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Characters that Help You Learn: Individualized Practice with Virtual Human Role Players

H. Chad Lane

Institute for Creative Technologies
University of Southern California
lane@ict.usc.edu

Abstract. This paper describes how virtual humans can be used as role players in for communicative tasks that require modification of one's social skills. Examples are discussed, including systems for intercultural communication and doctor-patient interviewing, and we conclude with a discussion of the challenges of providing individualized practice by dynamically adjusting the behaviors of virtual humans to meet specific learner needs.

Keywords: virtual humans; social skills; pedagogical experience manipulation

1 Introduction

Pedagogical agents are most often designed to play the role of tutor or peer in virtual learning environments [1]. In these roles, the agent works alongside the learner to solve problems, ask questions, hold conversations, and provide guidance. Over the last decade or so, a new breed of pedagogical agents has emerged that do not play the role of expert or peer, but rather act as the *object* of practice. That is, instead of helping on the side, it is the interaction itself (with the agent) that is intended to have educational value. Here, the agent is usually a *virtual human* that is playing some defined social role in an interaction. To "succeed", the learner must apply specific communicative skills. For example, to prepare for an international business trip, one might meet with a virtual foreign business partner to negotiate a contract agreement.

The technological goal is to simulate an authentic social context for the practice and learning of new communicative skills. In describing the challenges of modeling human reasoning and emotion related to building virtual humans, Gratch and Marsella [2] state that "The design of these systems is essentially a compromise, with little theoretical or empirical guidance on the impact of these compromises on pedagogy" (p.215). What are the implications of the pedagogical demands on virtual human design? How could virtual humans facilitate learning? In this paper, we explore some methods for providing guidance *through* the virtual human role players. Inspired by anecdotal statements from expert human role players who reported adjusting their behaviors based on observations of learners, we outline the dimensions of what is adjustable in virtual and discuss some examples of how virtual human role players might similarly adapt to meet specific learner needs.

2 Virtual human role players

Live role playing has a long history in education [3] and because it is interactive and situated, is a common strategy for teaching social interaction skills [4]. There are problems, however, with the approach. Role playing in classrooms or offices is not situated in a realistic context, and when done with peers, raises authenticity concerns. Expert human role players are generally the best option, but are not cost-effective and can be prone to inconsistency (between different role players and due to fatigue). Virtual humans that exist in authentic, virtual environments, are beginning to emerge that address some of these problems.

Cultural learning, interpersonal communication, and language learning are popular targets for virtual human-based training systems. For example, BiLAT [5] is a serious game that situates the learner in a narrative context to prepare and meet with a series of virtual humans to solve problems. A similar structure is used in the Tactical Language family of serious games where the focus is on conversational language, communicative, and intercultural competence [6]. Another prominent domain for virtual humans is clinical training. Virtual "standardized" patients have been used to train psychiatric students in the classification of post-traumatic stress disorder (PTSD) cases [7] as well for the practice of positive non-verbal behaviors during clinical interviewing, such as body positioning and eye gaze [8]. Virtual humans have been used in countless other social contexts, including for police officer training [9], teaching coping behaviors for bullying in schools [10], and demonstrating healthy play for children with autism [11]. Across the wide spectrum of these applications, most of the individualization that occurs is (1) at the learner's discretion, and (2) at the scenario level (e.g., to select appropriate characters to meet with). In the sections that follow, we discuss how the level of individualization might be pushed down into the dynamic behaviors of the characters themselves.

3 What can be tailored in a virtual human?

The efficacy of virtual humans to support intercultural and social skill learning has been shown in numerous studies [12-14]. In each case, character models were developed based on analysis of human-human data and input from experts with realism taking highest priority. What counts as "realistic" is therefore based primarily on expert opinion and subject to great amount of variance given the often inconsistent nature of human behavior. People with the same cultural background may possess very different opinions about a certain cultural value because of regional or personality differences, for example. Stories for characters can be easily constructed that lead to different outcomes (e.g., "the character is having a bad day"). Thus, different reactions to the same action – either between characters, or even from the same character at a different time or place – are entirely plausible. It seems there is a vast (and to date, unarticulated) space of communicative experiences that we might consider "realistic". This section describes a few of the more prominent dimensions in which current virtual humans communicate.

Fig.1. Expressions of anger, skepticism, appreciation, and umbrage by ICT virtual humans [15]

Nonverbal behaviors. Observable, nonverbal behaviors during interactions with virtual humans are often a primary focus in studies of their communicative competency and fluidity. For example, the role of eye gaze, nodding, and gestures play a significant role in generating feelings of rapport in users [16]. When no attempt is made to align nonverbal behaviors with the utterances of users ("non-contingent" responses), feelings of distraction and disfluency in speech follow. The implication for learning with virtual humans is that if their nonverbal behaviors are unnatural to the point of being a distraction, learning may be hindered.

Nonverbal behaviors play a large part in the expression of emotion and it is possible to convey a great deal of implicit feedback through them. There is staggering complexity that emerges from facial expressions alone, but also through gaze, body positioning and movement, and gesturing (examples are shown Figure1). Such signals also come in varying levels of *intensity*, as measured by onset, duration, and length [17], and so these all represent adjustable parameters that would enable the system to *dampen* or *magnify* nonverbal backchannel feedback from the virtual human.

Content. The information conveyed and the words used to encode a message represent another critical dimension in the space of configurability. A message may have more or less content, more or less meaning, more or fewer emotive words, more or less explanatory content, and so on. The "best" choice of content depends heavily on many factors, including the context of the simulated social situation (e.g., business vs. casual), the culture and personality of the virtual human (e.g., reticent vs. talkative), the familiarity of the character with the user, and more.

Cognitive, communicative, and emotional models. The most sophisticated virtual humans are able to do complex, task-based reasoning and behave based on underlying representations of the dialogue, their intentions, desires, the task domain, and their emotions [15]. Nonverbal and verbal behaviors follow from these basic underlying representations and they are naturally influenced by the incoming utterances of a human user. For example, a threatening utterance might trigger a withdraw intention, which in turn increases terseness and the likelihood of compliance. Speaker intentions may vary greatly from how the message is received. Misunderstandings between a learner and a virtual human role player can have a profound effect on the learner's evolving understanding of the skills being practiced.

4 Towards adaptive virtual human role players

Dynamic tailoring can be understood as influencing or overriding the standard behaviors of a simulation, as it is running, for pedagogical reasons [18]. In domains like human behavior, where there is significantly more freedom in what may be considered realistic than in many other domains (like physics), the idea is to select actions within this range of acceptability that will have the most pedagogical benefit. Given the dimensions of adjustability discussed in the previous section, some pedagogical goals dynamic tailoring could be used to achieve are:

1. support *recognition* when errors are committed or ideal actions taken
2. provide an *explanation* for observed reactions and emotional state changes
3. suggest a *repair* for how a learner might revise their beliefs

These are the same broad goals typically addressed by explicit feedback from a human or computer tutor [19]. The difference is that these goals are achieved through the character, by modifying utterances, beliefs, or behaviors, while maintaining the narrative context and not detracting from the perceived realism of the experience.

Achieving these pedagogical goals is more complicated than it is with explicit feedback. To alter behavior, it is necessary to both select what dimension to tailor (e.g., nonverbal, content, model) and how to do it. Further, a method for ensuring fidelity (acceptability, believability, etc.) should be included in the form of preconditions on modification rules or as a separate filter. Some examples of how a character might achieve the goals of recognition, explanation, or repair include:

1. amplification of virtual human response behavior, such as the intensity of facial expressions or use of emotionally charged vocabulary (recognition)
2. description of a causal link between a user action and a negative (or positive) result via additional content (e.g., "By suggesting X you are essentially blaming me for the problem."; explanation)
3. clarification of a relevant domain concept by including it in the content of an utterance ("In my culture we believe X…"; explanation; repair).
4. suggestion of an alternative communicative action that would have produced a better outcome (e.g., "If I were you, I'd …"; repair)

The central idea behind all of these strategies is to build on the existing feedback already coming from the virtual human, but alter it to address a specific need of the learner. The changes can be generated from shallow modification rules, such as "increase the intensity of facial expressions to enhance feedback" or through deeper, model-based adjustments like "increase the cultural pride of the character, which will produce longer utterances that explain beliefs and/or values."

We have completed a prototype system that modifies the content of character utterances to both amplify feedback and provide explanations [18]. The system, built as a supplemental component to BiLAT [5], tracks meetings with characters and augments character utterances when errors are made and when a specific knowledge component (cultural knowledge, in this case) is first encountered. For example, if an error is made by a beginner, the character might bring up the underlying cultural difference in their response (a content adjustment). Other learners would get the standard simulation response. Currently, the system uses a rudimentary student model to track learner's progress and studies of the system effectiveness are being planned.

For virtual human role players to adapt based on pedagogical aims, it is likely that more sophisticated learner models will be necessary. Building learner models for domains such as cultural learning and interpersonal skills is no simple task, but even crude distinctions can be helpful. Of course, a key question is whether such adaptations threaten fidelity and the implications of that. If learners figure out the characters are secretly "helping", does it ruin the fantasy? How does this affect learner affect and motivation to engage? Also, what if realism is breached – does this necessarily hinder learning? Future studies will need to address these questions as well as determining if support from pedagogical experience manipulation can be as effective (or complementary to) explicit help from a tutoring system.

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