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Individual differences in performance, workload, and stress in sustained attention: Optimism and pessimism

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ABSTRACT

The relationship between optimism, pessimism and vigilance was investigated as a function of the degree to which different display formats facilitated performance across types of perceptual discrimination. Pessimism was associated with display and task dependent differences in workload, stress, and coping strategy. Optimism by pessimism interaction was observed for stress (Tense Arousal). Neither trait was associated with performance differences. Pessimism, but not optimism, was related to coping strategy independent of experimental condition. The results of this study were more consistent with a coping/cognitive resources perspective on optimism and pessimism than with an explanation based on learned helplessness theory. Further, the data supported the contention that optimism and pessimism are correlated but distinct constructs. The results also underscore the importance of considering both task parameters and person characteristics when evaluating the performance, workload, and stress of sustained attention.

1. Introduction

Vigilance, or sustained attention, refers to the ability to monitor displays over time. Vigilance performance declines with time on watch, in part because cognitive resources available for task performance are depleted at a rate faster than they can be replenished (Parasuraman, Warm, & Dember, 1987). The resource theory explanation is supported by the finding that perceived workload and stress increase as a function of increased task demands (Warm, Matthews, & Finomore, 2008). Several studies of the workload of sustained attention have employed the NASA-Task Load Index (TLX; Hart & Staveland, 1988), a well-regarded measure that provides a global index and the relative contributions of six sources of workload (*Mental Demand*, *Physical Demand*, *Temporal Demand*, *Performance*, *Effort*, and *Frustration*). Research has shown that task characteristics that impair performance also induce high workload, and that the *Mental Demand* and *Frustration* subscales are the largest contributors to these effects (Warm et al., 2008). Stress has been measured using the Dundee Stress State Questionnaire (DSSQ; Matthews et al., 2002), which consists of eleven factor-analytically determined scales grouped into three secondary factors of cognitive state: *Task Engagement*, reflected by scales of Energetic Arousal, Concentration, and two Motivation scales (Intrinsic and Success); *Distress*, consisting of primary factors of Tense Arousal, Hedonic Tone, Self-Esteem, and Control and Confidence; and *Worry*, reflected by scales of Self-Focused Attention and two forms of Cognitive Interference (Task-Related and Task-Irrelevant). Several studies have shown that vigilance is associated with declines in *Task Engagement* and increased *Distress*, and that task factors that impair performance also increase the stress of vigilance (Warm et al., 2008). Further, the limited control observers typically have over the task environment may also be a significant source of stress in vigilance (Hancock, 1998).

Although the effects of vigilance on performance, workload, and stress are robust, large within-group variability is typically observed. Research on the individual differences variables driving this variability have produced mixed results (Berch & Kanter, 1984), and the interactive effects of person and task characteristics have yet to be clearly identified (Szalma, 2008). One skill that may differentiate good performers from poor ones is the capacity to cope with high workload and stress. Traits that influence vigilance may therefore include those related to stress and coping, such as optimism and pessimism. Optimism and pessimism have been defined in terms of differences in expectancies regarding the future, with the former associated with more favorable expectancies than the latter (Scheier, Carver, & Bridges, 1994). Further, optimism and pessimism have been found to be associated with differences in performance and stress response. For instance, using a double median-split approach to categorize individuals as 'optimists' or 'pessimists', Helton, Dember, Warm, and Matthews (1999) reported that although there were no significant differences between

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trait groups in overall performance, pessimists achieve a steeper vigilance decrement and higher levels of post-task stress relative to optimists. Efforts to replicate the performance results have been mixed (e.g., Helton, Matthews, Warm, & Dember, 2005; Szalma, Hancock, Dember, & Warm, 2006), but subsequent experiments confirmed that pessimism is associated with higher levels of stress in vigilance (e.g., Szalma et al., 2006).

One of the major theoretical approaches to explain differences in performance and stress response as a function of optimism and pessimism has been learned helplessness theory (Abramson, Seligman, & Teasdale, 1978), which argues that differences occur because pessimistic individuals have learned to habitually disengage or 'give up' in difficult or demanding situations or when failure occurs. Further, these outcomes are related to two expectations: Outcome (hopeless expectancies) and control (helpless expectancies). These expectancies operate by a diathesis–stress mechanism: Individuals who are pessimistic are more vulnerable to helpless and hopeless responses in stressful situations (Gillham, Shatte, Reivich, & Seligman, 2002). On the basis of learned helplessness theory, Gillham et al. (2002) argued that the positive expectations of optimistic people should facilitate motivation to maintain performance in the face of difficult situations, but that pessimistic expectancies should reduce effort and impair performance.

However, it is possible that individual differences in performance and stress may be due to the different styles of coping (Scheier et al., 1994) and differences in cognitive resources available for task performance (Szalma, 2008). Optimism has been associated with lower stress levels, and greater active or problem/task-focused coping and less avoidant coping, while pessimism has been associated with higher levels of stress, and more emotion-focused and avoidant coping (Scheier et al., 1994). As a result of more active coping, individuals high in optimism may devote more of their resources to task performance, while individuals high in pessimism may have fewer resources to allocate to the task because they are diverting some of their resources to either emotion-focused or avoidant coping efforts to deal with the stress posed by the task demands. Alternatively, it is also possible that more pessimistic individuals have learned ways of engaging in compensatory effort in order to maintain performance. If this were the case, one would expect attenuated performance differences but higher perceived workload and stress as a function of increased pessimism.

The resource theory perspective leads to the prediction that task difficulty should moderate the relation between optimism, pessimism, and performance, workload, and stress, such that individuals higher in pessimism and lower in optimism should exhibit greater performance decrements and increased workload and stress as task difficulty is increased. However, task characteristics that facilitate performance (e.g., render the perceptual discrimination easier) should have a larger positive effect on individuals higher in pessimism and lower in optimism, because such individuals presumably have fewer cognitive resources to devote to the task and will therefore benefit more from a manipulation that reduces the resources required for performance. By contrast, the helplessness theory leads to the prediction that imposition of a difficult vigilance task, in which observers have little or no control over task parameters (Hancock, 1998), should elicit helplessness appraisals across task conditions, so that individuals higher in pessimism will show similar patterns of performance, workload, and stress response regardless of task/display characteristics.

In vigilance research one of the most potent determinants of task difficulty is signal salience. High salience has been found to improve performance and relieve the workload and stress of sustained attention (Warm et al., 2008). One way in which signals can be made more salient is via the use of configural displays, which utilize easily perceived features that improve performance for tasks requiring integration of information (Bennett & Flach, 1992). Such displays work in part because the elements form an easily perceivable, integrated feature that 'pops out' and is much more salient than displays with separated elements without such feature integration. A previous study found that use of a configural display was associated with an attenuated vigilance decrement, possibly due to enhanced signal salience (Szalma et al., 2006). Hence, use of these display formats for tasks requiring integration of information may improve performance and reduce workload and stress. By contrast, cases in which display features do not support the discrimination requirements of the task should have substantially lower signal salience, and individuals higher in pessimism and lower in optimism may show greater vulnerability to performance impairment and increased workload and stress. The current study evaluated this possibility by manipulating display format and the degree to which it facilitated the perceptual demands of the task (i.e., the difficulty of the discrimination). Based on resource theory, it was expected that in the more demanding task conditions (in which the display format is not well suited for the perceptual discrimination required) pessimism should predict more emotion-focused coping and avoidant-coping, higher stress levels, and greater perceived workload. Higher levels of optimism should predict greater task-focused and less emotion-focused and avoidant coping, and lower levels of workload and stress. In the easier conditions the benefits of a display format that facilitates performance should be greater for those higher in pessimism and lower in optimism. Based on previous research (Helton et al., 1999), if there are performance differences as a function of traits it will likely manifest in changes over time, such that increased pessimism should be associated with a steeper decrement and optimism should be related to an attenuated decrement in the more demanding conditions.

2. Method

This study was designed to examine both group and individual differences. The group differences are summarized elsewhere (Szalma, 2002); this report focuses on investigation of individual differences. Hence, only general information regarding the experimental procedure and the tasks is reproduced here.

2.1. Participants

Ninety-six undergraduates (48 men and 48 women) at a northeastern US university participated in the study in exchange for course credit. They ranged in age from 18 to 46 years old, with a mean of 20.8 years.

2.2. Experimental design

Two levels of task-type (dot-figure distance monitoring vs. midpoint identification) were factorially combined with three display types: Bar-graph with different baselines (BGDB), bar-graph with a common baseline (BGCB) and a polygon-graph (PG), yielding six experimental groups. The BGCB and PG displays facilitate performance on midpoint identification tasks, but do not support performance on tasks requiring discrimination of separate display elements (Bennett & Flach, 1992). The BGDB display does not facilitate performance on either task. Sixteen observers were assigned at random to each of the six conditions, with the restriction that the groups were equated for participant sex.

2.3. Displays and tasks

The displays employed were adapted from those used in previous research (see Bennett & Flach, 1992), and are shown in Fig. 1. In the midpoint identification task input and output values in the bar-

graph displays were represented by the heights of the rectangles. Neutral events were cases in which the height of the output bar was the average of the heights of the two input bars, and critical signals were cases in which the height of the output bar was higher or lower than this average. In the polygon display inputs and outputs were defined as the distance from the bottom to the top of the polygon under each dot. Neutral events were cases in which the output was the average of the two inputs, but for this display the perceptual feature was the linearity of the top of the polygon. Critical signals were cases in which this linearity was broken (see Fig. 1). In the dot-distance monitoring task input and output values were represented as the vertical distance of each black dot from its respective rectangle or from the polygon. Neutral events were cases in which all three dots were an equal distance from their respective rectangles, and critical signals were cases in which one of the three dots was closer than the others to its rectangle. For both tasks the participants were instructed to respond whenever a critical signal appeared on the screen. In all conditions, stimuli were presented at a rate of 26 events/min. Twelve critical signals appeared at random intervals during each of the four 6 min periods on watch [p(signal) = .08]. Observers responded by pressing the spacebar on a computer keyboard. Responses occurring within 1.5 s after the onset of a critical signal were recorded as correct detections. All other responses were recorded as false alarms.

2.4. Measurement of dependent variables

Performance was measured using signal detection theory indices of perceptual sensitivity (A') and response bias (β''_D). Sensitivity measures accuracy in discrimination of signals from non-signals, and response bias is an index of response criterion (how willing the observer is to make an affirmative response regarding the presence of a critical signal). Perceived workload was assessed using the NASA-TLX, and self-reports of stress were assessed using the DSSQ. The DSSQ also includes three coping scales that assess the degree to which an individual engages in task-focused coping, emotion-focused coping, and avoidant coping. Optimism and pessimism were measured using the Optimism/Pessimism Inventory developed by Dember and his colleagues (see Dember, 2002). Scores can range from 18 to 72. As optimism and pessimism are likely to be partially independent constructs (Dember, 2002), the instrument yields separate scores for optimism and pessimism.

3. Results

The descriptive statistics for Optimism (M = 53.83; SD = 5.14; coefficient α = .71) and Pessimism (M = 37.97; SD = 6.66; coefficient α = .80), and the correlation between the scales (r = −.52, p < .001), were similar to those obtained from prior samples using

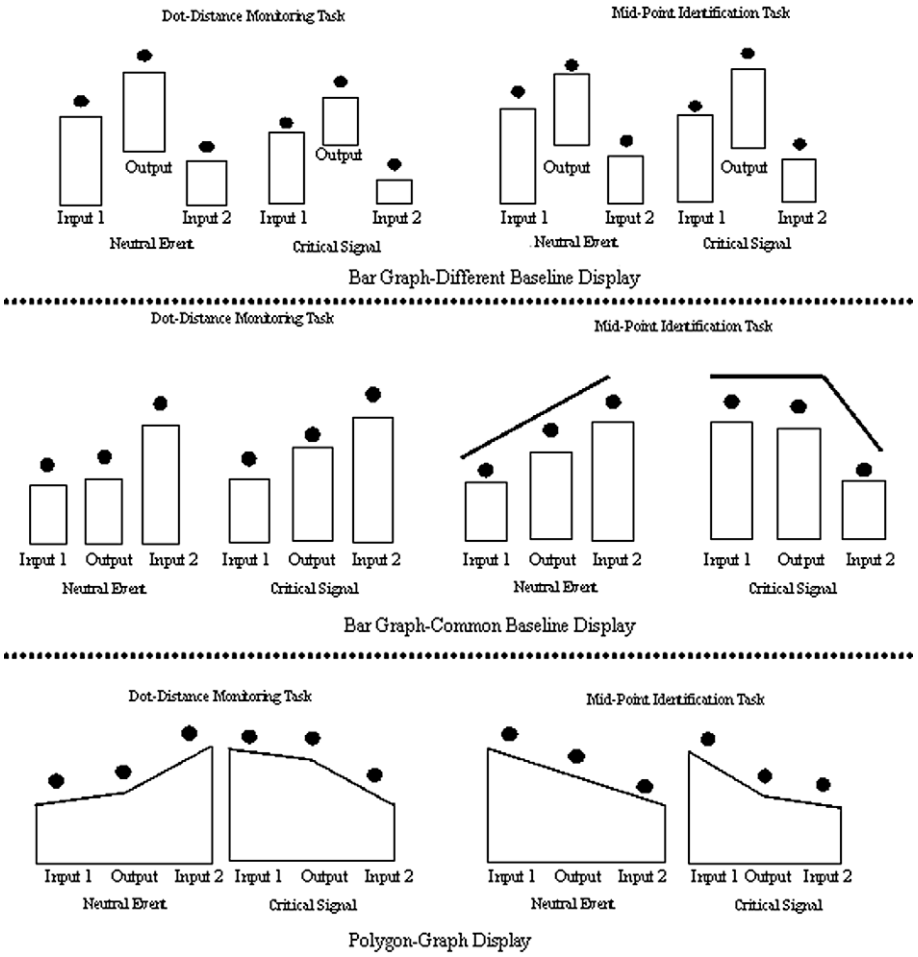

Fig. 1. Displays employed in the present experiment. In each case the output is in the middle, flanked by the two inputs. The lines above the rectangles in the bar graph-common baseline display indicate the emergent feature. Critical signals were cases in which the linearity of the three rectangles was broken. In the Mid-point identification task participants were instructed to ignore changes in the distance of each dot to the bar or polygon. In the dot-distance monitoring task, participants were informed to ignore changes in the heights of the bars or shape of the polygon. *Note*. The labels in each display and the lines above the rectangles are for illustrative purposes and were not present during the task.

Table 1
Summary of hierarchical regression variables.

Step in regression	Variables added
1	Task, display, task × display
2	Pessimism, optimism
3	Task × pessimism, task × optimism, display × pessimism, Display × optimism, pessimism × optimism
4	Task × display × pessimism, task × display × optimism
5	Task × display × pessimism × optimism

Table 2
Summary of optimism and pessimism regressions ($N = 96$).

Criterion	Step	Variable	R^2	ΔR^2	p	β	p
Global workload	3	T × P	.29	.14	.042	−2.06	.005
Mental demand	3	PG × P	.32	.16	.013	−2.00	.018
Effort	3	T × P	.29	.16	.020	−2.38	.020
Pre–post stress							
Distress							
Tense Arousal	3	Opt × P	.25	.20	.007	−1.98	.006
Worry							
Cognitive interference Task-Related	3	T × P	.21	.18	.015	−1.74	.022

Note: T = Task type; P = Pessimism; Opt = Optimism; PG = Polygon graph display.

this instrument (Dember, 2002). Task and trait effects were evaluated using hierarchical regression (Pedhazur, 1997).

The variables entered at each step are shown in Table 1. Note that step 1 is equivalent to an ANOVA of independent variable effects, which are reported elsewhere (Szalma, 2002). Significant product vectors were tested using the Johnson-Neyman procedure for simultaneous regions of significance using a criterion of $\alpha = .15$ (Pedhazur, 1997). To control for Type I error, evaluation of the product vector regression coefficients was done using the modified Bonferroni correction described by Jaccard and Turrisi (2003). Statistics for the steps with statistically significant ΔR^2 values and product vectors are summarized in Table 2.

3.1. Performance

Regressions of performance (sensitivity and response bias) were performed in two ways: (1) an overall score based on the entire vigil; and (2) a difference score between the first and last periods on watch. The regressions of overall A' and change in sensitivity did not result in significant ΔR^2 values. Similar regressions for β''_D indicated no significant effects for product vectors involving either trait.

3.2. Global workload

A significant ΔR^2 was observed at step 3, with a significant task by pessimism regression coefficient (Fig. 2). The midpoint identification task induced less workload than the dot-distance task for individuals with pessimism scores in the middle-to-high range.

3.3. Workload scales

Significant regressions were observed for weighted mental demand and weighted effort. The other scales showed no significant effects related to pessimism.

3.4. Mental demand

A significant ΔR^2 was obtained at step 3, with a significant PG display by pessimism regression coefficient (Fig. 3). The PG display was less mentally demanding than the BGDB display for individuals in the middle to upper range of pessimism.

3.5. Effort

A significant ΔR^2 was obtained at step 3, with a significant task by pessimism regression coefficient (Fig. 4). The midpoint identification task induced less workload than the dot-distance task for individuals with pessimism scores in the middle-to-high range.

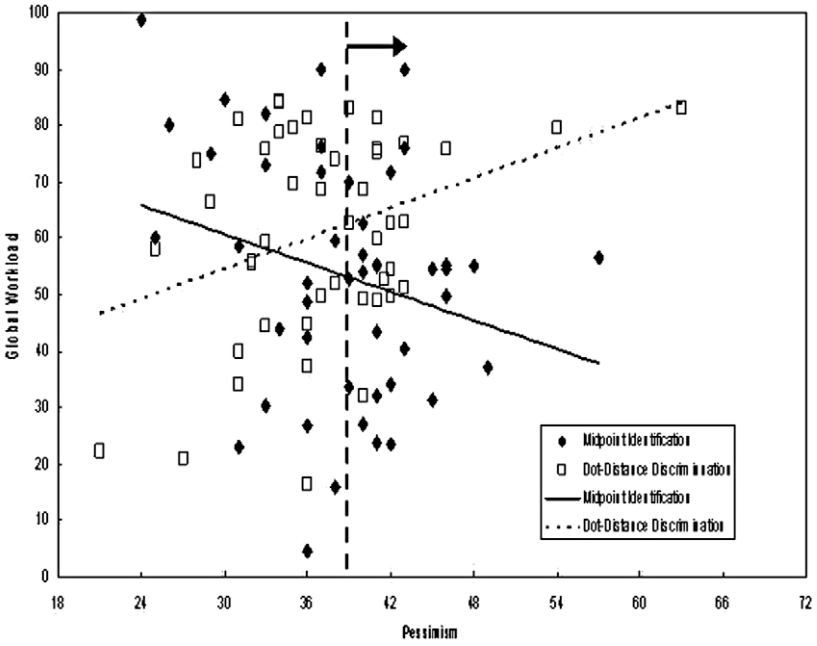

Fig. 2. Global workload as a function of pessimism and task type. *Note*. The dotted vertical line and the arrow indicate the significant region of group differences in global workload.

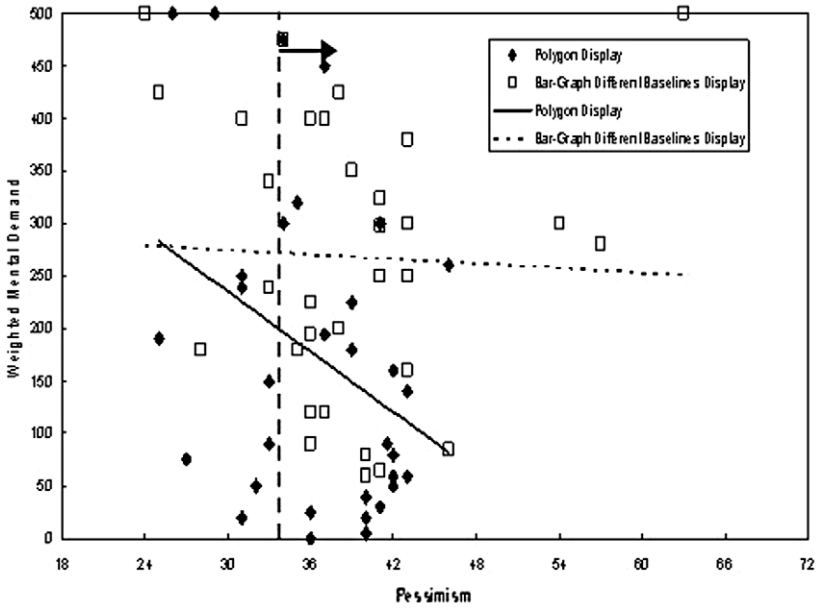

Fig. 3. Weighted mental demand as a function of pessimism and display type. *Note*. The vertical dotted line and the arrow indicate the region of significant group differences in weighted mental demand.

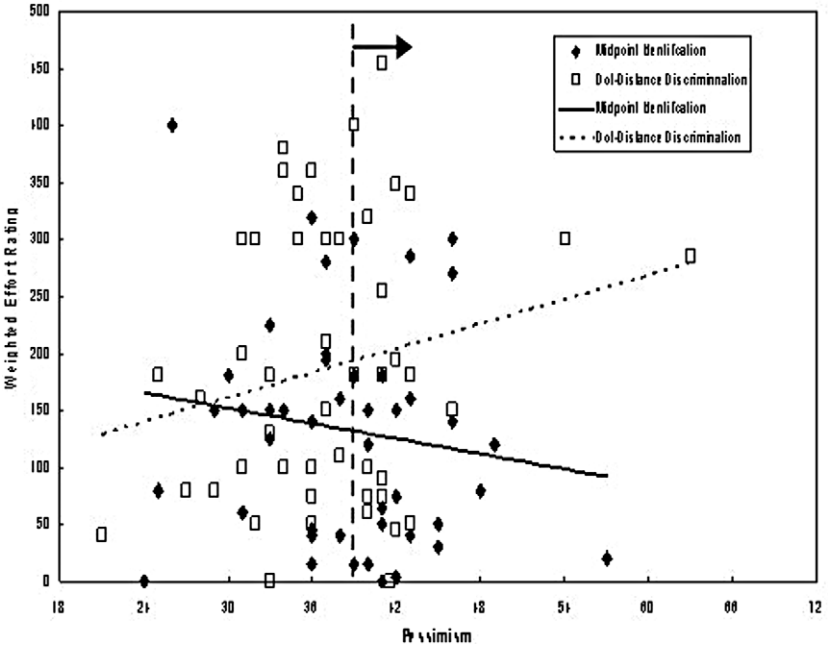

Fig. 4. Weighted Effort as a function of pessimism and task type. *Note*. The vertical dotted line and the arrow indicate the region of significant group differences in weighted effort.

3.6. Pre–post task stress state

A significant ΔR^2 was observed for pre–post change in Tense Arousal at step 3, with a significant optimism by pessimism regression coefficient. Hence, the relationship between Tense Arousal and each trait varied as a function of the other trait. Following procedures described in Jaccard and Turrisi (2003), optimism and pessimism data were mean-centered and 'high' and 'low' levels of optimism defined in terms of scores one standard deviation above and below the optimism mean, respectively. Separate regression functions were computed for pessimism at each level of optimism (Fig. 5). Across all experimental conditions, pessimism predicted increased pre–post task Tense Arousal only for individuals relatively low in optimism. For individuals relatively high in optimism the reverse trend was observed: higher pessimism scores were associated with a pre–post *decline* in Tense Arousal.

For Task-Related Cognitive Interference, a significant ΔR^2 was obtained at step 3, with a significant task by pessimism regression coefficient (Fig. 6). The Johnson-Neyman procedure failed to yield a solution, which can occur when the within-groups error variance is sufficiently large to procedure a negative value for the square root operation of the function (Pedhazur, 1997). Separate regressions

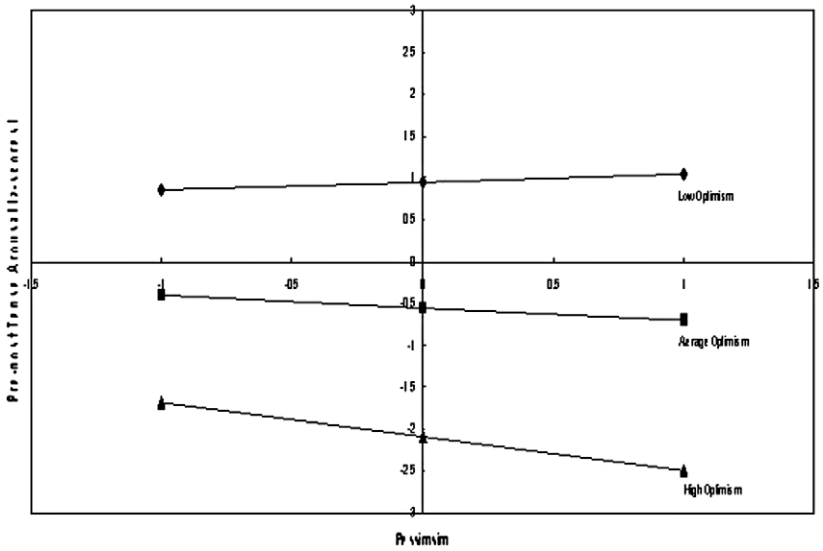

Fig. 5. Pre-post change in tense arousal as a function of pessimism at three levels of optimism. *Note*. Scores are mean-centered. Each line represents the regression of tense arousal on pessimism when the level of optimism is set at its mean or +/− 1 SD above or below the mean. Each regression line was generated by entering three values for pessimism: −1 (one SD below the mean for pessimism), 0 (pessimism mean), or +1 (1 SD above the mean for pessimism).

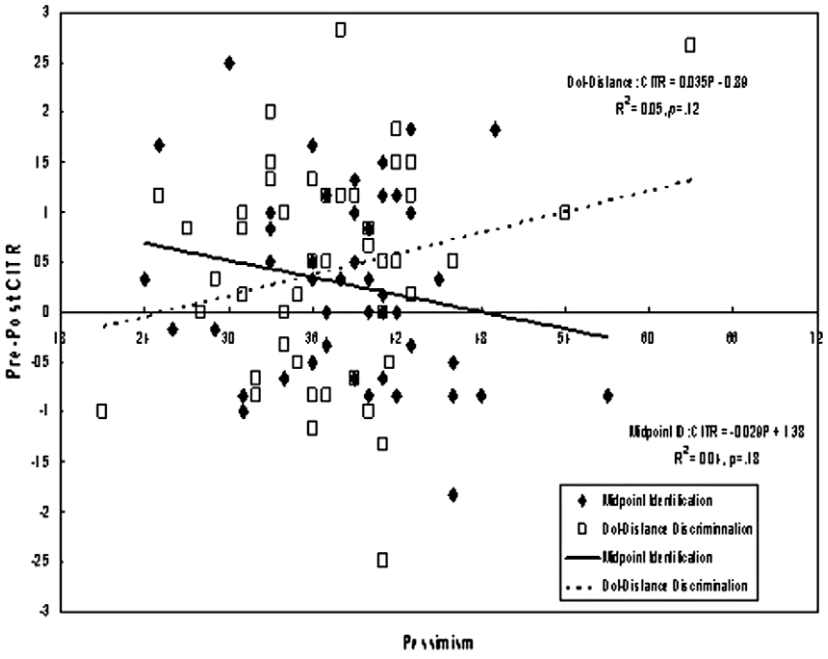

Fig. 6. Pre-post change in Cognitive Interference-task related as a function of pessimism and task type. *Note*. No region of significant group differences is indicated because the Johnson-Neyman procedure failed to yield a solution. The separate regression equations for each task type are shown in the Figure. CITR = Cognitiver Interference-Task Related.

were computed for the two tasks, but neither regression was statistically significant.

3.7. Coping measures

There were no significant product vectors involving the experimental conditions for any of the coping measures. A regression for emotion-focused coping yielded a significant regression coefficient for pessimism, $\beta = .26$, $p = .02$, $R^2 = .10$, but not for optimism or the product vector. Increased pessimism was associated with more emotion-focused coping (Fig. 7). There were no statistically significant regressions for Task-focused or Avoidant coping.

4. Discussion

The purpose for this study was to evaluate the joint effects of task and person characteristics on the performance, workload and stress associated with vigilance. Consistent with previous research, pessimism and optimism did not significantly impact overall performance (Szalma et al., 2006). However, these traits also did not predict change in performance as a function of time on watch. These results conflict with those of Helton et al. (1999), who reported a steeper performance decrement for pessimists. However, there are important differences between Helton et al. (1999) and the study reported herein. First, Helton and his colleagues em-

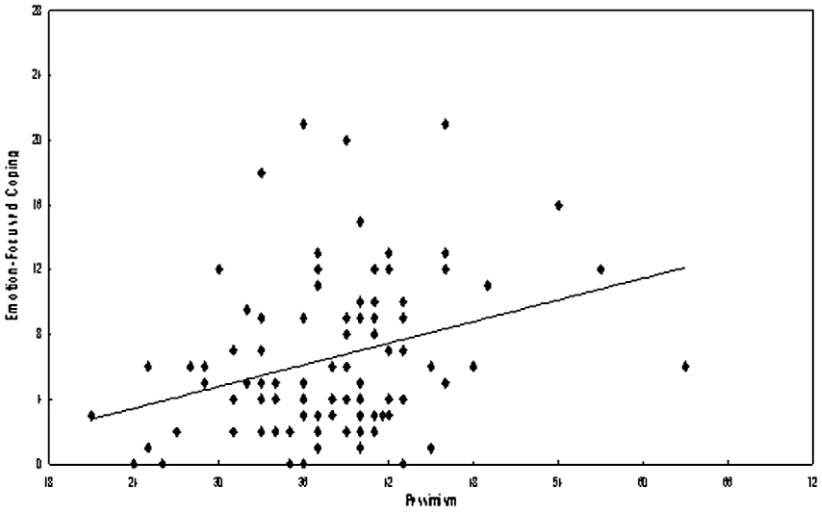

Fig. 7. Emotion-focused Coping as a function of Pessimism.

ployed a double-median split to derive a group of optimists and a group of pessimists. By contrast, a hierarchical regression approach was employed in this study. Second, the task used by Helton et al. (1999) was a very demanding 12-min vigil with a very high event rate (58 events/min) and a very difficult perceptual discrimination. The tasks in this study were longer (24-min), the event rate was much lower (26 events/min) and the perceptual discriminations were likely easier than those employed by Helton and his colleagues. It may be that pessimism and optimism effects on performance emerge only under the most demanding task conditions.

4.1. Workload

The pessimism-workload relationship varied as a function of task and display format. The dot-distance task was associated with higher global workload and effort than the midpoint identification task for those higher in pessimism. The PG display induced less mental demand at higher levels of pessimism. Consistent with prediction, the PG display was more beneficial to pessimists (lower mental demand), possibly by freeing resources for allocation to the discrimination demands. However, contrary to expectation, this benefit was observed only for one of the configural displays, and this effect was observed for *both* tasks (i.e., regardless of whether the display supported the perceptual discrimination). This suggests that the PG display aids individuals higher in pessimism by freeing resources for general, non-specific (i.e., discrimination requirements) processes associated with sustained attention. The greater effort required in the dot-distance discrimination task may reflect the need to scan the display for each distance and make a quick comparative judgment. By contrast, the midpoint identification task consisted of stimulus elements that were larger, rendering the comparative judgment easier and therefore requiring less compensatory effort. Note, however, that significant differences were observed only for those relatively high in pessimism. It may be that these differences emerge only for those higher in pessimism because these individuals have fewer cognitive resources (perhaps due to emotion-focused coping to deal with negative affect) to allocate to the task, and must exert more effort to recruit more resources to meet task demands.

4.2. Stress

Pessimism was associated with pre–post changes in Tense Arousal, but the effect depended on optimism, such that increased pessimism was associated with increased Tense Arousal only for individuals who were also low in optimism. Indeed, higher pessimism scores predicted *lower* Tense Arousal among individuals high in optimism. Thus, the negative effects of pessimism on task-induced tension may be mitigated if the person is high in optimism. Tense Arousal is a facet of the broader state of *Distress*, reflecting a core relational theme of capacity overload (Matthews et al., 2002). These results are consistent with previous research which has found that higher pessimism is associated with higher *Distress* (Helton et al., 1999; Szalma et al., 2006). There may be variations in the stress–pessimism relationship as a function of the cognitive processes required for task performance, but pessimistic individuals' experience using compensatory effort to deal with general life stress may aid them for dealing with the stress of vigilance (e.g., by emotion-focused coping) under some task conditions. It may be that pessimistic individuals who are also high in optimism have more cognitive resources available for coping, relative to those who are low in optimism.

For Cognitive Interference there was a non-significant trend for pessimism predicting increased cognitive interference in the dot-distance task but *reduced* interference in the midpoint identification task. The greater effort reported by individuals higher in pessimism may have been due to the cognitive interference they were experiencing as they scanned the distance of each dot for comparison. The midpoint identification task, with its larger display elements to be monitored, may have required fewer cognitive resources for those higher in pessimism, thereby reducing the potential for cognitive interference to exert an effect. However, this interpretation should be considered as highly speculative, given the uncertainty regarding the statistical reliability of the results.

4.3. Coping

Pessimism was associated with more emotion-focused coping across conditions, but neither optimism nor pessimism was associated with task-focused or avoidant coping strategies. These results may be due to the generally aversive nature of vigilance tasks, in which observers are compelled by an external authority (experimenter in laboratory, or a supervisor in work settings) to monitor displays with little or no control over task parameters (Hancock, 1998). Hence, even optimistic individuals may fail to use task/problem-focused coping strategies, as they tend to use such strategies only when they perceive the situation as controllable. Their

use of this coping strategy declines when they do not believe it will be effective (Aspinwall, Richter, & Hoffman, 2002).

4.4. Theories of optimism and pessimism

With respect to theories of optimism/pessimism, the results of the current study are more consistent with the view that optimistic and pessimistic individuals differ in their coping styles (Scheier et al., 1994) and in the amount of cognitive resources available for allocation to the task (Szalma, 2008). The evidence does not support the learned helplessness perspective, which predicts that individuals high in pessimism and low in optimism should be more likely to 'give up' in the face of demanding tasks with limited control over task conditions. However, in the context of more difficult perceptual discriminations individuals in this study who were high in pessimism exhibited *greater* compensatory effort, reflected in higher global workload, effort, and Tense Arousal. These findings do not imply that more pessimistic individuals ubiquitously 'give up' by responding with helplessness behavior. Instead, it may be that individuals higher in pessimism show workload and stress effects only when compensatory effort is not sufficient (or there are insufficient resources to devote to such efforts due to their greater reliance on emotion-focused coping to deal with their negative affect) to overcome the demands of the task (e.g., the dot-distance task; the BGDB display). When the display is organized such that perceptual discriminations are facilitated (i.e., made easier), a greater reduction in workload is observed for more pessimistic individuals, but at a cost of increased stress. It may be that the greater effort and workload reflect effortful recruitment of resources to compensate for the reduced capacity resulting from their negative affect and emotion-focused coping strategies, resulting in maintaining performance levels similar to those lower on the trait. This interpretation is tempered, however, by the finding that pessimism and optimism were unrelated to task-focused coping in this study.

An alternative explanation for the results of this study may be differences between optimists and pessimists in their stress appraisals. Pessimistic individuals tend to appraise events as being beyond their control, while optimistic individuals are more likely to believe they can cope with demands (Dember, 2002; Scheier et al., 1994). The differences in perceived workload and stress for those higher in pessimism may be due in part to greater accuracy in their appraisals of task demands. Future research should explore this possibility, perhaps by manipulating the degree of control observers are allowed over task characteristics.

5. Summary and conclusions

The results of this study indicate that optimism and pessimism are differentially related to the workload, stress, and coping response associated with sustained attention and that for pessimism these relations depend on task parameters to some degree. Pessimism was more strongly related to the criterion variables than optimism, supporting the contention that optimism and pessimism are correlated but distinct constructs (Dember, 2002). Further, the relationship between person and task characteristics changes as a function of the different dimensions of workload and stress. Hence, there is a complex pattern of relationships among task characteristics, person characteristics, and dependent variables measured that should be investigated further.

A significant challenge for future research will be to integrate theoretical models of traits with those of the cognitive processes associated with performance, workload, and stress. While there is work that addresses this issue (for a review see Szalma, 2008), there is an acute need to incorporate the cognitive patterning of traits into resource theory models of performance and stress. Integration of theories of personality, stress, coping, and cognition (e.g., sustained attention) is necessary to address these complex relationships. The current study provides a small vista to view this complex landscape by providing further evidence that pessimism is associated with the performance, workload, and stress of sustained attention.

This study also demonstrates that establishing a set of predictive equations for selection of operators with superior vigilance skills may be difficult, as the association of pessimism with the criterion variables depends on task parameters. Rather than deriving selection procedures for vigilance, researchers and practitioners should consider incorporating individual differences research into design principles that will improve the utility of displays for all operators and permit modification of training procedures to fit the needs of the individual (e.g., stress coping for certain kinds of display formats/task demands). For such efforts to succeed, however, will require more complete models of sustained attention (and cognition generally) that include mechanisms for the joint effects of person and tasks characteristics. Development of such models represents a major challenge for future research.

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