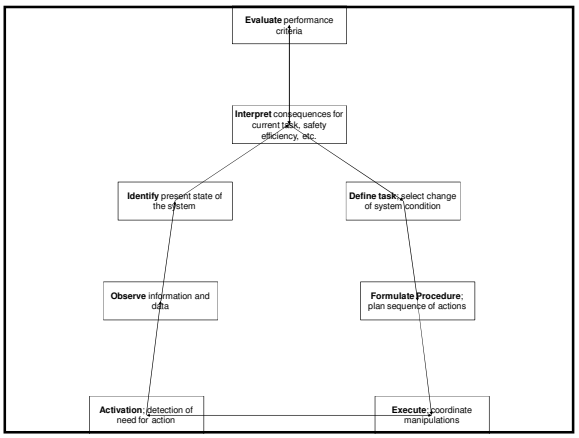
Rasmussen (1986); Vicente (1999)

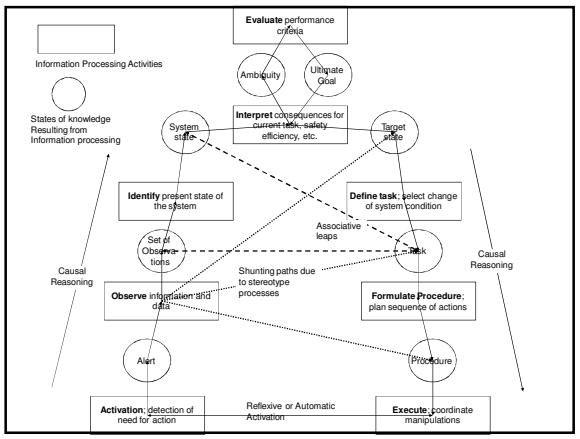


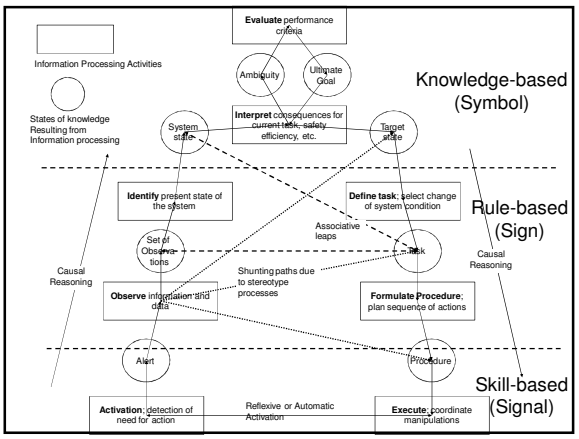

Evaluate
Observe
Identify
Interpret
Define task
Formulate Procedure
Activation
Execute


Evaluate
Interpret
Identify
Define task
Observe
Formulate Procedure
Activation
Execute


Evaluate performance criteria
Interpret consequences for current task, safety efficiency, etc.
Identify present state of the system
Define task: select change of system condition
Observe information and data
Formulate Procedure: plan sequence of actions
Activation: detection of need for action
Execute: coordinate manipulations

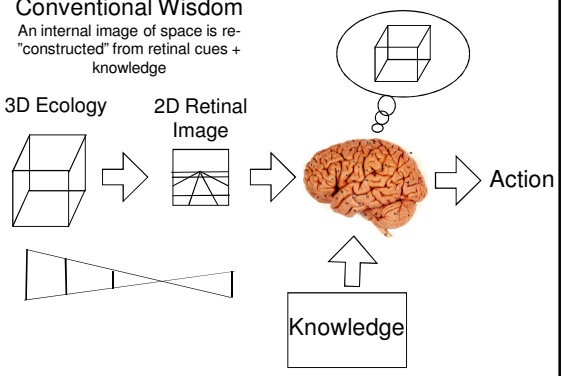

Evaluate performance criteria
Interpret consequences for current task, safety efficiency, etc.
Identify present state of the system
Define task: select change of system condition
Observe information and data
Formulate Procedure: plan sequence of actions
Activation: detection of need for action
Execute: coordinate manipulations


Evaluate performance criteria
Information Processing Activities
Ambiguity
Ultimate Goal
States of knowledge Resulting from Information processing
System state
Interpret consequences for current task, safety efficiency, etc.
Target state
Identify present state of the system
Define task: select change of system condition
Associative leaps
Set of Observations
Task
Causal Reasoning
Shunting paths due to stereotype processes
Causal Reasoning
Observe information and data
Formulate Procedure: plan sequence of actions
Alert
Procedure
Activation: detection of need for action
Reflexive or Automatic Activation
Execute: coordinate manipulations


Evaluate performance criteria
Information Processing Activities
Ambiguity
Ultimate Goal
Knowledge-based (Symbol)
States of knowledge Resulting from Information processing
System state
Interpret consequences for current task, safety efficiency, etc.
Target state
Identify present state of the system
Define task: select change of system condition
Rule-based (Sign)
Associative leaps
Set of Observations
Task
Causal Reasoning
Shunting paths due to stereotype processes
Causal Reasoning
Observe information and data
Formulate Procedure: plan sequence of actions
Alert
Procedure
Skill-based (Signal)
Activation: detection of need for action
Reflexive or Automatic Activation
Execute: coordinate manipulations

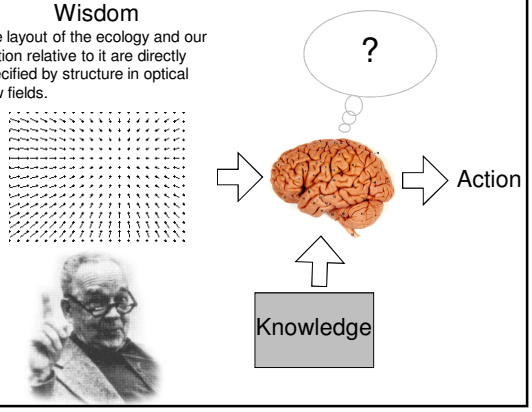
Conventional Wisdom

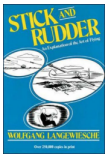
An internal image of space is re-"constructed" from retinal cues + knowledge

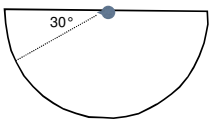


Unconventional Wisdom

The layout of the ecology and our motion relative to it are directly specified by structure in optical flow fields.







The passenger might say, "The airport is about 3,000 feet below us but still many miles away." The pilot ... will say the same thing differently, "The field now lies 5 degrees under the horizon.
Both statements, the passenger's and the pilot's express the same thing. But there is one difference: the passenger is only guessing ... But the pilot is not guessing, although he doesn't know distance and height either, he does know that the field under him lies at that angle; he could even prove it from where he sits ... And here is another difference: The pilot's statement is useful; it is angle rather than actual height and distance that matters. Here is why.

Langewiesche, W. (1944). Stick and Rudder. New York: McGraw Hill.

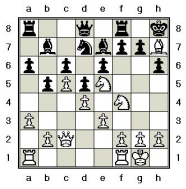
Stroop

Blue	Green	Yellow	Red
Green	Blue	Red	Yellow
Red	Yellow	Blue	Green
Yellow	Red	Green	Blue

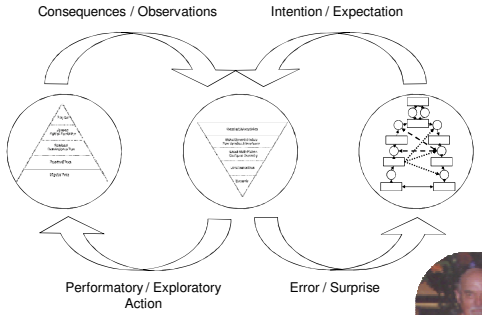
1111
3
222222
44
55555
888
99
7777

Expertise

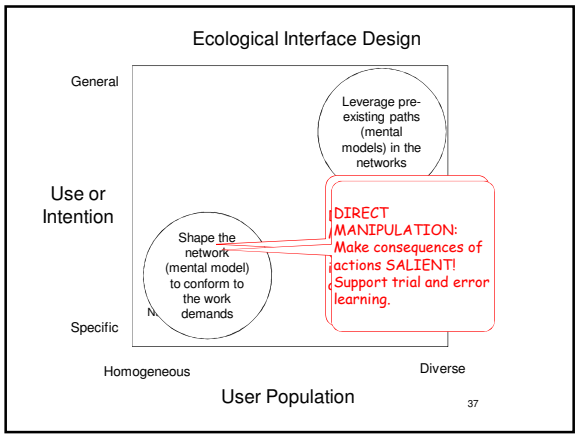
White mates in five moves - Problem 3

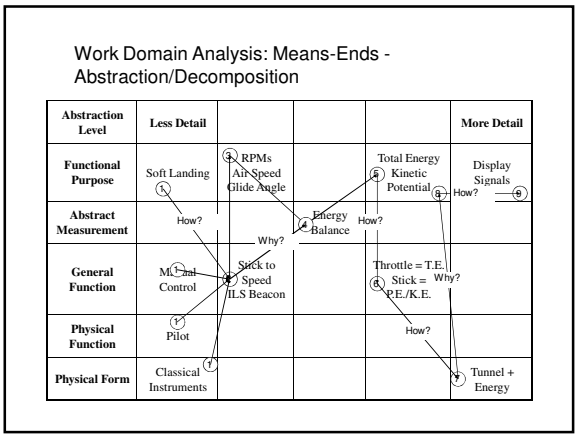


Cognitive Systems Engineering



Rasmussen (1986); Vicente (1999)





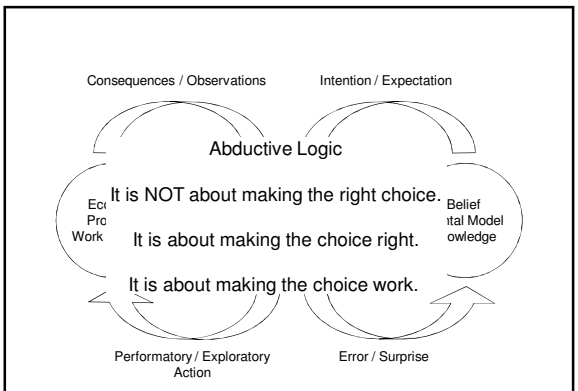
Review

- Eco - Logic
  - Abduction
  - Triadic
  - Unified Ontology of What Matters
- Cognitive Systems Engineering
  - Abstraction Hierarchy
  - Decision Ladder
  - Ecological Interface
- Outside the boxes?

Emotion/Empathy/Beauty

People who lean on logic and philosophy and rational exposition end by starving the best part of the mind.

William Butler Yates



QuickTime™ and a
mpeg4 decompressor
are needed to see this picture.

Common Threads

- Optical Flow, Direct Perception (Gibson)
- Automatic Processing (Shiffrin & Schneider)
  - Consistent vs Variable Mapping
- Working Memory (de Groot, Simon & Chase)
  - Game vs Random
  - Eye movements (Reynolds)
- Recognition Primed Decision Model (Klein)
- Ecological Rationality (Gigerenzer) vs Heuristics/Biases (Kahneman et al.)

44

Logic

Deduction: All planets with life have water.
This planet has life.
There is water on this planet.

Induction: This planet has life.
There is water on this planet.
All planets with life have water.

Abduction: All planets with life have water.
There is water on this planet.
This planet has life.

Human Reasoning vs Logic

Logic is based on structure of argument, substance and context are irrelevant.

Example: If A, then B
B
therefore A (valid or not)

Human reasoning is situated (pragmatic). Heavily influenced by the substance and context.

Measure validity of arguments against our experiences.

Case-based.