



## Virtual social facilitation

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### ABSTRACT

People perform differently when in the presence of others than when alone. This effect has been termed social facilitation. Social facilitation effects are observed by examining the performance of participants performing simple and complex tasks. Performance and accuracy are facilitated for simple tasks and inhibited for complex tasks when a participant is in the presence of another, compared to when a participant is alone. The vast majority of previous studies on social facilitation have examined the effects of the actual, instructed or imagined presence of a human being on cognitive performance, but only very few studies have investigated whether this effect extends to non-human agents like avatars, computers or robots. This report aims to redact a state of art on virtual social facilitation to direct the next steps of future research.

### Highlights

- Many studies confirm the presence of social facilitation in a virtual environment.
- Virtual social facilitation influences the performance of the task, interacting with other factors.
- Virtual social facilitation can affect the mood state of the individual.

### Introduction

Social facilitation theory deals with the impact of social presence on individual performance. It is one of the oldest social psychology theory in the history of the field. The theory focuses on changes in performance that occur when individuals perform in the presence of others versus alone. The term "facilitation" refers to the early observations that performance was enhanced when others were present. Subsequent research has found the relationship between social presence and individual performance to be complicated. Task complexity, evaluation context, and type of presence are some of the factors that researchers have demonstrated moderate the impact of presence on performance. Social facilitation theory now refers not only to performance enhancements, but also to impairments (Aiello & Douthitt, 2001).

The study of phenomena now referred to as social facilitation can be traced to the early observations and experiments of Norman Triplett in the late 1890s. Triplett (1898) noticed that bicycle racers turned in faster times when they were racing with other cyclist than when they raced alone. The fastest times were produced by cyclists who actually raced against each other in competition. The next fastest times were by cyclist who raced against the clock but had a tandem or other multicycle setting the pace. The slowest time were by cyclists who raced against the clock with no pace setter. These observations inspired subsequent experimentation by Triplett and others.

Triplett's (1898) observations of cyclists involved obviously competitive situation. Subsequent researchers attempted to conceptually separate competition from social facilitation (cf. Allport, 1920; Zajonc, 1980). In fact, they highlight the notion that people perform differently when others are present, even though they are not interacting.

Allport (1920) coined the term "social facilitation" and extended the research of that time by attempting to control potentially extraneous influences, such as competition.

Allport wanted to learn about the more basic social influences of others on individual performance, and he therefore attempted to design experiments that would minimize competition effects. He instructed his participants to avoid comparing themselves to others and to not consider the situation as competitive.

Although the early social facilitation research explored some of the explanations that are still considered viable today, results of studies were

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inconsistent. It is likely that part of the reason for some of the inconsistencies may be the research methods that were used. Sample sizes were often small, and experimental conditions were often poorly controlled (Aiello & Douthitt, 2001).

In spite of the problems with many of the early studies, they raised many of the theoretical issues and questions that continue to be explored and that require further development today.

Another inconsistency in early research relates to the kinds of tasks performed and was not brought into clear focus until Zajonc (1965) wrote his seminal article. Zajonc reviewed the social facilitation literature beginning with the Triplett study and provided a viable explanation for some of the inconsistencies in these earlier studies. Zajonc used drive theory to explain individual reaction to the presence of others and introduced task complexity as a critical moderator of facilitation-impairment effects.

His article helped to advance social facilitation theory by integrating the past half-century of animal and human studies and by stimulating subsequent research that further developed explanations for the social facilitation-impairment phenomenon (Aiello & Douthitt, 2001).

No single theory has emerged that can effectively account for this phenomenon. Currently, there are three prominent explanations: drive theories, evaluation apprehension, and cognitive process on performance (Guerin, 1993).

The first category of reaction is increased drive or arousal. Zajonc (1965; 1980) asserted that individual drive or arousal levels increase in the (mere) presence of others, and that it is this increase that either enhances simple task performance or impairs complex task performance.

The second category involves a concern about comparison with others. In the presence of others, individuals may become concerned about how they look or perform in comparison with others. These concerns include apprehension about the possibility of being evaluated by others (Cottrell, 1972), desire to present oneself in a certain way to others (Baumeister, 1982; Bond, 1982), or intention to match performance to a socially constructed standard (Carver & Scheier, 1978, 1981, 1982).

The third category involves a shift in cognitive processing capacity caused by the distracting presence of others (Baron, 1986).

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## Virtual social facilitation

Interest in virtual humans or embodied conversational agents (ECAs) is growing in the realm of human computer interaction. Many believe that interfaces based on virtual humans have great potential to be beneficial. Anthropomorphizing an interface means adding human-like characteristics such as speech, gestures, and facial expressions. These components are remarkable in conveying information and communicating emotion. However, humanized computer interfaces are not welcomed by all researchers. Apparently, simply adding human characteristics to an interface does not guarantee a more usable and useful interface (Park & Catrambone, 2007).

It is clear that rigorous empirical study within a systematic research agenda is necessary to obtain a clearer understanding about the utility and usability of virtual humans. It is also important to consider the social dimension of the interaction between users and virtual humans. How do users interact with virtual humans? Do people respond to a virtual human as we do to a real human?

Apparently, there is a striking similarity between how humans interact with one another and how a human and a virtual human interact (Park & Catrambone, 2007).

Nass et al. suggest that users can be induced to elicit social behaviors even though users assume machines do not possess emotions, feelings, or “selves”. Further research suggested that people respond to computer generated personalities in the same way they tend to respond to human personalities (Moon & Nass, 1996; Nass & Lee, 2000).

One prominent social phenomenon is the social facilitation effect. Would this phenomenon be equally observed with virtual humans? This question of whether the social facilitation effect transfers equally to a virtual human is crucial in designing effective ECAs (Park & Catrambone, 2007).

Many studies present evidence of virtual social facilitation. Walker, Sproull, and Subramani (1994) investigated participants’ responses to a synthesized talking face displayed on a computer screen in the context of a questionnaire study. Compared to participants who answered questions as presented via a text display on a screen, participants who answered the same questions spoken by a talking face spent more time, made fewer mistakes, and wrote more comments. Walker et al. claimed that this enhancement in task performance was due to social facilitation. Aiello & Kolb (1995) supports the view that electronic performance monitoring (EPM) influences productivity in a manner that is consistent with the social facilitation framework. Sproull, Subramani, Kiesler, Walker, and Waters’s study (1996) similar to Walker et al.’s study, participants responded to a talking face versus a text display. They attempted to investigate people’s arousal and attention level to see the effects of social facilitation. Arousal was captured by asking participants “How relaxed did you feel?” and “How confident did you feel?” during use of the system. Attention level was measured by recording information on how much time participants spent in each section of the experiment, the number of items they skipped in the scales, and the number of words participants wrote in the task. Participants reported to be more aroused (less assured and relaxed) in the face conditions than in the text condition. Also, computer-based performance monitoring (CPM) can have a positive impact on productivity. Subjects who were monitored only on the data entry task attempted more entries and keyed more entries correctly on that task than subjects who were not monitored at all (Kolb & Aiello; 1997). In another study, the perception of being monitored by an animated character has the same effects performance as being monitored by a human, either electronically or in person (Rickenberg & Reeves; 2000). Thus, other studies support the presence of social facilitation in a virtual environment (Bradner & Mark, 2001; Rafaeli & Noy, 2002; Bartneck, 2002; Blascovich, Loomis, Beall, Swinth, Hoyt, & Bailenson, 2002; Park & Catrambone, 2007). One study went further and found that participants were inhibited while performing complex math problems when in the presence of a human, virtual human projected life-size, and a virtual human in an immersive virtual environment (Zanbaka, Ulinski, Goolkasian, & Hodges, 2007).

However, other studies argue that virtual social facilitation does not exist. In a study on the persuasiveness of a lifestyle mobile coaching application using social facilitation, wasn’t found difference between achieving lifestyle goals between a group with social facilitation and a group without (Gasser, Brodbeck, Degen, Luthiger, Wyss, & Reichlin, 2006). Also, Baldwin, Branyon, Sethumadhavan, & Pak (2015), through three manipulations aimed at mimicking social facilitation effect demonstrated in Park & Catrambone’s (2007) research, no significant effects on performance could be replicated. This suggests that this social psychology principle may not be applicable in a human-machine interaction paradigm.

Niehaves & Tavakoli (2012) found two factors influencing virtual social facilitation: monitoring and feedback. The positive effect of

monitoring in the virtual presence setting resembles the findings in the physical presence setting. Feedback however is different in that regard. Its influence can be considered significant only in the virtual presence setting. Measurement does not increase performance in either setting. Designing spaces in which social interactions are maximized can influence social facilitation (Goel, Junglas, Ives, & Johnson; 2012).

Studies have investigated some interactions with virtual social facilitation. A significant effect came from the assessment of locus of control. Interface designers may want to avoid using animated characters when they know that they are designing for people with an internal locus of control. The addition of characters may make interactions more robust, however, when users perceive that they lack control over their success (Rickenberg & Reeves; 2000). In a study there found a gender difference: the results indicate that women perceived more evaluation potential when 'Clip' (computer icon) was present than when 'Clip' was not present. Women tended to experience social inhibition in study one due to the arousal associated with evaluation apprehension when 'Clip' was present. In contrast, men, who experienced little evaluation apprehension in the presence of 'Clip' appear to enjoy a social facilitation response to the computer icon. (Hall & Henningsen; 2008). A study on social facilitation in online and offline gambling support hypothesis that both social facilitation and medium (i.e., online or offline) may increase players' risk-taking behaviour, a priori it would suggest there should be a significant interaction between the two (Cole, Barrett, & Griffiths; 2011). Another study on social facilitation in virtual reality-enhanced exercise suggested that social facilitation interacts with an exerciser's competitive orientation. However, in this study, participants who were lower on competitiveness maintained their initial level of exercise effort, and thus effort did not appear to be adversely affected by the introduction of on-screen competitors. This study suggests also that working out with a superior virtual partner can be effective for enhancing exercise performance (Köhler effect) (Anderson-Hanley, Snyder, Nimon, & Arciero; 2011). Hertz & Wiese (2017) found neither the hypothesis that social facilitation is observable when the incarnation is low, nor the hypothesis that social facilitation varies according to the human, concluding that virtual social facilitation does not exist.

Other results replicated the social facilitation effect both for human and robotic presence (Riether, Hegel, Wrede, & Horstmann; 2012). Findings indicate that males tend to think of the robot as more human-like and accordingly show some evidence of "social facilitation" on an arithmetic task as well as more socially desirable responding on a survey administered by a robot. In contrast, females saw the robot as more machine-like, exhibited less socially desirable responding to the robot's survey, and were not socially facilitated by the robot while engaged in the arithmetic tasks (Schermerhorn, Scheutz, & Crowell; 2008).

One effect of virtual social facilitation has been investigated. In line with motivational research, the results support the hypotheses that in the presence of Electronic Performance Monitoring (EPM), individuals would experience a more positive subjective mood state for easy tasks and a more negative subjective mood state for difficult tasks. The fundamental implication of these findings is that the implementation of a system of electronic monitoring, if an individual is performing an easy task, may result in this individual having a more positive mood state (Davidson & Henderson; 2000).

## Conclusion and Discussion

Through the revisions of these articles we understand that the presence of social facilitation in the virtual environment is not yet completely clear. I suppose that the construct of social facilitation probably changes in a virtual environment.

Baldwin, Branyon, Sethumadhavan, & Pak's study (2015), that replicate the social facilitation effect of virtual humans found by Park and Catrambone (2007), support that this phenomenon not exist in the virtual environment. These findings are theoretically important because demonstrate that a highly researched and widely replicated phenomenon in the social psychology may not necessarily apply to the context of human-machine interaction. It also places limits to the generalizability of the previous findings. The differences between the previous study (Park & Catrambone, 2007) and Baldwin et al.'s study are different geographic location and subject population (a metropolitan technical school versus a rural land-grant university). Thus, there may be selection differences.

Therefore, it is very important to investigate, with further research, the presence of social facilitation in virtual environment.

Another step for research on virtual social facilitation is the consideration of possible mediating variables such as attention, knowledge of the subjects about the virtual or human essence of the observatory, the type of virtual stimulus, the difference between digital and non-digital natives. These variables, the perception of the subject's virtual world and its characteristics probably influence virtual social facilitation.

However, if a designer is trying to improve users' performance during a particular task, using only virtual agent may not be the best solution. Instead, the interface should perhaps also rely on ecological support rather.

## Potential Impact

It is still necessary to investigate the presence of virtual social facilitation so that it is possible to develop better virtual environments. Understanding this phenomenon could have potential impacts in various fields, such as virtual pedagogy. To achieve this purpose, it is necessary to formulate a new construct that includes the various characteristics of the virtual environment.

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