

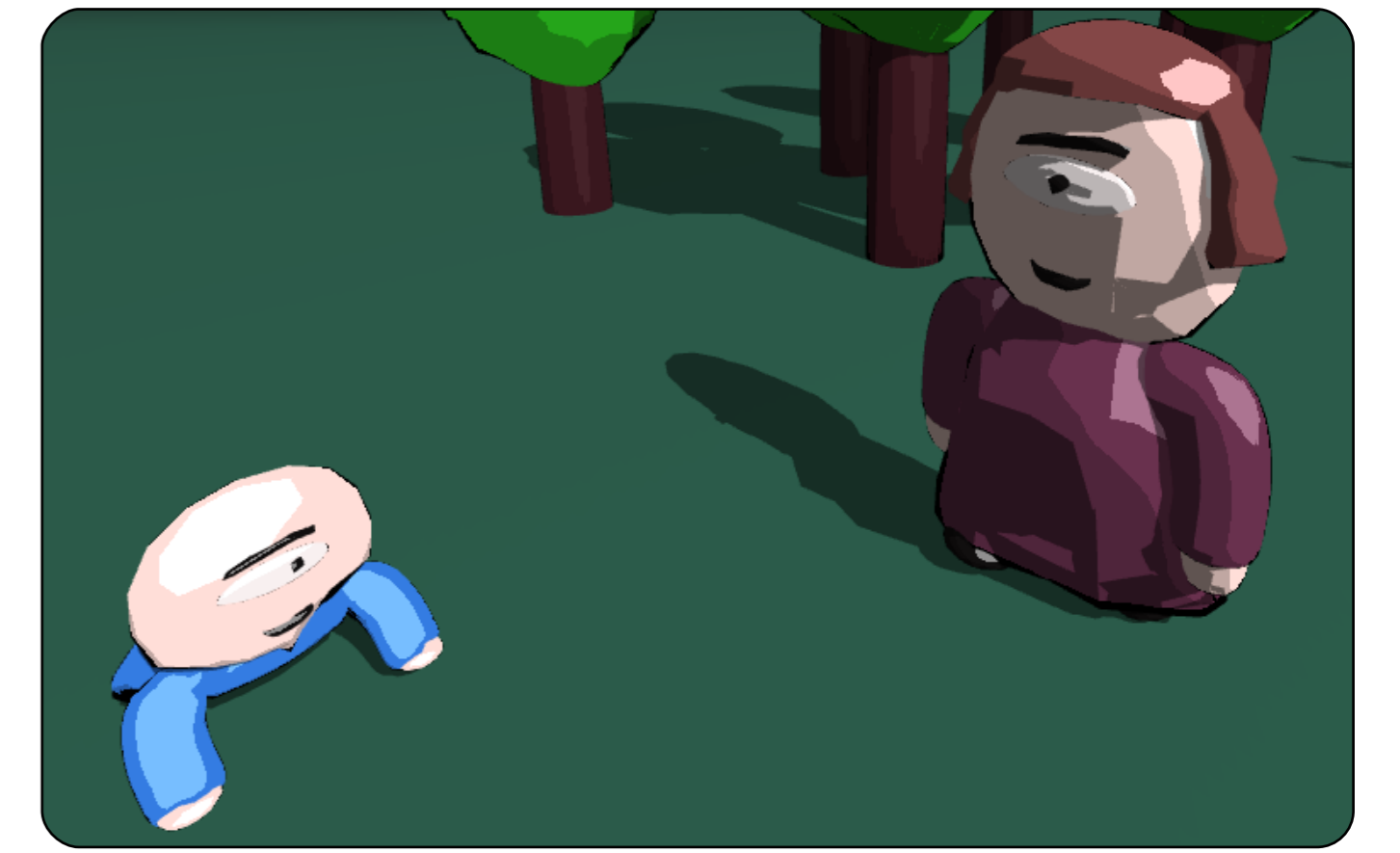
Building a computational model of emotion based on parallel processes and resource management



Stefan Rank

Austrian Research Institute for Artificial Intelligence (OFAI)
stefan.rank@ofai.at

Capturing the temporal and embodied properties of emotional mechanisms by computational modelling based on communicating concurrent processes and the competition for limited resources



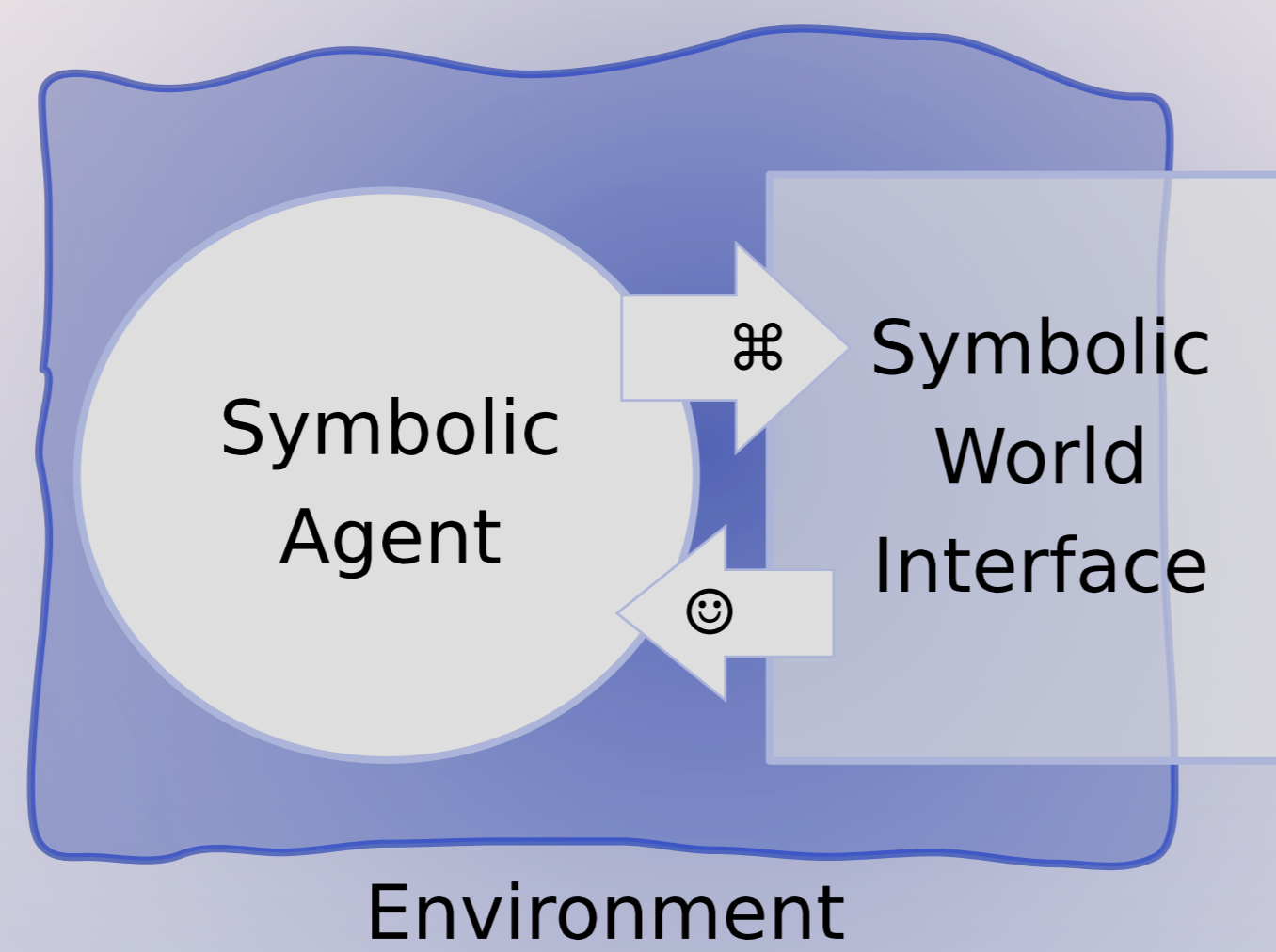
Dramatic story-worlds

- Virtual environments inhabited by **synthetic characters**.
- Users participate actively in the creation of **narratives**.
- Require software agents with **emotional competences** to exhibit autonomy and personality.

Limitations in earlier work

Experience gained in previous projects revealed common shortcomings of affective architectures:

- **Symbolic sensing and acting**
The exchange of pre-structured symbolic information does not match the intricate relation between perception and appraisal in real life.
- **Reified emotions**
A small set of distinct emotion types is often used as a **mechanism** rather than as a means of post-hoc analysis or reflection.
- **Rigid behaviour structures**
Classic planners are based on activity sequences with relatively coarse granularity, while emotional adaptivity also affects finer details.



Objectives

Model sensing and acting over time

Emotional phenomena are inherently temporal. A suitable mechanism for sensorimotor interaction needs to account for this dynamicity.

Provide a rich embodiment for virtual worlds

Consider boundedness, tractability, virtual physicality, and limited control as part of the simulation requirements.

Cover multimodal interaction

To approach the breadth of human activity, different modalities should be considered:

→ Seeing, Hearing, Smelling, and basic physical movement and manipulation

Simplifications:

e.g., vision as false colour rendering, smell using spheres of influence.

Consider human performance

Interaction with a human in real-time constrains the allowed pace of the model: timely interaction is neither too slow nor too fast.

Provide a social setting

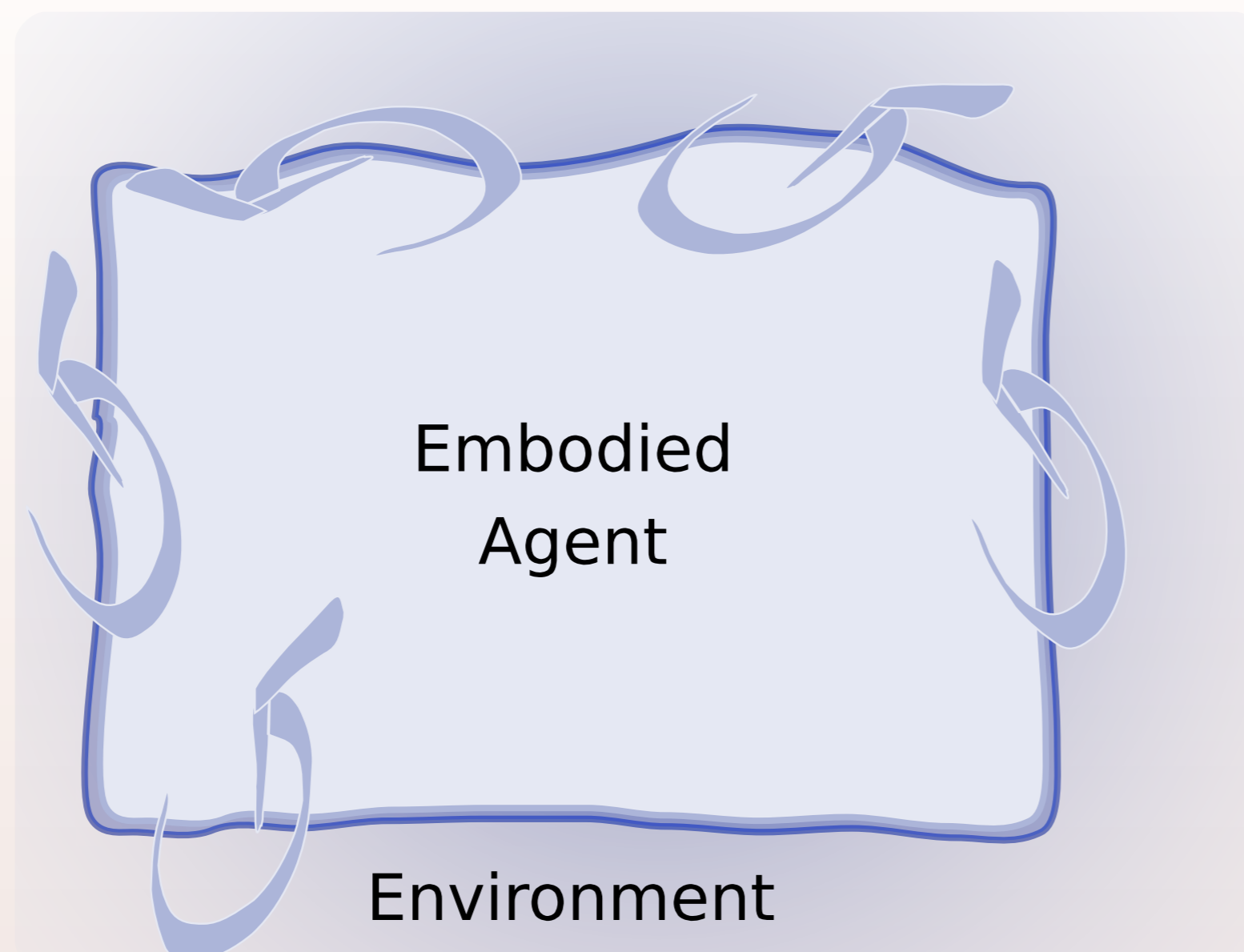
Interaction between two (or more) agents and a human user assures a suitable setting for the social aspects of emotion.

Clarify the significance of situational meaning structures

These hypothetical constructs (aka appraisal frames) aggregate information of individual appraisal checks. In process-based models it is unclear, how, when, and whether to perform such integration.

Parsimony

Caveat: a parsimonious model may be more readily understandable but at the risk of not matching the inherent complexity of emotional phenomena.



Proposed method

Resources and concurrent processes as **building blocks** for modelling an affective agent:

- A **process** models one strand of activity. It is either running (i.e. allocated a processing time resource), or dormant.

It can communicate with other **concurrent** processes, request control of resources, wait for a notification of changes in other processes, start or stop other processes.

- **Resources** are an abstraction of the limited control an agent has over the part of the world that constitutes it.

Types (so far): processing time, communication channels, and interactors (sensors and actuators).

Explicit time management:

- Needed to ensure that interaction between subsystems (virtual environment and processes in agent models) is scheduled in a fair and predictable fashion on conventional hardware.

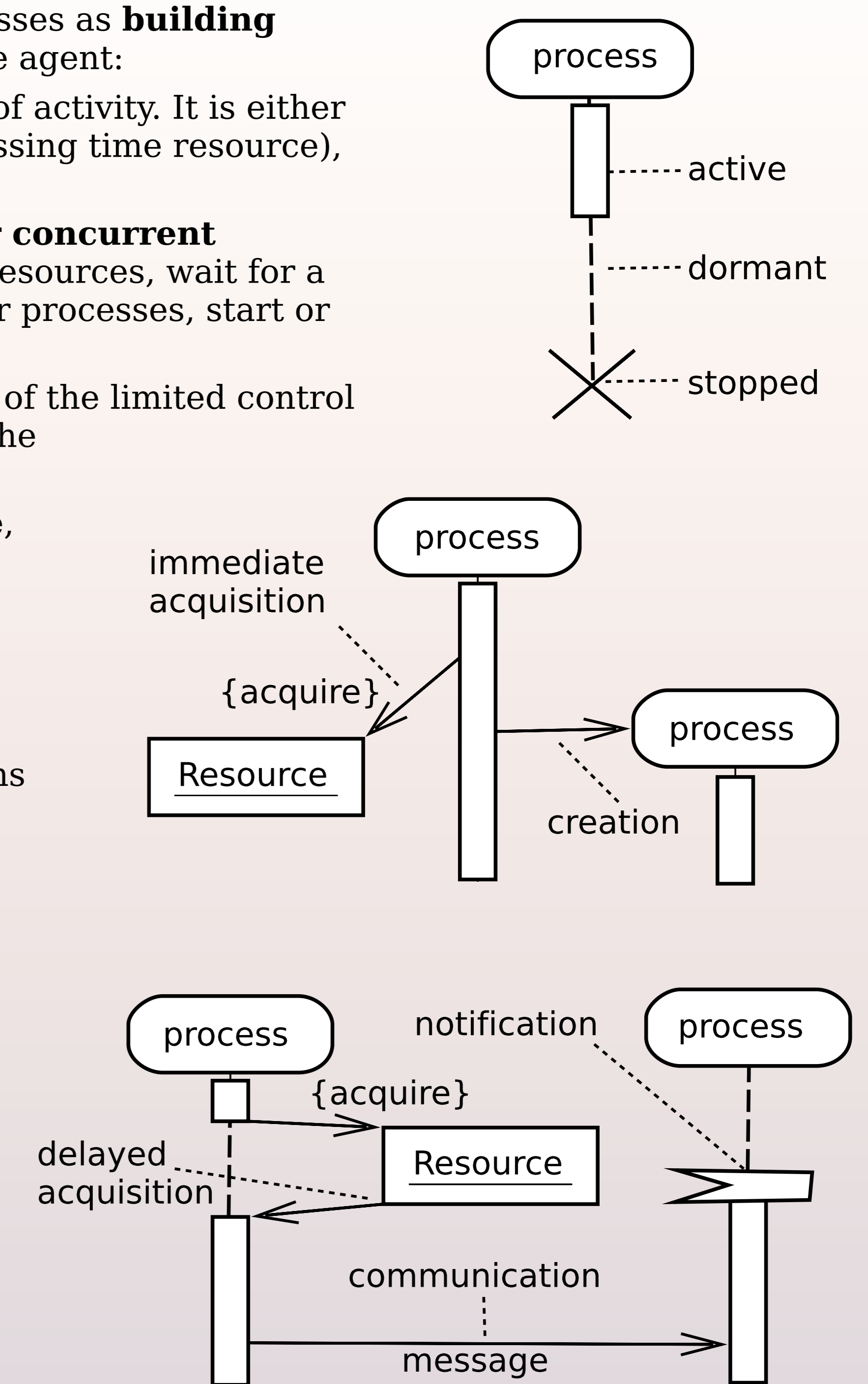
Structuring principles for the implementation:

- Typology of processes
Concerns, activities, behaviours, tasks, regulation processes, and action tendencies.
- Principal domains of resources

Correspond to the five principal organismic subsystems involved in emotion: cognition, physiological regulation, motivation, motor expression, monitoring.

Incremental approach:

- Focus on one specific emotional phenomenon at a time, e.g. a disgust episode.
- Avoid introducing unwarranted postulates, e.g., a priori personality parameters, a global planning process.
- **Necessary shortcuts** should be made explicit, e.g., encapsulate out-of-reach functionality as resources to be refined.



Evaluation plan

Different disciplines suggest different evaluation criteria:

- Human-Computer Interaction: Usability
- Psychology: Controlled laboratory experiments
- Computer science: Feasibility and performance measures

Planned evaluation criteria:

- Simple performance measures, defined for a specific target phenomenon: e.g., higher level **interaction scripts** to be matched against traces of actual runs of the system.

Disgust script

- child approaches dog poop
- mother looks at child
- mother looks at dog poop
- mother expresses disgust facially
- mother retreats
- mother approaches child
- mother's expression intensifies
- ...

Disclaimer and Acknowledgments

- This poster reflects only the author's views. The European Community is not liable for any use that may be made of the information contained herein. This work is carried out within the EU FP6 Network of Excellence Humaine [IST-2002-2.3.1.6 507422]
- OFAI is supported by the Austrian Federal Ministry for Science and Research and by the Austrian Federal Ministry for Transport, Innovation and Technology [FFF 808818/2970 KA/SA]

2007-09-13 @ Affective Computing and Intelligent Interfaces (ACII 2007) Doctoral Consortium, Lisbon, Portugal (EU)