THE ROLE OF CHOICE AND INDIVIDUAL DIFFERENCES IN THE MITIGATION OF NOISE AND TASK STRESSORS ON VIGILANCE

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The present study investigated the effects of perceived control over aspects of a task (difficulty) on stress and workload in a vigilance task. Additionally, individual differences in dispositional factors and coping strategy chosen by the operator were considered. Prior research has indicated that pessimism has an effect on the level of experienced stress. Additionally, coping strategies have been linked to stress and workload ratings in a variety of tasks (Matthews & Campbell, 1998). While these factors have been investigated independently, as is frequently the case, their complex interaction has remained unaddressed. In the study, we found that optimism was negatively related to task engagement, though it was positively related to distress. Additionally, it was found to be a predictor of task-focused coping behaviors. More conscientious people were less likely to engage in task-focused or emotion-focused coping. Those who were less pessimistic tended to have heightened worry over the task.

INTRODUCTION

Individual differences in operator characteristics influence vigilance performance and the stress experienced by people engaged in such tasks (Berch & Kanter, 1984; Helton, Dember, Warm & Matthews, 1999). Some of those differences, such as personality traits and response strategy, have been shown to influence perceived workload on a variety of tasks (Damos, 1988). One of the goals for the present investigation was to extend the findings of Szalma (2002) on the impact of dispositional pessimism, and differences in the coping strategies observers employ, on stress and workload of vigilance. In this study these effects were extended to included noise stress and the impact of perceived control on the workload of stress and vigilance. Following Dember, Galinsky, and Warm (1992), perceived control was manipulated by providing participants the illusion that they could choose the difficulty level of the vigil. Dember and his colleagues observed that such a manipulation attenuated the vigilance decrement, and it is possible that perceptions of control may also reduce the workload and stress of vigilance.

Pessimism and Performance

In addition to predicting stress-state, Szalma (2002) also observed an impact of pessimism on coping strategies adopted by observers. As Matthews and Campbell (1998) have noted, the study of coping strategies for dealing with workload and stress has received little attention in human factors. To address this gap, they developed a coping inventory for task stressors (CITS) for immediate post-task assessment of coping strategies that individuals use. Three strategies were identified based upon Lazarus and Folkman’s (1984) transactional theory of stress. These are task-focused coping, in which the individual copes with stress through behavior aimed at changing the stressful situation, emotion-focused coping, which is directed at changing one’s emotional response, and avoidance-focused coping, in which the individual diverts attention away from the task. Individuals high in pessimism tend to engage in emotion-focused coping, while optimists tend to use task-focused coping (Scheier & Carver, 1987). Moreover, while Helton and his colleagues (1999) did not directly measure coping strategy, their findings that pessimists reported higher levels of distress and less task engagement suggest that pessimists were employing emotion-focused coping, since post-task distress implies that form of coping, and optimists were more likely to use task-focused coping, since higher task engagement implies use of that strategy (Matthews & Campbell, 1998). Indeed, Szalma (2002) observed that pessimists were more likely to engage in emotion-focused coping, although that variable did not predict the degree of task or avoidant coping adopted by operators.

Stress State and Performance

Matthews and Campbell (1998) observed consistent patterns of correlation among coping strategies and the post-task stress states of observers, as measured by the Dundee Stress State Questionnaire (DSSQ), a multi-dimensional instrument for assessing transient states associated with mood, arousal, and fatigue (Matthews, et al., 1999). The DSSQ consists of 10 factor analytically determined scales, which load onto three secondary factors that reflect the individual’s stress state. Three of the scales reflect Task-Engagement (energetic arousal, motivation, and concentration), three scales
constitute the dimension of Distress (tense arousal, confidence and control, and hedonic tone), and four scales define the dimension of Worry (self-focused attention, self-esteem, task relevant cognitive interference, and task-irrelevant cognitive interference). Matthews and Campbell (1998) observed that task-coping correlated with energetic arousal and motivation, indicating greater task-engagement, while emotion-focused and avoidance-focused coping were both related to increased worry, reflected by both kinds of cognitive interference. Emotion-focused coping was also linked to higher tense arousal and lower hedonic tone (increases in distress), while avoidance-focused coping was linked with a drop in energetic arousal (lower task-engagement). In view of these findings, a goal for this study was to investigate how differences in pessimism and optimism impact the stress associated with vigilance tasks. The main hypotheses were that:

- Those who experience noise conditions will be more distressed and less engaged than those who do not, but the effect will be attenuated by having perceived control.
- Pessimists will show increased distress and lower task engagement than optimists.
- Pessimists will be more likely to engage in emotion-focused coping, while optimists will be more likely to engage in task-focused coping.

METHOD

Participants

Forty-four undergraduate Psychology students (22 female, 22 male) from a southeastern university participated in the study for extra credit. The students ranged in age from 18 to 45 with a mean age of 23.21. All participants had normal or corrected-to-normal vision.

Instruments

Adjective Checklist. The adjective checklist is based on the Big Five Factor Theory of Personality. The participants are asked to respond to how representative they feel the adjectives are to themselves. The five constructs measured are extraversion, conscientiousness, agreeableness, neuroticism, and openness to experience.

DSSQ. The Dundee Stress State Questionnaire (DSSQ) (Matthews et al., 1999) is a 104-item multidimensional self-report instrument for assessing transient states. Specifically, the DSSQ is made up of eleven sub-scales measuring Energetic Arousal, Tense Arousal, Hedonic Tone, Motivation, Self-focused Attention, Self-Esteem, Concentration, Confidence and Control, Task Relevant Interference, and Task Irrelevant Interference. These ten scales load onto three secondary scales: distress, worry, and task engagement.

OPI. The Optimism-Pessimism Index (Dember et al., 1989) is a fifty-six-item questionnaire (eighteen items indicating optimism (O), eighteen items indicating pessimism (P), and twenty filler items) that directly taps expectations. Respondents are asked to rate their agreement with the items using a four-point Likert-type scale ranging from 1 (strongly agree) to 4 (strongly disagree). Unlike other measures of optimism-pessimism (such as the ASQ and LOT), the O/P measures pessimistic tendencies separately from optimistic tendencies. In the initial study with this instrument (Dember et al., 1989), the items on the O scale had a coefficient alpha of .84. The items on the P scale had a coefficient alpha of .86. In another study (Dember and Brooks, 1989), O had a test-retest reliability correlation of .75 over a two-week interval, and P a test-retest reliability correlation of .84.

Procedure

Upon arrival, participants were given an informed consent form, which they read and signed before proceeding. Following the informed consent, participants took the OPI, the Adjective checklist, and the pre-task DSSQ. They worked through a 15-minute practice session of the task, which gave them response-based feedback of hit, miss, or false alarm. No feedback was given for correct rejections. The twenty participants were then assigned at random to one of the four conditions: control-noise, control-silent, choice-noise, and choice-silent. Choice was manipulated by asking the participant if they would like an easy task or a hard task. This was followed by a 30-minute vigilance task, based on one of the focused attention tasks from Szalma’s (2002) study, which was divided into four continuous 7.5-min periods of watch. Immediately following the task, participants completed the post-task version of the DSSQ.

Noise

In the present study, noise was used as an environmental stressor in half of the conditions. For this experiment, noise was presented in 1 second bursts of white noise that were presented through a Creative Labs Audigy sound card to Sennheiser HD270 headphones at 90 dB. The gaps between noises were randomized, ranging from 10 seconds to 75 seconds.

RESULTS

In addition to the Individual Differences variables discussed earlier, the impact of two experimental manipulations (noise and choice) was included in the regression analyses. The influence of personality, noise, and choice was evaluated via regression, using dummy coding for the categorical variables.

Noise and Choice

With regard to the state-based stress measures, the only dimension noise influenced was change in distress from pre-task to post-task. An interaction between noise and pessimism was found to predict distress, F(3,40)=6.291, p=.024. An additional interaction between choice and optimism was also found to predict distress, F(3,40)=6.618, p=.019. Separate regression analyses for noise and no noise conditions of the data, seen in Table 1, revealed that when noise was absent, those people who were pessimistic were less distressed. This difference is absent when noise is present. Separate regression
analyses for choice and no choice conditions, seen in Table 2, showed that those high in optimism tended to be more distressed when they did not have choice, though this effect is eliminated when they are given choice.

Table 1. Summary of Regression Analysis for Pessimism predicting Distress, for each Noise condition.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>P (no noise)</td>
<td>-1.14</td>
<td>.029</td>
<td>-1.736</td>
<td>&lt;.0005*</td>
</tr>
<tr>
<td>P (noise)</td>
<td>-.014</td>
<td>.056</td>
<td>-.056</td>
<td>.805</td>
</tr>
</tbody>
</table>

Note: * p<.05  # .1>p>.05

Table 2. Summary of Regression Analysis for Optimism predicting Distress, for each Choice condition.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>O (no choice)</td>
<td>.176</td>
<td>.064</td>
<td>.526</td>
<td>.012*</td>
</tr>
<tr>
<td>O (choice)</td>
<td>.061</td>
<td>.040</td>
<td>.328</td>
<td>.136</td>
</tr>
</tbody>
</table>

Note: * p<.05  # .1>p>.05

Pre- and Post-Task Stress State

Results of regression analyses of each pre-task stress state on personality measures and pre-vigil stress state are shown in Tables 6-8. Optimism significantly predicted the use of task-focused coping, with those who scored higher in optimism being more likely to utilize task-focused coping strategies.

Pre-task engagement significantly predicted avoidant focused coping, with those who were less engaged being more likely to employ avoidant coping strategies.

Conscientiousness was a significant predictor of both task-focused and emotion-focused strategies, with those scoring higher in conscientiousness being less likely to use either task or emotion-focused coping strategies.

Table 6. Summary of Regression Analysis for Variables Predicting Task-focused Coping.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>.421</td>
<td>.203</td>
<td>.419</td>
<td>.046*</td>
</tr>
<tr>
<td>Pessimism</td>
<td>-.050</td>
<td>.172</td>
<td>.055</td>
<td>.770</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>-.088</td>
<td>.037</td>
<td>-.336</td>
<td>.024*</td>
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<tr>
<td>Extraversion</td>
<td>-.002</td>
<td>.031</td>
<td>-.011</td>
<td>.938</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>.001</td>
<td>.046</td>
<td>.004</td>
<td>.982</td>
</tr>
<tr>
<td>Pre-Distress</td>
<td>-.988</td>
<td>1.052</td>
<td>-.186</td>
<td>.354</td>
</tr>
<tr>
<td>Pre-Engagement</td>
<td>2.055</td>
<td>1.423</td>
<td>.218</td>
<td>.158</td>
</tr>
<tr>
<td>Pre-Worry</td>
<td>1.268</td>
<td>.932</td>
<td>.222</td>
<td>.182</td>
</tr>
</tbody>
</table>

Note: * p<.05  # .1>p>.05

Table 7. Summary of Regression Analysis for Variables Predicting Emotion-focused Coping.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>.029</td>
<td>.144</td>
<td>.044</td>
<td>.843</td>
</tr>
<tr>
<td>Pessimism</td>
<td>-.029</td>
<td>.121</td>
<td>-.050</td>
<td>.810</td>
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<td>Conscientiousness</td>
<td>-.068</td>
<td>.026</td>
<td>-.398</td>
<td>.015*</td>
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<tr>
<td>Extraversion</td>
<td>-.005</td>
<td>.022</td>
<td>.032</td>
<td>.835</td>
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<tr>
<td>Neuroticism</td>
<td>.044</td>
<td>.032</td>
<td>.237</td>
<td>.186</td>
</tr>
<tr>
<td>Pre-Distress</td>
<td>.412</td>
<td>.745</td>
<td>.119</td>
<td>.584</td>
</tr>
<tr>
<td>Pre-Engagement</td>
<td>-.784</td>
<td>1.008</td>
<td>-.128</td>
<td>.442</td>
</tr>
<tr>
<td>Pre-Worry</td>
<td>1.220</td>
<td>.660</td>
<td>.328</td>
<td>.073</td>
</tr>
</tbody>
</table>

Note: * p<.05  # .1>p>.05

Table 8. Summary of Regression Analysis for Variables Predicting Avoidance-focused Coping.

<table>
<thead>
<tr>
<th></th>
<th>B</th>
<th>Std. Error</th>
<th>B</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Optimism</td>
<td>.160</td>
<td>.175</td>
<td>.188</td>
<td>.366</td>
</tr>
<tr>
<td>Pessimism</td>
<td>-.127</td>
<td>.147</td>
<td>-.164</td>
<td>.396</td>
</tr>
<tr>
<td>Conscientiousness</td>
<td>-.051</td>
<td>.032</td>
<td>-.231</td>
<td>.120</td>
</tr>
<tr>
<td>Extraversion</td>
<td>-.020</td>
<td>.027</td>
<td>-.102</td>
<td>.473</td>
</tr>
<tr>
<td>Neuroticism</td>
<td>.062</td>
<td>.039</td>
<td>.256</td>
<td>.126</td>
</tr>
<tr>
<td>Pre-Distress</td>
<td>.036</td>
<td>.904</td>
<td>.008</td>
<td>.969</td>
</tr>
<tr>
<td>Pre-Engagement</td>
<td>-4.460</td>
<td>1.223</td>
<td>-.582</td>
<td>.001*</td>
</tr>
<tr>
<td>Pre-Worry</td>
<td>1.519</td>
<td>.801</td>
<td>.314</td>
<td>.066</td>
</tr>
</tbody>
</table>

Note: * p<.05  # .1>p>.05

DISCUSSION

Our findings for optimism supported those of Szalma (2002), with optimism being positively related to pre-task distress and task engagement. Additionally, it is of note that
when optimists are given choice, the increases in distress that accompanied the task are missing.

Note that pessimism did not predict emotion-focused coping, while optimism did not significantly predict task-focused coping. While this was not expected, based on the general literature on pessimism, it is consistent with the results obtained by Szalma (2002), suggesting that the relation between disposition and coping may depend on the task domain.

The collective results of this experiment and other studies examining the effects of pessimism on stress and coping indicate that designing vigilance tasks for individuals who differ in their characteristics may depend on the nature of the display to be monitored. Further research will investigate the task parameters that influence the relation between optimism/pessimism and stress and coping. In addition, future research will address performance differences due to noise and choice, and workload effects associated with the choice and noise conditions will be evaluated.

ACKNOWLEDGEMENT

The views expressed in this work are those of the authors and do not necessarily reflect official Army policy. This work was supported by the Department of Defense Multidisciplinary University Research Initiative (MURI) program administered by the Army Research Office under grant DAAD19-01-1-0621.

REFERENCES


