

## Towards a simulation of the Adult Attachment Interview with language using autonomous agents

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## Introduction

- Computational models of internal processes vs statistical/mathematical models of external behaviour
  - A position paper building on earlier work
- Why simulate attachment?
  - Theoretical precision and exploring non-linearities/emergence
  - Providing new questions/predictions for empirical researchers
  - The holy grail - online dynamic models which provide real-time predictions and suggestions for intervention, c.f. Intelligent tutoring systems
  - Producing an 'artificial intelligence' that can engage with therapy
- Existing attachment models
  - Artificial neural network models
  - Robot systems inspired by rather than actually modelling human attachment
  - Agent based models
    - Petters 2006 – 2015, simulates infant attachment

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## Similarities and differences

- |  |   |
|--|---|
| <ul style="list-style-type: none"> <li>• Strange Situation           <ul style="list-style-type: none"> <li>– Secure (go back to play) VS insecure</li> <li>– Organised vs disorganised (e.g. stereotypies)</li> <li>– A kind of stress test</li> <li>– Described by physical behaviour, movements of body, face and gaze</li> </ul> </li> </ul> | <ul style="list-style-type: none"> <li>• AAI           <ul style="list-style-type: none"> <li>– Secure (full balanced coherent recall) VS insecure</li> <li>– Organised vs disorganised (e.g. loss)</li> <li>– A kind of stress test</li> <li>– Described by discourse properties (Grice's maxims)</li> </ul> </li> </ul> |
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## Grice's Maxims of Discourse

- AAI measures whether parent discourse shows
  - Quality
    - truthfulness, consistency
  - Quantity
    - succinct and complete
  - Relation
    - relevance to topic
  - Manner
    - clear and orderly
- Four categories
  - Autonomous –secure
  - Dismissing –avoidant
  - Preoccupied - resistant/ambivalent
  - Unresolved - disorganised

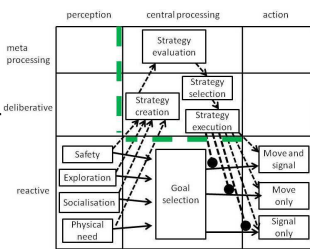
### AAI Simulation scenario

- **Language to be simulated will be an abstracted version of that in real transcripts**
  - But grounded in a microworld
    - a circumscribed domain where infant agents experience caregiving and are then 'matured' with social standards and values and then made able to engage in conversation about their own history/memories
- **Defensive/avoidant and preoccupied mechanisms emerge from the operation of a psychologically plausible model of language processing, memory, attention, and motivation**
  - So learning and emergence of behaviour patterns as a results of interaction with environment
- **Meta-processing where the agent can recognise its own avoidance/preoccupation is possible (or fail to recognise it)**

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### Adapting infant models of the Strange Situation

- Deliberative processes that emerge from lower level activation
- attentional bias in lower level activation
- redirection in dynamic construction
  - Mediated by stress?



- Petters (2006, 2010, 2015)

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### Alternative explanations

- Alternatives are not exclusive
- **Conscious/deliberate communication decisions**
  - But then higher cost of source monitoring
- **Unconscious processes**
  - Memory recall
    - frequency effects
    - affective bias (the Freudian repression explanation?)
  - Meta cognition (frequency and affective variants)
    - Over different timescales (seconds, minutes)
  - Attentional bias/flexibility
    - Focus away from past experiences
    - Focus towards past experiences

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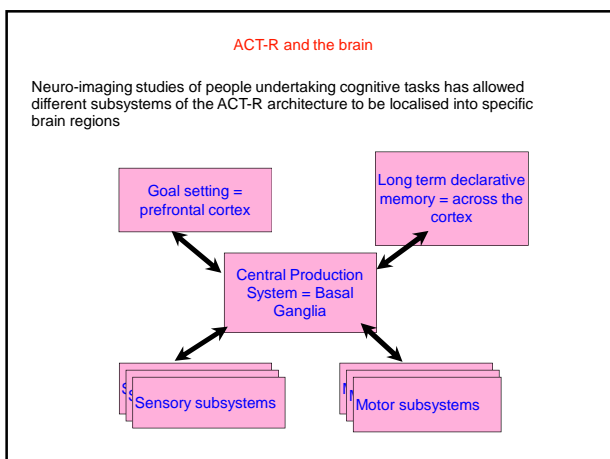
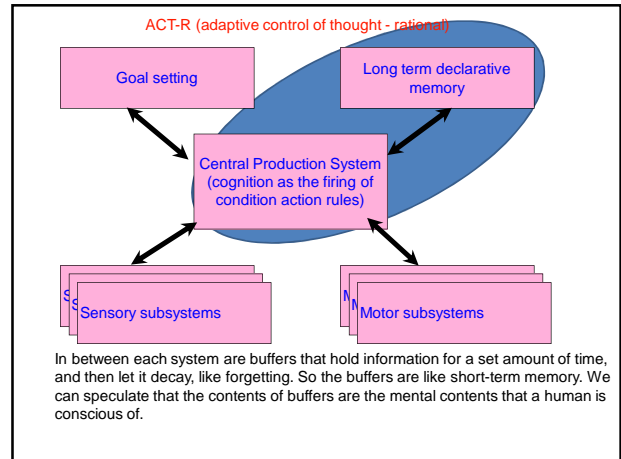
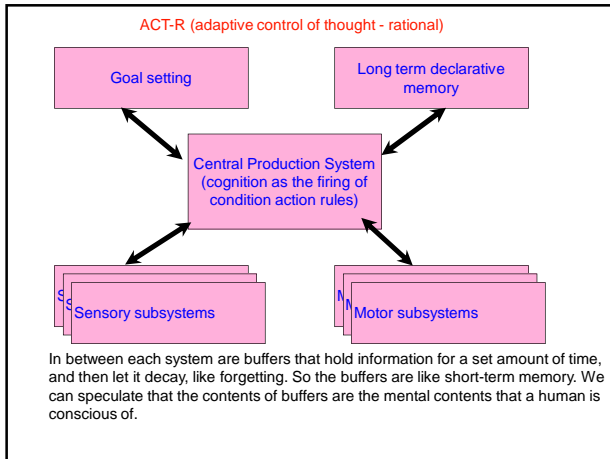
### Biases in memory retrieval in language production

- Lewis and Vasishth (2005) An activation-based model of sentence processing as skilled memory retrieval
- ACT-R combines declarative and procedural knowledge
- Whole architecture centred around a working memory 'buffer'

**Declarative memory** (all attachment related memories are held here, but they are not all equally accessible)

**Working Memory** (the buffer between systems where we see different kinds of elements combined in language productions)

**Procedural Memory** (with a bias towards recent retrievals, and perhaps also with an affective bias. May also have meta productions which scan previous utterances)



## Conclusion

- **Computational modelling**
  - From the attachment control system to cognitive architectures
  - Agent Based Modelling in a circumscribed domain
- **The Strange Situation**
  - Secure vs insecure
  - Organised versus disorganised
- **The Adult Attachment Interview**
  - Move to the level of representation/language
  - Narrative/Gricean discourse measures of attachment
  - Memory, meta-cognitive, and attentional biases leading to defense /avoidance and preoccupied reactions which are observed in discourse properties
  - ACT-R model of language production as a starting point, with EPIC style meta-cognition

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ACT-R - what do the productions look like?

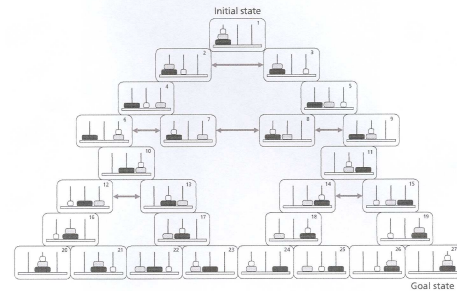
```

(P initialize-addition
=goal>
  ISA      add
  arg1     =num1
  arg2     =num2
  sum      nil
==>
=goal>
  sum      =num1
  count    0
+retrieval>
  isa      count-order
  first    =num1
)

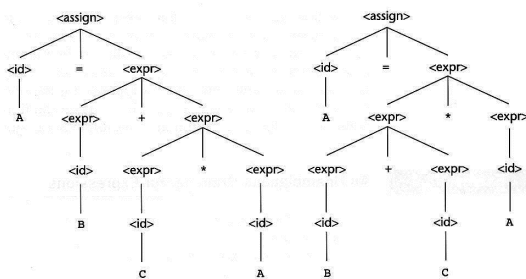
;;; When there is a stem and no suffix we
;;; have an irregular
(p past-tense-irregular
=goal>
  isa      goal
  state    done
=imaginal>
  isa      past-tense
  verb     =word
  stem     =past
  suffix    blank
==>
=goal>
  state    nil
)
(spp past-tense-irregular :reward 5)
  
```

## Tower of Hanoi problem space

The problem space of legal moves in the Tower of Hanoi problem



## Two parse trees for the same sentence



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## Behavioural and Cognitive Components of Attachment Theory

- Hospitalisation; maternal deprivation, bereavement (Bowlby 1944 onwards)
- Ganda study (Ainsworth 1967)
- Naturalistic study of exploration in a park (Anderson 1972)
- The Strange Situation Procedure** (Ainsworth, Blehar, Waters and Wall, 1978)
- Attachment Q sort (Waters and Deane (1985)
- Measures in later childhood; adolescence; adult romantic relationships;
- Adult Attachment Interview (AAI)**
- Secure-base scripts in adults (Waters and Waters 2006)
- ethological 'behaviours'
  - reflexes, Fixed action patterns, Releasing stimuli, Displacement
- instincts that have to be constructed (and reconstructed)
  - expectable environments, flexible repertoire direct by outcomes, so a special kind of instinct
- higher level control structures
  - set goals, plans, Internal Working Models, Natural Language
- Attachment control system → Cognitive architectures for attachment
  - Reactive and deliberative architectures for infants in the Strange Situation and exploration in the first year of life
  - But currently no language using agents in attachment simulations

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