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## Virtual Actor with Social-Emotional Intelligence

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### Abstract

This work continues the effort to design and test the cognitive architecture eBICA: a general model of emotionally biased behavior control and decision making, with the focus on social emotional relationships. The key building blocks of the model include dynamics of mutual appraisals of actors, bi-directionally linked to behavior, on the one hand, and on the other hand – to M-schemas, that establish normal behavior of two or more actors involved in a mutual relationship, such as partnership. To test the model, we implement a Virtual Actor embodied as an avatar in a specifically designed virtual environment, and use several paradigms of its social interaction with humans. We show that virtual environments and associated paradigms can be divided into a hierarchy, on top of which are paradigms with dynamically changing social relationships and roles. Using paradigms of this kind, we show that a virtual actor can be indistinguishable from a human participant in three dimensions: efficiency, believability and social acceptability. Some of the social measures demonstrate a higher-than-human performance, inspiring an idea of a new challenge for BICA and AI. The general model of a Virtual Actor presented here is anticipated to sparkle ideas of broad impacts on many practical areas.

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## 1 Introduction

Research in the field of cognitive architectures that capture the essence of the human mind [1] becomes increasingly popular today. Today intelligent virtual agents with elements of social-emotional intelligence are in the focus of attention [8,11]. This work is a continuation of our previous line of research [2-7,10,13].

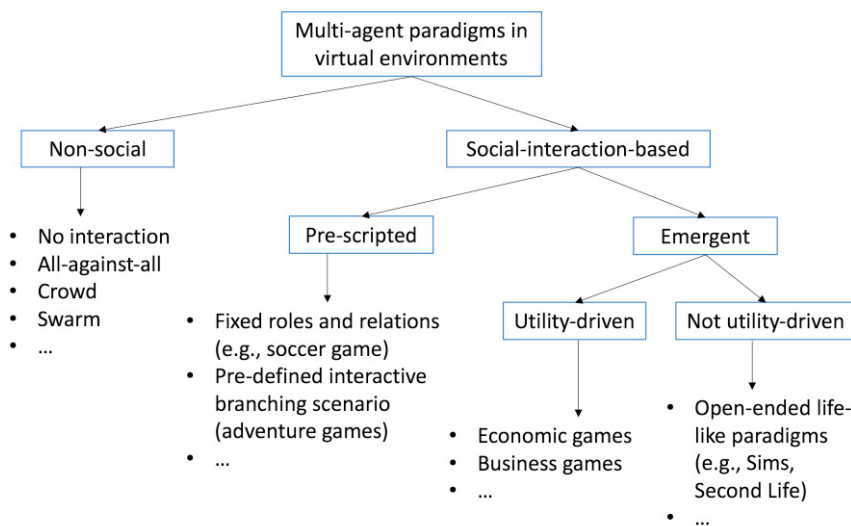
Our previously used virtual environment [2] has been modified and further enhanced with new functionality in this study. The previously used experimental paradigms [2,3,4] are re-implemented in the new environment, and new paradigms are added here. The main objective of the study is to explore practically the following question: “Is it possible to create a Virtual Actor within the framework of the

chosen environment and paradigms, such that its behavior is indistinguishable from the human behavior, on three groups of measures: efficiency, believability, and social acceptability?” Here we provide an answer.

## 2 Materials and methods

### 2.1 The Hierarchy of Virtual Environments

There are many kinds of virtual environments used today in cognitive modeling and research. Environments are divided into single-user multi-user, by type of control, by tasks facing the subject. An important aspect of a virtual environment in the context of the present study is an opportunity of social dynamics between actors in a virtual environment. Existing environments can be divided according to the type of social interaction: 1) no social interaction, 2) static social interaction, 3) dynamic, naturally emerging social interaction. The resultant taxonomy is shown in Figure 1.



**Figure 1:** Taxonomy of multi-agent paradigms of social interactions in virtual environments, such as computer games. Utility-driven social interactions include rational behavior based on the maximization of a certain utility function. Not utility-driven social interactions may be driven by social emotions and individual feelings, among other factors.

Non-social, or independent, behavior occurs when social relationships among subjects are not impossible in the context of a given virtual environment. In this case, the overall effectiveness of the participant is independent of his or her ability to socialize and to emotionally interact with other participants, but is determined solely by factors like the reaction speed and previous experience with games in virtual environments.

Pre-scripted, or static social interactions occur in those virtual environments, in which social roles are set in advance and remain unchanged throughout the session. Thus, this environment allows participants to demonstrate the social and emotional aspect of their relationships, but at the same time, rapid changes in relations with each other are impossible.

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