Charismatic and Eloquent Instructor Avatars with Scriptable Gesture

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1. Introduction

Almost a century ago, Edward Sapir noted that we "respond to gestures with an extreme alertness" according to "an elaborate and secret code that is written nowhere, known to none, and understood by all". Here are our vision and initial results towards breaking the code of effective instructor gestures in education.

Instructor gestures are essential in education. Pointing, circling, or underlining captures and guides the students' attention. Complex concepts are further elucidated in gestures, which complement verbal explanations. For example, when learning mathematical equivalence, students benefit from the instructor making a balance gesture (Figure 1, left), which reminds students of their tangible experiences with the concept of equilibrium, such as from playing on a teeter-totter, or from comparing weights held in each of their hands. Gestures can also help convey instructor charisma, which engages students and ultimately enhances learning. For example, parallel outward-focused gestures convey a speaker's extroverted and therefore appealing personality.

Traditional education research on instructor gesture has been slowed down by the difficulty of creating video stimuli that are both complex and precise. First, instructor actors cannot easily learn the scripts for multiple conditions, and any error requires an additional take. Moreover, instructor actors cannot repeat exactly the same voice intensity, voice pace, enthusiasm level, and secondary motion from one condition to the next. Paradoxically, video stimuli can appear unnatural—the instructor actor focuses on executing the script with precision as opposed to simply being a teacher and focuses on the explanations given to students.

Advances in computer graphics now allow enrolling computer animation characters as instructor avatars in education research. Instructor avatars have infinite memory and energy, and they can easily keep secondary delivery parameters constant. However, generating animation stimuli with instructor avatars has its own challenges. One challenge is that current computer animation software systems require artistic talent and technical expertise to model, animate, and control characters.

2. Approach

In this talk we present our work for overcoming this challenge: we describe an approach that allows creating animation stimuli for research in instructor gesture, without the prerequisites of artistic talent or programming expertise; we describe a system that implements the approach; and we report on using our system to investigate the benefits of instructor gesture in the context of mathematical equivalence learning.

Figure 1. *Instructor avatar making a balance gesture to suggest the equilibrium desired in math equivalence (left), and a parallel outward-focused gesture to indicate that it is now the student's turn to solve a similar problem.*

Our approach is based on two observations. First, one cannot expect education researchers to model and animate their own characters. Instead, the instructor avatar should be selected from a database of pre-modeled characters; simple animations should be computed on the fly, and more complex animations should be predefined and made available through the database. Second, one cannot expect researchers to program the generation of stimuli. Instead, they should have the ability to control the avatar through a high-level English-like scripting language.

3. Results

We have developed a system that implements this approach. The system provides an animation character that serves as an instructor avatar. The avatar can speak, write on a nearby white board, point to any location on the board, and make embodied cognition gestures and charisma gestures (Figure 1, video). The avatar is controlled with a script written using a text editor.

Our system has been used so far in two studies on instructor gestures. The first study investigated which type of charisma gesture makes the instructor more appealing. The study involved 56 college students. The gestures tested differed based on whether they were executed with one hand, with two hands unsynchronized, or with two hands in parallel, whether they were inward, vertical, or outward, and whether they were of small or large amplitude (i.e. $3\times3\times2 = 18$ conditions). Outward-focused parallel gestures made the instructor most appealing.

The second study measured learning of mathematical equivalence after exposure to a lesson given by the avatar, with and without gesture. The study involved 51 third and fourth grade students. In one condition the avatar gestured and in one it did not. The study revealed that students in the gesture condition learned substantially more than those in the no gesture condition.

We thank Susan Cook, Katherine Duggan, and Howard Friedman. We acknowledge funding through NSF #1217215 and ED IES # R305A130016. The opinions expressed here are those of the authors and not those of the funding agencies.

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SIGGRAPH 2014, August 10 – 14, 2014, Vancouver, British Columbia, Canada.
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ACM 978-1-4503-2977-4/14/08