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ASSOCIATIONS BETWEEN MOOD AND PERFORMANCE OF FOCUSED ATTENTION AND CATEGORIC SEARCH CHOICE REACTION TIME TASKS

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ABSTRACT

Background: In many studies, mood and cognitive performance are measured. However, the associations between them are rarely examined. In the present study, a number of different mood states covering different time periods were recorded, and associations with measures from focused attention and categoric search tasks were examined. The effects of age were also investigated. **Method:** Two hundred and seventy staff or students (159 females, 113 males; mean age 35.4 years, age range 17-65 years) from Cardiff University were recruited into the study. Two hundred and fifty had complete data and they were included in the present analyses. Participants carried out a focused attention two-choice reaction time task and a categoric search task. The outcomes analysed here were mean reaction times, lapses of attention, errors, the speed of encoding new information, response organisation, and selective attention measures. **Results:** Measures from the profile of fatigue-related symptoms (emotional distress, cognitive difficulty, fatigue and somatic symptoms) covering the last three months were not significantly correlated with the performance measures. A negative mood in the last week was significantly associated with errors in the two tasks. Mood at the time of testing was not associated with the performance measures. Older participants performed the tasks more slowly and accurately than younger individuals. **Conclusion:** Measures of mood were largely not significantly correlated with the performance measures. The exception was negative mood over the last week, with high negative mood scores being associated with more errors. Age had a significant effect on performance, and different speed-error profiles were observed for older and younger participants.

KEYWORDS: Negative mood; Positive mood; Alertness; Hedonic tone; Anxiety; Emotional distress; Cognitive difficulties; Fatigue; Somatic symptoms; Age; Focused attention; Categoric search; Choice reaction time; Errors; Lapses of attention.

INTRODUCTION

Focused attention often involves the identification of stimuli in known locations. Another type of attention, categoric search, involves identifying where the stimulus is, followed by its identification. These two types of attention have been measured in choice reaction time tasks developed by Broadbent and colleagues.[1,2] As well as measuring selective attention, these tasks also measure mean reaction time, errors, and lapses of attention (occasional very long reaction times). In addition, they measure stages of information processing, such as the encoding of new information and response organisation.[3] Three main measures of attention have been derived from these tasks. The first measure was the difference between the two tasks (Spatial uncertainty little: SPUL). The second measured the focusing of attention (the Eriksen effect, ERIK). The third, measured in the categoric search task, compared the effects of stimuli occurring in the same or different locations on successive trials (the place repetition effect, PREP).

Initial studies with these tasks focused on the associations between selective attention measures and obsessional personality and cognitive failures.[1] Further research showed that these measures were also sensitive to testing at different times of day.[2] The global measures and those reflecting different stages of processing have been shown to be sensitive to changes induced by caffeine,[4-12] alcohol,[13,14] chewing gum,[15,16] ingestion of food,[17-22] noradrenergic drugs,[23,24] cholinergic drugs,[25] aromas,[26] exposure to noise,[27] minor illnesses,[28-32] sleep deprivation,[33] shiftwork,[34] time of day,[35,36] cognitive failures,[37] chronic fatigue syndrome,[38] and age.[39,40]

In many of the studies that used these tasks, mood was also measured. The present study examined associations between the measures from the two choice reaction time tasks and mood over several months, positive and negative mood in the previous week, and mood before and after performing the tasks.

METHOD

The study was approved by the ethics committee, School of Psychology, Cardiff University, and carried out with the informed consent of the participants.

Design

The participants completed questionnaires measuring mood states in the last three months and the previous week in a session where they were also familiarised with mood rating and reaction time tasks. They then completed a test session between 11.00 and 13.00 or 16.00-18,00. This involved mood rating followed by the focused attention and categoric search tasks, and then another rating of mood. The order of focused attention and categoric search tasks was counterbalanced.

Participants

The participants were recruited from the university staff and students. Two hundred and seventy-two volunteers (113 males and 159 females; mean age 35.4 years, age range 17-65 years) were recruited, and two hundred and fifty completed the study.

Details of the tasks

Mood rating

The mood was rated on a 50-point scale using 18 bipolar visual analogue scales (e.g. Drowsy-Alert, Happy-Sad, and Tense-Calm). [41] These ratings give three factors, namely alertness, hedonic tone and anxiety. The mood rating was carried out before and after the performance tasks.

Focussed Attention Task

This task was developed by Broadbent et al.[1,2] Target letters were upper case A's and B's. On each trial, three warning crosses were presented on the screen, with the outside crosses being separated from the middle one by either 1.02 or 2.60 degrees. Volunteers were told to respond to the letter presented in the centre of the screen and ignore any distracters presented in the periphery. The crosses were on the screen for 500 msec and were then replaced by the target letter. The central letter was either accompanied by 1) nothing, 2) asterisks, 3) letters which were the same as the target or 4) letters which differ - the two distracters were identical, and the targets and accompanying letters were always A or B. The correct response to A was to press a key with the forefinger of the left hand, while the correct response to B was to press a different key with the forefinger of the right hand.

Volunteers were given ten practice trials followed by five blocks of 64 trials. In each block, there were equal numbers of near/far conditions, A or B responses and equal numbers of the four distracter conditions. The nature of the previous trial was controlled.

The task gives three main types of outcome measures:

1. Global indicators of speed, accuracy, and lapses of attention.
2. Speed of encoding of stimuli
3. Resistance to distraction and focusing of attention.

Categoric search task

This task was also developed by Broadbent et al.[1,2] Each trial started with the appearance of two crosses in the positions occupied by the non-targets in the focused attention task (i.e. 2.04 or 5.20 degrees apart). Volunteers did not know, in this task, which of the crosses would be followed by the target. The letter A or B was presented alone on half the trials and was accompanied by a digit (1-7) on the other half. Again, the number of near/far stimuli, A versus B responses and digit/blank conditions were controlled. Half of the trials led to compatible responses (i.e. the letter A on the left side of the screen or the letter B on the right), whereas the others were incompatible. The nature of the preceding trial was also controlled. In other respects (practice, number of trials, etc.), the task was identical to the focused attention task.

The task gives four types of measures

1. Global indicators of speed, accuracy, and lapses of attention.
2. Speed of encoding of stimuli
3. Speed of response organisation
4. Measures of spatial attention.

Questionnaires

The participants completed the Profile of Fatigue Related Symptoms (PFRS)[42] and the Positive-Negative mood states questionnaire[43] at the familiarisation session. The PFRS measured emotional distress, cognitive difficulty, fatigue and somatic symptoms over the last three months. Positive and negative moods in the last week were also recorded.

RESULTS

Analysis was carried out using IBM SPSS version 27. Initial correlations between the mood measures and the outcome measures from the choice reaction time tasks were then computed. The data from the performance tasks were then analysed with MANOVAS. The covariates were the mood measures, age and time of day. Age and time of day have been shown to be important predictors of performance of these tasks.

Correlations between mood and performance

Profile of fatigue-related symptoms

There were no significant correlations between the PFRS measures and the choice reaction time measures.

Mood states in the previous week

Positive mood was not significantly correlated with any of the choice reaction time measures. Negative mood was significantly correlated with the number of errors in both the focused attention ($r=0.17$ $p<0.01$) and the categoric search task ($r=0.16$ $p<0.05$).

Mood before and after testing

None of the mood measures were significantly correlated with the choice reaction time measures. Changes in

mood were calculated, and the difference scores were correlated with the performance measures. None of these correlations were significant.

Age

Older participants were slower but more accurate than the younger participants. This resulted in significant correlations for the mean reaction time, number of lapses and errors in both the focused attention and categoric search tasks. These results are shown in Table 1.

Table 1: Correlations Between Age and Speed and Accuracy Measures in the Two Tasks.

Variable	Correlation (r)	Significance
Focused attention RT	0.50	p< 0.001
Focused attention lapses	0.27	p<0.001
Focused attention errors	-0.21	p<0.001
Categoric search RT	0.54	p<0.001
Categoric search lapses	0.42	p<0.001
Categoric search errors	-0.35	p<0.001

MANOVAS

The measures from the choice reaction time tasks were the dependent variables. The covariates were the PFRS scores, positive and negative mood in the last week, mood before and after testing, changes in mood (difference between mood before testing and mood after testing), time of testing and age. The only significant mood effect was negative mood over the last week, where performance accuracy decreased as negative mood increased. There were also significant effects of age, with older participants being slower but more accurate than the younger ones.

DISCUSSION

The aim of the present analyses was to examine associations between mood, measured over several time periods and covering a variety of different aspects, and different measures from focused attention and categoric search choice reaction time tasks. The mood measures were the profile of fatigue-related symptoms (emotional distress, fatigue, cognitive difficulty and somatic symptoms) over the last three months, positive and negative mood over the last week, and alertness, hedonic tone and anxiety before and after performing the tasks. Age was also included in the analyses, as this is an established predictor of the performance of choice reaction time tasks. The global performance measures used were mean reaction times from the two tasks, errors, and lapses of attention (occasional very long reaction times). In addition, measures of selective attention (SPUL; ERIK; and PREP) were derived from the tasks. Task parameters were manipulated to examine the speed of encoding of new information and response organisation.

The analyses showed very few associations between the mood measures and the performance outcomes. The exception was a negative mood in the last week, which was associated with more errors on both tasks. Age had significant effects on speed and accuracy, with older participants performing the tasks more slowly and more accurately. The absence of mood effects could reflect several things. First, mood and performance involve different processes, and that plausibly explains why both are measured in studies that examine changes in state. Alternatively, the factors influencing individual differences in the two outcomes could be different, which would lead to little association between the two. Other research has examined mood and cognition by using the mood-induction technique. These studies have usually also involved the processing of positive and negative stimuli, with results often showing mood congruency effects.

CONCLUSION

Mood and cognitive performance are both measured in many studies, although the associations between them are rarely examined. In the present research, several different mood states covering different time periods were recorded, and associations with measures from focused attention and categoric search tasks were analysed. The effects of age were also investigated. Two hundred and fifty participants had complete data, and they were included in the present analyses. Participants carried out a focused attention two-choice reaction time task and a categoric search task. The performance measures analysed here were mean reaction times, lapses of attention, errors, the speed of encoding new information, response organisation, and selective attention measures. The results showed that measures from the profile of fatigue-related symptoms (emotional distress, cognitive difficulty, fatigue and somatic symptoms) covering the last three months were not significantly correlated with any of the performance measures. A negative mood in the last week was significantly associated with errors in the two tasks. Mood at the time of testing was not associated with the performance outcomes. Younger participants performed the tasks more quickly but less accurately than older individuals. In summary, most measures of mood were not significantly correlated with the performance measures. The exception was negative mood over the last week, with high negative mood scores being associated with more errors. Age had a significant effect on performance, and different speed-error profiles were observed for older and younger participants. The present

findings show that mood and performance of focused attention and categoric search tasks are largely independent, and both should be included in studies of different environments and changes of state.

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