

## Facilitating Sustained Attention: Is Mere Presence Sufficient?

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Research on sustained attention regularly reports declines in task performance as a function of time on task, a phenomenon commonly called the vigilance decrement. Therefore, previous work from theoretical and applied fields has focused on attenuating this performance decrement. Recently, aspects of social facilitation have been used to attain this goal. Social facilitation, or improving task performance through the social presence of an individual, has been found to improve performance on sustained attention tasks. However, the extent to which the forms of social facilitation can mitigate performance are unclear. Thus, the impetus of the present research was to explore the effects of two prevalent forms of social facilitation (i.e., mere presence and evaluative presence) on a sustained attention (i.e., vigilance) task. In sum, 132 observers completed a 24-min cognitive-based vigilance task. The results indicated that an evaluative presence produced the strongest effects on performance, such that the proportion of false alarms was significantly reduced relative to no social presence. Moreover, the mere presence of an individual did not significantly improve vigilance task performance. The results of the present experiment suggest that an evaluative context may be necessary for social presence to improve detection performance on tasks that require sustained attention.

KEYWORDS: evaluation apprehension, vigilance, social facilitation, mere presence

Sustained attention is a prevalent component in the average person's daily life (Langner & Eickhoff, 2013). For instance, the U.S. Department of Transportation (2014) has reported that nearly 87% of the driving-age population (i.e., over age 16) owns a license and regularly drives a vehicle. Driving requires the continuous maintenance of sustained attention to retain control and to avoid accidents (Louie & Mouloua, 2017). Moreover, several organizations require employees to perform sustained attention tasks as a part of their daily responsibilities; for example, medical screeners (Warm, Matthews, & Parasuraman, 2009) and air traffic controllers (Hitchcock, Dember, Warm, Moroney, & See, 1999; Pigeau, Angus, O'Neill, &

Mack, 1995) must sustain attention to successfully review X-ray screenings and flight paths, respectively.

Sustained attention can be divided into two overarching components: vigilance and concentration (Mirsky, Anthony, Duncan, Ahearn, & Kellam, 1991). Vigilance, specifically, has been described as the ability to maintain attention for extended periods of time and to respond to infrequently occurring critical signals (Davies & Parasuraman, 1982; Mackworth, 1948). The history of vigilance research dates back to World War II, when it was reported that naval operators detected fewer critical signals the longer they were on watch (Mackworth, 1948). This pattern of declining performance as a function

of time (or period) on watch is commonly called the vigilance decrement (Davies & Parasuraman, 1982; See, Howe, Warm, & Dember, 1995) and has recently been argued to be the most pervasive finding associated with vigilance research (Fraulini, Hancock, Neigel, Claypoole, & Szalma, 2017). This decline in detection performance is theorized to occur because the availability of finite cognitive resources declines over time as a function of task demands, which results in fewer correct responses and longer response times (i.e., cognitive resource theory; Helton & Russell, 2011; Helton & Warm, 2008; Parasuraman, Warm, & Dember, 1987; Warm, Parasuraman, & Matthews, 2008).

Previous research has provided a consistent profile of vigilance and the subsequent decrement, such that the proportion of correct detections and false alarms declines as a function of period on watch, whereas response time increases as a function of period on watch (Davies & Parasuraman, 1982; Parasuraman, 1979; Warm et al., 2008). In order to examine detection performance over time, previous vigilance research has traditionally divided time on watch into equitable time periods in terms of signal and nonsignal presentations, so that the proportion of hits and false alarms can be directly compared across time periods (Davies & Parasuraman, 1982; Warm et al., 2008). Importantly, participants are unaware of these “periods on watch” because the tasks are typically presented as one uninterrupted task, similar to how real-world organizational tasks are performed, such as baggage screening.

As a critical component of vigilance research, practitioners and researchers alike have consistently sought to ascertain factors that can reduce the performance decrement associated with vigilance. Toward this end, it has recently been argued that improving motivation is one way to attenuate the vigilance decrement (Hancock, 2013), and so researchers have focused on identifying motivational factors that improve vigilance task performance (Warm et al., 2008). Rest breaks (Arrabito, Ho, Aghaei, Burns, & Hou, 2015; Helton & Russell, 2017) and feedback (i.e., knowledge of results [KR]; Antonelli & Karas, 1967; Szalma, Hancock, Dember, & Warm, 2006) are two factors with motivational components that have been demonstrated to improve performance and reduce the vigilance decrement. Similarly, it has been postu-

lated that the presence of another person (i.e., social facilitation) may be an additional factor related to improving vigilance task performance (Claypoole & Szalma, 2017).

#### *Social Facilitation*

Social facilitation is typically characterized by improved performance on well-learned or simple tasks and impaired performance on novel or complex tasks in the presence of another person (Bond & Titus, 1983; Cottrell, 1972; Zajonc, 1965). Social facilitation has been identified as the oldest phenomenon in social psychology, dating back to 1898, when Triplett discovered that cyclists pedaled faster when they were racing against another person (Aiello & Douthitt, 2001, Bond & Titus, 1983; but see Stroebe, 2012). Since then, the effects of social facilitation have been examined in several domains of psychology, including cognitive, industrial or organizational, and sports psychology (for reviews see Bond & Titus, 1983; Geen & Gange, 1977; Strauss, 2002).

Several theories have been postulated to account for the performance effects associated with social facilitation (e.g., distraction theory, self-presentation theory), but Zajonc's (1965) mere presence theory and Cottrell's (1972) evaluation apprehension theory are the most supported and cited theories of social facilitation (Bond & Titus, 1983; Claypoole & Szalma, 2017; Geen & Gange, 1977).

Zajonc's (1965) mere presence theory of social facilitation suggests that in the mere presence of others, a person's general drive is increased. This increase in drive causes increased arousal, which leads to a greater likelihood of a dominant response relative to a nondominant response. A correct dominant response is more likely to occur when the task is simple or familiar, and so facilitating the dominant response improves performance. However, the converse is also true: If a task is difficult or unfamiliar, the correct response is less likely to be dominant, and performance will therefore be diminished (Zajonc, 1965). The main argument of Zajonc's mere presence theory was that the “mere presence” of another person was sufficient to facilitate performance by increasing drive and arousal (Zajonc, 1965).

Conversely, Cottrell (1972) argued that the “mere presence” of another person is insufficient for influencing performance. Cottrell proposed that social

facilitation effects (i.e., increased drive and arousal) would occur only when participants believed they were being evaluated or were concerned with the potential for evaluation. For instance, one study demonstrated that only participants who completed a simple task under evaluative presence achieved higher performance; those who completed the task with a merely present audience did not demonstrate improved performance (Cottrell, Wack, Sekerak, & Rittle, 1968).

Several reviews have indicated that most of the previous empirical results have focused on providing support either for the mere presence of others or for the necessity of evaluation apprehension (Bond & Titus, 1983; Guerin & Innes, 1982). However, previous research has produced inconsistent results related to the sufficiency of mere presence. For instance, one experiment reported that participants who either were in the mere presence of another person or were evaluated by another person exhibited a significantly higher response rate on a word construction task than participants who completed the task alone (Rittle & Bernard, 1976). Interestingly, there were no significant differences between the two social presence conditions (Rittle & Bernard, 1976), which suggested that the mere physical presence of another person was sufficient to induce social facilitation effects, supporting Zajonc's (1965) theory. Conversely, another experiment demonstrated that participants who completed a pseudorecognition task in the presence of evaluative spectators emitted more dominant responses than participants who completed the task in the presence of merely present spectators or who completed the task alone (Cottrell, Wack, Sekerak, & Rittle, 1968). Furthermore, participants who were merely in the physical presence of an audience did not exhibit an increase in the emission of dominant responses relative to the control condition, suggesting that an evaluative context is necessary to improve performance.

Moreover, Manstead and Semin (1980) have also demonstrated that social facilitation effects do not always occur. Their results indicated that there were no significant performance differences (i.e., mean number of trials needed to achieve 0 errors on a maze task) between performing the maze task in front of an "audience" or completing the task alone (Experiment 3, Manstead & Semin, 1980).

Overall, there has been no clear consensus on which theoretical perspective best explains the effects of social facilitation (Bond & Titus, 1983; Geen & Gange, 1977; Guerin & Innes, 1982; Sanders, 1981) or which form of social presence (mere or evaluative) is sufficient for improving performance. However, it has been argued that evaluation apprehension may play a critical role in *maintaining* drive levels (Guerin & Innes, 1982) and thus may be more beneficial for improving performance on tasks that require sustained attention, such as vigilance.

#### *Sustained Attention and Social Facilitation*

Limited previous research has demonstrated that social facilitation can be used to improve vigilance task performance. For instance, military personnel who completed a sensory-based vigilance task in the evaluative presence of their commanding officer correctly detected more signals than those who completed the vigil alone (Bergum & Lehr, 1963). Similarly, participants who completed a sensory-based vigil under an evaluative presence (both human and closed-circuit TV monitoring) missed fewer signals than those who completed the task alone (Putz, 1975). Importantly, in both experiments a performance decrement still occurred, but overall performance was improved through the use of evaluative presence.

In addition to providing support for the effectiveness of evaluative presence, recent research has also demonstrated that performance can be facilitated through the use of mere presence. For instance, Yu and Wu (2015) examined the effects of mere audience presence on a simulated baggage screening vigilance task. Their results indicated that participants who completed the vigil in the mere presence of another person were faster to respond to critical signals than participants who completed the vigil alone (Yu & Wu, 2015). Interestingly, the operationalization of mere presence used in their experiment actually included evaluative contexts (i.e., monitoring participants while they completed the task) and thus could be argued as an operationalization of evaluative presence rather than mere presence.

To date, there have been only two experiments that have directly compared the effects of mere presence and evaluative presence on a vigilance task (i.e., Claypoole & Szalma, 2017; Klinger, 1969). Klinger compared the effectiveness of "mere" co-action,

where participants completed an identical vigilance task while in the same room as one another, with “evaluative” co-action, where participants also received information about each other’s errors. The results indicated that the potential for evaluation was necessary for co-action to improve performance, because only participants who completed the vigil under evaluation demonstrated fewer missed signals (Klinger, 1969). However, Klinger confounded the effects of co-action (which is a distinct form of social facilitation; Aiello & Douthitt, 2001) and feedback (i.e., KR; Kluger & DeNisi, 1996), so it is unclear whether the type of social presence or the performance feedback was responsible for improving performance.

Conversely, Claypoole and Szalma (2017) demonstrated that the proportion of false alarms was lower for participants who completed a sensory-based vigilance task under both supervisory evaluative presence and peer observer mere presence when compared with participants who completed the vigil alone. Interestingly, there were no significant differences between the evaluative and mere presence conditions, suggesting that perhaps mere presence can be sufficient for improving vigilance task performance (Claypoole & Szalma, 2017). However, this was true only when the data were divided based on qualitative responses to feelings of evaluation (pp. 1490–1492). When all participants were included in the analyses, social presence did not improve vigilance task performance at all. Thus, performance was improved only when participants were filtered out based on their perception of the social presence, which suggests that the perception of social presence may be an important factor in social facilitation. Furthermore, this experiment confounded the effects of supervisory versus peer observer status in addition to the form of social presence. Importantly, observer status has been identified as a potential moderating factor in the effects of social facilitation (i.e., Miller, Hurkman, Robinson, & Feinberg, 1979). Thus, the potential benefits of using mere presence to improve vigilance task performance in that study should be interpreted with caution.

Taken together, these studies demonstrate that social facilitation can be used to improve vigilance task performance. However, although performance is often improved, the type of performance measured is inconsistent (i.e., speed vs. accuracy). Social fa-

cilitation has been found to improve vigilance task performance in terms of correct detections (Bergum & Lehr, 1963; Funke et al., 2016), missed signals (Klinger, 1969; Putz, 1975), false alarms (Claypoole & Szalma, 2017), and response time (Yu & Wu, 2015); however, only one study has reported the effects of social presence on *each* of these metrics of performance (Claypoole & Szalma, 2017). Thus, it is still unclear which metrics of performance are most affected by social presence.

Additionally, the type of presence used in the previous research has also been inconsistent. Performance improvements have been found with supervisory and evaluative presence (Bergum & Lehr, 1963; Claypoole & Szalma, 2017; Klinger, 1969; Putz, 1975), co-acting presence (Funke et al., 2016; Klinger, 1969), and, to an extent, mere presence (Yu & Wu, 2015). However, none of the previous experiments have directly compared the effects of mere presence with evaluative presence without confounding limitations (i.e., supervisory presence, co-action). Thus, is mere presence sufficient for facilitating sustained attention, or is an evaluative presence necessary for maintaining arousal levels over an extended period of time, and which measures of sustained attention task performance are most affected by social presence?

## STUDY

As previously discussed, there is limited research on the effects of social facilitation and vigilance task performance. Based on the inconsistencies in the previous research, it is unclear which forms of social facilitation affect detection performance associated with vigilance tasks. Thus, the purpose of the present study was twofold: to extend previous research to determine whether the predominant forms of social facilitation (i.e., mere presence and evaluative presence) both improve vigilance task performance and to further explore which measures of performance are most affected by social facilitation (i.e., speed vs. accuracy). In contrast to previous research, the present experiment carefully controlled for evaluative effects in the mere presence condition, to avoid confounds that occurred in previous research. Based on previous empirical and theoretical research (Cottrell, 1972; Guerin & Innes, 1982; Klinger, 1969), it was hypothesized that sustained attention performance would

be most affected by a social presence that contained an evaluative aspect and that the proportion of false alarms would be the measure of performance most affected by said evaluative social presence (Claypoole & Szalma, 2017).

## METHOD

### *Participants*

The minimum number of participants needed was determined a priori by a power analyses conducted in G\*Power 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007). Based on the parameters (i.e.,  $\alpha = .05$ , power = .90), the minimum number of participants needed was  $N = 132$  ( $F = .25$ ). In total, performance data from 132 participants (90 female) were collected across all three conditions. The gender proportion was representative of the overall gender proportion of the participant pool at the university where the data were collected. All participants were undergraduates recruited through the research participation system at a large university in the southeastern United States. All participation was on a voluntary basis; however, participants did receive course credit for completing the study. Average age of participants was 20.23 ( $SD = 4.50$ , range 18–53 years).

### *Conditions*

There were three experimental conditions in the present study: evaluative observer, mere presence observer, and no observer present (control). The experimental conditions were based on modifications from previous experiments that examined performance effects attributed to social presence (Claypoole & Szalma, 2017; Guerin, 1986; Kidd & Christy, 1961; Putz, 1975). All participants completed the vigil in a private, uniformly lit room.

In the evaluative observer condition, participants completed the vigil in the presence of a research assistant who sat approximately 1 meter behind and 45° to the left of the participant (Claypoole & Szalma, 2017; Putz, 1975). The research assistant was instructed to take notes on a clipboard and create the appearance of actively evaluating the participant while he or she completed the vigil (Amsler, Findley, & Ingram, 2013; Claypoole & Szalma, 2017). In the mere presence observer condition, participants completed the vigil in the presence of a research assistant who sat at an adjacent desk, facing in the other direction. Before the vigil began, the research assistant instructed the participants to alert them at the conclusion of the

task so that they could close the program. While the participant completed the vigil, the research assistant was engaged in a secondary task (e.g., reading a book; Guerin, 1986). From this position, the research assistant could not see or evaluate the participants' performance on the task; the assistant remained in this position throughout the entire vigil. In the no observer present (control) condition, the participants completed the entire vigil alone in the room. There was no social presence at any point during the task (Claypoole & Szalma, 2017).

### *Experimental Task*

The vigilance task used in the present experiment was adapted from Warm, Fishbein, Howe, and Kindell (1976; also cited in Warm & Jerison, 1984). The present task used four 6-min periods on watch to examine detection performance over time, similar to previous iterations of the task (i.e., Warm et al., 1976). Importantly, participants were unaware of these distinct periods on watch, because the task stimuli were presented for 24 uninterrupted minutes. In this task, the participants were required to monitor a display that consisted of repeated presentations of two-digit numbers. A critical signal for detection was defined as pairs of numbers that differed by 0 or  $\pm 1$ . For instance, “23,” “55,” and “10” were all critical signals, whereas “91,” “04,” and “68” were not. Each stimulus was presented for 1,000 ms and was followed by a 1,500-ms interstimulus interval (blank screen), resulting in an event rate of 24 events per minute. The participants were instructed to respond by pressing the spacebar when a critical signal was presented. They were allowed to respond at any time during the 2,500-ms interval of each trial. In the 24-min vigilance task, five critical signals were presented every 6 min, for a total of 20 critical signals across the four periods (signal probability = 0.035). The timing of the presentations of the five critical signals was randomized within each period on watch, but the presentations of the critical signals were held constant across participants (i.e., all critical signals were presented at the same time for each participant).

### *Procedure*

When participants arrived at the research laboratory, they were requested to provide their student identification, to remove any timepieces, and to power down any electronic devices. Participants were assigned at random to one of three conditions, each of which included a script for the researchers to follow. In all of the conditions, participants completed a demograph-

ic questionnaire before the social presence manipulation. After the questionnaire was completed, the social presence manipulation was implemented (i.e., evaluative presence, mere presence, or no presence). Example stimuli were presented, as well as a 5-min practice session to familiarize participants with the task. No feedback was provided during the practice session, and there were no performance criteria established for participants to begin the full experiment (i.e., the computer program did not automatically prevent participants from completing the experiment based on performance criteria). However, practice data were analyzed ad hoc as a screening criterion to remove participants from the final analyses who did not understand the task (note: no participants were removed). Immediately after the practice task, the participants began the 24-min vigilance task. After the vigilance task was completed, the researcher debriefed the participants and thanked them for their time.

## RESULTS

A univariate analyses of variance (ANOVA) was computed for each of the dependent measures, followed by least significant difference pairwise comparisons where appropriate. Each measure of performance was analyzed by a 3 (condition)  $\times$  4 (period) mixed ANOVA, with repeated measures on the second factor. Significant condition by period interactions were further analyzed by testing of the simple effects of period within each condition. The dependent mea-

asures of interest related to performance included hits, false alarms, and median response times. There were 132 participants across each of the three conditions (mere presence observer, evaluative observer, and no observer present [control]), with 44 (31 female), 44 (26 female), and 44 (33 female) participants in each condition, respectively.

### Proportion of Hits

There was no significant main effect of condition for the overall proportion of hits (i.e., correct detections),  $F(2, 129) = 0.848, p = .430, \eta_p^2 = .013$ , suggesting that neither form of social presence was associated with improved correct detection performance. The proportion of hits decreased significantly across all three conditions as a function of period on watch,  $F(3, 387) = 3.462, p = .016, \eta_p^2 = .026$  (Figure 1), which is typical of traditional vigilance experiments (i.e., the vigilance decrement; Warm et al., 2008); however, the interaction between condition and period on watch was not significant,  $F(6, 387) = 0.612, p = .721, \eta_p^2 = .009$ .

### Proportion of False Alarms

The results indicated a significant main effect of condition for the overall proportion of false alarms (i.e., errors of commission),  $F(2, 12) = 3.310, p = .040, \eta_p^2 = .049$ . Post hoc analyses indicated that those in the evaluative observer condition committed significantly fewer false alarms ( $p = .015, d = .44$ ) relative to the no

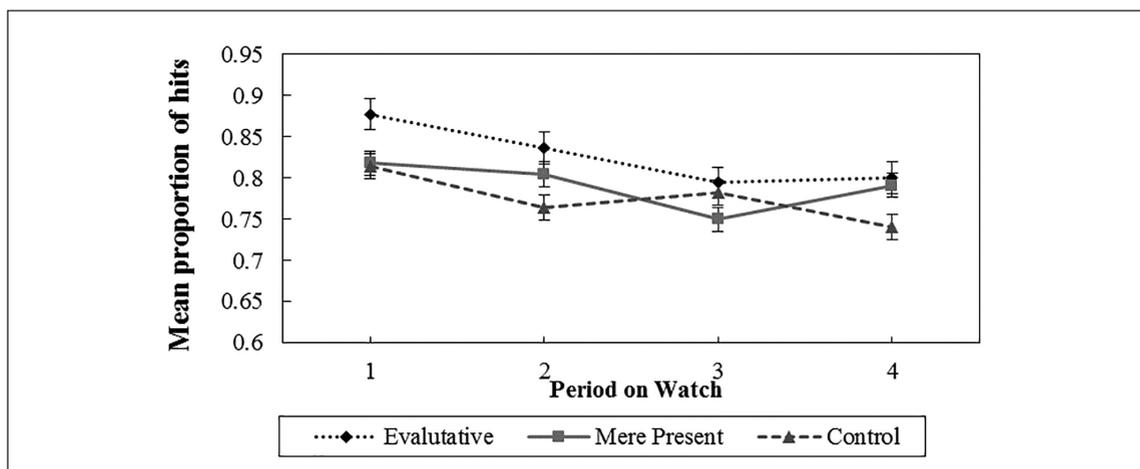


FIGURE 1. Proportion of hits across conditions as a function of period on watch. Error bars are standard error

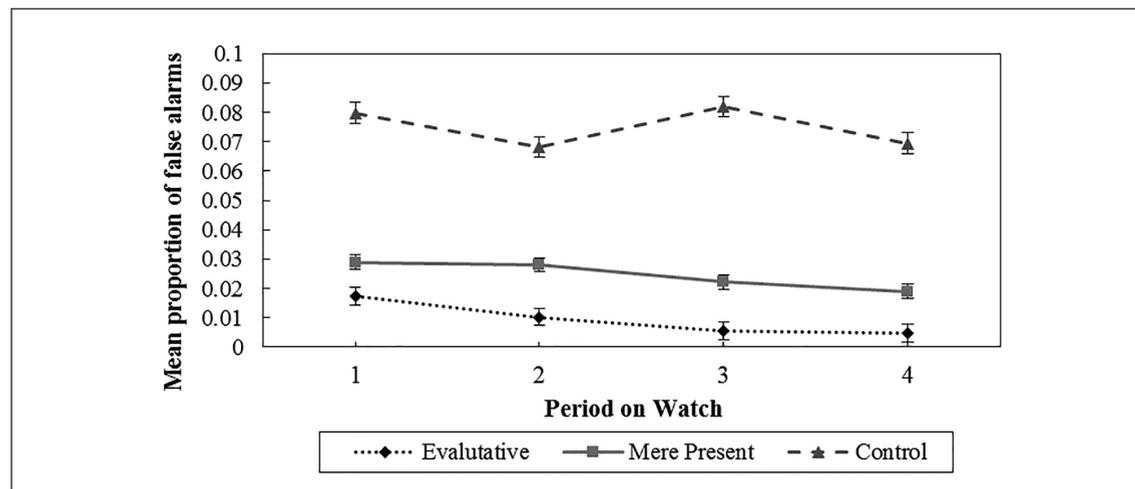
observer present (control) condition. Furthermore, those in the mere presence observer condition did not commit significantly fewer false alarms relative to the no observer present (control) condition ( $p = .061, d = .35$ ). There were no significant differences in the proportion of false alarms between the evaluative observer condition and mere presence observer condition ( $p = .572, d = .39$ ), consistent with the previous literature on social facilitation (Claypoole & Szalma, 2017; Cohen, 1980; Miller et al., 1979; Rittle & Bernard, 1976; Schmitt, Gilovich, Goore, & Joseph, 1986).

To further clarify the effects of condition on false alarms, two orthogonal contrasts were computed. The first contrast compared the two social presence conditions (coefficients of  $-1, 0$ , and  $1$  were used for the mere presence observer, no observer present [control], and evaluative observer conditions, respectively). This contrast indicated that there were no statistically significant differences in false alarms between the two social presence conditions,  $t(129) = -0.532, p = .596$ . The second contrast compared the control condition with the average of the two social presence conditions (coefficients of  $+\frac{1}{2}, -1$ , and  $+\frac{1}{2}$  for the mere presence observer, no observer present [control], and evaluative observer conditions, respectively). This contrast was statistically significant,  $t(129) = -27.230, p < .001$ , indicating that the two social presence conditions combined achieved significantly lower false alarm rates relative to the control condition.

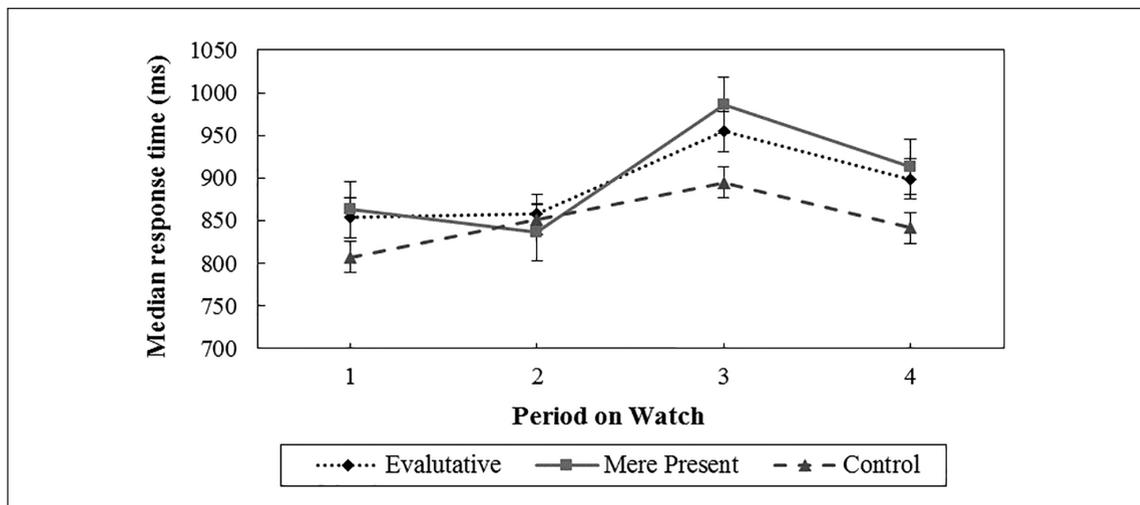
Moreover, the proportion of false alarms decreased significantly across all three conditions as a function of period on watch,  $F(3, 387) = 5.941, p = .001, \eta_p^2 = .044$  (Figure 2), which is typical of traditional vigilance experiments (Warm et al., 2008). The interaction between condition and period on watch was also statistically significant,  $F(6, 387) = 2.208, p = .042, \eta_p^2 = .033$ . Tests of simple effects of period within each condition indicated that participants in both the no observer present (control) condition,  $F(3, 129) = 3.439, p = .019, \eta_p^2 = .074$ , and the evaluative observer condition,  $F(3, 129) = 10.001, p < .001, \eta_p^2 = .189$ , experienced a decline in false alarms as a function of period on watch. Participants in the mere presence observer condition did not experience a significant decline in false alarms as a function of period on watch,  $F(3, 129) = 1.769, p = .156, \eta_p^2 = .040$ . The results indicated that participants in the evaluative observer condition experienced the sharpest decline in false alarms as function of period on watch, which was thus associated with the strongest effects on performance over time.

#### Median Response Time

The results indicated no significant main effect of condition for overall median response time,  $F(2, 130) = 2.601, p = .078, \eta_p^2 = .039$ . Median response time significantly increased across all three conditions as a function of period on watch,  $F(3, 366) = 18.551, p < .001, \eta_p^2 = .132$  (Figure 3). However, the interac-



**FIGURE 2.** Proportion of false alarms across conditions as a function of period on watch. Error bars are standard error



**FIGURE 3.** Median response time (in ms) across conditions as a function of period on watch. Error bars are standard error

tion between condition and period on watch was not significant,  $F(6, 66) = 1.312, p = .251, \eta_p^2 = .021$ .

## DISCUSSION

Social facilitation has been shown to improve performance on a variety of tasks, including cognitive-based (Huguet, Galvaing, Monteil, & Dumas, 1999) and motor-based tasks (Strauss, 2002). However, relatively little is known about how social facilitation affects performance on sustained attention tasks, such as vigilance (Bergum & Lehr, 1963; Claypoole & Szalma, 2017; Putz, 1975; Yu & Wu, 2015). The limited previous research has provided inconsistent results that do not demonstrate clear evidence as to which specific form of social facilitation (i.e., mere presence or evaluative presence) affects accuracy and speeded measures of performance. Thus, the purpose of the present study was twofold: to extend previous research to determine whether the predominant forms of social facilitation (i.e., mere presence and evaluative presence) both improve vigilance task performance and to further explore which measures of performance are most affected by social facilitation.

As predicted, evaluative presence was associated with the strongest effects on performance, such that the overall proportion of false alarms was reduced. The results also indicated that the mere presence of another person did not significantly improve detec-

tion performance, which is consistent with the previous literature (Cottrell, 1972; Guerin & Innes, 1982; Klinger, 1969). However, it is worth noting that the effects of mere presence approached significance, and the effect sizes were similar to those of the effects of evaluative presence. This suggests that perhaps mere presence can improve performance in general, but these effects are weak for tasks that require the maintenance of arousal, such as sustained attention, which is consistent with the results of the previous literature (Claypoole & Szalma, 2017). Because mere presence did not strongly influence sustained attention performance, this further supports the contention that for tasks that require prolonged maintenance of arousal levels, such as sustained attention, mere presence may not be sufficient (Guerin & Innes, 1982). Instead, an evaluative aspect may be needed to influence performance (Cottrell, 1972), especially on tasks that require extended heightened levels of arousal.

Interestingly, there were no significant differences between mere presence and evaluative presence; evaluative presence significantly improved performance only when compared with no social presence at all. Although this is a common result in the previous literature (Claypoole & Szalma, 2017; Cohen, 1980; Miller et al., 1979; Rittle & Bernard, 1976; Schmitt et al., 1986), this finding may occur for two reasons. First, it may suggest that the mere physical presence of another person can influence

performance on other tasks besides sustained attention, such as cognitive or motor-based tasks, and that only in tasks where maintaining arousal is necessary (e.g., sustained attention) is an evaluative presence needed to produce strong effects and maintain performance. Furthermore, perhaps mere presence is an ambiguous social situation (i.e., can a person's mere physical presence truly be viewed as merely present?) (Manstead & Semin, 1980), which suggests that the inconsistent results in the history of social facilitation (i.e., Cottrell et al., 1968; Rittle & Bernard, 1976) may actually be attributed to the inconsistencies in the participants' perceptions of the social presence. For instance, Claypoole and Szalma (2017) found significant results only when they divided their data based on perceptions of their manipulations. This data partitioning resulted in the removal of 75 participants, or approximately 45% of their total sample. This data reduction suggests that a significant number of participants did not believe in the mere presence of the assistant. Thus, mere presence may be an ambiguous social situation that does not produce consistent effects on performance, and therefore an evaluative presence would be more beneficial for consistently improving performance.

In a similar vein, it has been argued that additional factors outside the specific type of presence also mediate the performance effects associated with social facilitation. Explicitly, it has been argued that "the impact on audience presence may well depend on the perceived identity of the audience, its relationship to the individual, the nature of the task being performance, and so on" (Manstead & Semin, 1980, p. 120). Supporting this argument, the present experiment has provided additional evidence that the nature of the task (i.e., sustained attention) is an important factor to consider when exploring how social facilitation affects human performance.

Interestingly, neither form of social facilitation influenced performance in terms of correct detections or response times. Combined with the previous literature, these results suggest that social facilitation may depend on a variety of factors, such as task type, performance measures, and form of presence (Claypoole & Szalma, 2017; Manstead & Semin, 1980). These results have theoretical implications because the dominant theories of social facilitation (Cottrell, 1972; Zajonc, 1965) explicitly operationalize task

performance as the emission of dominant responses. However, in the present task a dominant response should manifest as a correct detection, but performance was improved only when it was operationalized as false alarms (or errors). Clearly, reducing false alarms is not increasing a dominant response, but overall task performance was in fact improved for observers who completed the task with an evaluative observer. Because it has been argued that the notion of a dominant versus a subordinate response is ambiguous at best (Glaser, 1982), perhaps the dominant theories of social facilitation should be amended to include a more descriptive yet broad definition of performance that encompasses accuracy and speed. Moreover, the results of the present experiment suggest that for tasks that require the continuous maintenance of drive levels, mere presence may not be sufficient, which supports Cottrell's (1972) theoretical interpretation of evaluation apprehension.

The present experiment provided further empirical evidence that social presence produces the strongest effects on false alarm performance rather than correct detection or response time performance. Although this result is similar to more recent work on social facilitation and sustained attention (Claypoole & Szalma, 2017), other research has demonstrated that social presence may result in faster response times (Yu & Wu, 2015) or more correct detections (Funke et al., 2016). Because each of these experiments contains unique parameters, future work should seek to replicate the findings reported in the present manuscript and the previous literature to determine whether the unique task parameters presented in each experiment (e.g., type of presence, task type) mediate the performance effects of social facilitation on sustained attention.

As previously discussed, the history of research on vigilance has provided a consistent profile of performance, such that performance decrements occur as a function of time on task (Davies & Parasuraman, 1982; See et al., 1995; Warm et al., 2008), and these performance decrements are the most pervasive findings in vigilance research (Fraulini et al., 2017). The results of the present experiment were consistent with that of the traditional profile of vigilance, such that the proportion of correct detections and false alarms decreased as a function of period on watch, whereas response times increased as a function of period on

watch. In the presence experiment, social presence (i.e., mere or evaluative) did not attenuate the decrement, but overall performance was improved. Thus, although performance still declined as a function of time on task, evaluative social presence was associated with better performance overall, consistent with previous research (Bergum & Lehr, 1963; Putz, 1975).

### Conclusion

In the present study, vigilance task performance was assessed to determine the extent to which two forms of social facilitation, mere presence and evaluative presence, could influence sustained attention. Previous research has suggested that social facilitation may improve vigilance task performance, but little is known about which specific forms of presence affect specific measures of performance (Claypoole & Szalma, 2017; Yu & Wu, 2015). The results of the present study indicated that an evaluative presence was necessary to influence performance on a sustained attention task, such that the proportion of false alarms (i.e., errors) was significantly lower for participants who completed the sustained attention task in the presence of an evaluative observer. Consistent with previous arguments (i.e., Cottrell, 1972; Guerin & Innes, 1982), the present study provides further evidence that an evaluative presence is a necessary component of social facilitation in tasks that require the maintenance of drive levels and attention. Moreover, only false alarms, not response time or correct detections, were affected by social presence. This suggests that social facilitation may not affect all measures of performance equally. Thus, future research should explore which measures of performance are affected by social facilitation on different types of tasks, such as cognitive or motor.

Future work should extend the results of the present study to further evaluate additional forms of social presence, such as co-acting (Cottrell, Rittle, & Wack, 1967; Klinger, 1969) and electronic performance monitoring (Aiello & Douthitt, 2001), especially as it relates to sustained attention and maintaining drive levels. Although social facilitation is a predominant field of study (Bond & Titus, 1983), little is known about how the different implementations of social facilitation affect sustained attention, which, as previously discussed, could be used as an instrument of

improving organizational performance in establishments that require employees to complete sustained attention tasks, such as the Transportation Security Administration (Tiwari, Singh, & Singh, 2009).

### NOTE

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