# Actors vs. Animation for Adult Learning ?

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## ABSTRACT
While computer based training has been around for decades, the marriage of games and education is not so old. Given that education often focuses on the learning of children and children love playing games, the marriage is destined to last. What is not so clear is whether playing games is suited to adult learning. Our focus is on workplace training of adults to allow them to experience certain situations rather than to pass on book-type knowledge. Many challenges face us in this endeavour. To focus our attention on those aspects that are critical for learning from training simulations we present our findings from the first in a number of studies. This study looks at the value of watching actors in a video compared to observing game characters involved in a similar scenario in terms of what is noticed, remembered and able to be reasoned about to determine how the media compare as training devices.

## Categories and Subject Descriptors
I.3 [**Computing Methodologies**]: Computer Graphics.
I.6.8 [**Computing Methodologies**]: Simulation and Modelling – types of simulation – *animation, visual.*

## General Terms
Design, Experimentation, Security, Human Factors.

## Keywords
simulation, training, game engine.

## 1. INTRODUCTION
The long-term goals of our research are to develop techniques in the areas of knowledge acquisition, cognitive modelling and language generation to enable building training simulations that will assist the transfer of tacit knowledge in the area of risk management associated with crime and terrorism. The training environment will be created using game and virtual reality technology. Using these virtual environment technologies we are able to produce less expensive and more accessible systems that allow increased control of the environment together with increased ecological validity (degree of relevance to the real world). For risky situations of the type that we are exploring, a virtual environment is also much safer.

The development of realistic virtual environments requires substantial technical expertise as well as advancement in graphics, design, scenario/story generation, language and agent technology. Developing a virtual world is costly and building characters that are believable with natural speech, body and facial gestures, and reasoning capabilities is currently the focus of much research. Whether the focus is on entertainment or education, many projects developing virtual environments have multi-million dollar budgets and large multidisciplinary teams of computer scientists, linguists, psychologists, animators, graphic artists and designers. Two noteworthy projects are the Net Environment for Embodied Conversational Agents (NECA) [2] supported by European Commission aimed at developing conversational agents that are able to speak and act like humans and the Mission Rehearsal Exercise (MRE) [3] System supported by the US Army where the participants experience in an immersive environment sights, sounds and circumstances similar to what they may encounter in real-world scenarios. To make a contribution to this field of research we have chosen to focus our attention on certain aspects of the problem that match our expertise and that will deliver the greatest gain.

To this end, we are conducting a number of trials to determine which aspects of the simulation are most critical for learning. For example, is body language, speech, believable characters or the display of emotions (more) critical for the trainees learning about risk situations? We will concentrate our attention on those aspects that the studies reveal are most important.

Of key concern is the fact that game and virtual reality technology produces cartoon-like or animated characters. Is it feasible to expect educated professionals such as police officers to play games and watch cartoons? Can they learn from such an experience and can that learning be transferred to real situations? Our project seeks to deal with these issues. From the trials we will be conducting we hope to get some answers to questions such as: 1."Is spoken language in a game more memorable than written language?" 2."In particular, is presentation of language in a speech bubble satisfactory for learning or does it detract from the experience" 3."To what extent is interactivity and control in a game critical for learning?" 4."Is body language critical for understanding the content of a conversation?" 5. "What features differ between games for learning and games for fun?" For example, while repetition may be boring and not provide entertainment, it may enhance learning. 6."Are videos of real humans more useful for learning than a representation in a game engine of those characters". If the answers to these questions reveal that some aspects are unimportant or less important then we will focus on those of greater importance. The study described in this paper was designed to directly address the last question and also sheds light on question 5.

## 2. THE STUDIES DESCRIBED
To determine whether a game-based representation of a scenario compared favourably with a video containing human actors for gaining training and experience in a domain, we have been recording the current reality TV series "Border Security" that was first screened on ATN 7 in the second half of 2004. Figure 1 shows a screen shot from the episode used in task 1 described below.

**Figure 1. A screenshot from Border Security taken from the video demonstration used in our study.**

For the purposes of this study we have simulated some of the TV scenarios with the Unreal Tournament game engine. We next describe the details of the study comparing the learning opportunity using an episode from the video and an episode recreated in Unreal Tournament.

**Goal:** Determine whether watching a video recording of a scenario involving humans produced better, worse or the same results as a simulation of a similar scenario created in a game engine with animated characters. The questions sought to compare the participants' attention, memory and reasoning in both situations as indicators of the potential value of the media for learning.

**Participants:** Third year Computer Graphics students (approx. 150 enrolled)

**Timing, Location and Recruitment:** The study was introduced in a lecture in the final week of first semester 2005. If students chose not to participate they could leave. Those that stayed participated in the following tasks in the order below. About six students left once the lights dimmed. 75 chose to stay. Originally, we wanted to do an online study which randomly assigned participants to the video or game group. However, with time constraints related to ethics clearance and game demonstration development we needed to run the study in the final week or not until the following year when this unit ran again. We believed that response rates to an online study conducted during the busy exam period or after the exams would be extremely low.

**Task**s: Each participant was involved in two tasks.

*Task 1:* Students watched and heard a scenario from the Border Security video. See a screen shot in Figure 1. The scenario ran for 11 minutes.

A sheet with the following questions was distributed to each student. Students were given 7 minutes to answer the questions. The sheets were then collected.

=== Questionnaire for Scenario 1 (Video Demo) ===

1. Was the passenger male or female?
2. What was the nationality of the passenger?
3. What caused the passenger to be interrogated by the immigrations officer?
4. What was the passenger's purpose of seeking entry into Australia?
5. How many passports does the passenger own?
6. What questions did the officer ask that you felt were particularly relevant in determining if the passenger was guilty of some illegal behaviour?
7. What aspects of the passenger's passport could be identified as possibly fraudulent activities?
8. Was the passenger guilty of illegal behaviour?
9. How long was the passenger detained?

*Task 2:* We first oriented the students with the slide shown in Figure 2. Then students watched a 7-minute game demonstration of a similar scenario from the Border Security video that had been created in the Unreal Tournament Game Engine. Instead of watching real people, students watched two action figures moving between rooms and talking to each other. The two characters who appeared were three-dimensional action figures[1]. These characters were not ideal but were all that was available to us at the time. The demonstration included an audio recording using three different voices to represent the three people involved in the scenario. Note that Ross, the customs officer, never appeared on screen. The conversation also appeared in speech bubbles which popped up in different places on the screen depending on who was speaking, see fig. 3. The characters did not change their posture, body or facial gestures.

After the demonstration, each student was given the following set of questions. The purpose of questions 1-9 were to determine if they observed and recalled the details of the interaction and if they detected any risky situations or behaviours.


**Figure 2. An introductory slide to prepare the participants for the game environment**

=== Questionnaire for Scenario 2 (VR Demo) ===

1. Was the passenger male or female?
2. What caused the passenger to be interrogated by the immigrations officer?
3. What was the passenger's purpose of seeking entry into Australia?
4. What aspects of the passenger's passport could be identified as possibly fraudulent activities?
5. Did the passenger have a previous passport?
6. Did the passenger claim to not have a criminal record on his passenger card?
7. How did the immigrations officer confirm the identity of the passenger?
8. What questions did the officer ask that you felt were particularly relevant in determining if the passenger was guilty of some illegal behaviour?
9. Was the passenger guilty of illegal behaviour?

[1] Agent Smith from The Matrix (Paul) was downloaded from: http://www.download.com/Unreal-Tournament-2004-Agent-Smith-model/3000-7453_4-10297755.html?tag=lst-4-9 Max Payne (Daryl) was downloaded from: http://www.ut2003hq.com/pafiledb/pafiledb.php?action=file&id=3048

10. Do you see potential in the approach for training simulations? Why?
11. What additional features could be added to the Virtual Reality demo to make it better and in what way?
12. Any other comments?

Questions 10-12 were intended to gather the participants' overall impressions and suggestions. We thought the responses might be valuable given that the students had just completed a computer graphics unit which also considered the use and development of computer games.

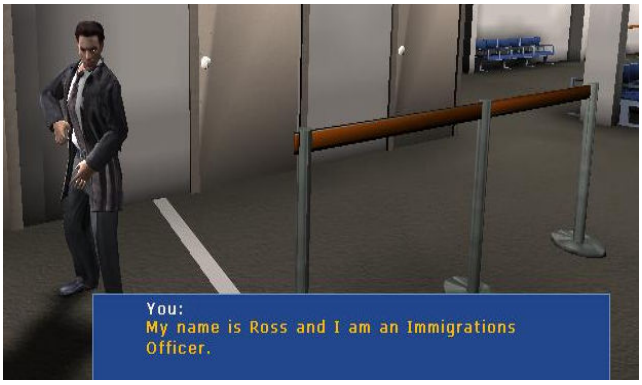


**Figure 3. A cutdown screenshot from the game demonstration showing a speech bubble**

In the design of our study we note the following potential shortcomings and our reasons for the choices we made.

*Two different scenarios used.* The scenarios used in task 1 and task 2 were different. However, since we chose to conduct the study in a lecture to capture more participants we were not able to assign students to different groups but needed to subject them to both types of media using different but similar scenarios.

*Language not represented in the same way.* It would have been better to have identical types and balances of audio, visual and textual input. However, we had not captured teletext with the video and had no time to add this feature to the video. The absence of body language, facial gesture, lip synching, etc in the demo may also alter the messages conveyed in the original video scenario. Again due to time and budget constraints, we were not able to program to the characters in the game demo to this level of detail. However, we know from artificial intelligence and animation research [1] that it is not always necessary to recreate a completely realistic situation.

*Both media are not interactive* Participants identified this as a limitation of both media used in the study. Our next study will focus on the importance of interactivity for learning.

*Differing degrees of repetition and demonstration lengths.* As noted in our description, the video demonstration ran for 11 minutes and the game demonstration ran for 7 minutes. We chose the two scenarios due to their similarity of content, so that we could have the same number of questions with similar degrees of difficulty. However, there was a lot of repetition in the video and the use of textual summaries, as in Figure 4.

# 3. RESULTS

The actual responses to questions 1-9 for the two demonstrations are not of key interest and thus we will not present the detailed answers. What was of interest was the level of accuracy of the answers in the two demonstrations. If the video had resulted in more correct answers then we would need to consider whether some aspect of the game demo had interfered with the cognitive processes involving perception, memory or reasoning. In addition to the potential effects as a result of the limitations mentioned in the previous section, possible other reasons for poorer results with the game demonstration could include: lack of realism and the over simplicity of the game environment which only contained two rooms, two 3-dimensional game characters and the recorded dialogue compared to a rich environment in the video involving many people, sights and sounds, which is typical of an airport situation. Lack of realism could have caused the observer to switch off or not take the situation seriously and thus not bother trying to remember the facts. Oversimplification could have also caused the observer to switch off due to boredom or lack of visual or audio clues.

On the other hand, if the game demonstration achieved more accurate answers, then we could conjecture that a simplified environment allowed the audience to focus on the key issues. Additionally, the removal of repetition could have reduced boredom and thus increased attention span. Let us see what actually happened.

Our analysis involved determining the accuracy of the responses to the questions and whether the video or game demos had more correct answers. Both surveys had the same number of questions deemed to be of similar complexity relating to the demonstration, but the questions were given in sequential order according to the sequence of events in the scenario. This meant that the questions which roughly mapped to each other were not necessarily in the same order. Firstly we needed to map each question to its counterpart. The mappings are given in Table 1. Please use this table to look up the corresponding question number for the Game results in the results table in Table 2.

**Table 1. Mapping of survey questions**

| Video | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Game | 1 | 6 | 2 | 3 | 5 | 8 | 4 | 9 | 7 |

**Table 2. Number of correct answers to survey questions**

| Q# | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Video | 72 | 62? | 14 | 61 | 69? | 99 | 13 | 55 | 43 |
| Game | 72 | 61 | 62 | 42 | 69 | 93 | 8 | 39? | 55 |

Interpretation of the answers was not easy. The questions in the survey were open-ended and thus did not offer a range of possibilities to choose from. This made data entry a little tricky. We also found that for some questions (the ones shown with a question mark (?) in Table 2) that we were unsure whether the answer was the right one. This occurred for two reasons. Firstly, the question itself was misinterpreted or not clearly specified. For example, question 7 in the Game survey (which maps to question 9 in Table 2) stated "How long was the passenger detained?" The correct answer, given by 43 participants, was 4 days. However, this answer relates to how long they were held in the detention centre, which is what we intended the question to mean. Some students have interpreted the question to mean "how long was the passenger being interrogated/detained at the airport?" It is interesting to note that the correct answer could only be given if you read the summary text at the end of the scenario provided by the demo (see Figure 4) as it was not discussed or mentioned verbally.

Another example involving mis/interpretation of the question is question 9 in the Game survey (question 8 in Table 2) which

asked "Was the passenger guilty of illegal behaviour?" The split of responses were 26 said Yes and 39 said No. We are unsure what the final verdict should be. The passenger did lie about having past convictions, but these turned out to be minor offences from a long time ago and the passport appeared to have been innocently damaged through getting wet. In the end, the passenger was allowed to enter Australia.


**Figure 4. Screenshot from the video showing how text has been used by the producers to pass on and reinforce information**

The second type of problem occurred where it was not clear from the scenario what the correct answer was. For example, question 5 in the Video asked "How many passports does the passenger own?" 27 said 1 passport and 42 said 2 passports. In the scenario only one passport was examined, but there was mention of the passenger having (had) a Romanian passport and his daughter having a Canadian and Romanian passport. As our key concern was whether one representation increased the level of attention, memory and reasoning capabilities we were still satisfied that the participant had observed the key aspects and thus combined the two responses together. However, the response by 9 participants who said the passenger in the video scenario was not guilty was clearly wrong. They did not observe what had actually happened and had also missed the summary provided in Figure 4. However, such controversies demonstrate the value of providing these scenarios/reenactments, in either form, as a basis for discussion and exploration of the issues that can face a customs officer.

A third type of problem concerned shortcomings of the media or distractions. Getting the right answer to question 3 in the video required paying attention and switching your mind to the video immediately. The slightly worse recall of the game demonstration details could possibly be accounted for due to the poor sound quality of the audio recording, the fact that each time Paul appeared there was distracting laughter and our speaker for Ross was, unavoidably, a female. However, all students correctly answered that the passenger, Ross, was a male. This goes to show how willing audiences are to suspend belief and that realism is not necessarily the holy grail.

In answer to question 10 "Do you see potential in the approach for training simulations? Why?" 32 said Yes, 19 said No, others were either undecided or did not answer the question. We have combined and summarized the responses to the final three questions into the following set of pros and cons.

The overall advantages of using games for training simulations include: funny; free to make mistakes; able to try new things; practice time is not limited; text is helpful, rather than just vocal (overseas student); easy to understand the problem; more clear compared to the video demo; potential to recreate a lot of scenarios; improves the understanding and absorption process: images are better than slides; cost-effective; no harsh after effects of security breach in the case of real life training.

The overall disadvantages of using games for training simulations include: background noises are needed; boring; not realistic; possibly can not model all scenarios; video demo tends to repeat a lot and in turn makes it more memorable; not dissimilar from simply reading a case study, although you get a better understanding of the atmosphere; it is not clear enough compared to the video demo; there is a clear limitation in making the characters look nervous (facial expressions); found it easier to remember video demo details compared to game demo details.

We draw the following general conclusions:

- students believed there was some value in using games for training but interactivity was seen as a key missing ingredient in what we had delivered.
- the ability to correctly remember and reason about the scenario details were very similar using either media. Our overall feeling is that participants remembered slightly more detail in the video scenario compared to the game scenario, but a case could be argued either way.
- we assume the use of repetition and textual summaries in the video were chosen by the producers to give the watcher the opportunity to try to solve the problem and also to prolong the suspense in finding out if the suspect is guilty or not. In our demonstration we did not use repetition, but simply created a continuous story. It is not clear whether this was the right choice, but since some students said the demonstration was boring (probably because the environment is simpler) we can't imagine that repeating information will make the scenario more engaging and thus memorable.

Our next study, to be conducted in semester 2 2005, will investigate whether interactivity with the characters is actually important for learning or whether this is a popular misconception.

## 4. ACKNOWLEDGMENTS

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