Chapter 6
Interaction of Simulated Actors with the Environment

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Abstract

The current chapter explores the possibilities of an improvement of the interaction of an ACT-R actor with its environment including other actors. This is done in the framework of a project aiming at a multi-actor simulation environment based on the ACT-R architecture. Two objections against traditional cognitive architectures like Soar and ACT-R, namely the lack of physical grounding and the lack of symbol grounding, are explained. For a possible improvement of this situation, organizational semiotics and simulation of emotion seem to offer promising perspectives. Organizational semiotics offers us concepts for the encoding of the environment in the form of affordance signs, social constructs, and social norms. This leads to new declarative chunk types in ACT-R. An emotion subsystem can maintain an emotional state that encourages task performance, learning, and social behaviour. An awareness subsystem enables task switching based on the emotional state and the selection of those social constructs and norms that are applicable to the current situation.

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P.-J. Charrel and D. Galarreta (Eds.),
Project Management and Risk Management in Complex Projects, 109–130.

6.1 Introduction

We aim at the development of a multi-actor simulation environment based on ACT-R that can be used for experimentation with concepts from organizational semiotics and organization theory (Roest 2004; Helmhout *et al.* 2004, 2005a,b). However, at the beginning of our project, ACT-R knew only a single-actor implementation that could not be used for multi-actor simulations. Our first task, therefore, has been to make ACT-R suitable for multi-actor simulation.

Thus far, we have succeeded in rebuilding ACT-R as a Java program, and have realized several enhancements that enable actors to interact in a multi-actor environment (Roest 2004; Helmhout *et al.* 2004, 2005a,b). The single-actor ACT-R program has been replaced by a client-server system in which each actor is a client running on some machine, and the simulated physical environment is the server running on some (maybe other) machine. The communication between actors (and environment) is based on TCP/IP sockets, the FIPA protocol, and XML messages. The ACT-R memory organization has been made more flexible in order to enable new memory access structures (buffers) that are necessary for handling interactive behaviour like movement, perception, communication, and social behaviour. A module for perception and movement in two-dimensional space has been added, as well as a module for the sending and interpretation of (XML) messages. For running experiments, a module for the collection of data and storing these in an external database has been realized. The user interface enables running simulations, and inspecting the contents of each actor's memory contents in terms of declarative chunks and productions (and their activations). Experiments with actor interaction while moving in a two-dimensional world have been done, showing the formation of (tacit) social constructs (Helmhout *et al.* 2005b).

This chapter explores the possibilities of getting a further step ahead in the direction of an improvement of the interaction of the ACT-R actor with the environment and with other actors. For possible improvements we have turned to two areas: organizational semiotics and simulation of emotion. Organizational semiotics offers us a concept for the encoding of signals from the environment and the actor body in the form of affordances, and gives us the concepts of social construct and social norm as regulators of socially acceptable behaviour. Simulations of emotion give us the emotional state that, when monitored, could be used for flexible switching between goals and for the encouragement of social behaviour.