

Do I need a body to encourage you? The effect of embodiment on social facilitation

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Abstract— Social facilitation refers to the phenomenon that the presence of others can improve one’s performance in simple tasks. This work investigates whether/how we can achieve the same effect using virtual characters. In particular, we want to study the difference among using a digital character, a cognitive robot, and a real person to achieve this effect. We also want to investigate the importance of feeling being evaluated for social facilitation to take place.

Keywords— *Cognitive Robot; Virtual Character; Social Facilitation; Behavioral Impact*

I. INTRODUCTION AND MOTIVATION

With the rapid development of Artificial Intelligence technologies, in recent years, there has been an increasing interest in creating humanlike virtual characters and incorporating them as part of people’s lives, as an assistant, a tutor/trainer, or a companion.

Despite of the wide range of applications that have been proposed, to what degree virtual characters can truly replace the roles played by real human is still a question which needs to be investigated. For example, do we trust them the same way as trust a person? Will we respect a virtual character? Can they have authority over us? Of course, the answers of many of these questions depend on the design of the virtual characters and their tasks. On the other hand, it is worthy to investigate the general question of whether there is anything unique of interacting with people.

In this work, we study one of the positive effects of having others around – the social facilitation effect [1,2,3,4,5,6]. When surrounded by other people, we can often do our own tasks better. As long as the task does not require us to be fully immersed in it, the feeling of having others around can often make us more efficient and more accurate. This phenomenon has been documented empirically. Triplett found that cyclists perform better when racing with other cyclists [5]. Floyd Allport showed that people perform better in word association tasks and multiplication assessments when in a group setting than when alone [1]. Examples of social facilitation are also common in our daily lives: sometimes we prefer to do our work in a library or in a coffee shop than at home alone, and

exercising in a gym with others usually feels better than doing the same routines alone.

Social facilitation is particularly interesting to the designers of virtual characters because it is a unique type of social interaction. Though the presence of others is critical, social facilitation requires very little social interaction. The others who are present may be doing something relevant, or they may simply be observing. Zajonc has demonstrated that sometimes the mere presence of others is sufficient [8]. A natural question to ask therefore is: can we replace people with virtual characters and still achieve the same effect?

This work is aimed at studying whether/how social facilitation can be created using virtual characters. In the next sections, we will briefly review related theories about social facilitation and then describe our ongoing work of an empirical study for evaluating the importance of various factors that have been proposed as contributing to this phenomenon.

II. SOCIAL FACILITATION

A number of psychologists have investigated this phenomenon. Most of the proposed theories attribute this phenomenon to two factors: elevated arousal level and the feeling of being evaluated.

Zajonc [8] explained social facilitation by the person’s increased level of arousal. According to the Yerkes-Dodson law of arousal level and task performance, a mild level of arousal facilitates simple tasks. Because other people’s behaviors are unpredictable to us, their presence put us into the state of greater alertness, which increases our arousal level. This theory explains why sometimes the mere presence of others can influence our task performance. In fact, Zajonc has demonstrated that social facilitation not only happens in human beings, but also happens in other animals, such as solitary cockroaches.

Evaluation theory on the other hand argues that it is not the mere presence of others, but the feeling of being evaluated causes increased performance [4]. Blascovich further pointed out that people may either experience being challenged or threaten in this case [2].



Fig. 1. Robot/Character observes the subject

III. PROPOSED EMPIRICAL STUDY

In this work, we want to study how to create social facilitation using virtual characters. In particular, we want to study the difference between using digital characters and using cognitive robots to achieve this effect.

We use solving Jigsaw puzzles as our example domain. Various computer based Jigsaw puzzles have been created. We choose this task because it shares some similarities with other computer based practice programs for math and logic, and we hope the results of this study will shine lights on how such learning environments should be designed.

Our experiment uses a 3*2 between-group design with two independent variables. One is the form of embodiment, which has three levels: digital avatar, cognitive robot and real human.

When replacing real people with virtual characters, we are facing the problem that the subjects may not perceive the virtual characters as real people, and therefore will not experience the sense of being evaluated. It has been shown that cognitive robots are more convincing than virtual characters when giving users instructions [7]. In this work, we will compare the effectiveness of using a cognitive robot, using a digital avatar, and having a real person around for social facilitation.

Figure 1 shows the setup of the experiment. When the subject is solving the puzzles on a computer, a digital avatar, a robot or the experimenter will be around. The digital avatar will be displayed on a computer monitor next to the subject. To “embody” a human-like character, a special cognitive robot is created by combing the digital upper body of the avatar with a movable lower body. Thus, the character gains mobility without losing the expressive power of using facial expressions and gestures. This robot is built in our lab

using a Willow Garage’s Turtlebot [8], which has a Kinect on top of an iRobot Create, and which has an elevated platform onto which a netbook is placed.

Both increased arousal level and the sense of being evaluated can contribute to the effect of social facilitation. Since most of added stimuli will increase the user’s arousal level because of their novelty to the user, in this study we concentrate on evaluating the impact of the latter factor.

The second independent variable is the users’ perceived level of being evaluated, which also has two levels. In the low level, the digital avatar, the robot or the experimenter will gaze at the subject randomly according to a pre-planned schedule and then gaze away. In the high level, the computer which runs the Jigsaw puzzle will perform preliminary online analysis on the subject’s performance, and the digital avatar, the robot, or the human experimenter will gaze at the subject more often when the subject’s progress is slow.

There is an additional control condition in which the subjects are not accompanied by anyone when solving the puzzles.

The experiment is currently undergoing. The results from this study will inform us how an observing characters’ behaviors should be designed in future work. In general, we hypothesize that the more embodied forms will have greater impacts on the subjects. It is hard to predict how the level of expressed evaluation in the current setting will affect the subjects’ performances because if the subjects are over stressed or disturbed their performance will drop.

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