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The Effect of Challenge and Threat Appraisals Under Evaluative Presence

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Abstract

Four studies were conducted to examine whether cognitive appraisals, manipulated through the task instructions, moderated social facilitation effects. In Study 1, participants in the challenge condition performed better on a mental arithmetic task when the experimenter was present. Conversely, participants in the threat condition performed worse when the experimenter was present. Study 2 extended these findings across two math tasks that varied on degree of difficulty. The pattern of performance data failed to support prior drive theories and provided support for a unique contribution of cognitive appraisals in explaining social facilitation effects. Study 3 validated the appraisal manipulations by using multiple measures of cognitive appraisals. Finally, Study 4 offered increased validity by replicating the performance data using an anagrams task.

The Effect of Challenge and Threat Appraisals Under Evaluative Presence

Research in social psychology has long been interested in studying how the presence of others affects performance (Triplett, 1898). Zajonc (1965) offered the first parsimonious explanation that was able to account for both performance facilitation and performance impairment in the presence of others. Since Zajonc's seminal investigation, several alternative explanations of social facilitation have been proposed, but few have been able to provide both performance and physiological data. A study by Blascovich, Mendes, Hunter, and Salomon (1999) provided both performance and physiological evidence that cognitive appraisals (Lazarus & Folkman, 1984; Tomaka, Blascovich, Kelsey, & Leitten, 1993) play an important role in how presence affects performance and may help explain some of the disparity in the social facilitation literature (see Feinberg & Aiello, 2006, for review).

Social Facilitation

Social facilitation refers to how the presence of others (physical, imagined, or electronic; see Aiello & Douthitt, 2001 for review) leads to performance facilitation when the task is simple or well-learned and to performance impairment when the task is complex or not well-learned.

Theories of social facilitation. There are several theories that offer explanations for social facilitation effects. Zajonc (1965) believed that the mere presence of others was sufficient to produce the necessary arousal for social facilitation. Zajonc (1980) interpreted drive or arousal as an alertness for the unexpected, a preparedness to respond to others. Zajonc posited that the mere presence of others leads to increases in the emission of dominant responses which ultimately leads to facilitation on well-learned tasks and impairment on unlearned tasks. Zajonc (1980) focused on the mere presence of another, while other researchers have focused on a single co-actor or multiple co-actors, an audience, the experimenter, electronic presence, or even a mannequin (see Guerin, 1993, for review).

Zajonc's (1965, 1980) original explanation relied upon Hull-Spence (Spence, 1956) notions of drive with generalized arousal and a number of subsequent studies have attempted to capture data of any physiological measures that would support this perspective. A meta-analysis by Bond and Titus (1983) found little empirical support for physiological evidence and Sanders (1981) argued that arousal was merely a hypothetical construct not meant for empirical measurement.

A number of studies provided alternative explanations to Zajonc's mere presence theory, many of which, however, predicated their theories on changes in physiological drive. For example, Baron, Moore, and Sanders (1978) attributed the arousal present in social facilitation to attentional conflict. They claimed that "the crucial feature of audience and co-action treatments is their distracting quality" (p. 818). Individuals need a certain amount of attention to perform well on a given task. Attention to other people or other tasks will therefore conflict with the attention needed for the task at hand. This attentional conflict acts as a source of arousal that produces social facilitation effects. This process became known as distraction-conflict theory.

Distraction-conflict theory was one of the first major theories of social facilitation to stress the importance of cognitive factors which may lead to differential performance effects in the presence of others. While distraction-conflict theory focused on how situational demands may impact cognition and in turn performance, additional cognitive explanations began to emerge that also accounted for social facilitation effects. Studies by Sanna and colleagues (Sanna, 1992; Sanna & Mark, 1996; Sanna & Pusecker, 1994; Sanna & Shotland, 1990) found that the manipulation of participants' self- efficacy and outcome expectancies (through practice item performance and feedback) could lead to social facilitation effects. For example, Sanna (1992) manipulated performance expectancies by providing either positive or negative normative feedback (i.e., scored in the 20^{th} or 80^{th} percentile). Participants in the high-efficacy condition

showed facilitation in the coaction condition, whereas participants in the low-efficacy condition showed impairment in the coaction condition on a subsequent vigilance task.

Research has provided evidence that cognitive factors may underlie social facilitation effects. However, no study was able to provide consistent physiological data to support and buttress these explanations. For example, a study by Wright, Tunstall, Williams, Goodwin, and Harmon-Jones (1995) cast doubt on arousal-based explanations of social facilitation effects by failing to find corresponding physiological data to support these theoretical explanations.

A study by Blascovich, Mendes, Hunter, and Saloman (1999) offered a cognitive explanation for social facilitation and provided both performance and physiological evidence to support their theory. Consistent with previous research on self-efficacy effects (e.g., Sanna, 1992; Sanna & Pusecker, 1994), Blascovich and colleagues (1999) found that difference in how participants cognitively appraise a task may underlie social facilitation effects. More specifically, they posited that challenge and threat appraisals may moderate the effect of presence on performance. Lazarus and Folkman (1984) defined cognitive appraisals as "the process of categorizing an encounter, and its various facets, with respect to its significance for well-being" (p. 31). Threat and challenge appraisals are specific types of appraisals that occur before, or in anticipation of, stressful situations. A challenge appraisal is more likely when people feel that they have the adequate resources to deal with a potential stressor. With a challenge appraisal, an individual perceives the possibility for gain, feels energized, and is eager to perform. If people do not feel that they have the adequate resources to deal with a potential stressor then a threat appraisal is more likely. With a threat appraisal, an individual perceives the potential for loss with little to be gained in the situation. Blascovich and colleagues (1999) found that the presence of an audience led to a challenge pattern of physiological response and subsequent performance facilitation for participants who performed a learned task and a threat pattern of physiological

response and subsequent impairment for participants who performed an unlearned task. Unlike previous models of social facilitation, this cognitive appraisal model provides concrete evidence of physiological changes that occur in the presence of others based on task type as was originally hypothesized by Zajonc (1965). Thus, while there may be conceptual overlap between self-efficacy, cognitive distraction, and cognitive appraisals (Mikolajczak & Luminet, 2008), the cognitive appraisal explanation has added utility in that it provides a framework for both performance and physiological changes in the presence of others.

Limitations of Previous Research

Although Blascovich et al.'s (1999) study provided initial support for some of the underlying mechanisms of social facilitation effects, several important limitations still exist. Therefore, the present investigation attempts to provide additional support for the cognitive appraisal explanation of social facilitation effects and attempts to demonstrate that this explanation is distinct from other theoretical approaches. The present investigation addressed limitations in the previous research by: a) varying task difficulty, b) varying task types, c) experimentally manipulating cognitive appraisals, d) addressing theoretical and psychometric issues in the measurement of challenge and threat appraisals, and e) identifying underlying psychological constructs and confounding variables of challenge and threat appraisals.

Varying task difficulty. In Blascovich et al.'s (1999) study, participants performed two different tasks (a number categorization and a pattern recognition task), but these tasks were pre-selected to be of equal difficulty level. Participants were randomly assigned to one of the two tasks which were learned to criterion. However, it is important to examine how differences in appraisals affect performance across simple and complex tasks. This is critical for two reasons. First, it would provide evidence that challenge and threat appraisals can affect performance across a spectrum of task difficulty levels, thus adding increased external validity. In actual work

or academic settings people might perform a variety of tasks that differ on complexity. Second, and perhaps more importantly, this would provide an important test as to whether the appraisal explanation is distinct from previous theoretical explanations of social facilitation effects. Zajonc (1965), and other drive theorists (e.g., Cottrell, 1972; Baron, Moore, & Sanders, 1978), might argue that challenge and threat appraisals merely manipulate drive or arousal, and thus this perspective is not distinct from previous approaches. Drive theorists would therefore predict that manipulating cognitive appraisals should lead to a pattern of data consistent with prior drive theories. For example, if the threat appraisal manipulation elevates arousal, then that manipulation should lead to increased performance on the simple well-learned task, but to decreased performance on the complex task. However, if the challenge and threat manipulations yield a similar pattern of data across both the simple and complex tasks, then it would contradict predictions made by drive theories. For example, if the threat manipulation leads to performance impairment in both the simple and complex tasks, this finding could not easily be explained by drive theorists. Thus, manipulating task difficulty level provides an important test for the validity of the cognitive appraisal explanation of social facilitation effects.

Varying task type. In addition to varying task difficulty level, it is also important to show that challenge and threat appraisals can differentially impact performance in the presence of others across several types of tasks. Blascovich et al. (1999) demonstrated performance effects across two categorization/recognition tasks. The present studies attempt to extend these findings to both numeric (mental arithmetic) and verbal-creative (anagrams) tasks. This manipulation would offer additional generalizability of these performance effects.

Manipulating cognitive appraisals. Under the present investigation, challenge and threat appraisals were experimentally manipulated through the task instructions rather than spontaneously measured (Blascovich et al., 1999). Instruction sets similar to those successfully

used by Tomaka and colleagues (1997) in eliciting challenge and threat appraisals were utilized. Early research (Lazarus, Opton, Nomikos, & Rankin., 1965) found that cognitive appraisals could be manipulated by varying the instructional set (denial instructions or intellectualization instructions). Participants produced very different physiological responses to a film they viewed depending on which set of instructions they received. A study by Tomaka, Blascovich, Kibler, and Ernst (1997) extended these findings to challenge and threat responses. By varying the instructional set, they were able to obtain physiological responses that suggested either a challenge or threat appraisal. A study by Drach-Zahavy and Erez (2002) also varied the instructional set to correspond to either challenge or threat appraisals and found that appraisal instructions led to differences in performance outcomes. Although there is conceptual overlap with the instructional manipulation of efficacy expectancies in past studies (e.g., Sanna, 1992), manipulating appraisals would have greater applicability by demonstrating that it may be possible to yield performance effects in a single exposure without false feedback or prior practice.

Measuring cognitive appraisals. Blascovich and colleagues' study (1999) measured challenge and threat responses through physiological patterns of cardiac response and vascular resistance. However, this particular study failed to measure additional indexes of challenge and threat response. Previous studies (e.g., Tomaka, Blascovich, Kibler, & Ernst, 1997) have relied upon use the of the cognitive appraisal ratio. The ratio is comprised of a primary appraisal that measures the perceived stress of the upcoming task (numerator) and a secondary appraisal that measures perceived resources to cope with the stressor (denominator). Ratios above 1 indicate a threat appraisal, whereas ratios below 1 indicate a challenge appraisal. Although previous studies have demonstrated that this ratio is correlated with corresponding physiological measures of challenge and threat responses (e.g., Tomaka et al., 1997), other studies have failed to find such

evidence (e.g., Hartley, Ginsburg, & Heffner, 1999). Furthermore, the cognitive appraisal ratio may have some serious psychometric and theoretical limitations. For example, while the ratio has been defined as a measure of demands and resources, it is unclear whether these items are assessed on comparable scales. Thus, it is unclear whether a score of 1 truly distinguishes between challenge and threat appraisals. Furthermore, Lazarus and Folkman (1984) defined both threat and challenge as forms of primary appraisals that are not mutually exclusive of one another. Use of an appraisal ratio treats these constructs as opposites along a single continuum (i.e., either one makes a challenge or threat appraisal). This is clearly a departure from how challenge and threat appraisals were originally conceptualized. Finally, the appraisal ratio has not been sufficiently tested for its psychometric properties. A number of studies (e.g., Maier, Waldstein, & Synowski, 2003; Wright & Kirby, 2003) have criticized the use of the appraisal ratio as a valid approach to measuring challenge and threat appraisals. Therefore, an additional measure of challenge and threat appraisals would offer additional validity for use of the appraisal ratio and provide additional validation that challenge and threat appraisals were actually manipulated. Ferguson and Matthew's (1999) Appraisal of Life Events (ALE) scale was specifically designed to measure challenge and threat appraisals in a manner consistent with Folkman and Lazarus' (1984) original conceptualization of these constructs. In addition, the ALE scale has been validated and shown to be psychometrically sound (Ferguson & Matthews, 1999).

Related psychological constructs. Although use of multiple measures of challenge and threat appraisals (cognitive appraisal ratio and ALE) add increased validity, it is also critical to a) identify some of the underlying mechanisms behind these appraisals and b) rule out potential confounds that might also be manipulated through the task instructions. Previous studies have identified motivation (e.g., Tomaka et al., 1997; LePine, Lepine, & Jackson, 2004) and mood (e.g., Maier, Waldstein, & Synowski, 2003) as key constructs in the appraisal process and

therefore differences in appraisal should yield differences on these measures. In order to distinguish the current perspective from previous theoretical approaches it is important to rule out the effects of distraction, apprehension, or effort. Therefore no differences should be found between the challenge and threat conditions on these measures.

Present Studies

Study 1 was designed to replicate and extend the previous findings (Blascovich et al., 1999; Sanna & Pusecker, 1994) that challenge and threat appraisals may moderate the effect of presence on performance with three key changes: 1) challenge and threat appraisals were experimentally manipulated, 2) all participants performed the same mental arithmetic task without any experimental manipulation of prior exposure or practice, and 3) challenge and threat appraisals were measured using the cognitive appraisal ratio. Study 2 added the independent variable of task difficulty (simple and complex mental arithmetic tasks) as well as several key dependent measures (e.g., mood and motivation) that may provide insight into the underlying processes behind challenge and threat appraisals. Study 3 used an alternative measure of challenge and threat appraisals, the ALE scale, in conjunction with the cognitive appraisal ratio. In addition, several key dependent measures were included to test whether they served as potential confounds. Finally, Study 4 replicated the previous findings using a non-mathematical anagrams task in order to demonstrate that the findings generalize across different task types.

Study 1

Study 1 was designed to test a) whether participants' cognitive appraisals could be manipulated through the task instructions and b) whether those appraisals would moderate the effect of presence on performance. It was hypothesized that participants in the challenge appraisal condition would perform better with the experimenter present, whereas participants in the threat appraisal condition would perform worse with the experimenter present. All

participants performed the same mental arithmetic task and only the appraisal instructions and the presence of the experimenter varied by condition.

Method

Participants. Participants were 91 undergraduates recruited from introductory psychology classes for partial fulfillment of a course requirement. The data of eight participants were discarded because a) they failed to understand the experiment's instructions, b) their computer malfunctioned or c) there was incomplete data, leaving 83 participants (23 males and 60 females) in the analyses.

Design

The experimental design was a 2 (challenge vs. threat) x 2 (experimenter present vs. alone) between-subjects design. Participants were randomly assigned to one of the four conditions.

Apparatus and materials A mental arithmetic task was presented to participants on a Power Macintosh™ 7100/66. The task was programmed into a psychology experiment software program, Psyscope v2.1. All questionnaire items were also presented to participants through Psyscope.

The mental arithmetic task involved participants being presented with 3 digits that they needed to sum together. The digits were presented simultaneously for a total of 1 second. After a brief delay (200 ms) a single digit was presented. Participants were told, through the use of a "+" or "-" whether to add or subtract that digit to or from their previous total. Participants recorded their answer on the task sheets provided. Participants were given 6 minutes to complete as many trials as they could.

Procedure. Each participant performed the experiment individually with each session lasting about one half hour. After signing the consent form, participants answered several pre-task questionnaire items. The experimenter then read one of two instructional sets.

The challenge instructions, similar to those used by Tomaka et al. (1997), focused on participants' ability to perceive the task "as a challenge to be met and overcome" and to perceive themselves as someone "capable of meeting that challenge" (see Appendix).

The threat instructions, also similar to those used by Tomaka et al. (1997), focused on the difficulty of the task and the participants' need to work "as quickly and efficiently as possible". The instructions emphasized the importance of both speed and accuracy (see Appendix).

Immediately after hearing the instructions, participants' cognitive appraisals were assessed. Participants' primary appraisal was assessed by asking "How difficult do you expect the mental arithmetic task to be?" Secondary appraisal was assessed by asking "How able are you to cope with the mental arithmetic task?" As in previous studies (Tomaka & Blascovich, 1994; Tomaka et al., 1993; & Blascovich et al., 1999), the two appraisal variables were combined into a ratio to yield a single index of cognitive appraisals. This ratio has been used in previous studies of challenge and threat appraisals (see Blascovich & Tomaka, 1996, for review).

After completing the cognitive appraisal measures, participants had six minutes to complete the mental arithmetic task. Participants recorded their answers on the sheets provided and hit the spacebar to move on to the next set of digits.

Presence. Participants completed the mental arithmetic task either alone or with the experimenter present. In the alone conditions, participants were told that the experimenter would leave the room and that they would complete the remainder of the experiment alone. At the end of the experiment, a screen prompted the participants to come get the experimenter, who was

waiting in an office two doors from the lab. In the experimenter present condition, the experimenter remained in the room sitting quietly 4 feet behind and to the left of the participant.

Dependent measures. Participants' performance on the mental arithmetic task was measured by the number of items answered correctly. In addition, participants completed both pre-task and post-task questionnaire items. Items measured individual differences in cognitive appraisals (i.e., cognitive appraisal ratio), attitudes toward math (e.g., "I enjoy math"), and attitudes toward the experiment (stressed about task, evaluation apprehension, distracted, effort). Lastly, participants were debriefed about the nature of the experiment.

Results

Task difficulty. A post-task questionnaire item asked participants to rate the difficulty of the task on a 7-point Likert scale (1= *very easy*, 7= *very difficult)*. There were no significant differences in how participants perceived the difficulty of the task between conditions. Overall participants rated the task as close to average (M= 3.67).

Cognitive appraisal ratio. Participants' primary appraisals were divided by their secondary appraisals yielding a single index number. Values above one indicated a threat response and values below one indicated a challenge response. Participants in the threat condition averaged above 1 (M = 1.04) and participants in the challenge condition averaged below one (M = .94). Although these findings were consistent with the predicted hypothesis, the difference, however, was only marginally significant, $t(82) = 1.54$, $p = .06$.

Performance. A 2 (challenge vs. threat instructions) x 2 (experimenter present vs. alone) ANCOVA (math ability, as indicated by self-report measures, was used as a covariate) was conducted on the performance data. Of primary interest, a significant appraisal by presence interaction was found for the number of items correct, $F(1,78) = 7.25$, $p < .01$. Participants in the challenge condition performed better with the experimenter present compared to participants who

performed alone, whereas participants in the threat condition performed significantly worse with the experimenter present than when alone (see Table 1). To further examine this interaction, simple effects tests were conducted. Among participants who received the threat instructions, the presence of the experimenter inhibited their performance compared to participants performing the task alone for the number correct, $t(41) = 2.64$, $p < .01$ (1-tailed). Simple effects tests among participants who received the challenge instructions showed a trend in the predicted direction for number correct, $t(43) = 1.44$, $p < .10$ (1-tailed).

In addition to the interaction effect, the main effects on performance were also analyzed. Contrary to expectations, participants in the threat condition performed better than participants in the challenge condition, $F(1,78) = 15.96$, $p < .01$ (see Table 1). There were no significant effects for the number of errors made. This may be due, in part, to the relatively low error rate for the challenge ($M = 5.61$) and threat ($M = 6.43$) conditions.

Post-task questionnaire items. There were no significant interaction effects and no significant main effects for appraisal instruction for the post-task questionnaire items (stressed about task, evaluation apprehension, distracted, and effort). There was one presence main effect in which participants felt more distracted with the experimenter present, $F(1, 80) = 6.66$, $p < .05$.

Discussion

Study 1 provided support for the notion that cognitive appraisals may play an important role in moderating the effect of presence on performance. All participants performed the same mental arithmetic task and yet the presence of others led to a facilitation trend for participants who received the challenge instructions and performance impairment for participants who received the threat instructions. Since all participants performed the same task, performance differences cannot be explained by inherent differences in the task itself, such as task difficulty, experience with the task (i.e., how well-learned the task was), or the role of dominant responses.

The data provided evidence that cognitive appraisals, once isolated from the objective nature of the task, are sufficient to predict both facilitation and impairment effects. The findings also suggest that it may be possible for a supervisor to affect an individual's appraisals by framing a task in the desired light. Therefore, teachers, supervisors, managers, and other individuals in authority may want to consider the possible effect of framing a task in a manner consistent with either challenge or threat appraisals.

There were, however, several questions left unanswered by Study 1. The instructions were successful in yielding an appraisal ratio above 1 for participants in the threat condition and below 1 for participants in the challenge condition. The instructional set appeared to be sufficient to produce performance effects, but did not yield significant differences in the appraisal ratio (only a marginal difference). Although the results were clearly in the hypothesized direction, it may be possible that stronger wording in the instructions would yield a larger difference in the appraisal ratio. Therefore, in Study 2 the instructions were changed to further emphasize the challenge and threat components. Perhaps the instructions in Study 1 were too subtle to yield statistical differences in the self-report data. In addition, an unexpected main effect was found for task instructions on performance. Participants in the threat condition significantly outperformed participants in the challenge condition.

Study 2

Study 2 was an extension of Study 1 with several important changes and additions. First, the instructions were strengthened to add further emphasis to the challenge and threat components. Second, an additional factor, task difficulty, was also examined. Participants performed either a simple mental arithmetic task or a more complex mental arithmetic task. Task difficulty was manipulated in order to demonstrate that the results generalize over a wider range of task difficulty levels. More importantly, Study 2 tested whether challenge and threat appraisals

have the same impact on performance in the presence of others regardless of the task difficulty level. Manipulating task difficulty level allowed for an examination of whether the data was consistent or not with drive theories of social facilitation. Finally, several additional dependent measures (i.e., mood and motivation) not examined in Study 1 were measured and analyzed in order to get a more complete understanding of how appraisals moderate the effect of presence on performance. Previous research in social facilitation and cognitive appraisals has identified mood and motivation as potentially important mediators of presence effects. For example, Davidson and Henderson (2000) found that mood depended on whether participants were performing a simple or complex task and whether they were electronically monitored or not. Research by Feinberg (2003) has suggested that motivation (specifically achievement-goal motivation) may play an important role in understanding social facilitation effects. Similar to Study 1, presence and appraisals (task instructions) varied by condition.

Method

Participants. Participants were 238 undergraduates recruited from introductory psychology classes for partial fulfillment of a course requirement. The data of four participants were discarded because a) they failed to understand the experiment's instructions or b) their computer malfunctioned, leaving 234 participants (138 males and 96 females) in the analysis.

Design. The experimental design was a 2 (challenge vs. threat) x 2 (experimenter present vs. alone) x 2 (simple vs. complex task) between-subjects design. Participants were randomly assigned to one of eight conditions.

Apparatus and materials. A mental arithmetic task was presented to participants on a Power Macintosh™ 7100/66. The task was programmed into a psychology experiment software program, Psyscope v2.1.

For the simple task, participants were presented with 2 digits that they needed to sum together. The digits were presented simultaneously for a total of 1 second. After a brief delay (200 ms) a single digit was presented. Participants were told, through the use of a "+" or "-" whether to add or subtract that digit to or from their previous total. Participants recorded their answer on the computer keyboard. The complex task was similar except participants were required to initially sum together 3 digits. Furthermore, the initial digits were presented for a total of only 750 ms.

In addition to the mental arithmetic task, participants were also asked to complete several pre-task and post-task questionnaire items. The questions were either Likert-scale items or categorical items including measures assessing the participant's perceptions of the task (e.g., how difficult participants thought the task was) , mood (how "pleased" and how "happy" participants felt), and motivation (how "motivated" participants felt and how "important was it to perform well" on the task). Participants answered by pressing the appropriate number on the computer keyboard.

Procedure. After signing the consent form, the experimenter read one of two instructional sets. The challenge instructions, similar to those used by Tomaka et al. (1997), focused on participants' ability to perceive the task "as a challenge to be met and overcome" and to perceive themselves as someone "capable of meeting that challenge". In addition, the instructions emphasized that most participants are able to succeed on the task with a little effort and concentration and even participants who don't enjoy math were able to handle the task and have an enjoyable experience. This additional component was added to strengthen the challenge appraisals from Study 1 (see Appendix).

The threat instructions, also similar to those used by Tomaka et al. (1997), focused on the difficulty of the task and participants' need to work "as quickly and efficiently as possible". The

instructions emphasized the importance of both speed and accuracy. In addition, the instructions emphasized that participants often have difficulty with the task and have found it stressful and frustrating. This additional component was added to strengthen the threat appraisals from Study 1 (see Appendix).

Immediately after hearing the instructions, participants' cognitive appraisals were assessed. Participants' appraisals were assessed and scored in the same manner as in Study 1 (Tomaka & Blascovich, 1994; Tomaka et al., 1993; & Blascovich et al., 1999).

After completing the cognitive appraisal measures, participants were given a brief demonstration of the mental arithmetic task. Participants were then told they would be completing 2 four-minute trials of the mental arithmetic task. At this point, the experimenter informed the participants, depending on the condition, that they would either be in the room as the participants completed the task or wait outside the room in an office two doors down the hall.

Dependent measures. Participants' performance on the mental arithmetic task was measured by the number of items answered correctly. In addition, participants completed a post-task questionnaire. Items in the questionnaire measured mood ("I feel pleased" and "I feel happy"), motivation ("I was motivated to perform well" and "It was important for me to perform well"), and evaluation apprehension and also contained several manipulation checks ("The experimenter was present as I performed the task" and "The task was difficult"). Lastly, participants were debriefed about the nature of the experiment.

Results

Manipulation checks. When asked whether someone was present in the room as they performed the task, over 99% of participants in the presence condition answered "yes", whereas 100% of participants in the alone condition answered "no". Furthermore, when participants were asked whether they believed the experimenter was monitoring their performance, 91% in the

presence condition answered "yes", whereas 97% of participants in the alone condition answered "no".

Analyses were also conducted to examine whether participants in the challenge condition appraised the task as more "challenging" compared to participants in the threat condition. Consistent with prior research (e.g., Tomaka et al., 1997), an appraisal ratio was calculated by dividing how stressful participants thought the task would be by participants' perceived ability to cope. A score above 1 would indicate a threat appraisal and a score below 1 would indicate a challenge appraisal. A significant main effect[1] for the appraisal ratio was found, $F(1, 225) = 7.73$, $p < .01$. Participants in the threat conditions had an appraisal ratio above 1, $M = 1.07$, whereas participants in the challenge conditions averaged below 1, $M = .87$. Also consistent with expectations, there was a main effect for task-type, with participants who completed the complex task perceiving it as being more threatening than participants who completed the simple task, $F(1, 225) = 15.06$, $p < .01$. Finally, participants rated the complex task ($M = 5.11$) as more difficult compared to participants completing the simple task ($M = 3.34$), $F(1, 227) = 82.39$, $p < .001$.

Performance. A 2 x 2 x 2 (task x presence x instructions) between-subjects ANOVA was conducted on the performance data.[2] A significant presence by instructions interaction was found for the number of items answered correctly, $F(1, 227) = 4.33$, $p < .05$. For both the simple and complex task, it appeared that participants in the challenge condition performed better when the experimenter was present (see Table 2). However, for participants who received the threat instructions, performance was higher in the alone condition (see Figure 1). This pattern of results was consistent across both tasks. Follow-up simple effects analyses revealed both a significant effect for facilitation in the challenge condition, $t(114) = 1.68$, $p < .05$, and impairment in the threat condition, $t(117) = 2.63$, $p < .01$. Consistent with the experimental hypotheses, there was

also a significant main effect for task type, $F(1, 227) = 142.71$, $p < .001$. Participants who performed the simple task performed better ($M = 108.3$) than participants who performed the complex task ($M = 74.8$).

Additional performance analyses. Secondary analyses of the performance data yielded several significant main effects. The quality of performance (percent correct) of participants in the threat condition ($M = .81$) was not as high as participants in the challenge condition ($M = .85$), $F(1, 227) = 8.15$, $p < .01$. While participants in the threat condition may have attempted more items (both correct and incorrect responses) than participants in the challenge condition ($M = 112.33$ compared to a $M = 105.75$), $F(1, 227) = 7.59$, $p < .01$, they also made significantly more errors ($M = 20.53$ for the threat condition compared to $M = 14.12$ for the challenge condition), $F(1, 227) = 12.34$, $p < .01$.

Mood. All of the post-task questionnaire items were initially analyzed in a 2 x 2 x 2 (task x presence x instructions) MANOVA in order to control for experiment-wise alpha. Follow-up univariate ANOVAS were examined to assess the measures in which there were significant effects. Significant effects were found for appraisal, $F(11, 174) = 2.14$, $p < .05$, presence, $F(11, 174) = 3.00$, $p < .01$, and the appraisal by presence interaction, $F(11, 174) = 2.51$, $p < .01$. Significant presence by appraisal interaction effects were found for two post-task questionnaire items designed to assess mood: how pleased participants were, $F(1, 227) = 5.12$, $p < .05$ and how happy participants were, $F(1, 227)= 3.81$, $p < .05$. A similar pattern of results was found for each measure, with presence not appearing to affect mood in participants who appraised the task as a challenge. However, presence led to significantly lower feelings of being pleased and happy for participants who appraised the task as a threat (see Table 3). Both items, pleased ($r = .40$, $p < .01$) and happy ($r = .36$, $p < .01$), were significantly correlated with performance.

Motivation. A significant 2-way interaction effect was also found for a post-task questionnaire item designed to assess how motivated participants were, $F(1, 227) = 11.50$, $p < .01$, and how important it was to perform well, $F(1, 227) = 4.75$, $p < .05$. These results seem to indicate that presence led to increased motivation for participants who appraised the task as a challenge, but presence led to decreased motivation for participants who appraised the task as a threat (see Table 3). Motivation was significantly correlated with performance, $r = .18$, $p < .01$ (across both the simple and complex task).

Additional analyses. Several significant main effects were found that were consistent with previous research in both cognitive appraisals (see Tomaka & Blascovich, 1994, for review) and social facilitation (Aiello & Douthitt, 2001). Participants in the presence condition were less happy, felt more evaluation apprehension, and felt more pressure compared to participants in the alone condition (see Table 4). In addition, participants in the challenge condition felt less frustrated, less pressure, and less evaluation apprehension, and also perceived the task as less difficult compared to participants in the threat condition (see Table 4).

Discussion

Once again a significant interaction effect was found, indicating that cognitive appraisals may moderate the effect of presence on performance. Participants in the challenge condition performed better with the experimenter present. Conversely, participants in the threat condition performed worse with the experimenter present. These results were consistent across both the simple and complex tasks.

In Study 2, the question of whether the moderating effect of cognitive appraisals generalized across tasks of varying difficulty levels was examined. The pattern of performance data (i.e., the number correct) appears quite similar across the simple and complex tasks. However, it is important to note that perhaps both tasks fell within the spectrum of moderate

difficulty, $M = 3.34$ and $M = 5.11$ for the "simple" and "complex" tasks, respectively. However, the findings do suggest that results may generalize across some varying degrees of difficulty. This pattern of data provides evidence that the manipulation of cognitive appraisals is not merely a reinterpretation of classic drive theory (Zajonc, 1965) and, in fact, the pattern of data would not be predicted under any of the prominent arousal-based theories. If manipulating cognitive appraisals merely served to manipulate drive or arousal in some way, then performance should be facilitated in the presence of others on the simple task and impaired on the complex task. However, manipulating a challenge appraisal led to performance increases across task difficulty levels and conversely manipulating threat appraisals led to performance impairment across task difficulty levels. The data suggest that the cognitive appraisal model of social facilitation may have yielded unique results and may yield unique predictions compared to the drive theories of social facilitation. However, it is possible that the difficult task was not difficult enough and perhaps an even more difficult task would yield different results (i.e., results consistent with drive theories). Both tasks involved addition and subtraction, but the difficult task required computation speeds at which the participants presumably would have had little prior experience or practice. The simple task may have entailed computations at speeds that participants may experience in everyday calculations. Future studies may wish to explore a wider range of task difficulty levels as well as other types of tasks. Replication of the performance results using a task similar to one used in a study that tested one of the drive theories of social facilitation may be of great utility in future research.

The performance data yielded some mixed findings regarding whether the challenge or threat instructions led to better performance. While participants in the threat condition may have attempted more items, they also made significantly more errors and had significantly lower

accuracy (percent correct). Since errors can be costly, supervisors and instructors may want to shy away from inducing threat appraisals.

In addition to exploring performance effects, Study 2 also explored the roles of mood and motivation. These variables offer a more complete picture of how appraisals may ultimately affect performance. Presence appeared to differentially impact participants' mood and motivation depending on whether they received the challenge or threat instructions. Presence did not have a negative impact (increased motivation and no difference in mood compared to the alone condition) for participants who received the challenge instructions, but had the opposite effect (decreased motivation and worse mood) for participants who received the threat instructions. Both mood and motivation were assessed using single questionnaire items rather than established scales. Future research needs to explore these constructs in greater detail. In Study 2 mood and motivation were assessed very broadly. Future researchers may wish to distinguish between different types of motivation and mood. For example, previous research has distinguished between mastery and performance motivation, intrinsic and extrinsic motivation, and approach versus avoidance motivation (Dweck & Leggett, 1988; Elliot & Church, 1997; Feinberg, 2003). Furthermore, future researchers may seek to manipulate mood and motivation to further examine these constructs as mediators in the appraisal and presence interaction.

Both Study 1 and Study 2 measured challenge and threat appraisals through use of the cognitive appraisals ratio. Although a number of studies have supported use of this measure (Tomaka et al., 1997), several researchers have questioned its validity (e.g., Maier, Waldstein, & Synowski, 2003). Therefore an additional method to assess challenge and threat appraisals would further validate the findings from Study 1 and Study 2.

Study 3

Study 3 was conducted to address two important limitations of the previous studies. In Study 1 and Study 2 cognitive appraisals were measured using the cognitive appraisal ratio. Study 3 assessed cognitive appraisals also using the Appraisal of Life Events (ALE) scale developed by Ferguson, Matthews, and Cox (1999) in order to validate that cognitive appraisals were manipulated and that the findings were not the result of some other psychological construct. The ALE scale has been found to have high internal validity and high test-retest reliability and was designed to be more consistent with how challenge and threat appraisals have been theoretically defined in the past literature (e.g., Lazarus & Folkman, 1984). In addition, the scale was also validated with various coping behaviors, stressors, and health measures (see Ferguson, Matthews, & Cox, 1999, for review). While the previous two studies suggested that cognitive appraisals were the key moderators of the performance effects, several alternative explanations may also explain the reported results. Study 3 attempted to rule out several potentially confounding variables that might be driving the performance effects.

Method

Participants and design. Participants were 46 undergraduates (19 males and 27 females) recruited from introductory psychology classes at a large northeast university for partial fulfillment of a course requirement. The experimental design was a 2 (challenge vs. threat) x 2 (experimenter present vs. alone) between-subjects design in which participants completed a simple mental arithmetic task.

Apparatus and materials. A mental arithmetic task was presented to participants on a Power Macintosh™ 7100/66. The task was programmed into a psychology experiment software program, Psyscope v2.1. The math task was identical to the simple task used in Study 2.

In addition to the mental arithmetic task, participants were also asked to complete several pre-task and post-task questionnaire items. The questions were either Likert-scale items or

categorical items, including measures assessing the participant's perceptions of the task, mood, self-efficacy, and motivation. Participants answered by pressing the appropriate number on the computer keyboard.

Procedure. After signing the consent form, the experimenter read one of two instructional sets. The "challenge" and "threat" instructions were identical to the instructions used in Study 2 (see Appendix). Immediately after hearing the instructions, participants' cognitive appraisals were assessed. Participants' appraisals were assessed using the situational version of the Appraisal of Life Events (ALE) scale developed by Ferguson, Matthews, and Cox (1999) as well as through the cognitive appraisal ratios similar to those used in the Study 1 and Study 2.

The ALE scale assesses challenge and threat appraisals independently through 6-point Likert items in which participants are asked to assess their perceptions of their current situation. The challenge scale includes items such as "enjoyable", "challenging", and "stimulating." The threat scale includes items such as "threatening", "hostile", and "fearful" (see Ferguson et al., 1999 for discussion of reliability and validity).

After completing the cognitive appraisal measures, participants were given a brief demonstration of the mental arithmetic task. The participants were then informed that the experimenter, depending on the condition, would either be in the room as they completed the task or would wait outside the room in an office two doors down the hall.

Dependent measures. Participants' performance on the mental arithmetic task was measured by the number of items answered correctly. In addition, participants completed a post-task questionnaire. Items in the questionnaire measured mood, motivation, and evaluation apprehension and also contained several manipulation checks. Lastly, participants were debriefed about the nature of the experiment.

Results

Manipulation checks. Analyses were conducted to examine whether participants in the challenge condition appraised the task as more "challenging" compared to participants in the threat condition. As in Study 1, there was a significant main effect for the cognitive appraisal ratio, $F(1, 43) = 4.14$, $p < .05$. Participants in the challenge condition scored below a 1 ($M = .71$) and the participants in the threat condition scored above a 1 ($M = 1.15$). In addition, there were significant main effects for the challenge, $F(1, 42) = 4.13$, $p < .05$, and threat, $F(1, 43) = 5.64$, $p < .05$ components of the ALE scale. Participants in the challenge condition scored higher on the challenge component ($M = 16.46$ v. $M = 14.15$) and lower on the threat component ($M = 8.83$ v. $M = 11.33$).

Performance. A 2 x 2 (presence x instructions) between-subjects ANOVA was conducted on the performance data. A significant interaction effect, similar to the pattern found in the previous studies, was found for the number of items answered correctly, $F(1, 42) = 5.07$, $p < .05$ (see Figure 2). Participants in the challenge condition with presence outperformed participants who performed alone ($M = 60.55$ v. $M = 51.08$), whereas in the threat condition, participants who performed in the presence of the experimenter answered fewer items correctly than participants performing alone ($M = 53.46$ v. $M = 60.46$). There were no significant effects for the number of errors. However, this may be due to the simple nature of the task and the relatively low error rate ($M = 7.32$ overall).

Additional analyses. Analyses of the post-task questionnaire explored whether the task instructions also produced changes on other psychological constructs that might also account for the performance effects. There were no significant differences found on self-reported distraction, effort, perceived difficulty of the task, perceived ability (self-efficacy), and motivation to perform to the best of abilities. There was a significant difference in perceived importance to perform

well, $F(1, 44) = 7.55$, $p < .01$. Participants in the challenge condition felt it was more important to do well than participants in the threat condition ($M = 5.00$ v. $M = 3.73$).

Discussion

The results of Study 3 replicated the performance results of the previous two studies in demonstrating a significant appraisal by presence interaction. In addition, Study 3 further strengthened the validity of the appraisal manipulation by demonstrating significant effects with two separate measures of challenge and threat appraisals, the cognitive appraisal ratio and the ALE scale. Use of the ALE scale in Study 3 offers convergent validity for the cognitive appraisal ratio and provides additional evidence that the experimental instructions were in fact manipulating challenge and threat appraisals.

In addition, Study 3 explored a few potentially confounding psychological constructs that may have also been manipulated through the task instructions. While it may be impossible to rule out all potential confounds (especially given the extent to which some of these constructs may overlap), non-significant results on several key post-task items (perceived distraction, effort, self-efficacy, difficulty, and motivation) coupled with significant findings on the measurements of appraisals, provide evidence that it is in fact the cognitive appraisals being manipulated rather than other psychological constructs. Although previous research (Mikolajczak & Luminet, 2008) has shown that challenge and threat appraisals may be driven by perceived self-efficacy, Study 3 measured trait, rather than state, self-efficacy ("I typically perform well on these types of tasks"). Therefore, pre-existing differences in self-efficacy can not explain these performance effects. The one key variable for which there was a significant effect was the perceived importance of doing well on the task. Given that the challenge instructions focused on the rewards of performing well, it was hypothesized that the appraisals led to this difference. However, the analyses cannot rule

out the possibility that differences in perceived importance of performing might be a potential confound.

In each of the previous studies, participants completed a mental arithmetic task. While Study 2 provided evidence that the results generalize across varying degrees of difficulty of this task, it is important to examine whether the results generalize across different task types. Study 4 replicated the previous findings using an anagrams task.

Study 4

Study 4 was designed to explore whether the previous results generalize to tasks other than a mental arithmetic task. Specifically, Study 4 explored whether the results extended to a task that involved problem-solving rather than rote mathematical skills. Again, it was hypothesized that presence would lead to performance facilitation in the challenge condition, but lead to impairment in the threat condition.

Method

Participants and design. Participants were 54 undergraduates (24 males and 30 females) recruited from introductory psychology classes at a small northeast liberal arts college for partial fulfillment of a course requirement. The experimental design was a 2 (challenge vs. threat) x 2 (experimenter present vs. alone) between-subjects design in which participants completed an anagrams task.

Apparatus and materials. Participants were given 8 minutes to solve 20 anagrams. The anagrams were presented on a sheet of paper and could be solved in any order that participants chose. The anagrams were adapted from Gribben (1970). The anagrams were all 5-letter words (e.g., EFHCI-chief, EUDJG-judge).

In addition to the anagrams task, participants were also asked to complete several pre-task and post-task questionnaire items. The questions were either Likert-scale items or categorical

items including measures which assessed the participants' perceptions of the task, mood, and motivation.

Procedure. After signing the consent form, the experimenter read one of two instructional sets. The "challenge" and "threat" instructions were identical to the instructions used in Study 2 and Study 3 (see Appendix). Immediately after hearing the instructions, participants' cognitive appraisals were assessed. Participants' appraisals were assessed using the Appraisal of Life Events (ALE) scale developed by Ferguson, Mathews, and Cox (1999) as well as through the cognitive appraisal ratios similar to those used in the previous studies.

After completing the cognitive appraisal measures, participants were given instructions on how to complete the anagrams task. The experimenter then informed the participant, depending on the condition, that the experimenter would either be in the room as they completed the task or would wait outside the room in an office two doors down the hall.

Dependent measures. Participants' performance on the anagrams task was measured by the number of items answered correctly within the 8 minute period. The number of errors was not assessed separately because the number of errors was the exact inverse of the number of items correct. In addition, participants completed a post-task questionnaire identical to that of Study 2.

Results

Manipulation checks. As in Study 2 and Study 3, there was a significant main effect for the cognitive appraisal ratio, $F(1,52) = 4.71$, $p < .05$. Participants in the challenge condition scored below a 1 ($M = .73$) and the participants in the threat condition scored above a 1 ($M = 1.12$). In addition, there were significant main effects for the challenge, $F(1,52) = 5.23$, $p < .05$, and threat, $F(1,52) = 4.56$, $p < .05$ components of the ALE scale. Participants in the challenge condition scored higher on the challenge component ($M = 16.17$ v. $M = 13.92$) and lower on the threat component ($M = 9.38$ v. $M = 12.72$).

Performance. A 2 x 2 (presence x instructions) between-subjects ANOVA was conducted on the performance data. A significant interaction effect, similar to the pattern found in the previous three studies, was found for the number of items answered correctly, $F(1,50) = 4.86$, $p < .05$ (see Figure 3). Participants in the challenge condition with presence outperformed participants who performed alone ($M = 12.71$ v. $M = 9.15$), whereas in the threat condition, participants who performed in the presence of the experimenter answered fewer items correctly than participants performing alone ($M = 9.33$ v. $M = 10.89$). While the mean performance was higher in the challenge condition, the difference was not significant ($M = 10.93$ v. $M = 10.11$).

Additional analyses. Analyses of the post-task questionnaire explored whether the task instructions also produced changes on other psychological constructs that might also account for the performance effects. There were no significant differences found on self-reported distraction, effort, perceived difficulty of the task, perceived ability (self-efficacy), and motivation to perform to the best of abilities, ps $> .10$. Unlike Study 2, there was no significant difference in perceived importance to perform well, $p > .10$.

Discussion

Study 4 replicated the performance interaction found in the previous three studies utilizing an anagrams task rather than a mental arithmetic task. The results of Study 4 suggest that the previous results may be generalized to non-mathematical tasks. In addition, while the results were not significant, unlike in Study 1, participants in the threat condition did not outperform the participants in the challenge condition. While both task types are problem-solving oriented, perhaps other types of tasks (e.g., creative tasks) may produce different effects. However, it appears that the performance effects are not just specific to arithmetic tasks.

General Discussion

Four studies provided evidence that the subjective appraisal of a task may lead to systematic differences in performance in the presence of others. In other words, challenge and threat appraisals appear to play an important role in moderating the well-documented effect of presence on performance (i.e., social facilitation).

Differences in participants' appraisals appear to produce performance effects in the presence of others that may be unique and distinct from the psychological mechanisms outlined in the drive theories of social facilitation. Specifically, the pattern of performance data in Study 2 appears to be inconsistent with a number of the drive/arousal based theories of social facilitation (e.g., Zajonc's mere presence theory, evaluation-apprehension theory, and the original version of distraction-conflict theory). Both the challenge and threat manipulations yielded a consistent pattern of performance across both the simple and complex tasks. This pattern of performance data suggests that the cognitive appraisal explanation of social facilitation is not a mere reformulation of one of the drive theories. Furthermore, the cognitive appraisal explanation has added utility in that it provides a theoretical framework to account for both performance and physiological changes (Blascovich et al., 1999) in the presence of others. While the present studies cannot rule out distraction-conflict theory (Baron, Moore, & Sanders, 1978), mere presence (Zajonc, 1965), or evaluation apprehension (Cottrell, 1972), the studies do provide evidence that cognitive manipulations, at the very least, may be sufficient to produce social facilitation effects. However, future researchers may wish to utilize more difficult tasks and/or replicate the performance effects using task identical to those used in studies testing the drive theories of social facilitation.

The data from the four studies provided additional evidence that performance in the presence of others could be affected by using subtle manipulations (i.e., manipulating task instructions). The effect of presence on performance has generally been assumed to operate

through proactive managerial (or instructional) behaviors (i.e., providing feedback, correcting behaviors, etc.). However, consistent with social facilitation theory, past research (e.g., Larson & Callahan, 1990) has found that even a more passive supervisory presence may also affect worker productivity. The effects produced by this relatively simple manipulation in the present studies, manipulating task instructions, have several important implications. To the extent that a supervisor or instructor can induce challenge appraisals through direct or indirect feedback and/or instruction, his or her presence has the potential to lead to performance facilitation.

Although the results are consistent with performance effects found by Blascovich et al. (1999) and Sanna and Shotland (1990), the present investigation offers several important extensions to prior social facilitation and cognitive appraisal research. The present studies extended previous research by replicating social facilitation effects across a number of tasks. In Study 2 the performance effects were replicated across tasks of varying difficulty levels. In Study 4 the performance effects were replicated using an anagrams task. The data suggests that performance effects found by manipulating cognitive appraisals may generalize across a spectrum of tasks, adding increased external validity to these findings. Therefore, managers or instructors dealing with a number of different tasks may have the potential to impact worker performance based on presence and how the task instructions are presented.

In Study 3 and Study 4, cognitive appraisals were also assessed using the ALE scale in addition to the cognitive appraisal ratios that had been used in previous research. The cognitive appraisal ratio has been criticized (e.g., Maier et al., 2003) for being inconsistent with previous definitions of challenge and threat appraisals (Lazarus & Folkman, 1984) and for lacking sound psychometric properties. Significant differences on both measures add support to the hypothesis that the task instructions were manipulating cognitive appraisals and provided important convergent validity for the appraisal ratio measure. In addition, the studies provided insight into

some of the psychological mechanisms (e.g., mood and motivation) that may mediate the effect of appraisals on performance. Furthermore, null effects on several key psychological constructs provide additional support that challenge and threat appraisals were manipulated and ruled out other potential variables that may have also been manipulated through the task instructions.

Differences in how individuals appraise a task might help explain small or null effects in previous social facilitation studies. It also may explain the circumstances under which employee monitoring or instructor supervision may lead to either positive or negative outcomes. A number of studies have examined how pre-existing individual differences might explain when social facilitation may occur. For example, a study by Aiello and Kolb (1995) found that participants' skill levels moderated the effect of presence on performance. Highly skilled participants showed performance facilitation in the electronic performance monitoring (EPM) condition compared to participants performing alone. The opposite pattern (performance impairment) was found for low-skilled participants in the EPM condition compared to participants performing alone. While skill level can be influenced by effective management or long hours of practice, the present investigation provides evidence that it may be possible under certain circumstances to manipulate individual differences in perception (i.e., challenge and threat appraisals) and thus increase the likelihood that performance facilitation might occur. Managers, teachers, and others may want to consider how individual workers may be affected by their work environment. Individuals who are more likely to view a task as challenging might perform best in the presence of others, whereas individuals who are likely to view a task as threatening might perform best in seclusion. Therefore, managers, teachers, and others should pay careful attention to how they frame a task in order to yield the desired performance effects for individuals working under evaluative presence.

One important limitation of the present studies was that cognitive appraisals were manipulated across the four studies with essentially the same instructional sets. Although these instructions were based on previous research (Tomaka et al., 1997) and have proven to be effective in manipulating cognitive appraisals, it is important to note that differences in the wording of the challenge and threat manipulations may have introduced potential confounding effects on performance. For example, the threat manipulation emphasized "speed" and "accuracy" whereas the challenge instructions did not. Although several confounding variables may have been ruled out through the post-task questionnaire items in Study 3 and Study 4, future researchers may wish to address the impact of the different language of the task instructions and perhaps devise more analogous instructions that could eliminate potential confounds. Furthermore, the present studies focused on just one specific method of appraisal manipulation. It would certainly be worthwhile to demonstrate that the performance effects found in the present studies could also be replicated by using additional challenge and threat manipulations (e.g., false performance feedback). Future researchers may wish to address whether these social facilitation effects occur across a wider spectrum of challenge and threat manipulations.

The present investigation offered further evidence that challenge and threat appraisals may play a key role in explaining social facilitation effects. Several limitations in the previous literature were addressed and Study 2 provided evidence that the moderating effects of cognitive appraisals may be distinct from the effects of other psychological or physiological mechanisms outlined in drive theories of social facilitation.

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Footnotes

[1]The effect size for the difference in appraisal ratio between the challenge and threat conditions was moderate ($\omega^2 = .028$).

[2]Math ability was not a significant covariate for the performance data and was therefore omitted from the analyses. Math ability was measured through self-reported math ability (7-point Likert item).

Appendix

Challenge Instructions

Even though this is a math task in which some people may have trouble, we want you to try hard to do your best. Try and think of the task as a challenge to be met and OVERCOME. Think of yourself as someone capable of meeting that challenge. We think you are more than CAPABLE of meeting the challenges of this task. Our research has shown that most participants are able to handle tasks like the one you are about to complete. And although some participants may expect the upcoming task to be difficult, most have found that they are more than able to perform well on the task if they concentrate and put some effort into it. In fact, most participants, even those who don't typically enjoy math, have stated that they were able to handle the task and felt good about their performance. Again, although this task may sound difficult, remind yourself that you are capable of performing well.

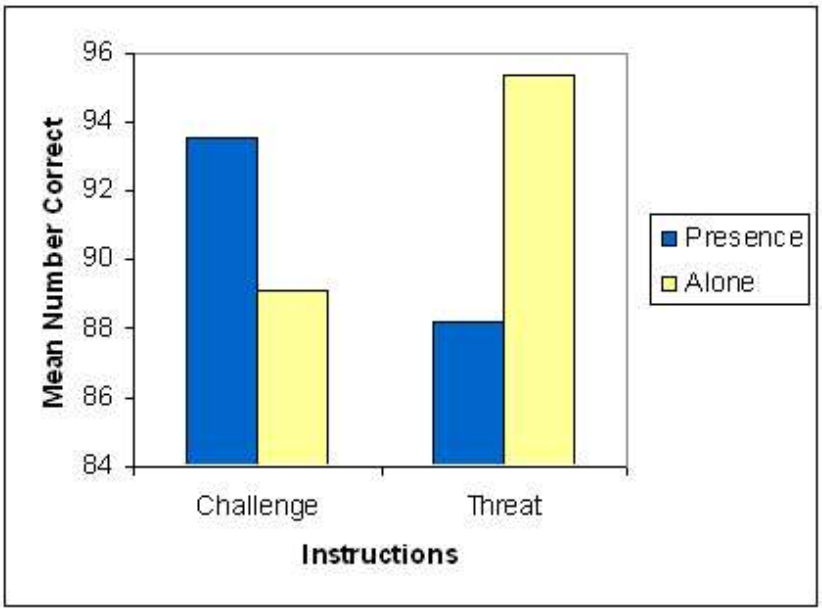
Threat Instructions

This can be a difficult task in which most people have trouble. It is important that you perform this task as QUICKLY and EFFICIENTLY as possible. Both the SPEED and ACCURACY of your answers will be examined. This can be a stressful and difficult task for many students. Our research has shown that many participants have trouble performing well on this task. Some students find this task very frustrating and stressful and find it quite difficult to perform with both speed and accuracy. Remember, it is important that you not only answer correctly, but quickly as well. Again, although this is a difficult math task that some find stressful, try to stay focused on the task

Note. Instructions were read to the participants. Words in all capitals were verbally emphasized by the experimenter.

Figure Caption

Figure 1. Mean number correct for appraisal by presence interaction Study 2.
Figure 2. Mean number correct for appraisal by presence interaction Study 3.
Figure 3. Mean number correct for appraisal by presence interaction Study 4.



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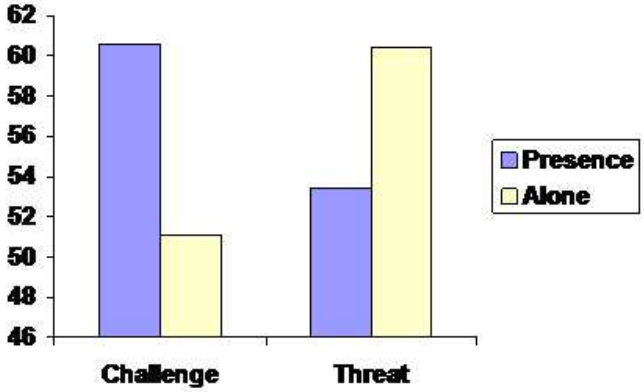
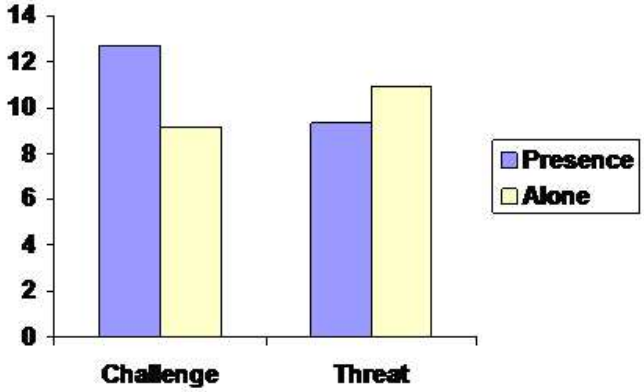


135x108mm (120 x 120 DPI)



135x108mm (120 x 120 DPI)

Table 1

Performance Data Study 1

Deleted: *Pilot*

Deleted: *y*

	# Correct		
	Mean	SD	n
Challenge[a]	32.89	12.21	42
W/ Presence[b]	35.20	13.72	22
W/O Presence[b]	30.59	10.49	20
Threat[a]	42.72	10.95	41
W/ Presence[b]	38.26	10.14	23
W/O Presence[b]	46.29	10.25	18

Note. Number of items answered correctly on the mental arithmetic task. Means adjusted for covariate (math ability).

[a] Significant main effect, $p < .01$ [b] Significant interaction, $p < .05$

Table 2

Task Performance Study 2

Deleted: *1*

	Items Correct	Simple Items Correct	Complex Items Correct
Challenge	91.33	108.71	73.96
Present	93.57	110.45	76.69
Alone	89.09	106.97	71.22
Threat	91.80	107.90	75.71
Present	88.22	106.30	70.13
Alone	95.39	109.50	81.29

Note. Mean number of items correct.

Table 3

Presence by Appraisal Interactions for Mood and Motivation Study 2

Deleted: *1*

	Challenge		Threat		
	Present	Alone	Present	Alone	*F*
Happy (mood)	4.10	4.26	3.50	4.33	3.89*
Pleased (mood)	3.81	3.90	4.38	3.55	5.12*
Motivated to perform (motivation)	4.77	4.27	4.18	5.25	11.50**
Important to do well (motivation)	4.47	3.89	4.20	4.63	4.75*

Note. All post-task questionnaire items measured using 7-point Likert scales. The variable "pleased" was reverse coded.
*df*s= 1, 227
* $p < .05$ ** $p < .01$

Table 4

Presence and Appraisal Main Effects for Post-Task Measures Study 2

Deleted: 1

	Presence			Appraisal Instruction		
	Present	Alone	*F*	Challenge	Threat	*F*
Evaluation Apprehension	5.70	5.00	10.83**	5.00	5.47	4.28*
Perceived Task Difficulty	4.28	4.12	.56(ns)	3.84	4.61	15.48**
Happy	3.80	4.30	8.02**	4.18	3.92	2.29 (ns)
Pressure	4.03	4.68	7.92**	4.72	3.99	9.81**

Note. All variables measured through 7-point Likert scale items after completing the mental arithmetic task. The variable "pressure" was reverse coded.

*df*s= 1, 227

* $p < .05$ ** $p < .01$