Is the Presence of a Companion Animal Dog Beneficial for Computer Operators?

Rie Takeshima and Iiji Ogawa

Teikyo University of Science
2525 Yatsusawa, Uenohara, Yamanashi-Ken, Japan 409-0193
takeshima@ntu.ac.jp

Abstract. This research was conducted to assess whether workers' social facilitation-inhibition could be evoked by introducing a companion animal dog into the workplace or not. The experiments were carried out with three kinds of work conditions: working alone, presence of a person, and presence of a dog. There were two different discrimination tasks using PC. During each task performance, participants' response times and the number of errors were measured to investigate their performance. Also, workers' Heart Rates and Oxidation-Reduction Potentials of Saliva were measured to monitor their physiological changes. Before/after each performance, their emotional states, as defined by the Profile of Mood States questionnaire, were measured. The results suggest that for complex tasks, a companion animal can produce inhibition effects. However, the results also suggest that for more complex and difficult tasks, the presence of a familiar companion animal dog might produce facilitation effects.

Keywords: companion animal dog, social facilitation and inhibition, task performance, physiological changes.

1 Introduction

Companion animals have recently been introduced into hospitals and nursing home facilities for therapeutic and recreational purposes; i.e., rehabilitation and mental support. They have become increasingly popular in Japan. Those activities may be beneficial in terms of health and performance for company employees who are engaged in word processing using PC in the workplace. In fact, a few companies allow employees to bring their companion animals into the workplace in Japan.

In the literature of social psychology, one classical test shows how the presence of others affects task performance. It is called the social facilitation-inhibition effect. It refers to performance enhancement of a simple or well learned task and performance impairment of a complex or novel task when completed in the presence of others. Zajonc (1965) suggests that this phenomenon is due to the facilitation of dominant responses that occur under increased physiological arousal. If the presence of a companion animal increases workers' physiological arousal, it can be said that social facilitation-inhibition may occur with a companion animal.

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Therefore, the present study was undertaken to assess performances on the simple task and the complex task with three kinds of work conditions: working alone, presence of a person, and presence of a dog and to examine if this theory from social psychology carries over to interacting with companion animal dogs in the context of social facilitation-inhibition. Also, to investigate participants' physiological and emotional changes before/during/after each performance, their Heart Rates, Oxidation- Reduction Potentials of Saliva, and emotional states, as defined by the Profile of Mood States questionnaire, were measured.

2 Method

The experiments were carried out in a shield room (W3.5m x D2.6m x H2.4m). The experimental setup used in this study and the description of performance tasks including participants and experimental procedure are described below.

2.1 Experimental Setup

A Pentium 4 Dell Dimension Desktop PC with a 20.1-inch monitor, 3.20GHz (CPU), and Windows XP (OS) were used to run the performance tasks and store the response times.

Companion Animal Dog. A medium size mixed male dog participated in the experiments as the companion animal dog. The dog was well-trained and in good health.

Heart Rates (HR). A heart rate monitor (Polar RS800CX) was used to measure the heart rates (HR: the number of heart beats per minute) and beat-to-beat (R-R) intervals. HR reflects parasympathetic and sympathetic activity (Randall, 1984). Based on the data collected, each participant's coefficient of variation of R-R interval ($CV_{R\text{-}R}$) was calculated to find out the level of physiological arousal during each task. It is said that if $CV_{R\text{-}R}$ decreases, the sympathetic nervous system holds a dominant position (Wheeler & Watkins, 1973; Pfeifer et al., 1982; Ogawa & Sakamoto, 2003); in other words, the level of physiological arousal can be said to have increased.

The Polar Pro trainer 5™ program was used to calculate low-frequency (LF) power (reflecting a mixture of parasympathetic and sympathetic activity) and high-frequency (HF) power (reflecting parasympathetic activity) by integrating the spectra from 0.04 to 0.15 Hz and from 0.15 to 0.4 Hz, respectively. The ratio of the power at low- and high-frequencies (LF/HF) has been suggested to be an indicator of sympathetic nervous system activity (Task Force of The European Society of Cardiology and The North American Society of Pacing and Electrophysiology, 1996).

Oxidation-Reduction Potential of Saliva (ORPS). An oxidation and reduction potential monitor (ARAGENKI LL-001, Live & Love, Japan) was used to measure the oxidation-reduction potentials of saliva (ORPS) to monitor oxidative stress levels (Okazawa, 2009).

Profile of Mood States (POMS) Questionnaire. The emotional state of each participant was evaluated by the Japanese version of the short form of Profile of Mood States (POMS) (McNair et al., 1992). This instrument consists of six factors: "tension-anxiety," "depression," "anger-hostility," "vigor," "fatigue," and "confusion." POMS score for each factor was calculated based on the results of the questionnaire. Ogawa (2006) suggested that the emotional states of "tension-anxiety" and "vigor" were better after the break period with the companion animal dog for the data input task and the addition task, respectively.

2.2 Performance Tasks

There were two different discrimination tasks using a personal computer: a simple and a complex task. For each task, a target symbol and some sample symbols were displayed on the computer screen as shown in Figure 1.

Simple Task. For the simple task, each participant was required to choose and input the corresponding number to one of the two symbols which was matched to the target symbols and appeared on the computer screen.

Complex Task. For the complex task, each participant was required to choose and input the corresponding number to one of the eight symbols which was matched to the target symbols and rotated by 180 degrees on the screen.

Participants were asked to respond as quickly as possible with the minimum number of errors for each task. Both tasks consisted of 10 test sessions of 8 trials following 2 learning sessions of 8 trials; test sessions lasted from 2 to 8 minutes.

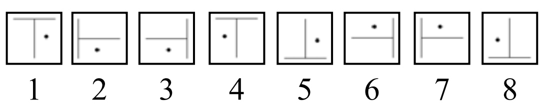

Fig. 1. Symbols used in the performance tasks

2.3 Participants

Fourteen university students (five male and nine female), between 19 and 23 years of age, participated in the experiments. Seven of them were familiar with the dog (dog-familiar) and the others were not (dog-unfamiliar). All participants had normal visual acuity and none of them disliked companion animals. Each participant provided written informed consent prior to participation.

2.4 Experimental Procedure

A 2 x 2 x 3 mixed experimental design was applied with two levels of dog-familiar factor (dog-familiar and dog-unfamiliar), two levels of task complexity (simple and complex), and three levels of work conditions (working alone, presence of a person, and presence of a dog). All participants experienced both tasks with three kinds of work conditions. The person and dog were positioned 130cm to 190cm from the participant and no physical contact could be made. The order of the work condition and the task was randomly assigned to each participant.

The experimental procedure for each condition is shown in Figure 2. On the day of each condition, an orientation of the experiment was given. The two performance tasks were carried out on the same day, and a break period of 10 minutes was given between them. During each task performance, their response times and the number of errors were measured to investigate their performance. Also, their HR and ORPS were measured to monitor their physiological changes. Before/after each performance, their emotional states, as defined by the POMS questionnaire, were measured.

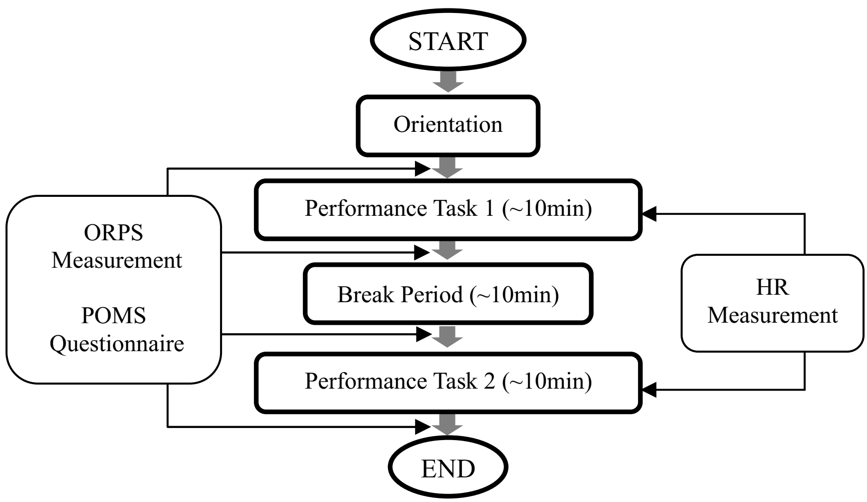

Fig. 2. Experimental procedure for each condition

3 Results

The task performance and the physiological data were treated with a repeated measure ANOVA to test for the between subject effect of dog-familiar factor, and the within subject effect of task complexity and work conditions.

3.1 Task Performance

Response times and the number of incorrect responses were automatically recorded for each participant on every trial. Response times were measured from the presentation of the symbols until the completion of the participant's response. Responses that were more than two standard deviations from the mean were not included in the analysis. Mean response times were calculated for the remaining correct responses. The number of errors was computed by summing the number of incorrect responses across the 80 trials in each condition.

Figure 3 shows the mean response times in milliseconds for each task by three work conditions and dog-familiar factor. There was a significant main effect for task complexity, F (1, 12) =327.11, p<0.01. Participants responded significantly faster on the simple task (mean=1040ms) than on the complex task (mean =3070ms). There was no main effect of dog-familiar factor and the work condition. However, for the simple task, 7 participants responded faster and only 2 participants responded slower when working alone. Also, for the complex task, 7 participants responded faster and only 3 participants responded slower when working alone.

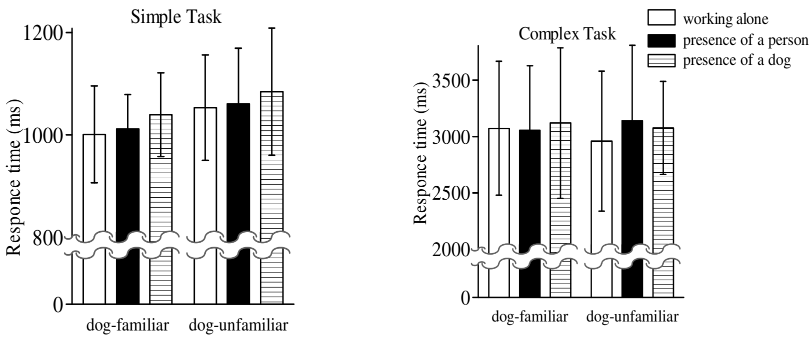

Fig. 3. Mean response time for each condition for the different tasks

Figure 4 shows the number of errors for each task by three work conditions and dog-familiar factor. There was a significant main effect for task complexity, F (1, 12) =4.77, p<0.05. Participants responded significantly better on the simple task (mean =1.41) than on the complex task (mean =3.98). There was no main effect of dog-familiar factor and the work condition. However, for the simple task, most dog-familiar participants (6 of 7 participants) responded with fewer errors when working alone, and with many errors when working in the presence of a dog. For the complex task, all dog-familiar participants responded with fewer errors when working in the presence of a dog.

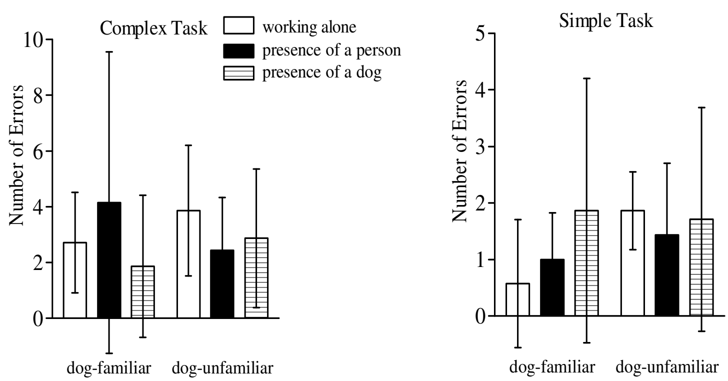

Fig. 4. Mean number of errors for each condition for the different tasks

3.2 Physiological and Emotional Changes

Figure 5 shows the mean HR for each condition for the different tasks. There was a significant interaction effect of work condition by dog-familiar factor, F (1, 12) =11.01, p<0.01. For dog-familiar participants, HR was the highest when working in the presence of a dog. On the other hand, for dog-unfamiliar participants, HR was the lowest when working in the presence of a dog. Table 1 shows the power spectrum analysis of heart rate variability for each condition. As a result of ANOVA, there was no main effect of dog-familiar factor and the work condition. Also, Pearson correlation coefficients between the task performance data and the physiological measurements for each condition are shown in Table 2.

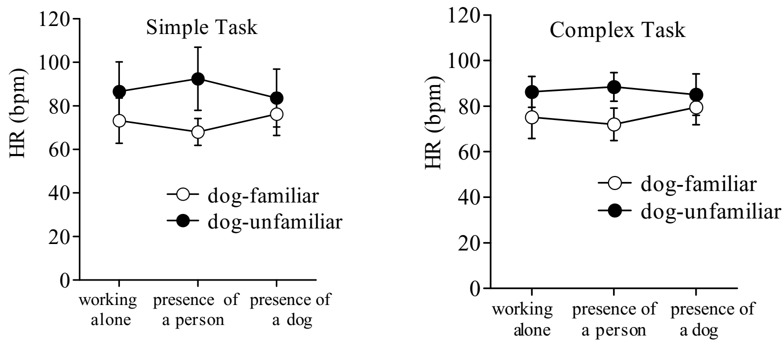

Fig. 5. Mean HR for each condition for the different tasks

Table 1. Power spectrum analysis of heart rate variability for each condition

	Simple Task					
	dog-familiar (n=7)			dog-unfamiliar (n=7)		
Condition	**working alone**	**presence of a person**	**presence of a dog**	**working alone**	**presence of a person**	**presence of a dog**
HF (ms^2)	657±587	846±503	563±400	460±447	236±214	400±308
LF/HF	118±52	126±74	191±192	210±148	294±213	182±68
CV$_{R-R}$ (%)	5.2±1.5	5.6±2.3	4.9±1.1	5.2±1.4	4.5±1.1	5.6±1.2
	Complex Task					
	dog-familiar (n=7)			**dog-unfamiliar (n=7)**		
Condition	**working alone**	**presence of a person**	**presence of a dog**	**working alone**	**presence of a person**	**presence of a dog**
HF (ms^2)	625±484	626±373	410±351	360±314	247±202	345±170
LF/HF	117±83	132±112	199±119	197±156	293±311	150±86
CV$_{R-R}$ (%)	5.4±1.1	5.7±2.2	4.9±0.8	4.7±1.0	5.0±1.6	5.8±1.6

For the simple task, there was a correlation between response times and HR ($p<0.05$), HF ($p<0.05$) and LF/HF ($p<0.05$), when working alone. For the complex task, there was a positive correlation between response times and LF/HF ($p<0.05$), and there was also a correlation between the number of errors and HR ($p<0.01$), HF ($p<0.05$) and CV_{RR} ($p<0.01$), when working alone. However, for both tasks, there was no correlation between response times and any physiological measurements when working in the presence of a familiar dog. For the complex task, there was also no correlation between the number of errors and any physiological measurements when working in the presence of a dog.

Table 2. Correlation Coefficients between the task performance data and the physiological measurements

		Simple Task				
Condition		**HR**	**HF**	**LF/HF**	**CV_{RR}**	**ORPS**
working alone	**response time**	0.631*	-0.577*	0.629*	-0.378	-0.233
	errors	0.255	-0.214	0.156	-0.032	-0.063
presence of a person	**response time**	0.249	-0.381	0.326	-0.077	0.650*
	errors	0.429	-0.052	-0.048	-0.101	-0.096
presence of familiar dog	**response time**	0.185	-0.298	-0.487	0.296	0.531
	errors	0.639	-0.624	0.925**	-0.676	-0.485
presence of unfamiliar dog	**response time**	0.839*	-0.254	-0.131	0.147	0.683
	errors	0.058	-0.229	0.279	0.139	0.362
		Complex Task				
Condition		**HR**	**HF**	**LF/HF**	**CV_{RR}**	**ORPS**
working alone	**response time**	0.094	-0.193	0.539*	-0.041	0.253
	errors	0.765**	-0.653*	0.468	-0.787**	-0.076
presence of a person	**response time**	-0.123	-0.080	0.291	0.234	0.327
	errors	0.074	-0.121	-0.136	-0.230	0.687**
presence of a familiar dog	**response time**	0.149	-0.009	-0.279	0.280	0.422
	errors	-0.219	-0.015	-0.637	-0.526	0.136
presence of an unfamiliar dog	**response time**	-0.023	-0.327	-0.100	-0.796*	-0.438
	errors	0.261	0.254	-0.051	0.215	-0.378

**$p < .01$ (two-tailed test). *$p < .05$ (two-tailed test).

Table 3 shows Pearson correlation coefficients between task performance data and emotional changes defined by the POMS scores, with the work conditions and dog-familiar factor. For simple task, there was a positive correlation between response times and tension-anxiety factor when working alone. However, for that task, there was no correlation between response times and tension-anxiety factor when working in the presence of a person or a dog. There was a negative correlation between response times and vigor when working in the presence of a person or an unfamiliar-dog and between response times and fatigue, and response times and confusion when working with a familiar-dog. For complex task, there was no correlation between response times and any POMS score.

Table 3. Correlation Coefficients between the task performance data and the POMS scores

Condition		Simple Task					
		tension-anxiety	depres-sion	anger-hostility	vigor	fatigue	confu-sion
working alone	response time	0.617*	0.327	-0.433	-0.529	-0.195	0.472
	Errors	0.143	-0.055	-0.207	-0.066	0.089	0.054
presence of a person	response time	0.098	-0.098	0.121	-0.566*	-0.228	-0.146
	Errors	-0.273	0.089	-0.113	0.248	-0.334	0.306
presence of familiar dog	response time	-0.661	-0.174	0.474	0.035	-0.788*	-0.861*
	Errors	0.410	0.250	0.162	-0.766*	0.764*	0.419
presence of unfamiliar dog	response time	-0.165	0.125	NA	-0.759*	0.199	-0.069
	Errors	0.213	0.076	NA	0.008	0.719	0.159
Condition		**Complex Task**					
		tension-anxiety	**depres-sion**	**anger-hostility**	**vigor**	**fatigue**	**confu-sion**
working alone	response time	-0.290	0.097	-0.405	-0.161	0.293	-0.053
	Errors	0.029	0.474	-0.236	-0.183	0.364	0.293
presence of a person	response time	0.214	-0.464	0.197	-0.343	-0.189	-0.058
	errors	-0.039	-0.326	-0.246	0.109	-0.554*	0.456
presence of familiar dog	response time	-0.141	0.549	NA	-0.506	-0.539	-0.494
	errors	0.298	-0.401	NA	-0.609	0.135	0.683
presence of unfamiliar dog	response time	-0.378	0.608	-0.399	0.467	-0.467	-0.336
	errors	-0.196	-0.211	0.737	0.657	0.292	0.347

**p < .01 (two-tailed test). *p < .05 (two-tailed test). NA = not applicable.

4 Discussion

The following discussion can be made within the limitation of the experiments.

4.1 Task Performance

Social facilitation effect did not occur with a companion animal dog or a person in this study. Generally speaking, for both tasks, the presence of a dog or a person did not improve the participants' performances. This may be due to the fact that both tasks in this study might have been too complex and challenging for the participants. In other words, the results suggest that for complex tasks, a companion animal can produce social inhibition effects just as in the presence of a person. However, for the complex task in this study, all dog-familiar participants responded with fewer errors when working in the presence of a dog. For the more complex and difficult task, the presence of a familiar companion animal dog might produce facilitation effects different from a person.

4.2 Physiological and Emotional Changes

HR showed a different tendency in the dog-familiar factor. The presence of a familiar-dog may raise heart rate. In other words, the presence of a dog may increase the dog-familiar participants' physiological arousal. However, there was little correlation between task performance and the physiological measurements when working in the presence of a dog, while there was a correlation when working alone. These results cannot be explained by social facilitation-inhibition. For the simple task in this study, there was a negative correlation between the response time and the POMS score of fatigue and confusion when working with a familiar-dog. The results suggest the presence of a familiar-dog may be effective in relieving fatigue and confusion when the performance was slower.

5 General Discussion

Whether the presence of a dog increases workers' physiological arousal and facilitates task performance or not may depend on the task complexity and the workers' dog-familiar factor. In other words, the presence of a dog may change the atmosphere even in the workplace. This is one of the reasons why activities with companion animal dogs have become popular in hospitals and nursing home facilities. However, further study is needed to verify the findings obtained from this study not only for more complex and difficult tasks but also for many workers in the workplace. It is our hope that the findings here will increase awareness of the benefits of introducing companion animal dogs into the workplace.

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