ESSAY 2

AIR MAIL

Research Proposal: Learning Expert Motor Tasks through Video Synthesis

Introduction

The project *Everybody Dance Now* creates quasi-realistic videos of expert movement mapped onto amateur subjects using computer vision and pose tracking. The effect is startling. It offers the opportunity of performance of expert and complex motor tasks on subjects who may never be able to physically perform these tasks—the technology proposes a possible reality. How can this proposed reality come into existence by way of the technology?

Research in cognitive neuroscience suggests the existence of mirror neurons—a specialized neuron that fires when observing the performance of another individual. These mirror neurons allow animals to reproduce performance by "memorizing" the sequence of firing and recreating it. Although the research is robust in this field, an opportunity to test the level of efficacy of these motor neurons based on the likeness of an individual to one's self has not yet been observed. This technology offers such an opportunity.

In a world of deep fakes and fraud, video synthesis technologies, including the discussed technology, offer many deceptive uses. Deception, in this context, can be a malicious goal, causing confusion and altering opinion. If we can deceive the mind, and take advantage of this system of mirror neurons, we may find cognitive benefits. Such benefits could improve training of athletes, dancers, and artists to perform above their current ability. It could also aid the physically-disabled, injured persons, or even children to perform tasks.

Research Proposal

In order to measure the benefits of this technology, we will have to compare its benefits to the benefits of any training video. First, a task must be chosen that will yield the most dramatic performance improvement over the length of the experiment. Performance of that task also must be measurable (the ability to paint is rather subjective and might not be suitable for the experiment). Sports and athletics have an innate measurability aspect to them and would fit the experiment nicely.

For the sake of convenience, the task of shooting free throws seems to work best for our purposes. The task is easily measurable, has an abundance of training videos

associated, and can yield dramatic performance improvements over a relatively short period of time.

In order to increase the magnitude of performance improvement, subjects would be selected on their amateurity of the task. We might consider blocking based on familiarity with the sport and general athletic ability which might augment their training in the experiment. A pilot study might identify these attributes, as well as others that might contribute to the magnitude of improvement.

In short, the exact research question would be as follows:

Does viewing a video representation of one's self performing a novel motor task increase training effects over the viewing of a similar video in which an expert is performing the task?

Pilot Study

Along with identifying the aforementioned attributes, a pilot study will aid in selecting training material. The selection of training material will be dependent on our ability to reproduce the poses and map those onto our test subjects. This exploration might prove difficult and time consuming since pose capturing is a time intensive task and video rendering must be performed for each subject.

The pilot will also elucidate the appropriate amount of training to see the power of the treatment effect. A few minutes of training and several trials will be insufficient in measuring improvements. It might also signal a need to explore other athletic tasks if improvements are difficult to measure.

Analysis

To find the efficacy of this type of training, the average treatment effect of the study will be taken. Under the *sharp-null hypothesis* that each subject would have seen the same improvements under either condition, using randomization inference, a *two-tailed p-test* with *alpha* set at 0.05 will determine if the treatment effect was observed due to chance alone. A two-tailed test is both more rigorous and would also confirm if the treatment is worse than the control condition.

Other Considerations

It might prove too time consuming to render all the video required to receive 100 observations for the study. In that case, some modification that might be adjacent to the proposed question could have similar results. Alternatives might be the effects of

training done by instructors who are similar in age, ability, ethnicity, or any other range of physical characteristics that is easily identifiable in a training video.