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Artificial Recognition System

Development and Evaluation

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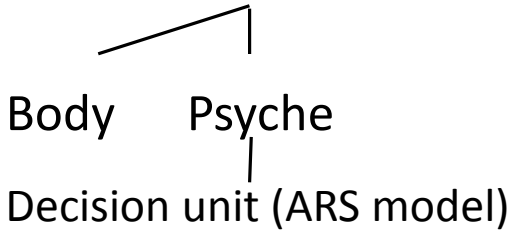
Artificial Recognition System (ARS) Project

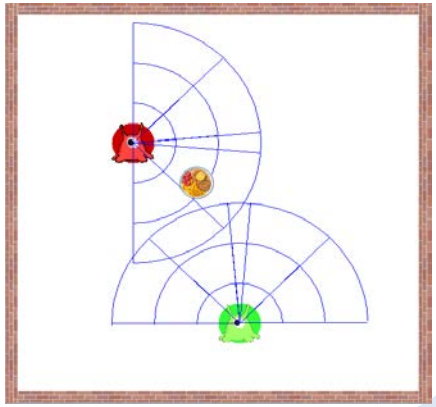
- General-purpose model of human information processing for the usage in various artificial systems

Human-Robot Interaction (Kismet)

Evacuation Simulation (ESCAPES)

- Humanoid agents in a virtual world





Key Features of the ARS Approach

- Functional model

  Generative approach: describing functions not behavior → generic, flexible

- Layered description model

  *Appropriate means of description for different **aspects** (neurons, neurosymbolics, psyche)*

- Holistic and unitary model

  Consistent and coherent integration of basic aspects (motivation, emotion, planning…)

- Top-down approach

  Concretize abstract functions incrementally, starting with psychic layer

- Bionic and interdisciplinary approach

  Translate knowledge into technical models

Basic question:

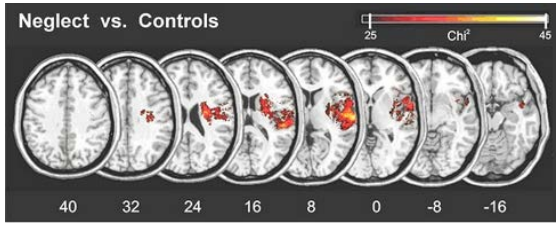
How to develop and evaluate such a model?

Challenges

- Restricted accessibility of mind's functioning
- Interdisciplinary understanding and knowledge translation
- Complexity in description and explanation

Restricted Accessibility of the Mind

- Various ways to get information about the mind's functioning
- Relevant knowledge for our objective? Right level (psyche)?
- Cannot be used directly
- Interpretation and knowledge translation required → Experts needed



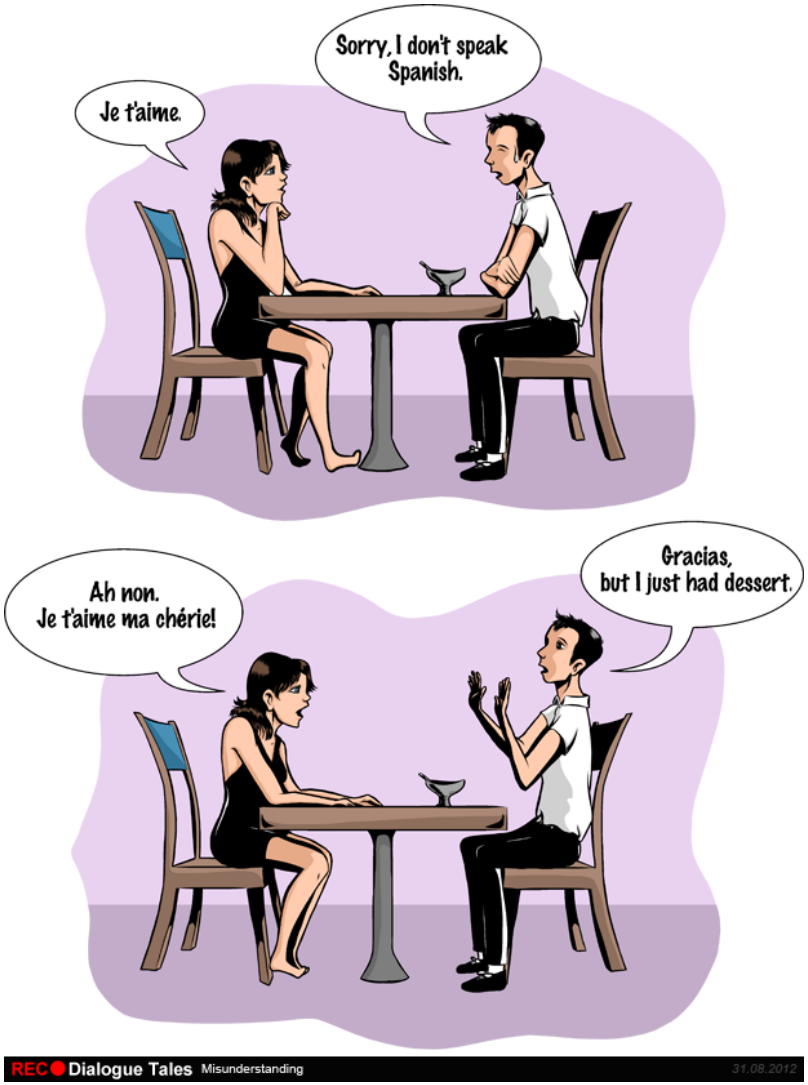
http://de.wikipedia.org/wiki/Elektroenzephalografie

http://homepages.uni-tuebingen.de/karnath/Research.html

http://www.edgehill.ac.uk/psychology/research-participation/

Interdisciplinary Understanding

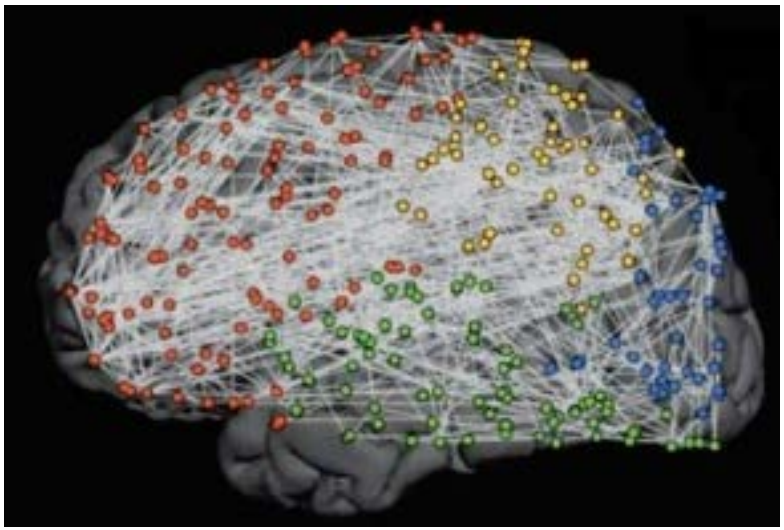
- Regular, intensive collaboration
- Different concepts, vocabulary….?



http://variationsphase.de/vp/2012/10/misunderstanding/

Complexity and Explanation

- Right level, relevant knowledge?
- Not only on neuronal level, also on psychic level
- Interplay of various factors determine behavior

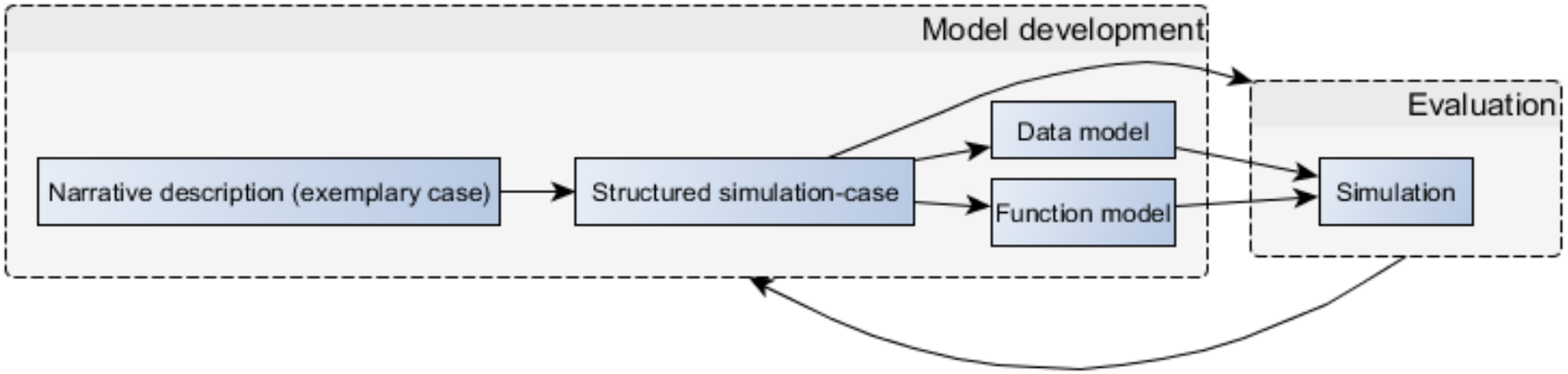


http://medtech-news.com/?p=38

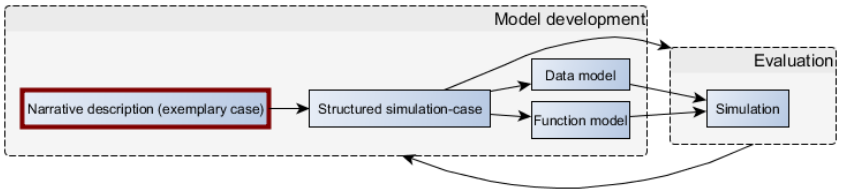
Case-driven Agent-based Simulation

Combination of

- Casuistics for interdisciplinary collaboration
- UC-based requirement analysis for deterministic structuring
- Agent-based simulation as a evaluation framework



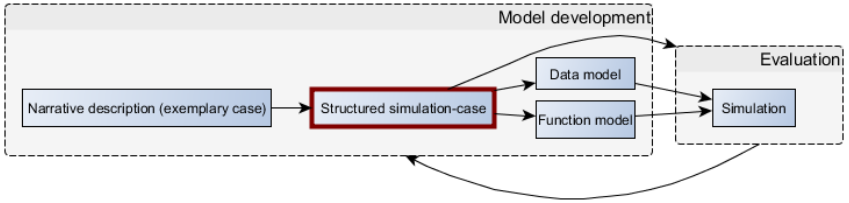
Step 1: Describe phenomena and assumptions

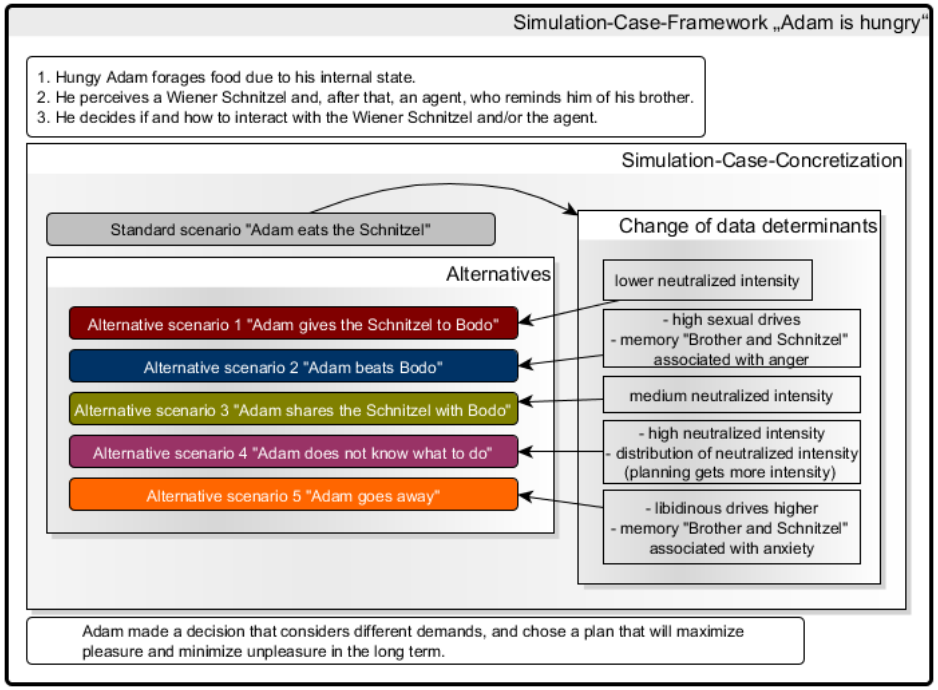


- Platform and tool for interdisciplinary collaboration
- Exemplify and discuss research question with a concrete *exemplary* case
  e.g. How two hungry agents behave in front of a food source (eat, share…)
- Enables stating (and testing) concrete assumptions
  (e.g. the role of emotions, drives, and norms)
- Avoids drifting into abstract discussions
- Embodies and integrate theories from different disciplines to explain behavior State of the art, experts‘ interpretation of real world conditions
- But: indeterministic, gaps in assumptions, inconsistent → no direct usage

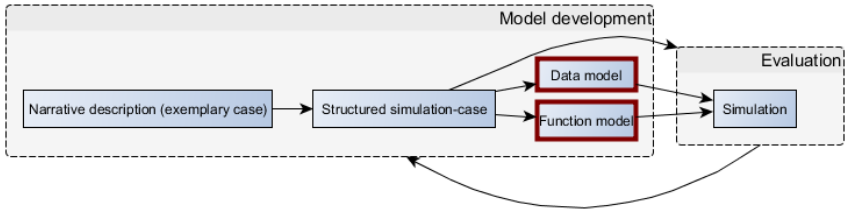
Step 2: Analysis and Structuring

- Clarify the exemplary case
  - Explication of assumptions
  - Consistent description
- Structure to deterministic description
  - Causal function description
  - Data determinants of behavior (*Memories, personality, environment, internal state*)
- Simulation-case (SC) enables
  - Requirements analysis
  - Computational model
  - Test plan for evaluation





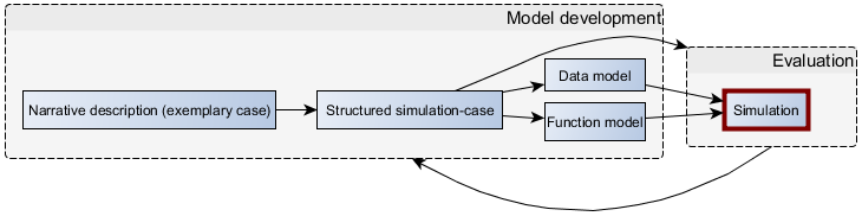
Step 3: Data and Functional Model



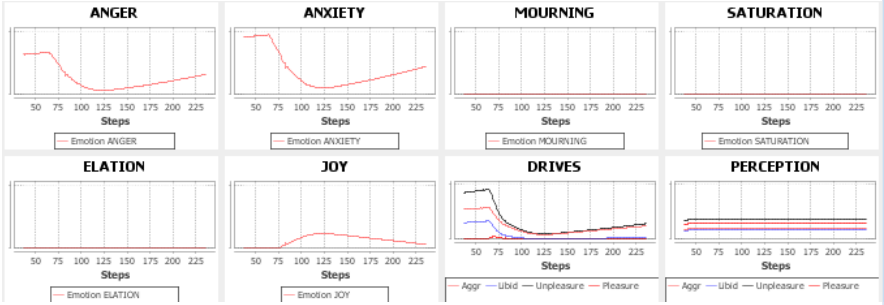
- Previous steps enable
  - Requirements statement
  - Algorithmic description of functions
  - Modelling of knowledge representation
- Specify function modules, interfaces, data

  Adaption or extension?
- Implemented in MASON (Java) and Protégé (Ontology)

Step 4: Evaluation

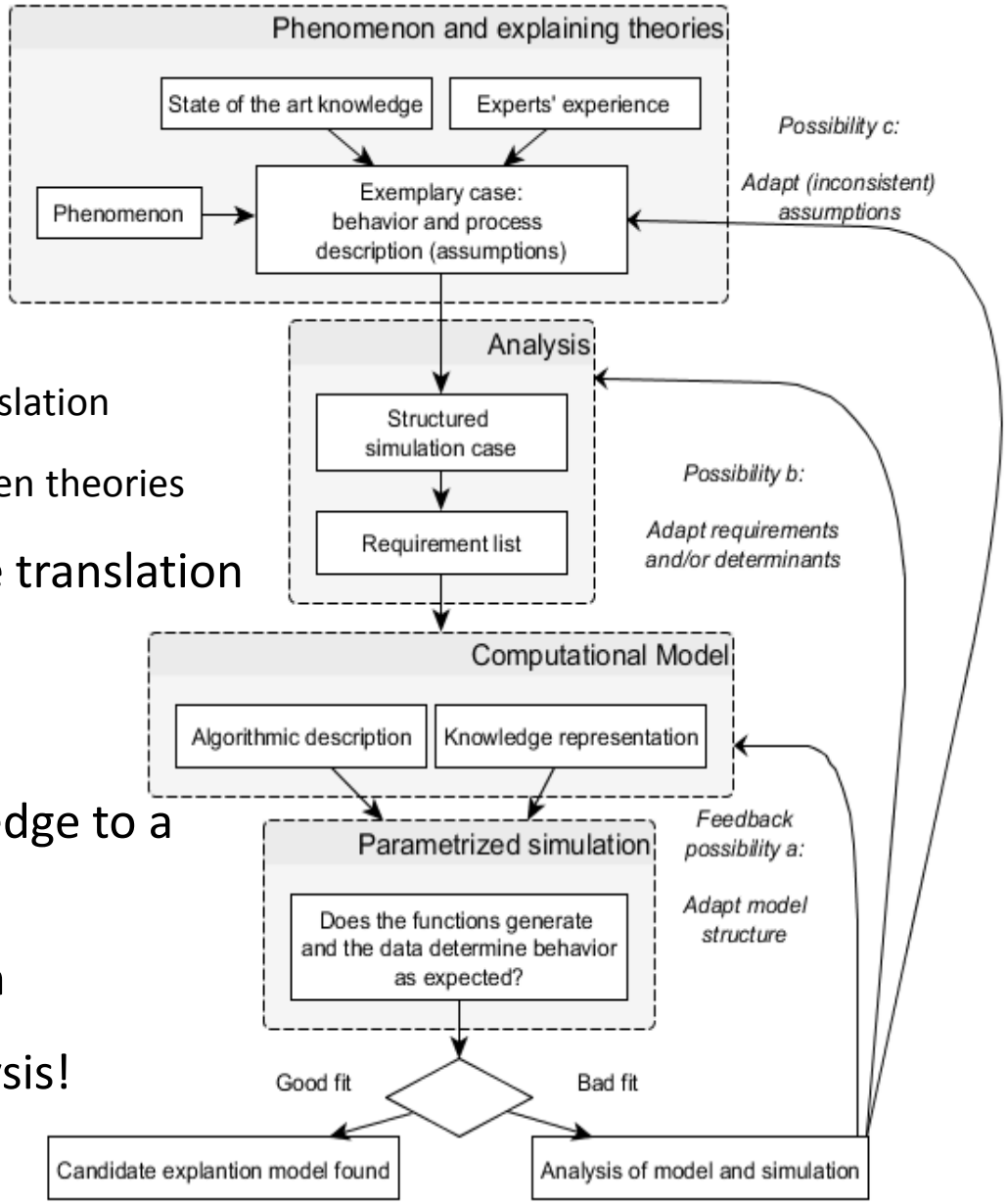


- Simulation-case as test-template → parameterize simulation according to scenarios
- Does the functions generate and data determine behavior as expected?
- How is the behavior generated?
- Test our hypotheses' predictability
  - Are the assumptions of exemplary case valid?
  - Does the interplay of specified factors (e.g. emotions, drives, norms) generate the expected behavior?
  - Does the specified data determine behavior (change)?
- Unexpected behavior or state → analysis on different levels → feedback cycles



Conclusion

- Feedback cycles
  - Possibility a, b: mistake in model translation
  - Possibility c: inconsistent in or between theories
- Bridge disciplines, test knowledge translation
- Concretize testable assumptions from other disciplines
- Structure interdisciplinary knowledge to a causal model and test plan
- SC scenarios → **model calibration**
- Stable model? → sensitivity analysis!
- Premises for model application in specific domains → Outlook



Thank you!