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Social facilitation and human–computer interaction ☆

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A B S T R A C T

The Computers As Social Actors (CASA) research paradigm has examined how individuals respond to computers programmed to interact in various ways. In the current research, we extend the principles of CASA to determine whether computer icons can be used to produce social facilitation effects. Varying task difficulty and the presence or absence of a computer icon (i.e., Microsoft word's Clip), performance on a typing task is considered. Overall, results provide some support for the contention that the mere presence of a computer icon may influence task performance.

1. Study one

Social facilitation posits that the presence of other people has an effect on task performance (Guerin, 1993). The "Computers As Social Actors" or "CASA" paradigm (Nass, Steuer, & Tauber, 1994) proposes that people respond to computer programs in the same manner that they respond to other people. Social facilitation and the CASA paradigm may be combined if social facilitation effects can be produced in the absence of other people when individuals work on a computer. Computer icons are a common component of computer programs. The aim of the present study is to determine if computer icons produce social facilitation effects.

1.1. Social facilitation

The mere presence of another has been found to have an effect on a participant's task performance. This effect has been termed social facilitation (Zajonc, 1965). Social facilitation effects are observed by examining the performance of participants performing simple and complex tasks. Performance and

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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. Various explanations exist for social facilitation effects.

1.1.1. Drive theories

Drive theories originate with the Hull–Spence drive model for behavior (Hull, 1943). This model posits two components which interact in a multiplicative function to determine drive. Drive and habit strength are the two components comprising this drive model. Drive is the degree of stimulation a participant experiences regarding an activity (Hull, 1943, p. 57). Habit strength is the familiarity and practice a participant has with a given task. As either factor is increased, performance potential increases multiplicatively:

$$E = H \times D.$$

This formula states that the potential for the occurrence of a particular response (E) is a multiplicative function of habit strength (H) and drive (D). Integrating this model into the social facilitation literature, Zajonc (1965) posited that the mere presence of others increases drive in a participant. As drive increases, propensity toward dominant responses increases. Both drive and habit strength influence dominant and non-dominant responses. The interaction of drive and habit strength predicts performance. For simple, or well-learned, tasks dominant responses are habitual and tend to be the correct response. Conversely, with complex, or unfamiliar, tasks dominant responses tend to be the incorrect response. Because the presence of others increases the potential for dominant responses, mere presence facilitates performance on simple tasks (i.e., tasks calling for dominant responses) and impedes performance on complex tasks (i.e., tasks calling for non-dominant responses).

A meta-analysis of over 240 studies concluded that the presence of others increases performance on simple tasks and decreases it on complex tasks (Bond & Titus, 1983). The meta-analysis supports mere presence as the primary explanation for social facilitation. As Guerin (1993) notes, all explanations of social facilitation effects, such as evaluation apprehension or distraction, inherently include mere presence. In this respect, mere presence is considered the most parsimonious explanation of social facilitation effects. Mere presence continues to be employed as a prominent framework for understanding social facilitation (e.g., Grant & Dajee, 2003; Platania & Moran, 2001).

No study has been conducted to date that examines social facilitation effects elicited without the presence of a conspecific. Researchers have studied social facilitation effects induced by a person teleconferencing and being monitored via computer network, terming these effects as electronic presence (Aiello & Svec, 1993). Aiello and Svec had participants perform a task on a computer with their performance monitored by the researcher in another room. In the present study, we seek to examine social facilitation when a person works alone on a computer, thereby examining the compatibility of the Computers As Social Actors (CASA) paradigm with social facilitation.

1.2. CASA

The CASA paradigm posits that people interact with computers as though computers were people (Nass, Moon, Fogg, Reeves, & Dryer, 1995). Researchers have examined human–computer interactions and found that participants react to computers that are programmed to interact with people no differently than participants react to other people. It is suggested that mindlessness occurs with human–computer interactions, such that people fail to critically assess the computer and its limitations as an interactive partner (Nass & Moon, 2000). As a result, norms of interaction observed between people occur no differently between a person and a computer. One limitation of CASA is that the computer programs with which the participants interact were made for the laboratory setting and do not necessarily generalize to the real world.

As examples, computers have been specifically designed for experimental studies to praise or criticize performance (Nass & Steuer, 1993), to display dominant or submissive cues (Moon & Nass, 1996; Nass et al., 1995), to flatter participants (Fogg & Nass, 1997), to display gender (Lee, 2003) or to display similar or dissimilar interaction cues with participants (Moon & Nass, 1998).

Mindlessness, as suggested by Langer (1992), explains the similarity of human–human and human–computer interaction. In essence, it is posited that individuals respond unthinkingly to computers as if they were other people.

The generalizability of CASA research has not been explored using a computer program that is popularly used outside of laboratory settings. Therefore, in this study we examine the CASA paradigm utilizing Microsoft Word, arguably the most widespread word-processing program in the world.

1.3. Hypotheses

The present study seeks to extend social facilitation research by exploring the unification of the social facilitation literature with the CASA paradigm. The CASA paradigm posits that people respond to computers much as they do to other people. If people do not distinguish between the presence of a computer program and that of another person, then we should be able to examine social facilitation effects in human–computer interactions.

In this study, we will have participants perform a typing task. Social facilitation effects can be observed using performance and accuracy measures. Herein, performance is defined as the number of letter sequences typed in a 5 min period, and accuracy is the number of letter sequences typed correctly in that time period. An error is recorded whenever a word does not correctly match a word provided in the document.

Mere presence will be manipulated using the presence or absence of a computer icon. The alone condition consists of a participant performing a simple or complex task without the presence of the computer icon, while the presence condition consists of a participant performing a simple or complex task with the presence of the computer icon. It is posited that the presence of a computer icon on the screen will elicit social facilitation and inhibition effects.

Hypothesis 1: Participants working on a computer in the presence of an icon will perform better on a simple typing task than those with no icon.

Hypothesis 2: Participants working on a computer in the presence of an icon will perform worse on a complex typing task than those with no icon.

1.4. Method

1.4.1. Participants

Eighty-two ($n = 82$) students from a large Midwestern university participated in this study. This sample of students consisted of 33 males and 49 females. Participants participated alone in a room with a notebook computer. Participants received extra course credit for participating.

1.4.2. Procedure

Individuals were randomly assigned to conditions. The experimenter instructed each participant to sit before the keyboard of a computer running Microsoft Word. In the presence condition, the default paperclip computer icon appeared in the upper right-hand corner of the screen. In the alone condition, no computer icon was present.

Each participant was given a document to type that varied in complexity depending on the condition. In the simple condition the text consisted of a column of familiar words, while in the complex condition the text consisted of letter combinations that did not form words.

The experimenter instructed each participant to type the list provided as quickly and as accurately as possible in 5 min. The researcher then left the room and closed the door. The target lists were long enough that no participant completed the entire list. Upon leaving the room, the experimenter began timing each participant. Each participant was allotted 5 min to type.

The default settings for Microsoft Word include "AutoCorrect" to correct common typing mistakes. All available correction options were turned off. Otherwise, default conditions for the program remained in effect.

The experimenter administered a questionnaire after individuals completed the typing task. Questionnaire items were used to as manipulation checks.

1.4.3. Measurements

1.4.3.1. Difficulty. Perceived difficulty of the task was measured using five, Likert type items anchored at strongly disagree and strongly agree (e.g., Typing the text was difficult). Overall, this item was reliable, $\alpha = .91$, $M = 3.33$, SD = 1.69.

1.4.3.2. Presence. Recognition of the presence of the computer icon was measured using five, Likert type items anchored at strongly disagree and strongly agree (e.g., I noticed the presence of the paperclip wizard). Overall, this item was reliable, $\alpha = .95$, $M = 3.17$, SD = 2.39.

1.5. Results

1.5.1. Preliminary analyses

1.5.1.1. Manipulation checks. In order to ensure individuals noticed the 'clip' icon in the presence conditions, a 2 (icon presence: present or absent) by 2 (task difficulty: difficult or easy) ANOVA was conducted on the measure assessing the presence of the icon. A significant main effect for icon presence emerged, $F(1,77) = 37.27$, $p < .05$, $\partial\eta^2 = .32$. When the icon was present, participants were more likely to note that presence, $M = 4.57$, SD = 2.41, than when it was absent, $M = 1.86$, SD = 1.45. No other effects were significant.

In order to determine if the difficult task was, indeed, perceived of as more difficult, a 2 (icon presence: present or absent) by 2 (task difficulty: difficult or easy) ANOVA was conducted on the measure assessing perceived difficulty. A significant main effect emerged for task difficulty, $F(1,77) = 35.99$, $p < .05$, $\partial\eta^2 = .31$. The difficult task was rated more difficult, $M = 4.27$, SD = 1.56, than the non-difficult task, $M = 2.37$, SD = 1.23. No other effects were significant.

Additionally, although no sex differences were predicted in this study, sex interacted significantly with the independent variables in this study. Sex effects will be considered after the tests of the hypotheses.

1.5.2. Hypotheses tests

1.5.2.1. Performance. Interaction effects were predicted in Hypotheses 1 and 2 such that the presence of the computer icon was expected to improve performance on simple tasks and impair performance on complex tasks. In addition, we would anticipate that performance would generally be superior on the simple task compared to the complex task. An a priori contrast analysis was performed to test the specific predictions of hypotheses. Overall, the contrast model was significant, $F(1,77) = 31.65$, $p < .05$, $\eta^2 = .05$, and the residual was not, $F(2,77) = 0.35$, $p > .05$, $\eta^2 < .01$ (see Table 1 for means, standard deviations, and contrast coefficients).

Although the model test supports our predictions, examination of the means indicates the difference between scores in the simple conditions, although following the pattern predicted, appears to be trivial. Thus, the predictions pertaining to social impairment in Hypothesis 2 receive stronger support than those in Hypothesis 1 for social facilitation.

Table 1
Performance on typing task

	Absence of icon			Presence of icon		
	M	SD	CC	*M*	SD	CC
Complex task	76.61	31.11	−2	61.99	17.02	−1
Simple task	114.33	40.85	2	114.70	48.81	1

1.5.3. Post hoc tests

As noted above, sex significantly interacted with the independent variables in this study. More specifically, a significant sex by icon presence interaction emerged for performance, $F(1, 73) = 4.39$, $p < .05$, $\partial\eta^2 = .06$. Post hoc comparisons were made comparing men's performance with the icon ($M = 100.27$, SD = 54.06, $N = 21$) and without the icon ($M = 77.98$, SD = 36.97, $N = 12$). Using the harmonic mean to control for differences in cell sizes, the difference for men's scores with and without an icon was significant, $F(1, 73) = 3.81$, $p = .05$, $\partial\eta^2 = .03$. In contrast, women's performance with the icon ($M = 72.96$, SD = 23.98, $N = 18$) and without the icon ($M = 102.30$, SD = 54.06, $N = 30$) displayed the opposite trend and was also significant, $F(1, 73) = 6.49$, $p < .05$, $\partial\eta^2 = .05$. Overall, men displayed social facilitation effects and women displayed social inhibition.

1.6. Discussion

Overall, the results of the study tend to support CASA. The presence of an animated computer icon served to produce effects partially consistent with social facilitation. Although Hypothesis 1, regarding social facilitation effects on a simple task, was not supported, Hypothesis 2, dealing with social inhibition on difficult tasks, was supported.

Interestingly, regardless of task difficulty, the icon seemed to promote social facilitation in men and social inhibition in women. It is possible that, although the tasks differed in difficulty, neither reached the level of being a non-dominant task. Given the amount of typing that may be expected of the typical college student, the possibility exists that a typing task is a dominant task. This would explain the results for men but would fail to offer any explanation for why women would perform worse in the presence of the icon.

It may be that the perceived sex of the icon may have affected the results in this study. Corston and Colman (1996) examined men's and women's performance on computer tasks under different audience conditions. Women's performance in the presence of a male audience or alone was worse than with a female audience. If 'Clip' was perceived as a male observer by women, it may have inhibited their performance by creating greater perceived task demands of the situation perhaps due to increased perceived evaluation potential.

Of course, it must be pointed out that the sex effects in this study were not hypothesized and the analyses regarding those effects were post hoc. We propose study two to examine a possible explanation for the sex difference that emerged.

2. Study two

We found in our initial examination of CASA and social facilitation that women displayed social inhibition in the presence of the icon 'Clip' while men displayed social facilitation. It is possible that this effect results from women feeling greater evaluation pressure due to the icons presence than do men. Social facilitation and inhibition effects can be explained by reference to evaluation potential.

Cottrell (1972) suggested that a participant's anticipation of being evaluated causes a drive based on evaluation apprehension. Evaluation apprehension has been commonly tested by comparing participants alone to those performing before an audience in which the audience has the potential to evaluate the participant. Evaluation apprehension increases drive, which causes the social facilitation effects. Guerin (1993) claims that it is impossible to have evaluation apprehension effects without mere presence effects. Evaluation apprehension effects are strong enough to overshadow mere presence effects (Guerin & Innes, 1982). Therefore, mere presence effects may be elicited independent of evaluation apprehension, but the converse is not possible.

If evaluation apprehension serves as the mechanism for the sex difference we found, we would anticipate an interaction between sex and icon presence on perceptions of being evaluated. More specifically, we hypothesize:

Hypothesis: Women will report higher levels of evaluation apprehension than men in the presence of the 'Clip' icon during a typing task.

2.1. Method

2.1.1. Participants

Undergraduate students from a large Midwestern University participated (men = 33, women = 48). Participants received course credit for participation.

2.1.2. Procedure

Participants performed the task on the same computer and operating system as in study one. All participants performed the task alone. Participants completed a 5 min typing task either in the visual presence (i.e., 'Clip' was visible on the screen) or absence of the computer icon 'Clip'. After completing the typing task, participants filled out the measure of their perception of being evaluated.

2.1.3. Measure

2.1.3.1. Perceived evaluation. Perceived evaluation was measured using a 5 item scale anchored at 1 and 7 (i.e., I felt like my performance was being evaluated), $M = 3.70$, SD = 1.54, $\alpha = .78$. Higher scores tended to indicate more perceived evaluation.

2.2. Results

The hypothesis was tested by comparing men's and women's perceptions of being evaluated in the presence and absence of 'Clip'. If our hypothesis is correct, we would anticipate a significant sex by icon presence interaction. Furthermore, we would anticipate men and women would differ significantly when 'Clip' was present, but not when 'Clip' was absent.

Our hypothesis was supported. Although neither main effect was significant, the interaction between sex and icon presence was significant, $F(1,77) = 4.78$, $p < .05$, $\partial\eta^2 = .05$. Although men, $M = 4.08$, SD = 1.25, $N = 12$, and women, $M = 3.64$, SD = 1.72, $N = 30$ did not differ significantly in perceptions of evaluation potential when no icon was present, $F(1,77) < 1$, $p > .05$, $\partial\eta^2 < .01$, a difference did emerge between men, $M = 3.12$, SD = 1.33, $N = 21$, and women, $M = 4.23$, SD = 1.48, $N = 18$, when 'Clip' was present during the task, $F(1,77) = 4.89$, $p < .05$, $\partial\eta^2 = .05$.

2.3. Discussion

Unexpectedly in study one we discovered that men and women responded differently to the presence of the computer icon 'Clip' on a typing task. A follow-up study was designed to explore the likelihood that men and women perceived the presence of 'Clip' differently. Our results indicate that women perceived more evaluation potential when 'Clip' was present than when 'Clip' was not present.

We argue that 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. We speculate that this reflects a small arousal brought about by the mere presence effect.

Overall, our results are intriguing for scholars of both CASA and social facilitation. The sex difference we uncovered speaks to the importance of further understanding how demographic characteristics may influence human–computer interactions. We offer, and test, a theoretical explanation for why men and women may respond differently to the presence of a computer icon. Further research is called for in this domain.

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