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PSYCHOSOCIAL AND DEMOGRAPHIC FACTORS AND PERFORMANCE OF FOCUSED ATTENTION AND CATEGORIC SEARCH CHOICE REACTION TIME TASKS AT DIFFERENT TIMES OF DAY

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ABSTRACT

Background: Research has investigated the associations between psychosocial factors and measures derived from focused attention and categoric search tasks. The present study continued this line of research with the psychosocial factors being extraversion, social support and anxiety and depression. The effects of age and time of testing 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 participated in the study. They completed the tasks between 11.00-13.00 or 16.00-18.00. Participants carried out a focused attention two-choice reaction time task and a categoric search task. The main outcomes of interest were mean reaction times, errors, lapses of attention, selective attention measures, the speed of encoding new information, and response organisation. **Results:** Anxiety and depression were associated with more errors, whereas extraversion and high social support were associated with faster reaction times. Older participants responded more slowly but more accurately. Responses were faster later in the day. The effects of the psychosocial factors were no longer significant when age and time of day were included in the analyses. **Conclusion:** Initial analyses showed significant effects of psychosocial factors and of age and time of day. Age and time of day remained significant when all factors were included in the analyses. This demonstrates the importance of controlling for age and time of testing in studies using these tasks.

KEYWORDS: Age; Gender; Extraversion; Social support; Anxiety; Depression; Focused attention; Categoric search; Choice reaction time; Errors; Lapses of attention.

INTRODUCTION

One major aspect of visual attention involves the identification of stimuli in known locations (focused attention: What is the stimulus?). Another involves identifying the location of the stimulus, followed by its identification (Categoric search: Where is the stimulus? What is the stimulus?). These two aspects of attention can be measured in choice reaction time tasks developed by Broadbent and colleagues.[1,2] From these tasks, three main measures of attention were derived. The first was the difference between the two tasks (Spatial uncertainty little: SPUL). The second, from the focused attention task, measured the focusing of attention (the Eriksen effect, ERIK). The last, based on the categoric search task, measured the effects of stimuli occurring in the same or different locations (the place repetition effect, PREP). Early studies with these tasks focused on the associations between these measures and cognitive failures and obsessional personality.[1] These measures were also sensitive to the changes in state that occur at different times of day.[2]

The tasks also measure the global outcomes of choice reaction time tasks, namely mean reaction time, errors, and lapses of attention (occasional very long reaction times). In addition, they measure stages of processing, such as the encoding of new information and response organisation.[3] The global measures and those reflecting different stages of processing have been shown to be sensitive to changes induced by exposure to noise,[4] time of day,[5,6] sleep deprivation,[7] shiftwork,[8] ingestion of food,[9-14] caffeine,[15-23] minor illnesses[24-28] alcohol,[29,30] chewing gum,[31,32] aromas,[33] noradrenergic drugs,[34,35] cholinergic drugs,[36] cognitive failures,[37] and chronic fatigue syndrome.[38]

The present research returned to the original use of the tasks, namely, to investigate individual differences. In the present study, age and gender were used as examples of demographic variables that should be controlled in studies using a between-subject methodology. The psychosocial factors investigated were extraversion, social support and loneliness, and anxiety and depression. The possible effects of these variables are

important from a theoretical perspective. In addition, the effects observed in the laboratory may also be transferred to real-life activities. Finally, from a methodological perspective, if these psychosocial factors are associated with objective indicators, then they may need to be covaried in research using a parallel group design.

METHOD
The study was carried out with the informed consent of the participants, following approval from the ethics committee, School of Psychology, Cardiff University.

Design
A between-subjects design was used, with volunteers being randomly allocated to two times of day (11.00-13.00, or 16.00-18.00). Prior to the test session, the volunteers were familiarised with the tasks.

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

DETAILS OF THE 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 following questionnaires at the familiarisation session:
- The Eysenck Personality Inventory[39]
- The Interpersonal Self-Evaluation List (ISEL)[40]
- The UCLA Loneliness Scale[41]
- The Hospital Anxiety and Depression Scale[42]

RESULTS
Analysis was carried out using IBM SPSS version 27. Initial factor analysis of the questionnaire data was carried out to determine whether the measures were independent. Correlations between the psychosocial factors and the outcome measures were then computed. The data from the performance tasks were then analysed with a MANOVA. The covariates were age, gender, time of day, extraversion, social support (ISEL), loneliness, anxiety, and depression.

Factor analysis
A three-factor solution accounting for 87% of the variance was obtained. The first factor was extraversion (49% variance, Extraversion 0.95), the next (26% variance) was social support/loneliness (social support 0.92, loneliness -0.86), and the last factor (12% variance) was anxiety (0.90) and depression (0.83).

Correlations between psychosocial factors and performance
Anxiety and depression were significantly positively correlated with errors on both tasks (Anxiety, focused attention: r =0.14 p <0.05; Anxiety, categoric search: r =0.13 p <0.05; Depression, focused attention: r =0.16 p <0.01; Depression, categoric search: r =0.17 p <0.01). Extraversion was negatively correlated with reaction time on both tasks, with extraverts being faster than introverts (Extraversion, focused attention: r = -0.21 p <0.001; Extraversion, categoric search: r = -0.21 p <0.001). Extraverts also had significantly fewer lapses of attention on the categoric search task (Extraversion, categoric search: r = -0.18 p <0.01). The faster speed of

response of the extraverts was associated with more errors on both tasks (Extraversion, focused attention: r = 0.13 p <0.05; Extraversion, categoric search: r = 0.13 p <0.05). The effects of extraversion on speed were due to the sociability component, whereas the effect on errors was due to impulsivity. High levels of social support and low levels of loneliness were associated with faster response speed on both tasks (ISEL, focused attention: r = -0.20 p <0.005; ISEL, categoric search: r = -0.14 p <0.05; Loneliness, focused attention: r = 0.15 p <0.05; Loneliness, categoric search: r = 0.17 p <0.01). There were no significant correlations between psychosocial factors and selective attention measures, nor were there any encoding or response organisations.

Gender, age, time of day and performance
There were no significant differences between the male and female groups. Age was split at the median (30 years), and the younger and older participants were compared in a MANOVA. There were significant effects of age, with older participants being slower but more accurate in both tasks. These results are shown in Table 1.

Time of day
Those tested in the afternoon were significantly faster on both tasks and had fewer lapses of attention than those tested in the morning (all p's < 0.05).

Table 1: Effects of age on performance.

Age	Task	Mean	SD	Significance
Younger	Focused R.T.	407msec	56	p<0.001
Older	Focused RT	468	83	
Younger	Focused lapses	2.4	6.3	p<0.005
Older	Focused lapses	6.7	15.1	
Younger	Focused errors	10.9	12.1	p<0.001
Older	Focused errors	6.2	11.2	
Younger	Categoric R.T.	533msec	59	p<0.001
Older	Categoric RT	591	77	
Younger	Categoric lapses	7.6	11.6	p<0.001
Older	Categoric lapses	18.5	23.6	
Younger	Categoric errors	14.0	12.9	p<0.001
Older	Categoric errors	7.1	6.0	

Effects of psychosocial factors when age and time of day were included in the analyses.

The effects of the psychosocial factors were no longer significant when age and time of day were included in the analyses.

DISCUSSION
The aim of the present research was to examine associations between some psychosocial factors and outcome measures from focused attention and categoric search choice reaction time tasks. The psychosocial factors considered were the personality dimension of extraversion, social support/loneliness, and anxiety and depression. Factor analyses showed that these variables were independent. Age and time of testing were also investigated, as these are established predictors of the performance of choice reaction time tasks. The outcome measures used were mean reaction times for 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.

Univariate analyses showed that those high in anxiety and depression made more errors. Extraverts and those high in social support had faster response times. Extraverts also made more errors. The older participants were slower but more accurate than the younger ones. Reaction times were faster when testing was later in the day. When all variables were included in the analyses, only age and time of testing remained significant. This shows the importance of controlling for age and time of day when using between-subject designs with choice reaction time tasks. Further research is now required to examine the effects of other types of individual differences, such as health-related behaviours, on these tasks to determine whether these should be controlled for in future studies of choice reaction time. In terms of theoretical implications and practical relevance, the current results show that age and time of day are the key variables to focus on. It is also important to determine whether these effects are important in work and education, as well as in activities in other contexts (e.g.

driving). Effects observed in the laboratory may translate into reduced efficiency and safety in real life.

CONCLUSION
Previous research has examined associations between psychosocial factors and measures derived from focused attention and categoric search choice reaction time tasks. The present study focused on the psychosocial factors of extraversion, social support/loneliness and anxiety and depression. The effects of time of testing and age were also investigated. Two hundred and seventy students or staff (113 males; 159 females, mean age 35.4 years, age range 17-65 years) from Cardiff University took part in the study. They completed the two tasks between 11.00-13.00 and 16.00-18.00. Participants carried out focused attention and categoric search two-choice reaction time tasks. The outcomes of interest were mean reaction times, lapses of attention, errors, selective attention measures (SPUL; ERIK; and PREP), response organisation and the speed of encoding new information. Higher levels of anxiety and depression were associated with more errors, whereas extraversion and high social support were associated with faster reaction times. Extraverts also made more errors. Older participants responded more accurately but more slowly than the younger participants. Responses were faster in the afternoon than in the morning. The effects of the psychosocial factors were no longer significant when time of day and age were included in the analyses. In summary, initial analyses showed significant effects of psychosocial factors, age and time of day. Age and time of day remained significant when all the factors were included in the analysis. This demonstrates the importance of controlling for age and time of testing in studies using these tasks.

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