Journal of Applied Psychology
1995, Vol. 80, No. 3, 339–353

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0021-9010/95/$3.00

Electronic Performance Monitoring and Social Context: Impact on Productivity and Stress

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In a laboratory study, the presence of individual- or work-group-level electronic performance monitoring (EPM) was manipulated as participants worked on a data-entry task alone, as a member of a noninteracting aggregate, or as a member of a cohesive group. The pattern of results suggested the operation of a social facilitation effect, as highly skilled monitored participants keyed more entries than highly skilled nonmonitored participants. The opposite pattern was detected among low-skilled participants. No signs of social loafing were detected among group-monitored participants. Nonmonitored workers and members of cohesive groups felt the least stressed. The implications of these findings for organizations adopting EPM systems are discussed.

Electronic performance monitoring (EPM) is one of many technological innovations employees face in today's workplace. Using network technology, EPM systems provide managers with access to their employees' computer terminals and telephones, allowing managers to determine at any moment throughout the day the pace at which employees are working, their degree of accuracy, log-in and log-off times, and even the amount of time spent on bathroom breaks. The study presented in this article examines how productivity and subjective experiences are affected by EPM and how the social context within which monitoring occurs moderates that influence.

Electronic Performance Monitoring

In 1987, the U.S. Congress, Office of Technology Assessment reported that more than 6 million American workers were subject to EPM. By 1990, that number grew to more than 10 million workers (9to5, Working Women Education Fund, 1990). Clerical employees and others who perform simple, repetitive tasks represent the preponderance of workers currently subject to electronic observation; however, trends indicate that the work performed by professional, technical, and managerial employees will also be electronically observed at some point in the near future (Garson, 1988; U.S. Congress, Office of Technology Assessment, 1987).

Some companies monitor the work of individual employees, whereas others choose to review statistics that first have been aggregated to reflect the performance of the larger work group. Monitoring at the work-group level is perceived by some to be less intrusive and less stressful to workers. This has led several countries (e.g., Norway and Sweden) to enact laws that limit the degree to which individual performance may be monitored. Although monitoring individuals is not prohibited in Japan, most Japanese firms prefer to focus their monitoring efforts on work teams. In the United States, individual monitoring is most prevalent (9to5, Working Women Education Fund, 1990; U.S. Congress, Office of Technology Assessment, 1987).

Empirical studies have provided strong evidence linking EPM with increased stress (Aiello & Shao, 1993; Amick & Smith, 1992; Smith, Carayon, Sanders, Lim, & LeGrande, 1992). In one survey of monitored workers, 81% of the respondents indicated that electronic observation made their jobs more stressful (Gallatin, 1989). Another study compared the attitudes of electronically monitored insurance workers with nonmonitored workers who performed comparable jobs and found that monitored workers reported feeling more stressed (Irving, Higgins, & Safayeni, 1986). In a laboratory experiment, individually monitored participants exhibited the highest amount of stress, nonmoni-

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A portion of this research was presented at the 1993 Society of Industrial and Organizational Psychology Conference in San Francisco.

We acknowledge and thank Loretta Wollering and Stephanie Madon for their contributions to the execution of this study. We also thank Rick Guzzo, Paul Paulus, and David Wilder for their comments and helpful suggestions on earlier drafts of this article.

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tored participants showed the lowest level of stress, and participants who believed that their work was aggregated with others before it was monitored produced intermediate stress scores (Aiello et al., 1991). Survey, case study, and experimental data have also indicated an association between EPM and decreased job satisfaction (Cahill & Landsbergis, 1989; Grant & Higgins, 1989; Irving et al., 1986), increased feelings of social isolation (Aiello, 1993; Amick & Celentano, 1991; Amick & Smith, 1992), and increased perceptions that generating quantity is more important than producing quality work (Gallatin, 1989; Shell & Allgeier, 1992).

The increased stress associated with EPM has been attributed to changes in job design that often are introduced concurrently with electronic observation. Specifically, monitored workers have complained about increases in workload and loss of control over the manner in which they perform their jobs (Smith et al., 1992). The elevated levels of psychological and somatic distress that follow may be understood from within the framework of Karasek's (1979) job strain model. As demand for productivity increases and decision latitude declines, EPM may transform ordinary jobs into high-stress positions. Monitoring may also reduce opportunities for employees to socialize at work, leading some to suggest that loss of social support is at least partially responsible for the stress associated with EPM (Amick & Smith, 1992).

Research supports the applicability of using a social facilitation framework to predict how EPM influences employee productivity. Consistent with the premise that simple-task performance is enhanced by the presence of an audience or coactors (Zajonc, 1965), Aiello and Chomiak (1992) demonstrated that participants working on an easy data-entry assignment performed at a higher rate when they believed that their work was electronically observed. Also in keeping with the social facilitation perspective, complex-task performance has been shown to suffer among computer-monitored participants (Aiello & Shao, 1992; Aiello & Svec, 1993). Social facilitation effects have been thought to derive from the mere presence of an audience or coactors (Zajonc, 1965), concern over evaluation (Cottrell, 1972; Geen & Gange, 1977), self-presentation concerns (Duval & Wicklund, 1972), distraction (Baron, Moore, & Sanders, 1978), and attentional factors (Baron, 1986; Geen, 1991).

The manner in which monitoring is conducted may influence productivity. When employees believe that their individual efforts are being observed, one would expect to find clear social facilitation effects: Performance on simple tasks should improve, and performance on complex tasks should decline. A different productivity pattern is expected, however, when work-group level monitoring is used. Research examining the phenomenon of social loafing has shown that at times people exert more effort when they think they are working alone than when they believe their work is being combined with that of others (Harkins, Latane, & Williams, 1980; Ingham, Levinger, Graves, & Peckham, 1974; Kerr, 1983). Harkins (1987) demonstrated that evaluation and identifiability of individual contributions are required if group performance losses are to be prevented. That is, when people believe that their individual efforts will be monitored (i.e., identified) and compared with the work of others in the group (i.e., evaluated), social loafing does not occur. In contrast, when people believe that their work will be pooled with others before it is reviewed, the possibility for individual contributions to be identified and evaluated is eliminated, and productivity loss results. Work-group-level monitoring, therefore, might not produce the same boost in simple-task performances as individual-level monitoring.

This study used the frameworks of social facilitation and social loafing to predict how EPM influences productivity. Specifically, participants working on a simple data-entry task were expected to perform at a higher rate when their individual efforts were electronically monitored than when their work was not observed. Participants whose work was monitored at the work-group level were expected to show some improvement in performance, but that improvement was not expected to be as high as for those who were individually monitored. We also predicted that monitored participants would have a more negative subjective experience during the experiment and would report feeling more stressed than nonmonitored participants.

Social Context

Almost all investigations of EPM study how electronic presence affects individual workers rather than the work group to which employees belong. Yet, social phenomena cannot be completely understood without considering the larger social context in which they occur. Researchers in organizational development, for example, have long advised that researchers adopt a systems view when investigating workplace issues (Beer & Huse, 1972; Friedlander & Brown, 1974). By using this approach, researchers can examine how EPM precipitates structural changes in the workplace, as some researchers (Aiello, 1993; Amick & Smith, 1992; Cahill & Landsbergis, 1989) did when they documented that workers became physically and socially isolated from one another after monitoring was introduced. Likewise, researchers can examine how the composition of the larger work system moderates the effects of EPM, as others (Chalykoff & Kochan, 1989; Kidwell & Bennett, 1994) did when they ex-

plored the management practices that promote employee acceptance of electronic observation.

The current study addressed this issue by considering how electronic presence influences individuals working alone, individuals surrounded by strangers (i.e., aggregate members), and individuals surrounded by members of a cohesive group to which they belong. We predicted that people who worked alongside of others (i.e., aggregate and group members) would produce at a higher rate on a simple task than people who worked alone, regardless of the presence or the absence of EPM. This prediction derives from the social facilitation framework, in which performance is thought to be influenced not only by an audience but by coactors as well (Zajonc, 1965). Moreover, we expected that membership in a cohesive group would have a particularly enhancing influence on productivity, independent of monitoring condition. Finally, we expected that members of cohesive groups would experience less stress than people who worked in the presence of strangers or alone.

Numerous studies have examined group cohesiveness in the workplace and have found that cohesiveness often produces results that are beneficial both to the individual employee and to the organization in which the employee works. Members of cohesive work groups tend to experience reduced turnover (Van Zelst, 1952), greater job satisfaction (Janssens & Nuttin, 1976; Manning & Fullerton, 1988; Van Zelst, 1952), a more positive view of the work climate (Janssens & Nuttin, 1976), and lower stress (Manning & Fullerton, 1988). The effects of group cohesiveness on productivity appear to be less straightforward, however. Group cohesiveness may lead to both increases and decreases in productivity (Guzzo & Shea, 1992). It is also possible for productivity to influence group cohesiveness as much as group cohesiveness influences productivity. For example, Bakeman and Helmreich (1975) found that high productivity at Time 1 was associated with stronger cohesiveness at Time 2. That is, productivity preceded, rather than followed, cohesiveness.

Generally defined as "the forces operating on the members to remain in the group" (Festinger, 1950, p. 274), three sources of group cohesiveness have been identified. These are task based, where members believe that group participation will help them achieve desired goals; socioemotional, where cohesiveness is based on mutual liking and a desire to affiliate; and prestige based, where participants are attracted to the status conferred by group membership (Anderson, 1975; Back, 1951; Festinger, 1950; Tziner, 1982; Zaccaro, 1991). Groups high in task-based cohesiveness tend to outperform noncohesive groups on additive tasks (tasks in which group performance scores are calculated by summing the scores obtained by individual group members). However, groups high in socioemotional cohesiveness generally are not more productive than noncohesive groups, because participants in socioemotional groups tend to interact with one another during task performance in a manner that disrupts overall productivity (Zaccaro, 1991; Zaccaro & Lowe, 1988). Researchers (e.g., Schachter, Ellertson, McBride, & Gregory, 1951; Tziner, 1982) have been able to obtain performance gains in socioemotional groups, however, when group members are encouraged to value performance goals. It appears that a group's motivational orientation moderates the relationship between socioemotional cohesiveness and productivity. Therefore, high productivity may be expected of groups characterized by strong mutual attraction but only when group norms are directed toward, rather than away from, achievement.

The protection against stress provided by group cohesiveness has been attributed to the benefits associated with receiving social support (Manning & Fullerton, 1988). Research has suggested that social support systems have a main effect on perceived well-being, whereby they protect people from physical and psychological disorders regardless of whether stressors are present, and a buffering effect, whereby social support systems reduce the impact of stressors on system members (Cobb, 1976; Cohen & Wills, 1985; House, Landis, & Umberson, 1988). Consistent evidence has been found to support the main effects model; however, studies examining the buffering hypothesis have produced more equivocal results (Kobasa, 1982; Shinn, Rosario, Morch, & Chestnut, 1984).

Summary of Hypotheses

Hypothesis 1: Individually monitored workers will perform at a higher rate on a simple task than group-monitored and nonmonitored workers. Group-monitored workers will perform at a somewhat higher rate than nonmonitored workers.

Hypothesis 2: Monitored workers will experience more stress than nonmonitored workers.

Hypothesis 3: Aggregate and group members will perform at a higher rate on a simple task than individuals who work alone.

Hypothesis 4: Members of cohesive work groups will perform at a higher rate than members of noninteracting aggregates.

Hypothesis 5: Members of cohesive groups will experience less stress than members of noninteracting aggregates and individuals who work alone.

We also examine whether social context moderates the effect EPM has on productivity and stress. For example, we may find that people who are monitored while work-

ing alone feel more stress than group members who are monitored.

Method

Participants

Participants were 202 undergraduate students enrolled in an introductory psychology course at a large northeastern university. They received partial course credit for their participation.

Design

Separate sessions of the experiment were run for each cell of the design. All participants performed a simple task while working alone, as a member of an aggregate, or as a member of a cohesive group. The work they performed was monitored at the individual level, at the work-group level, or not at all. That is, the social context condition and the EPM condition were orthogonally manipulated to create a 3 × 3 factorial design.

Procedure

Participants assigned to the aggregate and group social context conditions reported to the experiment location, a computer laboratory on the university campus, with 3–6 other participants with whom they were unacquainted. The laboratory was equipped with 35 IBM personal computers arranged in five rows. One computer in the center of the fifth row was designated the "supervisory" computer and was used by the study supervisor during the monitoring phase of the experiment. In the front of the laboratory, a semicircle of chairs was arranged for use by group members during the cohesiveness-building exercises in which they participated.

Some participants assigned to the alone social context condition reported by themselves to this same laboratory for their sessions of the experiment. For logistical reasons, the remaining participants in the alone condition worked in a smaller laboratory equipped with one personal computer workstation for the participant and a second supervisory computer used by the study supervisor during the monitoring manipulation. Analysis of performance and subjective experience scores for participants in the alone social context condition revealed negligible differences between individuals who reported to the larger laboratory and those who reported to the smaller laboratory ($p > .10$).

When participants arrived at their designated location, they were greeted by the experimenter and the study supervisor and were directed to sit at their assigned computer workstations. The supervisor informed the participants that they would be taking part in a study examining job design and thus would be working on a series of tasks that simulated the types of behaviors normally performed each day by employees in business. Participants were told that their first assignment would be to practice working on a data-entry task, whereby they would key into their computers a series of six-digit numbers from a worksheet. After the supervisor instructed the participants on how to use the data-entry software, participants worked on the task for 5 min. The software was designed to record the number of six-digit entries keyed by each participant during this 5-min period, thus providing a practice score that could be used as a measure of each participant's initial data-entry ability and baseline motivation level.

Social context manipulation. After participants completed the practice data-entry assignment, the supervisor informed them that they would work next on a series of tasks that characterized the types of behaviors often performed in a typical business meeting. In reality, this portion of the experiment was designed to induce a sense of cohesiveness among those participants assigned to the group social context condition while preventing a sense of connectedness from forming among aggregate members. Group members, aggregate members, and participants assigned to the alone social context condition all performed the same series of exercises, yet the manner in which they were permitted to engage in them was varied to foster the emergence of three distinct social climates.

Research has indicated that social attraction may be created under laboratory conditions by having small groups of participants merely interact with one another (Insko & Wilson, 1977) or participate in simple self-introduction exercises (Zaccaro & Lowe, 1988). In addition, a sense of cohesion has been promoted among dyad members by furnishing participants with false information about their unusual degree of compatibility with one another (Back, 1951; Tziner, 1982). Providing members with bogus feedback about their group's success on a particular task has also been effectively used as a means of enhancing feelings of connectivity and attraction (Anderson, 1975; Blanchard, Adelman, & Cook, 1975; Tziner, 1982). In the current study, all of these techniques were used to foster a sense of cohesiveness among group members.

After completing the practice data-entry task, participants assigned to the group social context condition left their computer workstations and were reseated for their "business meeting" in the semicircle of chairs situated at the front of the laboratory. The supervisor asked the 4–7 group members to introduce themselves to one another by relating their name, major, psychology class section, and reason for participating in the experiment. To ensure that group members interacted with one another rather than with the supervisor, the supervisor walked away from the participants while they engaged in this exercise.

When this introduction activity was completed, the supervisor returned and informed the group members that because business meetings are often used as forums for brainstorming, their next task would be to collectively develop a list of as many uses as they could think of for a student identification card. A group member seated at an end of the semicircle was asked to record the group's responses on a large white board visible to all members in the group. Group participants were provided with 5 min to complete the brainstorming task. Again, the supervisor left the group before the activity was initiated.

When this exercise was completed, the experimenter called time and distributed a pseudoprojective test (a brief, forced-choice, inkblot inventory), which each participant completed independently. These were collected and presumably scored by the experimenter while each participant worked alone on a filler questionnaire.

After all group members had completed the filler questionnaire, the study supervisor approached the group members and provided them with bogus positive feedback about their performance on the brainstorming task. She reported the total number of items the group had produced and informed participants that their group had done an "excellent job." The supervisor indicated that they were "among the best of the groups who had participated in the study to date" and, citing several examples from the group's list, related that their ideas were notably more novel and creative as well. The experimenter then returned to report that the group members had obtained unusually similar scores on their inkblot tests. She explained that this could be interpreted to mean that their "inner traits" were quite compatible in important ways that helped them work well together as a group. The experimenter then informed the participants that the business meeting was over and that they should return to their computer workstations to await instructions from the supervisor for their next appointed task.

Participants assigned to the aggregate social context condition performed the same business-meeting tasks as group members, but they worked on them without interacting with their aggregate coparticipants. After completing the practice data-entry task, aggregate members remained at their individual computer workstations, in contrast to group members who moved to the more intimate milieu of the semicircle. Aggregate members accomplished the self-introduction task by recording on a piece of paper their name, major, and so forth. They did not share this information with the 3–6 other aggregate members working in the same room as them. Aggregate members also worked independently on a paper-and-pencil version of the brainstorming task and after completing the pseudoprojective test and filler survey, were not provided with any feedback regarding their degree of compatibility with coparticipants. Instead, they were instructed to merely move on to the next assigned task.

Like aggregate members, participants assigned to the alone social context condition also worked on paper-and-pencil versions of the business-meeting tasks, yet they did so without the company of coparticipants. That is, except for the presence of the experimenter and the supervisor, these individuals were alone in the laboratory.

Monitoring manipulation. After the social context manipulation was completed, participants were informed by the supervisor that they would now work for 15 min on the same type of data-entry task that they had practiced earlier in the experiment. The supervisor reviewed the software instructions with them and then initiated the monitoring manipulation.

Participants assigned to the individual monitoring condition were told by the supervisor that their computers were connected through a network to a supervisory computer at the rear of the room. They were led to believe that through this system, their supervisor could and would observe their individual data-entry performance while they worked.

Participants assigned to the work-group monitoring condition were also told about the monitoring system but were informed that the software permitted the supervisor to observe only the combined performance of all the workers in the room. That is, their work would be consolidated with that of their coparticipants before it was viewed by the supervisor. Work-group-monitored participants assigned to the alone social context condition were led to believe that the supervisor could monitor only the combined output of their performance merged with that of other study participants who worked in different laboratories at the same time. This account was made believable by having a confederate who "was looking for one of the other locations of the experiment" knock at the door just prior to the beginning of the study.

Participants assigned to the no-monitoring condition were told nothing about the supervisory computer or the monitoring system. To further limit the degree of evaluation the participants felt, the supervisor explained that she had other work to do and therefore could not stay in the laboratory with them while they worked on the data-entry task. In contrast, in both the individual-level monitoring and work-group-level monitoring conditions, the supervisor remained in the room and appeared to operate the supervisory computer while the participants worked.

After the participants finished working on the data-entry task, the experimenter administered a series of questionnaires designed to elicit participants' self-reported ratings of stress, satisfaction, motivation, and other subjective impressions about the experiment. Aggregate and group members also completed a questionnaire assessing their degree of attraction to each other as well as their sense of group cohesiveness. Finally, for purposes unrelated to this study, participants completed the Rosenberg Self-Esteem Scale (1965) and the Internal/External Locus of Control Scale (Rotter, 1966). They were then debriefed.

Results

Preliminary Analyses

Participants. Because of equipment failure, we were unable to collect performance scores for 8 participants. Questionnaire data for these participants have been omitted from all analyses. In addition, data for 2 participants were discarded when a preliminary review revealed that their performance scores fell more than three standard deviations below the mean (i.e., they were outliers). It appears that these participants either failed to follow instructions or failed to take the experiment seriously, as they each keyed only 5 entries during the 5-min practice data-entry session ($M = 65.86$) and between 16 and 18 entries during the 15-min data-entry session ($M = 206.59$). After incomplete and outlier data were deleted, performance scores and questionnaire responses from the remaining 192 participants were available for analysis.

Manipulation checks. Responses on the postexperimental questionnaire indicated that monitored participants believed that they were observed when they were working on the data-entry task. Nearly all participants responded correctly to the question, "Was your performance on the data-entry task monitored by the supervi-

Table 1
Social Context Manipulation Check

Questionnaire response	Social context: Agg.	Social context: Group	F	df
Interacted with coparticipants	1.47	4.06	136.43***	1, 125
Aware of other participants	4.05	5.04	8.58**	1, 124
Compatible with other participants	3.67	4.87	23.45***	1, 124
Similar to other participants	3.59	4.29	5.86**	1, 124
Like other participants	3.82	5.06	35.94***	1, 124
If study continued, desire to work with same participants	4.26	5.24	11.24**	1, 117
Desire to work with same participants on class assignment	3.97	4.96	17.92***	1, 124
Desire to work on real job with same people	4.65	5.43	8.25**	1, 125
Desire to attend social event with same people	3.33	4.16	10.01**	1, 124

Note. The scale ranged from 1 to 7, with larger numbers indicating more of the attribute. Agg. = aggregate.
** $p < .05$. *** $p < .001$.

sor through her terminal?" When asked to report the degree to which they felt that their work was evaluated by using a 7-point scale ranging from 1 (*not at all*) to 7 (*a great extent*), nonmonitored participants scored below the scale midpoint (M = 2.86), whereas individually monitored (M = 4.55) and work-group-monitored (M = 4.19) participants scored above the midpoint, $F(2, 181) = 13.42$, $p < .001$. Contrary to expectations, a post hoc Scheffé test revealed that individually monitored participants did not report feeling significantly more evaluated than did participants who were monitored at the work-group level. Nevertheless, a Scheffé test showed that individually monitored participants felt more aware of the supervisor (M = 4.27 on a 7-point scale ranging from 1 = *not at all aware* to 7 = *very aware*) than either group-monitored (M = 3.32) or nonmonitored (M = 2.77) participants, $F(2, 182) = 12.31$, $p < .001$. Individually monitored participants also reported that monitoring affected their performance to a greater extent (M = 4.10 on a 7-point scale ranging from 1 = *not at all affected* to 7 = *very affected*) than participants who were monitored at the group level (M = 3.08), $F(1, 122) = 7.85$, $p < .05$.

Postexperimental questionnaire responses indicated that the social context manipulation was successful (see Table 1). Group members reported that they interacted more with their coparticipants and were more aware of them than were aggregate members. In addition, group members reported feeling more compatible with and more similar to one another and liking one another more than did aggregate members. Finally, group members indicated a stronger desire to remain with the group, even outside the context of the experiment, than did aggregate members. These findings suggest that the procedures used in the experiment successfully induced a sense of cohesiveness among group members that was not felt among participants assigned to the aggregate condition.

Description of Analyses

To determine if participants in the nine experimental conditions had equivalent baseline performance scores, we ran a 3 × 3 (Social Context × Monitoring Condition) analysis of variance (ANOVA), using baseline performance as the dependent measure. No significant difference was detected among participants assigned to the three monitoring conditions, $F(2, 183) = 1.21$, $p > .10$. However, the ANOVA did reveal a significant difference for social context, $F(2, 183) = 3.92$, $p < .05$. A post hoc Scheffé test showed that participants assigned to the cohesive group condition keyed at a higher rate prior to the experimental manipulation than participants assigned to

Table 2
Baseline Performance Scores

Social context	Monitoring condition: None	Monitoring condition: Individual	Monitoring condition: Work group	Overall M
Alone				
M	65.52	61.75	64.15	$63.84_{a,b}$
SD	17.77	15.12	22.58	18.48
n	21	20	20	61
Aggregate				
M	62.75	60.05	64.64	62.60_{a}
SD	22.65	17.58	16.73	18.48
n	16	21	25	62
Group				
M	79.96	70.23	67.00	72.35_{b}
SD	38.01	17.88	18.37	26.67
n	23	22	24	69
Overall				
M	70.32	64.14	65.32	63.93
SD	28.92	17.28	18.89	22.12
N	60	63	69	192

Note. Means with different subscripts differ significantly at $p < .05$, using the Scheffé post hoc contrast of means.

Table 3
Summary of Hierarchical Regression Analysis for Postmanipulation Performance

Variable	B	t	R^2	ΔR^2	F	df
Step 1						
Baseline performance (A)	2.05	15.18***	.55***			
Step 2						
Monitoring (B)			.55***	.01*	2.96*	2, 188
Individual vs. None	16.37	2.20**				
Group vs. None	13.49	1.85*				
Social context (C)			.55***	.00	0.52	2, 188
Aggregate vs. Alone	6.42	0.87				
Group vs. Alone	4.10	0.56				
Step 3						
A × B			.68***	.12***	35.29***	2, 184
A × Individual vs. None	1.24	4.03***				
A × Group vs. None	1.59	5.67***				
A × C			.65***	.10***	26.33***	2, 184
A × Aggregate vs. Alone	0.04	0.12	2, 184			
A × Group vs. Alone	−1.25	4.21***				
B × C			.57***	.01	1.09	4, 182

Note. F values represent F associated with incremental R^2.
* $p < .10$. ** $p < .05$. *** $p < .001$.

the aggregate condition (see Table 2). The interaction between social context and monitoring condition was not significant, $F(4, 183) = 0.71, p > .10$.

To help control for differences in baseline ability across the nine cells of the experiment and to account for the high correlation between baseline performance and postmanipulation performance ($r = .74, p < .001$), we analyzed all performance-related hypotheses using hierarchical regression analysis. Baseline performance was entered alone in the first step of the analysis. In the second step, monitoring condition and social context were added. Two dummy variables were created to accommodate the three levels of performance monitoring and to permit comparisons between individually monitored participants and the nonmonitored control group and between group-monitored participants and the nonmonitored control group. Likewise, two dummy variables were created to reflect the three levels of social context and to permit comparisons of aggregate and group member scores with the scores of participants who worked alone. In the third step of the regression analysis, two-way interactions between baseline performance, monitoring condition, and social context were entered.

The results of the hierarchical regression analysis are summarized in Table 3. This analysis revealed the presence of a significant interaction between baseline performance and monitoring condition. To further explore this interaction, we created separate regression equations for each monitoring condition, in which baseline performance was entered as the independent variable and postmanipulation performance was entered as the dependent variable (see Table 4). The interaction between baseline performance and social context was explored in the same manner (see Table 4). Figures 1 and 2 illustrate these interactions by showing predicted postmanipulation performance scores for participants with baseline scores between one and one-half standard deviations above and below the mean.

The postexperimental questionnaire contained 48 items designed to assess study participants' subjective reactions to the monitoring and social context manipula-

Table 4
Performance for Each Monitoring and Social Context Condition

Condition	R^2	F	B	t
Monitoring				
None	.28	23.02***		
Intercept			120.68	6.29***
Baseline			1.21	4.80***
Individual	.83	302.56***		
Intercept			27.22	2.51**
Baseline			2.85	17.39***
Group	.94	1,004.28***		
Intercept			−4.86	−0.69
Baseline			3.28	31.69***
Social context				
Alone	.77	193.48***		
Intercept			3.32	0.23
Baseline			3.06	13.91***
Aggregate	.87	386.86***		
Intercept			17.36	1.76*
Baseline			2.98	19.67***
Group	.31	29.68***		
Intercept			133.06	7.75***
Baseline			1.21	5.45***

* $p < .10$. ** $p < .05$. *** $p < .001$.

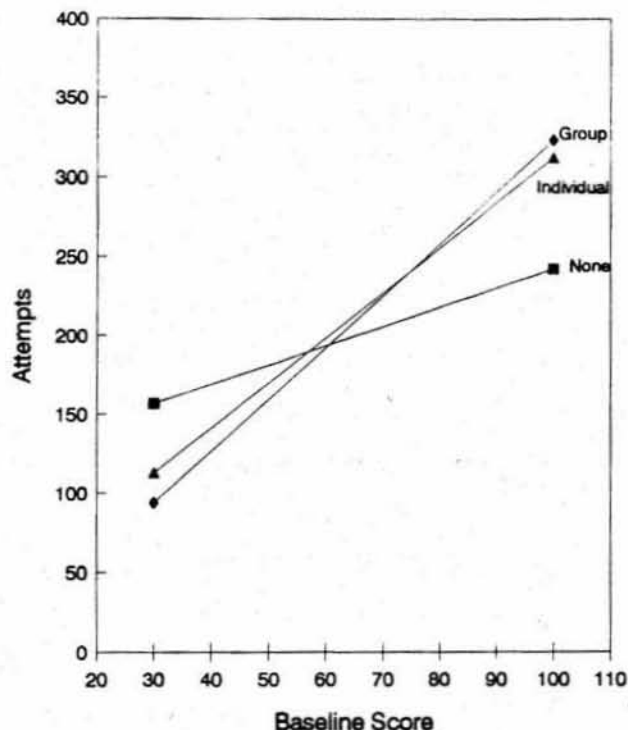

Figure 1. Predicted performance scores by monitoring condition.

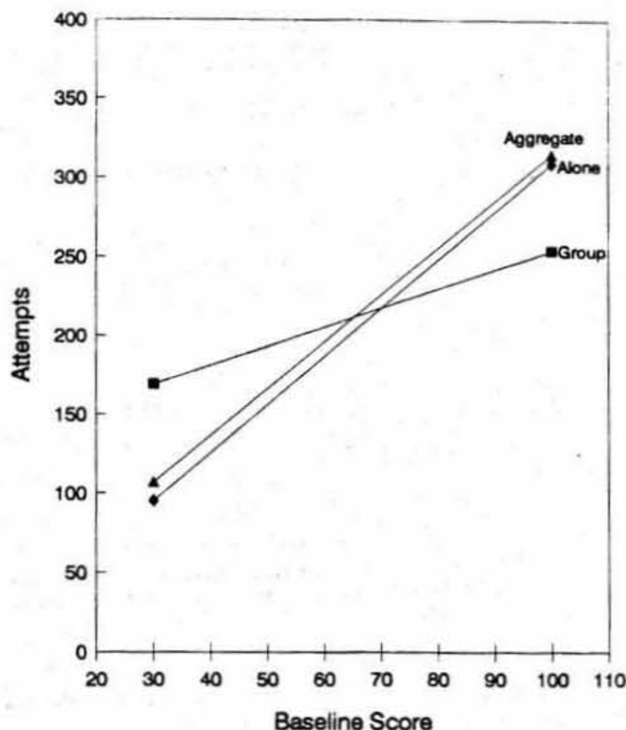

Figure 2. Predicted performance scores by social context.

tions. These 48 questions addressed six general areas: stress, motivation, and task climate associated with the data-entry task and stress, motivation, and task climate associated with the brainstorming task. Participants responded to each question by circling a response on a 7-point Likert-type scale. (See the Appendix for sample questions.)

Questionnaire responses were analyzed by exploratory factor analysis (varimax rotated) in which a six-factor solution (representing the six topic areas) was requested. The six factors accounted for 58% of the total variance. Only one item ("Did you feel that your work on the brainstorming task was being evaluated during the time you were working on the task?") loaded on the sixth factor; therefore, that factor was omitted from further analyses. The remaining five factors, which accounted for 53% of the total system variance, reflected data-entry stress, data-entry motivation, brainstorming stress, brainstorming motivation, and general task climate.

Composite scales representing each factor were created by summing items with factor loadings greater than or equal to .40. Correlations among the five composite scales are presented in Table 5. A listing of the items in the two stress scales and their factor loadings can be found in the Appendix. Mean scores for these scales are presented in Tables 6 and 7. Details regarding the remaining three scales are not presented here because they do not relate directly to the hypotheses presented in this article. Where appropriate, however, general findings related to components of these scales are discussed.

We tested the hypotheses regarding subjective response to EPM and social context by performing a 3 × 3 (Social Context × Monitoring Condition) ANOVA, with the two composite stress scales as dependent measures. Summaries of these analyses are presented in Table 8. Tests of the hypotheses related to EPM and social context are discussed in the sections that follow.

Table 5
Intercorrelations Among Subjective Scales

Variable	1	2	3	4	5
1. Data-entry stress	—				
2. Data-entry motivation	−.16**	—			
3. Brainstorming stress	.12	.16**	—		
4. Brainstorming motivation	.11	.09	−.55***	—	
5. General climate	−.40***	.29***	−.18**	.08	—

** $p < .05$. *** $p < .001$.

Table 6
Composite Data-Entry Stress Scores

Social context	Monitoring condition			Overall M
	None	Individual	Work group	
Alone				
M	47.20	43.63	43.30	45.41
SD	9.83	12.55	9.85	10.70
Aggregate				
M	44.07	39.89	44.64	42.97
SD	8.12	14.85	10.48	11.60
Group				
M	48.63	39.76	40.26	42.97
SD	9.85	12.17	12.48	12.14
Overall				
M	47.02_a	41.05_b	$43.35_{a,b}$	43.75
SD	9.45	13.10	11.09	11.51

Note. Lower composite scores indicate higher stress. Means with different subscripts differ significantly at $p < .05$, using the Scheffé post hoc contrast of means.

Effects of Electronic Performance Monitoring

In Hypothesis 1, we predicted that EPM would influence productivity. Individually monitored participants were expected to perform at a higher rate on a simple task than participants who were monitored at the work-group level or who were not monitored at all. Participants who were monitored at the work-group level were expected to show some improvement in performance; however, this improvement was not expected to be as pronounced as that shown by individually monitored workers. Supporting our first hypothesis, the regression analysis revealed that individually monitored participants keyed significantly more entries than nonmonitored participants. Group-monitored participants also keyed somewhat more entries than nonmonitored participants, although this difference was only marginally significant (see Table 3). Because of the significant interaction found between monitoring condition and baseline performance, however, it is inappropriate to interpret these main effects. Instead, analysis of the interaction is more enlightening. As can be seen in Figure 1, participants with high-baseline scores keyed more entries when their work was monitored, regardless of monitoring method. No social loafing was detected among high-baseline participants whose work was monitored at the work-group level. In contrast, participants with low-baseline scores keyed fewer entries when they were monitored in either individual or work-group mode.

Two interesting findings emerged when the various components of the data-entry motivation scale were analyzed using a 3 × 3 (Social Context × Monitoring Condition) ANOVA. First, a main effect for monitoring condition was detected for the question, "How motivated were you to perform well on the data-entry task?" $F(2, 181) = 3.75, p < .05$. A post hoc Scheffé test revealed that individually monitored participants reported feeling the most motivated (M = 5.91 on a 7-point scale ranging from 1 = *not at all motivated* to 7 = *very motivated*), nonmonitored participants reported feeling the least motivated (M = 5.19), and group-monitored participants did not differ significantly from either nonmonitored or group-monitored participants (M = 5.65). Second, a significant main effect for monitoring condition was found for the question, "How important do you think the data-entry task is?" $F(2, 180) = 3.20, p < .05$. Individually monitored participants reported that they felt the data-entry task was more important (M = 4.94 on a 7-point scale ranging from 1 = *not at all important* to 7 = *very important*) than did nonmonitored (M = 4.25) and group-monitored (M = 4.24) participants.

Hypothesis 2 predicted that monitored workers would experience more stress than nonmonitored workers. As can be seen in Table 8, a main effect for monitoring condition was detected when the data-entry stress scale was entered as the dependent variable, $F(2, 175) = 3.99, p < .05$. A post hoc Scheffé test revealed that individually monitored participants reported feeling the most stressed, nonmonitored participants reported feeling the least stressed, and group-monitored participants reported stress scores that were intermediate (they did not differ significantly from either individually monitored or nonmonitored participants; see Table 6).

Influence of Social Context

In Hypotheses 3 and 4, we predicted that the social context in which one works would influence productivity.

Table 7
Composite Brainstorming Stress Scores

Social context	Monitoring condition			Overall M
	None	Individual	Work group	
Alone				
M	39.00	50.50	39.10	42.85_a
SD	12.96	13.01	11.01	13.32
Aggregate				
M	42.20	47.67	46.84	45.98_a
SD	14.28	16.20	15.75	15.47
Group				
M	54.26	52.81	54.65	53.94_b
SD	11.22	9.15	12.08	10.80
Overall				
M	45.86	50.32	47.21	47.82
SD	14.26	13.07	14.49	14.01

Note. Lower composite scores indicate higher stress. Means with different subscripts differ significantly at $p < .05$, using the Scheffé post hoc contrast of means.

Table 8
Summary of Analyses of Variance for Stress Scales

Source	*df*	*SS*	*F*
Data-entry stress			
Social context (A)	2	238.39	0.93
Monitoring (B)	2	1,023.27	3.99**
A × B	4	289.48	0.60
Error	175	22,467.14	
Total	183	24,246.50	
Brainstorming stress			
Social context (A)	2	4,299.33	12.75***
Monitoring (B)	2	721.56	2.14
A × B	4	1,305.81	1.94
Error	179	30,187.63	
Total	187	36,514.32	

** $p < .05$. *** $p < .001$.

Specifically, participants who worked in the presence of coactors (i.e., aggregate and group members) were expected to be more productive on a simple data-entry task than participants who worked alone. Moreover, members of cohesive groups were expected to work at a higher rate than members of noninteracting aggregates. Contrary to these hypotheses, no main effect for social context was detected (see Table 3). However, we did find a significant interaction between social context and baseline performance (see Tables 3 and 4). As expected, low-baseline group members keyed more entries than low-baseline aggregate members or participants who worked alone; however, high-baseline group members actually keyed fewer entries than their high-baseline counterparts (see Figure 2). Also, although we had predicted that aggregate members would key more entries than participants who worked alone, they performed almost identically at each baseline level.

Participants' performance on the brainstorming task was analyzed to determine if brainstorming productivity was influenced by group membership. In fact, the average number of ideas produced by each group exceeded the average number of ideas produced by each aggregate member or participant working alone. However, group members produced fewer unique ideas per member than participants in the other social context conditions. (An average idea per member score was generated for each group by dividing the total number of unique ideas generated in the group by the number of its members. Likewise, for each aggregate, an average idea per member score was created by consolidating the ideas generated by each member of the aggregate, eliminating duplicate ideas, and dividing by the number of members in the aggregate.) Despite popular beliefs that group brainstorming encourages the production of more ideas per person, numerous studies (e.g., Diehl & Stroebe, 1987; Paulus, Dzindolet, Poletes, & Camacho, 1993), including our own, have found lower productivity among brainstorming group members.

Support was found for our fifth hypothesis in which we predicted that members of cohesive groups would experience less stress than members of noninteracting aggregates and individuals who worked alone. Table 8 shows that social context had a main effect on the amount of stress experienced when participants were working on the brainstorming task, $F(2, 179) = 12.75$, $p < .001$. Supporting our hypothesis, a post hoc Scheffé test revealed that members of cohesive groups felt the least stressed, whereas aggregate members and participants working alone did not differ in the amount of stress that they experienced (see Table 7).

Moderating Effects

Social context did not appear to moderate the effects of EPM on performance or stress. The interaction between monitoring condition and social context was not significant when task performance (see Table 3) or either of the stress scales (see Table 8) was entered as a dependent variable.

Discussion

Electronic Performance Monitoring

This study supports the view that EPM influences productivity in a manner that is consistent with the social facilitation framework. The social facilitation framework predicts that simple-task performance will be enhanced by the presence of an audience or coactors, whereas complex-task performance will be debilitated by social presence (Zajonc, 1965). Therefore, one would expect strong performance among high-ability workers who are electronically monitored and poorer performance among low-ability workers who are observed. In this study, if baseline performance is considered to be a measure of data-entry skill, then this is precisely the pattern of results we obtained. High-ability (high-baseline) participants performed faster on a simple task when they were monitored than when their work was not observed. In contrast, low-ability (low-baseline) participants actually keyed fewer entries when they were monitored. So, when monitored, faster workers get faster, and slower workers get slower. Monitoring actually appears to intensify performance in accordance with preexisting ability levels. The implication for the workplace is that EPM may lead to productivity improvements among employees who have attained a high level of task mastery. In contrast, EPM

may lead to performance debilitation among employees who are still learning the tasks that comprise their jobs.

Contrary to our expectation, participants who were monitored at the work-group level did not show signs of social loafing. Individually monitored and work-group-monitored participants performed almost identically. These results are surprising, because studies (cf. Harkins, 1987) generally have found performance decline among participants whose individual efforts cannot be identified and evaluated (as in work-group monitoring). Nevertheless, in the current study, group-monitored participants did report feeling slightly less motivated than individually monitored participants (although this difference was not statistically significant). Also, group-monitored participants considered the monitored task to be less important than did individually monitored participants. These findings suggest that group-level monitoring may be less effective than individual-level monitoring in communicating to employees that the tasks they perform are important (Larson & Callahan, 1990). It is possible that over time these subjective perceptions may translate into performance decline.

This study provides evidence that EPM induces feelings of stress among employees. These findings are consistent with results obtained in field surveys (DiTecco, Cwitco, Arsenault, & Andre, 1992; Gallatin, 1989; Irving et al., 1986; Smith et al., 1992), case studies (9to5, Working Women Education Fund, 1990), and laboratory experiments (Aiello & Shao, 1993; Aiello & Svec, 1993; Schleifer & Amick, 1989). Moreover, the results in the current study suggest that monitoring induces stress in a manner that is not completely explained by objective changes in job design and loss of social support. All participants were exposed to the same job design elements. It may be that although job design was objectively the same for monitored and nonmonitored participants, subjective perceptions about job demands and control differed. For example, perhaps monitored workers perceived higher demands for productivity, even though all participants were asked to work as quickly and as accurately as possible. Stress also may have originated from stronger feelings of evaluation that were reported by monitored participants, lending support to evaluation–apprehension-based models of social facilitation (Cottrell, 1972).

Monitoring at the work-group level appeared to provide group members with some protection against stress. Their stress scores fell between those who were monitored at the individual level and those who were not monitored at all, a pattern that has been found in other laboratory studies as well (Aiello et al., 1991). This finding suggests that one potentially effective strategy to reduce monitoring-related stress may be to use work-group-level observation.

Our ability to make recommendations based on these findings is qualified, however, by the fact that this study used only self-report measures to determine participants' stress levels. Self-report measures have been found to be problematic (Burke, 1987), as they sometimes produce results that are unrelated to physiological measures of stress (cf. Fried, Rowland, & Ferris, 1984). Answers to stress-related items on questionnaires also may reflect stable dimensions of a respondent's personality more than his or her response to a stressor. For example, people who are dispositionally oriented toward negative affectivity show a general pattern of reporting more stress and physical symptoms, even when no objective stressors are present (Watson, Pennebaker, & Folger, 1987).

In the current study, some evidence of a general response pattern is indicated by the significant correlations that were found between the data-entry stress scale and the general climate scale and between the brainstorming stress scale and the general climate scale. Participants who reported feeling more stressed on either task also rated the overall climate of the experiment to be less positive. In contrast, the correlation between the data-entry and the brainstorming stress scales was nonsignificant, suggesting that participants did differentiate between situations they found to be stressful and those they did not. Given that several other studies (cf. Aiello & Shao, 1993; Smith et al., 1992), in addition to the current one, have found that monitored workers are more stressed than nonmonitored workers, it can be assumed with some degree of confidence that EPM represents a workplace stressor.

Social Context

The results of this study provide some support for the view that subjective impressions of a task environment are affected by relations among work peers. Participants who worked alone or in an aggregate on the brainstorming task reported feeling the most stressed, whereas members of cohesive groups reported feeling the least stressed. Limited evidence was found, however, to indicate that social context also influences productivity. Aggregate members were not any more productive than participants who worked alone. Also, although cohesive group members with low-baseline scores keyed more entries than aggregate members and participants working alone, high-baseline group members keyed fewer entries than their high-baseline aggregate and alone counterparts.

The pattern of stress found in this study suggests that having the opportunity to interact with coworkers may make work on some tasks less threatening. Social support

systems have been shown to protect individuals against stress by providing additional resources to cope with stressors and by furnishing outlets for expressing tension (Cobb, 1976; Cohen & Wills, 1985; House et al., 1988). In the current study, group members received assistance from their coparticipants when they worked on the brainstorming task, perhaps helping to reduce the anxiety associated with task performance. In contrast, aggregate members and participants who worked alone did not receive help from their peers. Conversations among group members were not recorded while they worked on the brainstorming task; therefore, it is not known if group members capitalized on this opportunity to express tensions and concerns.

If working in a cohesive group provided participants with protection against stress, this benefit appears to have been transitory. Members of cohesive groups did not report feeling any less stress on the data-entry task than aggregate members and participants who worked alone. The effect of social support was limited to the brainstorming task. This may have been because access to group members was restricted during the data-entry phase of the study, whereas it was not during the brainstorming task. Group members also could not help one another complete the data-entry task as they could with the brainstorming task. Group membership appeared to provide protection against stress only in those circumstances in which group members were accessible and could provide concrete assistance.

Of course, it is possible that group members experienced less stress on the brainstorming task only, not because of any social support benefit but because of the experimental manipulation itself. To induce a sense of cohesiveness among participants assigned to the group condition, group members were provided with positive feedback regarding their performance on the brainstorming task. In contrast, aggregate members and participants who worked alone received no feedback. Perhaps this feedback led group members to feel less anxious about their performance on the brainstorming task yet did nothing to diminish their worries about work on the data-entry task.

Our failure to obtain the hypothesized effects of social context on productivity may be partially explained by limitations in the experimental procedure. Participants assigned to the alone condition never truly worked alone during the experiment. Although alone participants could not be motivated by coactors working alongside of them, as was the case with aggregate and group members, their performance may have been partially facilitated by the experimenter who remained in the laboratory at all times. Perhaps the effect of social context on productivity would have been more pronounced had participants assigned to the alone condition truly worked in the absence of any social stimulus.

The interaction observed between social context and baseline performance may have resulted from the positive feedback provided to group members on the brainstorming task. Baseline performance may be as much an indicant of general motivation level as it is a measure of task ability. When less motivated (low-baseline) group members were provided with positive feedback, they may have become more motivated to work on future tasks. In contrast, external incentives may create motivation loss among intrinsically motivated people (Deci & Ryan, 1985). Therefore, providing positive feedback to highly motivated (high-baseline) group members may have precipitated their productivity decline.

Moderating Effects

Finally, we examined whether social context would moderate the effects of EPM on productivity and stress. We suspected that monitored members of cohesive groups would feel less stress than monitored participants who were members of aggregates or who worked alone. Instead, no interaction between monitoring condition and social context was observed. This may have been because all participants, regardless of social context condition, were prevented from interacting with one another after the monitoring manipulation was introduced. Perhaps monitored group members would have reported feeling lower levels of stress than other monitored participants if group members had been allowed to recongregate midway through working on the data-entry task. That is, had monitored group members been provided with an opportunity to obtain social support from one another after the stress of monitoring was introduced, then a buffering effect may have been observed. Nevertheless, several studies examining other workplace stressors also have not obtained results that support the buffering hypothesis (Kobasa, 1982; Shinn et al., 1984). Social support as a moderator of work stress remains a hotly contested issue.

Conclusion

Additional research is necessary to explore the long-term effects of EPM. It was beyond the scope of this study, for example, to determine the cumulative effect of many days, weeks, or years of being subjected to electronic surveillance. Might employees eventually adapt to the stress of being constantly observed, or will the effects reported here accumulate and render employees more vulnerable to a myriad of stress-related illnesses?

We expect that a host of other factors will also influence the manner in which monitoring affects workers (cf. Aiello & Kolb, in press). For example, we would expect that the existence of an oppressive and punitive organiza-

tional climate would exacerbate the stressful effects of EPM. In contrast, if employees are involved early on in the introduction of a monitoring system and they feel that their input has been incorporated in the system adopted, they may feel greater ownership of their work process and experience greater motivation and less stress. Similarly, if employees are permitted to share in the rewards realized through increased productivity, they may come to view EPM in a positive manner because there are real stakes accruing to them under the system. More research is needed to document the characteristics of the organizational climate that enhance or exacerbate the effects of EPM. Information gained from such studies may help guide efforts to restructure organizations in ways that help optimize productivity and satisfaction while minimizing stress.

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Appendix

Items and Factor Loadings for Subjective Scales

Item and scale anchors	Loading on DE	Loading on BS
Data-entry stress[a]		
When working on the data-entry task I felt: 1 = *stressed*, 7 = *not stressed*.	.83	.11
When working on the data-entry task I felt: 1 = *uptight*, 7 = *calm*.	.78	.05
What degree of stress did you experience while working on the data-entry task? (reverse scored) 1 = *no stress*, 7 = *a great deal of stress*.	.77	.08
When working on the data-entry task I felt: 1 = *distressed*, 7 = *not distressed*.	.74	.02
When working on the data-entry task I felt: 1 = *frustrated*, 7 = *not frustrated*.	.69	.09
I would describe the climate/atmosphere for working on the tasks in this study as: 1 = *stressful*, 7 = *not stressful*.	.67	.20
How frustrating was it to work on the data-entry task? 1 = *very frustrating*, 7 = *not at all frustrating*.	.64	.07
How much pressure did you feel from your supervisor while working on the data-entry task? 1 = *quite a lot*, 7 = *none at all*.	.58	.02
To what extent did your supervisor affect your performance on the data-entry task? 1 = *very much*, 7 = *not at all*.	.52	.06
Brainstorming stress[b]		
When working on the brainstorming task I felt: 1 = *frustrated*, 7 = *not frustrated*.	.07	.85
When working on the brainstorming task I felt: 1 = *uptight*, 7 = *calm*.	.13	.84
When working on the brainstorming task I felt: 1 = *stressed*, 7 = *not stressed*.	.12	.84
How frustrating was it to work on the brainstorming task? 1 = *very frustrating*, 7 = *not at all frustrating*.	.02	.81
What degree of stress did you experience while working on the brainstorming task? (reverse scored) 1 = *a great deal of stress*, 7 = *no stress*.	.11	.77
When working on the brainstorming task I felt: 1 = *distressed*, 7 = *not distressed*.	.14	.73
When working on the brainstorming task I felt (reverse scored): 1 = *content*, 7 = *annoyed*.	.06	.62
How satisfied were you with your degree of creativity on the brainstorming task? (reverse scored) 1 = *very satisfied*, 7 = *not at all satisfied*.	.07	.57
How satisfied were you with your performance on the brainstorming task? (reverse scored) 1 = *very satisfied*, 7 = *not at all satisfied*.	.01	.57
How well did you feel you performed on the brainstorming task? (reverse scored) 1 = *very well*, 7 = *not at all well*.	.08	.55

Note. DE = Data Entry Stress Scale; BS = Brainstorming Stress Scale.
[a] Cronbach's $\alpha = .88$. [b] Cronbach's $\alpha = .92$.

Received April 9, 1993
Revision received May 12, 1994
Accepted August 3, 1994 ■