Chapter 18
Embodied and Embedded Intelligence: Actor Agents on Virtual Stages

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ABSTRACT
In this chapter, it is argued that the scope of simulation pedagogy can be extended beyond the medical health field with the development of actor agents on virtual stages. The literature on animated pedagogical agents is reviewed with a focus on embodied intelligence, and in particular, conversational ability. The embodied intelligence of virtual worlds is also reviewed, including the deployment of computer controlled avatars. The next section presents a review of work involving actor agents in Second Life including the authors’ research. A few of the major challenges are described and a conclusion is presented regarding the opportunities afforded by actor agents and virtual stages.

INTRODUCTION
Simulations, as defined by Sauve, Renaud, Kaufman, and Marquis (2007) may be argued as the quintessential adaptive learning system. According to Sauve et al. (2007) and Swanson and Ornelas (2001), a key feature of a true simulation is that it behave as a dynamic model of reality which responds to user initiated actions and perceptions. Users can control the reality of the simulation in ways that reflect their learning preferences and existing knowledge. Ideally, simulations are a perfect reflection of individual learning trajectories. Simulations are used in many disciplines but the present focus is on simulations in health care and in particular, the simulation of patients for training health care practitioners. This area was chosen because of the long standing tradition in medical
training regarding the use of Standardized Patients, actors paid to act as a patient with a standardized problem (see Barrows, 1993; Brender, 2005 for overviews of Standardized Patients, including their numerous benefits). Moreover, applications in this area could be extended to other service and social professions that work directly with people or clients. The key benefit in all domains is that a simulated client would allow students in any profession to practice high risk skills in a risk free environment.

In a 2009 review article, Nehring and Lashley describe 40 years of simulation practice in the nursing field and not surprisingly, patient simulations play a significant role. Even further back, Lees (1874) describes the use of a task trainer, or a type of mechanical dummy that students could use to practice their bandaging skills. Nehring and Lashley (2009) describe one notable dummy introduced in 1910 as Mrs Chase, who interestingly for the purposes of this article, was actually modeled after a real Mrs. Chase. Mrs. Chase was modified over the years to accommodate different patient procedures and included a major modernization in 1939. According to Nehring and Lashley (2009), the production of Mr. Chase occurred in the 1940s and the Chase couple continued to be produced for the next 30 years eventually to be replaced by mechanized and computerized mannequins. Nehring and Lashley (2009) reviewed 26 studies involving high fidelity computerized mannequins, where fidelity refers to the degree of reality replication, and found that most if not all studies report some positive benefit associated with high fidelity mannequins. However, they caution that the sample sizes are generally small and quite heterogeneous combined with measurement instruments of unknown construct validity. It is important to note that physical mannequins enable the physical manipulations required for procedural skills learning. In order to develop critical communication, interviewing, and assessment skills, Standardized Patients are required.

The use of Standardized Patients represent the pinnacle of patient simulation since trained actors embody the intelligence needed for a dynamic and adaptive simulation. Nehring and Lashley (2009) note that effective role playing teaches students metacognitive and social skills needed for nursing education. They also note that Standardized Patients have been used across a wide variety of skill acquisition from violence prevention to cultural competency. The advantages of Standardized Patients are well established according to Nehring and Lashley (2009) and include programmability to meet curricular goals, the provision of immediate feedback, improved clinical reasoning, increased student confidence, effective transitioning, risk free practice in medically sensitive scenarios, and decreased anxiety. Barrows (1993) also notes the enhanced accessibility of Standardized Patients and their ability to suspend reality and tolerate violations of social norms or poor clinical practice. However, the development and maintenance of a quality Standardized Patient program can be costly and time consuming and special populations (e.g. children, dementia patients) can be difficult to recruit and train (Nehring & Lashley, 2009). The use of Standardized Patients in medical simulations is clearly the gold standard (see Peabody, Luck, Glassman, Dresselhaus, & Lee, 2000) but it should be noted that artificial patients in simulations are not intended to replace this part of the curriculum. An artificial patient capable of emulating a Standardized Patient could address the problem of costs while providing additional benefits in the areas of availability, access, and possibly configurability. Artificial patients in medical simulations could also be useful as scaffolding so as to maximize the learning opportunity afforded by live actors.

In order for artificial standardized patients to be effective, they must be able to interact with students using natural language conversation of the type patterned after traditional patient-doctor interactions. Advances in conversational agent research have provided an important missing link